Critical Care Transport

Clinical Practice Guidelines

&

Treatment Protocols

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EAGLE COUNTY PARAMEDIC SERVICES

These guidelines are maintained in accordance with the ECPS Quality Management Program established pursuant to C.R.S. § 25-3.5-901 et seq. It is for use by Eagle County Paramedic Services CCT clinicians under medical direction of Dr. James Engeln and Dr. Jason Zeller and may not be redistributed.

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Medical Director Approvals

Jason Zeller M.D. & James Engeln M.D.

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Purpose of Clinical Practice Guidelines

Purpose:

- The Critical Care Clinical Practice Guidelines and Protocols are designed to provide clinical and operational guidance during specialty critical care inter-facility transport.

- The Critical Care Clinical Practice Guidelines and Protocols are to be used during critical care interfacility transport and in collaboration with the care plan from sending physician.
  - If these guidelines and the sending physician care plan are significantly different, defer to the Critical Care Clinical Practice Guidelines and Protocols to guide treatment.

- The Critical Care Clinical Practice Guidelines and Protocols are for specific patient conditions and state waiver-covered medications or skills that may be encountered during critical care transport.

- Any patient care pathway, medication or skill not specifically covered in the Critical Care Clinical Practice Guidelines and Protocols is covered under the ECPS Field Medical Protocols.

Section 1- General Care & Communications

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1-1 Critical Care Transport Team

Purpose:

Define what comprises a critical care transport team and what patients are to be transported via a critical care transport team. Includes policy and consideration for transport requests from in service facilities and outside of service area facilities.

The following crew configurations will be acceptable for critical care transport

CCT Crew Configuration #1	
Driver	EMT or Paramedic
Clinical Provider #1	Critical Care Paramedic
Clinical Provider #2	Critical Care Paramedic (May be CC Paramedic in training if clinical provider #1 is a P5cc)

CCT Crew Configuration #2	
Driver	EMT or Paramedic
Clinical Provider #1	Critical Care Paramedic
Clinical Provider #2	Paramedic

- Crew configuration #1 is preferred. Crew configuration #2 may be used when staffing, call volume or other factors do not allow for crew configuration #1.
  - Shift supervisor to complete IR when crew configuration 2 is used.

- If crew configuration #1 or #2 can not be utilized, shift supervisor is to delay transfer until staffing can accommodate needs or refer sending facility to outside CCT service to complete request.
  - If transfer is turned down by ECPS, shift supervisor must complete IR.

- Patients not meeting any of the below criteria **BUT** who are receiving or may receive a critical care medication or procedure defined by the ECPS service level guide **AND** are otherwise stable, may have the following crew configuration.

CCT Crew Configuration #3	
Driver	EMT or Paramedic
Clinical Provider #1	Critical Care Paramedic

- After receiving a CCT request, the shift supervisor should contact the on duty P5 to discuss appropriate crew configuration and additional needs prior to sending the transporting crew to the bedside.

1-1 Critical Care Transport Team

Patients receiving the following therapies or with the following conditions shall have critical care crew configuration 1 or 2, as outlined above.

Treatment/ Therapies for Transport
Mechanical ventilation
Non- invasive mechanical ventilation *(CPAP, BiPAP, HFNC)*
Intra-aortic balloon pump *(IABP)*
REBOA
Trans-venous or transcutaneous pacing
Any patient receiving on going vasopressor therapy *Norepinephrine, Epinephrine, Phenylephrine, Vasopressin, Dopamine, Dobutamine*
Any patient receiving TPA or TNK during transport

Patient Conditions
Any post cardiac arrest
Any diagnosed shock state *(Septic, Cardiogenic, Hemorrhagic/ Hypovolemic, Neurogenic)* OR Single or multi-system medical pathology with hemodynamic compromise OR Single or multi-system traumatic pathology with hemodynamic compromise
Aortic emergencies *(Dissection or Aneurysm)*
DKA (adult or pediatric)
Neurological emergency with decompensation *Ischemic CVA, Non Traumatic Intracranial Hemorrhage, Traumatic Intracranial Hemorrhage, Status Epilepticus*
Pulmonary Embolism with hemodynamic compromise

Definitions

Hemodynamic Compromise

- *Sustained hypotension or hypotension refractory to treatment (SBP <100mmHg or MAP <65)*
- *Sustained HR >120 or HR or arrhythmia refractory to treatment*
- *Persistent hypoxia or hypoxia refractory to treatment (Sp02 <92%)*
- *Acute altered mental status (GCS <12 or an acute decrease in GCS >2 points)*

Neurological decompensation

- *Acute altered mental status (GCS <12 or an acute decrease in GCS >2 points)*
- *Unilateral deficits*
- *Unequal or fixed pupils*
- *Decerebrate/decorticate posturing*
- *Clinical signs of herniation (Increasing blood pressure, decreasing heart rate, respiratory pattern changes)*

1-1 Critical Care Transport Team

Transport Requests From Facilities Outside of Service Area:

- **Transport Acceptance:**
  - Transport request must still allow for adequate coverage within primary service area
  - Outside service area transport requests with a CMRETAC risk assessment score of 15 or greater warrant additional discussion and risk mitigation.
  - Prior to EMS supervisor formally accepting transport request, the transporting crew must be contacted and the following steps completed:
    - Verification that the patient meets established criteria for dual CC Paramedic transport.
    - Transporting crew or designated P5CC contacts sending facility RN via the House Supervisor for patient report, to determine all patient needs are within ECPS CPG's and scope of practice.
  - Once above criteria is verified, crew will contact EMS supervisor to verify transfer acceptance.

- **Prior to Departure From Service Area:**
  - Transporting crew should vend any additional anticipated medications from ECPS vending machine or discuss procurement with sending facility prior to arrival.
  - Obtain additional Sapphire IV pumps and securing system.
  - All CCT equipment, including the following will be brought on all outside service area requests.
    - Arterial line capable monitor
    - Ventilator & ventilator securing system
    - CCT bags
    - EPOC
    - HFNC system & battery system (for all non- intubated patients)
  - All on board oxygen tanks with less than 1500 PSI will be swapped for tanks with 2000 PSI.
  - Ambulance will be fueled to a full tank of fuel prior to arriving at sending facility.

- **At Bedside:**
  - Follow ECPS CCT CPG's, contact medical direction as guided by CPG's
  - All IV infusions must be switched over to Sapphire IV pumps for transport.
  - Any facility specialty equipment, such as IABP may be transported. ECPS EMS supervisor should coordinate return of this equipment with sending facility house supervisor.

1-2 Contacting Medical Direction

Purpose:

Define guidelines for contacting medical direction.

Procedure:

For the purposes of critical care transport, if the clinical practice guidelines direct a consultation with medical direction or a question regarding a care plan for transport arises, use the following order of consultation unless otherwise specified;

1. **Contact receiving facility and accepting physician**
2. **Contact sending facility physician**
3. **Contact ECPS medical director**

Pediatric Specialty Center Transports:

For any patient being transported to a pediatric specialty center, the critical care crew will initiate a consultation with the accepting pediatric Attending or Fellow Physician, prior to departing the bedside at the sending facility. The purpose of this consultation is to ensure care plan priorities for transport. The sending physician should be involved in this consultation as well, to facilitate any treatment needs prior to departure.

This consult will be initiated by calling the following:

Children's Hospital of Colorado

OneCall: 720-777-3999

Rocky Mountain Children's Hospital

Pediatric Emergency: (720) 754-4115

Pediatric Inpatient: (720) 754-4400

Pediatric Intensive Care: (720) 754-4300

1-2 Contacting Medical Direction

Medical Direction Consultation Template:

- Provider name
- Clinical/ operational questions (purpose of the consult)
- Age, sex, chief complaint/diagnosis
- Pertinent HPI, PMHx
- Pertinent treatment already received
- Vital signs including weight
- Pertinent physical exam findings
- Pertinent labs and imaging results (e.g. chest x-ray or CT scans)
- Restate clinical questions above
- Receive consultation direction orders
- Restate/verify orders

Conditions requiring consultation with ECPS Medical Director or Clinical Administrator on Call prior to making patient contact:

- Patient weight less than 10kg
- Patient being ventilated with APRV
- Patient being ventilated in the prone position
- Mechanical ventilation with PEEP >15
- Any patient receiving continuous paralysis for transport

If unable to make contact with ECPS medical director, transfer for any of the above patients shall be turned down and referred to outside CCT capable organization.

Patients that shall not be transferred by ECPS:

- Patient with any high risk OB condition or Preterm Labor as defined in ***4-11 Preterm Labor***
- Patient weight less than 10kg receiving mechanical ventilation (invasive or non- invasive, CPAP, BiPAP, HFNC)
- Patient weight 5kg or less
- Patient with Impella being transported to any hospital other than St. Mary's Medical Center (Grand Junction) or to Eagle County Regional Airport for FW transport.

EMS supervisor to complete IR for transport turndowns.

1-3 Divert Policy

Purpose:

Define process and procedure in the event of a medical or operational diversion to a facility that was not the intended receiving facility or transferring care to a HEMS agency to complete the transport.

Operational Diversion:

- In the event of deteriorating weather or road conditions, road closure or mechanical issue that would prevent the continued safe transport to the accepting facility, a decision for an operational diversion may be made. The CCT crew should consult with EMS 10 and the sending facility to identify the next closest, most appropriate facility for the patient. This may include returning to the sending facility or utilization of a HEMS Diversion.

Clinical Diversion:

- In the event of significantly deteriorating patient condition (peri- arrest) or in the event of the patient going into cardiac arrest during transport, a decision for an clinical diversion may be made. The CCT crew should consult with EMS 10 and the sending facility to identify the next closest, most appropriate facility. This may include returning to the sending facility or utilization of a HEMS Diversion.

- In the event of a peri- arrest patient, the original accepting facility may be deemed the closest most appropriate based on the specialty services offered and the patient's needs.

HEMS Diversion:

- HEMS diversion is a critical strategy for patients requiring time-sensitive care, especially when reduced time to end intervention can significantly impact outcomes. This diversion should be considered and pre-arranged in scenarios where a HEMS request was originally made by the sending facility, however weather conditions impede helicopter use at the sending facility, but are favorable in the direction of travel of the receiving facility.

- Examples of time- sensitive care where reduced time to end intervention can significantly impact outcomes and a HEMS diversion should be considered include;
  - STEMI patient going directly to a PCI lab (excluding Valley View Hospital)
  - Patient with a CVA, Spinal Cord Injury, Aortic Dissection or Traumatic Injury going directly to a Interventional Radiology (IR) suite or Operating Room (OR).

1-3 Divert Policy

HEMS Diversion:

- The request for a HEMS diversion should be made prior to departing the sending facility. Contact the HEMS agency in the direction of travel and request a launch to one of the predetermined LZ's listed below.
- Provide the HEMS agency with the following;
  - Patient age, weight, transfer diagnosis, current mediations & infusions, airway status, destination facility, bed, ECPS ETA to the predesignated LZ and a ground contact channel of **S Tac D** (ECPS radios: J bank, channel 16)

- The ECPS crew will depart prepared to conduct the entirety of the transport to the intended destination should the air medical crew abort.

- Consideration should be given to the transfer of care time needed at the LZ, including transfer of medications/ infusions, mechanical ventilation and other devices to flight crew equipment.

HEMS rendezvous locations:

The following are pre-approved HEMS landing zones.

East:

- Summit Medical Center- Flight for Life hanger *(Flight for Life)*
- I-70 Exit 228- Georgetown Helipad *(Flight for Life)*
  - *Diversions east of Georgetown are unlikely to have any time saving benefit.*

West:

- I-70 Exit 133- Dotsero *(Classic Air Medical, Care Flight of the Rockies)*
- I-70 Exit 105- New Castle *(Care Flight of the Rockies, Classic Air Medical)*
- I-70 Exit 90- Grand River Health *(Care Flight of the Rockies, Classic Air Medical)*
  - *Diversions west of Parachute are unlikely to have any time saving benefit.*

1-4 Patient Assessment and General Care

Patient Assessment:

- Document initial patient assessment upon arrival at bedside.
- Document repeat patient assessments every hour or as needed based on change in patients condition.

Vital Signs:

- For any patient patient receiving invasive mechanical ventilation, non- invasive mechanical ventilation (HFNC, CPAP, BiPAP), any vasoactive medications or multi- system etiology, the following vital signs will be obtained and documented **every 5-10 minutes.**
  - **Heart Rate**
  - **Blood Pressure**
  - **SP02**
  - **ETC02** (if applicable)
- The following will be obtained and documented upon arrival at bedside, with any clinically significant change or treatment and upon arrival at receiving facility.
  - **GCS**
  - **RASS** (if applicable)
  - **Pain Score**
  - **EKG rhythm**

- All other patients will have the following vital signs obtained and documented **every 10-15 minutes.**
  - **Heart Rate**
  - **Blood Pressure**
  - **SP02**
  - **ETC02** (if applicable)
- The following will be obtained and documented upon arrival at bedside, with any clinically significant change or treatment and upon arrival at receiving facility.
  - **GCS**
  - **RASS** (if applicable)
  - **Pain Score**
  - **EKG rhythm**

Maintenance Fluids:

The following patients should receive continuous maintenance fluids:

- Adult patients when patient contact time will be >1 hour.
- All pediatric patients
- IV fluids should be LR or NSS if newly initiated, or any of the following if patient is already on a maintenance infusion:
  - NSS, LR, D5LR, D5NS, orD5 1⁄2 NS (any with up to 40 mEq Potassium Chloride per 1000 ml fluid).

Appropriate rates of maintenance IV fluids

- **Adult: 100 mL/hr** or as previously started at the sending facility.

Potassium Containing Solutions:

Administer Potassium Containing Solutions under the following guidelines;

- **Peripheral IV access:** Administer at max rate of **10 mEq/hr** in peripherial access site
  - Potassium containing solution may be administered at 10mEq/hr in up to two separate peripheral IV sites, for a total **max rate of 20mEq/hr**

- **Central vascular access:** Administer at rate of **10mEq/hr to max rate of 40mEq/hr**

- All fluids containing potassium must be administered by an infusion pump.

- **NEVER** IV push potassium or potassium containing solutions.

- Use a dedicated infusion line; avoid piggybacking to prevent accidental bolus delivery.

- Flush line with Normal Saline at 10-15 minute rate to clear remaining Potassium Solution.

Wrist Restraints:

- Place soft wrist restraints on all patients with an advanced airway.
- Assess and document neurovascular status of restrained extremities every hour.

Patient Age:

- Unless otherwise defined and for the purposes of patient care, patient ages are defined as:
  - Adult – Age ≥13 years.
  - Pediatric – Age 28 days to 12 years.
  - Neonate – Age <28 days.

Patient Positioning:

In transports greater than 2 hours, assess patient for and document the presence of pressure ulcers. Reposition the patient periodically to mitigate the development or worsening of pressure ulcers.

Ambient Temperature Management:

Limit patient exposure to temperature extremes:

- Use blankets or commercially available heating blanket as indicated to meet patient care needs, such maintaining patient's core body temperature.
- Temperature mitigation required if outside of these parameters: 68-78°F (20-25.5°C).
  - Temperature mitigation may include adjusting the vehicle climate control system, adjusting coverings on patient, and use of hot or cold packs.

PEDIATRIC

Purpose:

Provide a pediatric specific supplement to guideline ***1-4 Patient Assessment and General Care***.

Patient Age:

- Unless otherwise defined and for the purposes of patient care, patient ages are defined as:
  - Adult – Age ≥13 years.
  - Pediatric – Age 28 days to 12 years.
  - Neonate – Age <28 days.

Securing Pediatric Patients:

- Patients > 5kg, use available pediatric transport system.
- Patients <5kg cannot be transported by ECPS. Specialty team transport with isolette capabilities will be needed.

General Standards:

- Vitals signs are to be assessed and documented per guideline ***1-4 Patient assessment & general care***.
- If indicated, a cuffed endotracheal tube is preferred in infants and children.
- Two clinicians shall independently verify all pediatric medications prior to administration.
- Patients weighing less than 10kg and receiving mechanical ventilation (HFNC, CPAP, BiPAP, invasive ventilation) will not be transported by ECPS.
- Patients weighing ≤ 5kg will not be transported by ECPS.
- A pre-transport, hourly and arrival temperature is required for all pediatric patients.
- Medical direction, as outlined within the ***Medical Direction Guideline***, shall be consulted prior to departure of sending facility with any pediatric patient.

PEDIATRIC

Fluid Management:

- The standard fluid bolus is **10 – 20 mL/kg** of **0.9% Sodium Chloride**.
- The preferred routine **maintenance fluid is 5% Dextrose in 0.45% Sodium Chloride.**
- All maintenance fluids shall be calculated using the following formula:

Maintence Fluid Calculation:

- 4 mL/kg for the first 10kg
- 2 mL/kg for the second 10kg
- 1 mL/kg for any additional beyond 20kg

For example a 30 kg child would be calculated as follows:

- 40mL/hr +20mL/hr + 10mL/hr = 70mL/hr

KG	5	10	15	20	25	30	35	40	45	50
Rate (ml/hr)	20	40	50	60	65	70	75	80	85	90

Standard blood product volumes are follows:

- Whole Blood: 10ml/kg
- Packed Red Blood Cells: 10-20 mL/kg
- Fresh Frozen Plasma: 10-20 mL/kg
- Platelets/ Cryoprecipitate: 0.1 units/kg

Clinical Considerations:

- Patient weight from the sending facility will be used to determine the following:
  - Medication dosing
  - Fluid bolus
  - Maintenance fluid
  - Ventilator settings

- The commercially available guide will be used to determine the following:
  - Appropriate vital sign ranges
  - Appropriate sizing for airway management devices
  - Appropriate sizing for vascular access
  - Appropriate sizing for other adjunctive treatment devices

- For size specific equipment not carried in the ambulance, be sure to acquire this from the sending facility prior to departure.

1-6 Medication Administration & Cross Check

Purpose:

Define guidelines for use of a medication administration crosscheck during critical care transport.

Medication Crosscheck:

A medication administration cross check will be performed in the following settings during critical care transport;

- Receiving any initiated infusion medication from the sending facility
- Initiating any infusion medication
- Titrating any infusion medication
- Administering any bolus medication
- In the setting of a single provider transport, medication administration cross check will be performed with the bedside nurse at the sending facility if taking any initiated infusion medications for transport. During transport the single transport provider will perform a medication administration crosscheck with themselves utilizing the flow chart below.

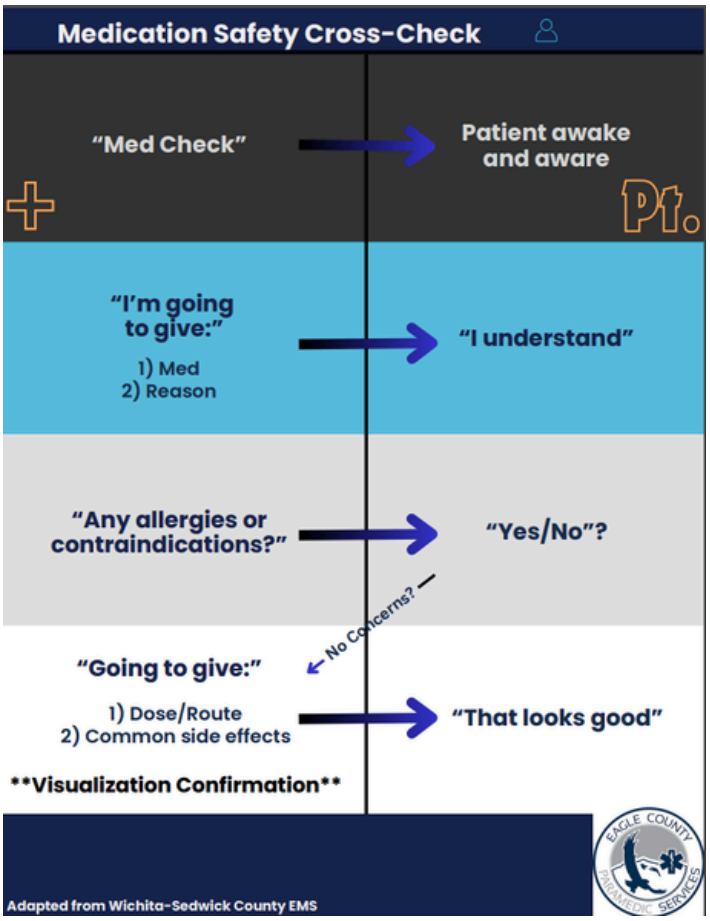
Medication Administration:

- All infusion medications will be transported and administered on an IV pump.
- Care should be taken to label distal ends of lines and cap any lines that are not compatible with other medications.
- All medications in the following guidelines may be administered IV/IO unless otherwise indicated.

1-6 Medication Administration & Cross Check

2-Provider Cross-Check

1- Provider Cross-Check



RED FLAGS of Lost Situational Awareness And Errors in Production

Situational Awareness is the ability to identify, process, and comprehend the critical elements of your team's actions with regard to achieving your team's goals.

Red flags are signs that you or someone on your team has lost situational awareness and a verification is needed.

- Intuition or a "bad gut feeling"
- Rushing
- Poor Communication
- Disagreement
- Task Saturation
- Trying Something New Under Pressure
- Interruptions
- Ambiguity
- Preoccupation
- Confusion

STOP & VERIFY

Establish a collective awareness by:

- **Review the situation out loud (SBAR)**
  - **S**ituation
  - **B**ackground
  - **A**ssessment
  - **R**ecommendation
- Defer to expertise
- Look it up (i.e. protocols, SOP)
- Contact the Medical Director

HARM — **Be the voice of the patient!** — EGO

Slow is smooth, smooth is fast!

1-7 Blood Product Administration

Purpose:

Guideline and considerations for administration of blood products during critical care transport.

Initiation of Blood Products:

Patients with one of the conditions listed below may require administration of blood products including whole blood, packed red cells, fresh frozen plasma, platelets, albumin or cryoprecipitate. All blood products from the sending facility should be typed and crossed for EMS administration.

- Acute blood loss, Anemia, Decreased hematocrit, Decreased clotting factors, Any other physician order for administration

Continuation of Blood Products:

If a unit of blood products is infusing at time of initiation of care based on sending physician order, complete administration of that unit as ordered. If additional unit(s) have been ordered, refer to relevant guideline for initiation.

Multi-Unit Infusions:

For patients receiving 3 or more units of any blood product over 1 hour **OR** patients who are receiving blood product transfusion and have known hypocalcemia, administer:

- **Calcium Chloride** (**10%**) **1 gm,** Mixed in 100ml NS and given over 10-15 minutes.

  OR
- **Calcium Gluconate** (**10%**) **3 gm** Mixed in 100ml NS and given over 10-15 minutes.

Plasma Infusions:

Fresh Frozen Plasma can be administered as outlined in relevant treatment guidelines.

- If no type-compatible plasma is available, contact medical direction prior to administering.
- Type A low titer B may be used in place of type AB plasma.

1-7 Blood Product Administration

Transfusion Reaction:

- Monitor patient for signs of serious (anaphylaxis) transfusion reaction.
- Document the presence or absence of a transfusion reaction for each unit of blood product administered.
- Signs of a serious transfusion reaction include fever (rapid temperature increase >3 degrees, hypotension, hives, dyspnea, wheezing, rigors, abdominal pain, nausea, vomiting, or diarrhea.

If symptoms of serious transfusion reaction are present:

- STOP the blood product
- Administer: **Methylprednisolone** (**Solu-Medrol**) **125 mg** and **Diphenhydramine** (**Benadryl**) **50 mg**
- In the event of a transfusion reaction, contact medical direction to discuss additional treatment of reaction as well as continuation of blood or additional therapies for underlying pathology.

Additional Considerations:

- Administer blood products via largest available access. If unable to establish IV access, blood product may be administered via IO.
- Use filtered blood tubing with 0.9% NS only (No LR, No D5W)

Pediatric Patients:

- Whole Blood: 10ml/kg
- Packed Red Blood Cells: 10-20 mL/kg
- Fresh Frozen Plasma: 10-20 mL/kg
- Platelets/ Cryoprecipitate: 0.1 units/kg
- Use a pump if available, otherwise syringe and stopcock in-line with tubing to draw the blood from the bag and administer.

1-7 Blood Product Administration

Verification & Documentation:

All units continued for transport or administered during transport should be checked for the following;

- Product name (e.g. packed red blood cells, fresh frozen plasma, platelets)
- Expiration date
- Blood recipient's type and Rh factor & blood band number
- Blood product type and Rh factor
- Blood Product Number
- Volume

The above information must be documented in the PCR for every unit transfused or taken from the sending hospital during transport.

Transport of Blood Products:

- Blood products provided by the sending facility may be transported by the ECPS critical care transport crew.

- Blood products must be transported in the approved transport cooler provided by the sending facility.

- Blood products will be verified with the above documentation points prior to leaving the facility.

- Blood products will remain in the approved transport cooler unless needed for administration.

1-8 Pain Management

Purpose:

To optimize analgesia of non- intubated patients during critical care interfacility transport.

- Consider analgesics already administered by the sending facility when considering pain management during transport.

Analgesia:

- **Fentanyl Bolus: 25-100mcg,** q10-20 minutes PRN
  - Maximum total dose 300mcg

- **Hydromorphone** (**Dilaudid**)**: 0.5 – 1 mg,** IV slow push, q30 minutes PRN
  - Maximum total dose 2mg
  - Consider half-dose in patients age > 65

- **Acetaminophen: 1 gram** over 15 minutes.

- **Ketorolac: 15 mg IV or 30mg IM**

- **Ketamine Bolus: 0.1 - 0.3 mg/kg IV,** Repeat q30 minutes PRN
  - Maximum single dose 40 mg
  - Maximum total dose 200mg
  - Not to be used to patients who are intubated, see guideline ***2-10 Sedation/ Analgesia/ Paralysis.***
- **Ketamine Bolus 0.5 mg/kg IM,** Repeat q30 minutes PRN
  - Maximum single dose 50mg
  - Maximum total dose 200mg
  - Not to be used to patients who are intubated, see guideline ***2-10 Sedation/ Analgesia/ Paralysis.***

- **Ketamine infusion 0.1 - 0.3 mg/kg/hr continuous infusion**
  - Titrate by 0.05- 0.1 mg/kg/hr
  - Not to be used to patients who are intubated, see guideline ***2-10 Sedation/ Analgesia/ Paralysis***

PEDIATRIC

Purpose:

To optimize analgesia of non- intubated patients during critical care interfacility transport.

- Consider analgesics already administered by the sending facility when considering pain management during transport.

Analgesia:

- **Fentanyl Bolus: 0.5-1 mcg/kg, IV/IO/IM/IN,** q10-20 minutes PRN
  - Maximum single dose 100 mcg
  - Maximum total dose 3 mcg/kg

- **Hydromorphone** (**Dilaudid**)**: 0.015mg/kg IV** slow push, q30 minutes PRN
  - Maximum single dose 1mg
  - Maximum total dose 2mg

- **Acetaminophen: 15 mg/kg IV,** over 15 minutes
  - Maximum total dose 1 gram

- **Ketorolac: 0.5 mg/kg IV**
  - Maximum total dose 15mg
- **Ketorolac: 1 mg/kg IM**
  - Maximum total dose of 30 mg

- **Ketamine Bolus: 0.1 - 0.3 mg/kg IV**, Repeat q30 minutes PRN
  - Maximum single dose 40 mg
  - Maximum total dose 200mg
  - Not to be used to patients who are intubated, see guideline ***2-10 Sedation/ Analgesia/ Paralysis.***
- **Ketamine Bolus 0.5 mg/kg IM/IN**, Repeat q30 minutes PRN
  - Maximum single dose 50mg
  - Maximum total dose 200mg
  - Not to be used to patients who are intubated, see guideline ***2-10 Sedation/ Analgesia/ Paralysis.***

- **Ketamine infusion 0.1 - 0.3 mg/kg/hr** continuous infusion
  - Titrate by 0.05- 0.1 mg/kg/hr
  - Not to be used to patients who are intubated, see guideline ***2-10 Sedation/ Analgesia/ Paralysis.***

1-9 Point of Care Testing

Purpose:

Guideline and considerations for use of Point of Care (POC) testing via the epoc during critical care transport.

General:

- POC testing can provide valuable and timely information that can help guide treatment decisions and effectiveness of on-going treatments during transport.
- Specific clinical indications will be utilized to determine the use for POC testing.
- The epoc is capable of running arterial or venous samples and obtaining the following results:
  - ABG, VBG with correction *(pH, pC02, p02, TC02, anion gap)*
  - Lactate
  - Hematocrit *(Calculates hemoglobin)*
  - BMP *(Sodium, Potassium, ionized Calcium, Chloride, Glucose, BUN, Creatinine)*

Indications:

- Any intubated patient:
  - **POC VBG or ABG** (if arterial access is present) should be obtained at bedside if clinically indicated and then every 60 minutes during transport.
  - POC results can assist in guiding effectiveness of ventilator strategy and can be used as a tool and data point with guiding ventilator setting changes.

- Diabetic Ketoacidosis:
  - **POC VBG or ABG** (if arterial access is present) **lactate and BMP** should be obtained at bedside if clinically indicated and then every 60 minutes during transport.
  - POC results can provide trending on status of anion gap closure, worsening acidosis and trends of other metabolic findings.
  - Treatment decisions based on POC results, outside of guideline ***4-1 Diabetic Ketoacidosis*** will be discussed with on-line medical control.

- Shock & Refractory Hypoperfusion (Medical or Traumatic)
  - **POC lactate** should be obtained at bedside if clinically indicated and then every 60 minutes during transport.
  - Lactate can help guide effectiveness of ongoing treatment and progression of shock state.
  - **POC Hematocrit** if shock state is due to known or suspected blood loss.

- POC labs as ordered or requested by physician:
  - POC labs outside of the above standing orders can be obtained under written orders or via- online medical direction from sending or receiving facility.

Time Sensitive Exceptions:

- Do not delay transport or delay time at bedside to obtain POC labs in time sensitive conditions such as CVA, STEMI, single or multi-system trauma or in conditions where the patient is being transported directly to interventional care such as PCI lab, Interventional Radiology Suite (IR) or Operating Room (OR).
  - If POC are labs are indicated or ordered in a time sensitive patient, obtain POC labs whenever practical during transport.

Documentation and Reporting:

- All POC lab results obtained during transport will be recorded in the flowchart of the EHR.
- All normal and abnormal lab result findings will be reported to the receiving facility.
- All epoc data events obtained, will be stored in the memory of the epoc device.
- Any device errors will be reported to the designated clinical administrator per ECPS CLIA polices and procedures.

Advance care delivery by bringing critical testing patient-side with the epoc® Blood Analysis System with the NXS Host

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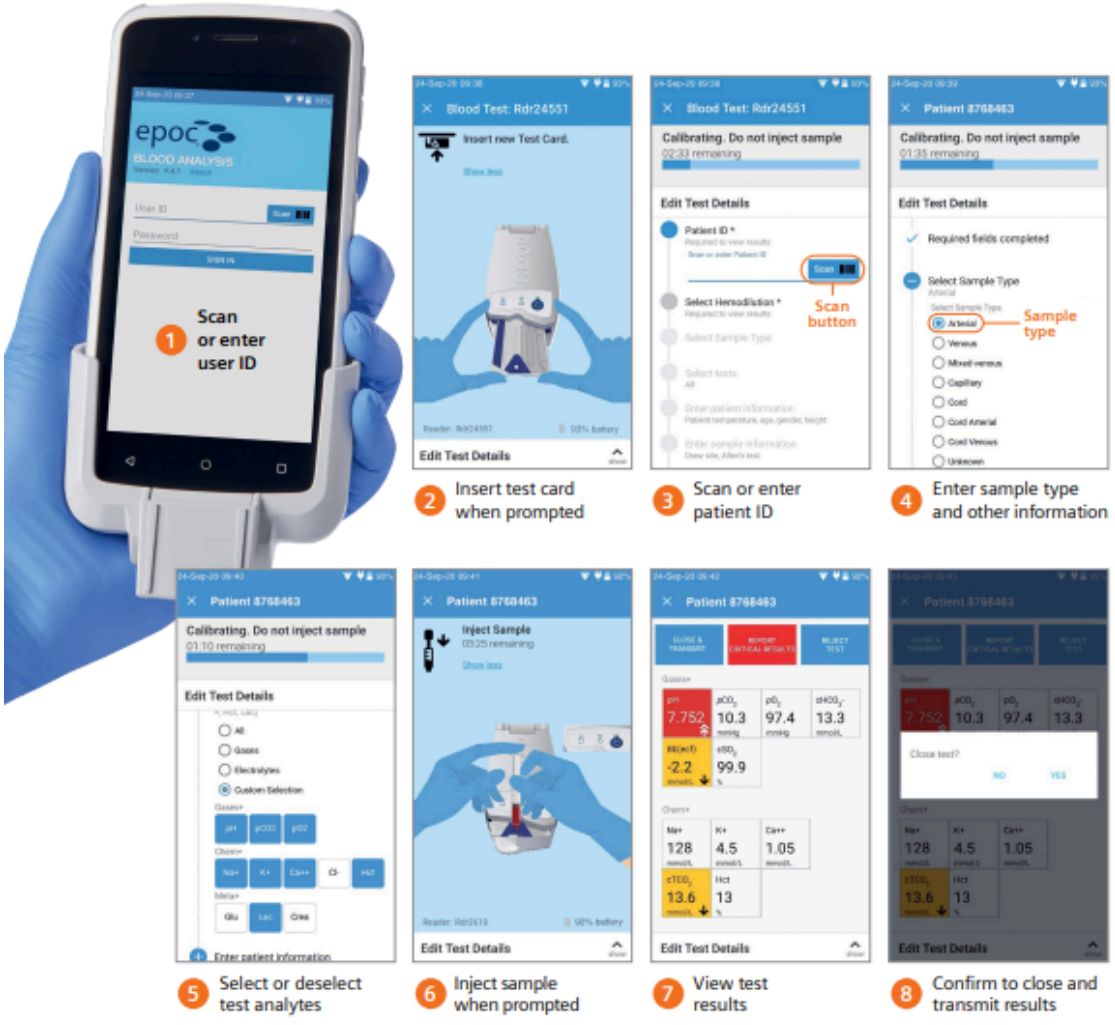

SIEMENS Healthineers

Section 2- Airway & Respiratory

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2-4 Mechanical Ventilation- Hamilton T1- (S)CMV+

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2-18 Acute Respiratory Distress Syndrome (ARDS)

2-1 Mechanical Ventilation- Clinical Considerations

Purpose:

Outline use, expectations and strategies for patients receiving mechanical ventilation.

General Considerations:

- When mechanical ventilation is required, the transport ventilator will be used. All inter-facility transfer patients received on a mechanical ventilator should have mechanical ventilation maintained from bedside to bedside and throughout transport unless unusual circumstances arise. A BVM shall be immediately available with the patient during all phases of care.

- Predicted/"ideal" Body Weight should be used for calculating settings. Set and titrate volumes/weight based on physiology of the presentation. Ventilation should be targeted to maintain eucapnia for the metabolic demands of the patient.

- The application of PEEP greater than 15cm H2O to an intubated patient requires a ECPS medical director consult.

- Peak Inspiratory Pressures should limited to <30 cmH2O, and Driving Pressures (PIP - PEEP) should be <15 cmH2O, this may vary depending on underlying pathology.

- Use heat-moisture exchanger (HME) filter, unless contraindicated due to creation of additional dead space.

- Clamp endotracheal tube when PEEP >10 cmH2O to prevent alveolar collapse with circuit change and prior to opening the circuit for recruitment maneuvers.
  - Clamp at the end of exhalation and no longer than 10 seconds.

Monitoring:

- Once patient is connected to the ventilator, assess for breath sounds, chest rise, comfort/anxiety, SpO2 and continuous EtCO2.
  - Continuously assess ventilator settings and patient response, adjust as needed.

- All intubated patients must be transported with a commercial tube securing device and wrist restraints in place.

2-1 Mechanical Ventilation- Clinical Considerations

Strategies to prevent ventilator-associated pneumonia (VAP):

- Assess cuff pressure on intubation or initial contact with all intubated patients, at highest elevation, and on drop off of patient at the receiving facility.
  - Document all pressures.

- Elevate head of bed (HOB) to at least 30 degrees if able.

- Place NG/OG tube for gastric suction if not contraindicated to prevent aspiration.

- Suction oral secretions.

Point of Care Testing:

- POC results can assist in guiding effectiveness of ventilator strategy and can be used as a tool and data point with guiding ventilator setting changes.

- **POC VBG or ABG** (if arterial access is present) should be obtained at bedside if clinically indicated and then every 60 minutes during transport.

2-2 Mechanical Ventilation- Hamilton T1- ASV

ADAPTIVE SUPPORT VENTILATION (ASV)

- Technology utilizing ideal body weight (sex, height) to determine ongoing respiratory rate (RR) and tidal volume (Vt) settings.

- ASV utilizes ongoing breath-to-breath assessment of compliance/resistance to determine patient response, minute ventilation and vary ongoing RR and Vt. It is generally a pressure control mode which will auto-adjust to obtain desired volumes based on minute ventilation settings.

- ASV mode takes 10 breaths to appropriately assess compliance and determine settings for the patient, some patient's may not be able to tolerate.

- In patients with high or erratic spontaneous respiration, metabolic acidosis/ high metabolic demand or other condition where specific regulation/titration of ETCO2 is desired, ASV should not be used. Instead consider SIMV+ or CMV+

Parameter	Action
% Minute Volume	**Initial:** 100%-200% to match the total expired minute volume being delivered with the facility's ventilator. **Titrate**: titrate by 10-20% (range 100%-200%) every 5-10 min to achieve goal ETCO2. **Considerations:** • Altitude: Add 5% for every 1500 feet above sea level. ◦ (For Vail Health Hospital this would start ASV at 125%) • Hyperthermia (>38.5c): Add 20% to initial setting • Increased metabolic demand ◦ If the existing minute volume cannot be matched at ASV 200% target minute volume, consider adjusting sedation and analgesia as needed or switching to SIMV+ or PSIMV+ if target minute ventilation is due to autoregulation of C02.

2-2 Mechanical Ventilation- Hamilton T1- ASV

Procedure: (**Adult**/ **Pediatric >10kg**)

- Set Mode to ASV

Set ventilation parameters based on patient values and relevant protocol confirm:

- Gender
- Patient Height
- %MinVol
  - Adjust between 100%-200% to goal ETC02
- PEEP (Peak End-Expiratory Pressure)
  - Adjust to achieve goal SP02
- Oxygen (FiO2):
  - Adjust achieve goal SpO2.
- Set Peak Inspiratory Pressure limit

- Start ventilation and connect to patient

Alarms:

- Observe ventilator auto-titrations as volume and rate are adjusted to meet %MinVol.
- Within 1-2 min of initiating ventilation or when patient is stable on the ventilator, adjust alarms parameters as needed.
- Monitor ventilator alarms and address any persistent alarms.

Documentation:

- **Settings:** Mode, %MinVol, PEEP, FiO2.
- **Parameters:** Ppeak, ExpMin Vol, Tidal Volume (VTE), Pinsp, ventilator breaths (fControl), spontaneous breaths (fSpont).
- If changes are made from the default settings, document TI (inspiratory time), I:E ratio, and flow trigger.

2-3 Mechanical Ventilation- Hamilton T1- SIMV+

SYNCHRONIZED INTERMITTENT MANDATORY VENTILATION (SIMV+)

- Volume control mode that delivers set tidal volume for time triggered breaths, and supports any patient triggered breaths with set pressure support. Can be a more comfortable mode for patients who have or require lighter sedation or spontaneous respiratory effort.

- If the patient does not trigger a breath, the ventilator/time triggered breaths are delivered in volume control in the same manner as in CMV or AC modes.

Procedure: (Adult/ Pediatric >10kg)

- Set Mode to SIMV+

Confirm ventilation parameters and set:

- Rate
- Vt (Tidal Volume)
- Ti (Time-Inspiration)
  - Adjust for I:E ratio
  - 0.3 - 0.9 is typical for pediatrics; 0.8 - 1.2 is typical in adults
- PEEP
  - Adjust to goal SP02
- FiO2
  - Adjust to achieve goal SpO2.
- ΔPsupport
  - Pressure delivered above the set PEEP to support spontaneous respirations
  - Generally a setting between 3 - 10 cmH2O is reasonable.
  - If spontaneous respirations are consistency small in volume due to weak efforts or increased resistance which is negatively affecting physiology or synchrony, increasing the support will deliver more volume.
- Set Peak Inspiratory Pressure limit

- Start ventilation and connect to patient

2-3 Mechanical Ventilation- Hamilton T1- SIMV+

Alarms:

- Within 1-2 min of initiating ventilation or when patient is stable on the ventilator, adjust alarms parameters as needed.

- Monitor ventilator alarms and address any persistent alarms.

Documentation:

- **Settings:** Mode, Psupport, Rate, Vt, PEEP, FiO2.

- **Parameters**: Ppeak, ExpMin Vol, Tidal Volume (VTE), Breaths per min (fTotal).
- If changes are made from the default settings, document TI (inspiratory time), I:E ratio, and flow trigger.

2-4 Mechanical Ventilation- Hamilton T1- (S)CMV+

SYNCHRONIZED CONTROLLED MANDATORY VENTILATION [(S)CMV+]

- Synchronized volume control with pressure limit.
- Delivers set volume, with set pressure control/limit with each breath.

Procedure: (Adult/ Pediatric >10kg)

- Set Mode to (S)CMV+

Set ventilation parameters confirm:

- Rate
- Vt (Tidal Volume)
- Ti (Inspiratory time, seconds)
  - Adjust for I:E ratio and Inspiratory pressure
  - 0.3 - 0.9 is typical for pediatrics; 0.8 - 1.2 is typical in adults
- PEEP
  - Adjust to achieve goal SpO2.
- FiO2:
  - Adjust to achieve goal SpO2.
- Set Peak Inspiratory Pressure limit

- Start ventilation and connect to patient

Alarms:

- Within 1-2 min of initiating ventilation or when patient is stable on the ventilator, adjust alarms parameters as needed.
- Monitor ventilator alarms and address any persistent alarms.

Documentation:

- **Settings:** Mode, Rate, Vt, PEEP, FiO2.
- **Parameters:** Ppeak, ExpMin Vol, Tidal Volume (VTE), Breaths per min (fTotal).
- If changes are made from the default settings, document TI (inspiratory time), I:E ratio, and flow trigger.

2-5 Mechanical Ventilation- Hamilton T1- PSIMV+

Pressure-Controlled Synchronized Intermittent Mandatory Ventilation Plus (PSIMV+)

- Pressure control mode that delivers time triggered breaths at the set pressure control, while patient triggered breaths are supported with set pressure support. Can be a more comfortable mode for patients who have or require lighter sedation, or spontaneous respiratory effort.

- Some studies show pressure control modes to be more effective at oxygenating patients with severe lung disease, however ventilation can be made challenging due to variable volumes delivered.

- Key to titration of this pressure setting is ensuring that adequate pressure is delivered to achieve desired minute volume.

- If the patient requires tight control or titration of ETCO2, consider change to ASV or a volume controlled mode to maintain previous minute ventilation or specific ETCO2 goal.

Procedure: (Adult/ Pediatric >10kg)

- Set Mode to PSIMV+

Set ventilation parameters and confirm:

- Rate
- Pinsp (Inspiratory Pressure)
  - Note: This is in addition to set PEEP
- TI (Time-Inspiration)
  - 0.3 - 0.9 is typical for pediatrics; 0.8 - 1.2 is typical in adults
  - Longer Ti may be needed to adequately oxygenate ARDS or severe lung disease
- PEEP
  - Adjust to achieve goal Sp02
- FiO2
  - Adjust to achieve goal SpO2.

2-5 Mechanical Ventilation- Hamilton T1- PSIMV+

Procedure: (**Adult**/ **Pediatric >10kg**)

- ΔPsupport
  - Turn off Psync
  - Set desired pressure support to be added to PEEP for patient triggered breaths
    - 3-10 cmH2O is generally reasonable.
    - If spontaneous respirations are consistency small in volume due to weak efforts or increased resistance which is negatively affecting physiology or synchrony, increasing the support will deliver more volume.

- Start ventilation and connect to patient

Alarms:

- Within 1-2 min of initiating ventilation or when patient is stable on the ventilator, adjust alarms parameters as needed.
- Monitor ventilator alarms while adjusting Pinsp and PEEP and address any persistent alarms.

Documentation:

- **Settings:** Mode, Rate, Pinsp, PEEP, FiO2.
- **Parameters:** Ppeak, ExpMin Vol, Tidal Volume (VTE), Breaths per min (fTotal).
- If changes are made from the default settings, document TI (inspiratory time), I:E ratio, and flow trigger.

2-6 Mechanical Ventilation- Hamilton T1- PCV+

PRESSURE-CONTROLLED VENTILATION (PCV+)

- Synchronized pressure controlled mode that for both time and patient triggered breaths will deliver a set inspiratory pressure.

- Volumes will be variable based on compliance, resistance and patient synchrony.
- Some studies show pressure control modes to be more effective at oxygenating patients with severe lung disease, however ventilation can be made challenging due to variable volumes delivered.

- If the patient requires tight control or titration of ETCO2, consider change to ASV or a volume controlled mode to maintain previous minute ventilation or specific ETCO2 goal.

Procedure: (Adult/ Pediatric >10kg)

- Set Mode to PCV+

Set ventilation parameters and confirm:

- Rate
- Pcontrol
  - Note: This is in addition to set PEEP
- Ti (Inspiratory time)
  - 0.3 - 0.9 is typical for pediatrics; 0.8 - 1.2 is typical in adults
  - Longer Ti may be needed to adequately oxygenate ARDS or severe lung disease
- PEEP
  - Adjust to acheive goal Sp02
- FiO2
  - Adjust to achieve goal SpO2.

- Start ventilation and connect to patient

2-6 Mechanical Ventilation- Hamilton T1- PCV+

Alarms:

- Within 1-2 min of initiating ventilation or when patient is stable on the ventilator, adjust alarms parameters as needed.
- Monitor ventilator alarms while adjusting Pcontrol and PEEP rand address any persistent alarms.

Documentation:

- Settings: Mode, Rate, Pcontrol, PEEP, FiO2.
- Parameters: Ppeak, ExpMin Vol, Tidal Volume (VTE), Breaths per min (fTotal).
- If changes are made from the default settings, document I:E ratio and flow trigger.

2-7 Mechanical Ventilation- Hypoxia Checklist

Purpose:

- Outline use, expectations and strategies for managing hypoxia in a mechanically ventilated patient.

Complete checklist as a read- do- verify checklist		
Check (**Read**)	**Action** (**Do**)	**Completed** (**Verify**)
Increase Fi02 to 100%	• Increase Fi02 to 100% using Fi02 selection or by pressing 02 button on Hamilton T1	
Check Ventilator Setup	• Verify 02 source • Check circuit for leaks or disconnections	
Circuit Obstruction	• Ensure no kinks or other obstruction	
ETT Obstruction	• Address patient biting tube or tube kinking	
Secretions	• Suction patient	
Filter Obstruction	• If sputum or debris in HME filter, replace filter	
ETT Cuff Leak	• Check cuff pressures and inflate ETT cuff as needed	
Ventilator Alarms	• Troubleshoot and address alarms • High pressure limit alarm will terminate any breath being delivered leading to lower than desired MV	
Assess Patient	• For signs of hemodynamic compromise (pulse oximetry may be inaccurate in low perfusion states) • For signs of poor ventilation dynamics, abnormal oxygen diffusion, or inadequate ventilator support	
If patient continues to decompensate, remove ventilator and initiate BVM ventilations while troubleshooting the ventilator		

2-8 Mechanical Ventilation- Hamilton T1- Reference

Purpose:

- Provide general reference material and considerations for use of the Hamilton T1 ventilator.

Preparation:

- Connect ventilation circuit to the ventilator
- Select Adult/Ped
- Enter patient variables:
  - Male / Female
  - Patient Height
- Perform a Preop Check prior to connecting to the patient:
  - Perform Tightness Test.
  - Perform Flow Sensor Test (turn flow sensor around and connect with adapter, then turn back around when indicated by ventilator).

Ventilator Circuit Configuration- Standard:

- Ventilator --> Tubing --> ETCO2 --> Flow Sensor --> Filter --> ET tube --> Patient

Ventilator Circuit Configuration- With Nebulizer:

- Ventilator --> Tubing --> ETCO2 --> Filter --> Nebulizer --> Flow Sensor --> ET tube --> Patient

Ventilator Circuit Configuration- Non- Invasive Ventilation:

- *Ventilator --> Tubing --> Filter --> Flow Sensor --> Mask --> Patient*
  - *Do not use ETC02 in-line or ETC02 cannula with NIV*

Ventilator Circuit Configuration- High Flow Nasal Cannula:

- *Ventilator --> Tubing to water chamber (Dry Limb) --> Heater/Humidifier--> Tubing to patient (Wet Limb) --> Nasal Cannula --> Patient*
  - *Do not use ETC02 in-line or ETC02 cannula with HFNC*

2-8 Mechanical Ventilation- Hamilton T1- Reference

Purpose:

Provide reference of terminology differences between the Hamilton T1 transport ventilator and the Zoll EMV+ transport ventilator.

T1 to EMV Translator

T1	EMV	Translation to T1
(S)CMV+	AC (V)	*Synchronized* volume control with pressure limit. Delivers set volume, with set pressure control/limit with each breath.
PCV+	AC (P)	*Synchronized* pressure control with each breath.
SIMV+	SIMV (V)	*Synchronized* intermittent mandatory ventilation with volume control in time triggered breaths, pressure support with patient triggered breaths.
PSIMV+	SIMV (P)	*Synchronized* intermittent mandatory ventilation with pressure control in time triggered breaths, pressure support with patient triggered breaths. "Psynch" when enabled matches ΔPsupport to ΔPinsp.
ASV	n/a	No comparable EMV mode – basically AI controlled Pressure Control SIMV.
SPONT	n/a (≈BL)	Think of this as CPAP or BiPAP™ for an invasive airway. Can be good for trach patients who need support. Can set PEEP and ΔPsupport.
NIV	CPAP/BL	Non-Invasive PPV. CPAP with or without pressure support (making it BiPAP™). Has apnea backup of PCV+
NIV-ST	n/a	Same as NIV, <u>but</u> has background set rate which can time trigger. Has apnea backup of PCV+
CPR	n/a	Essentially a pressure support mode.

"Synchronized" means something different on the T1 than the EMV. The EMV time triggers regardless of patient's triggers, so the EMV runs whatever set rate like a metronome - the patient can trigger *in addition to* that rate. There is very little S in EMV's SIMV. However, the T1 factors the patient's (flow) triggers into its time triggers for better synchrony. So:

<u>On the EMV</u>, a rate of 10 means it will give a breath every 6 seconds regardless of any patient triggered breaths in between, or on top of.

<u>On the T1</u>, a rate of 10 means if the patient triggers a breath, it will wait 6 seconds to deliver a time triggered breath. Patient triggers reset the time trigger.

PEEP Compensation: All modes on the T1 are PEEP compensated, meaning all pressure targets (ΔPinsp, ΔPsupport) are in addition to PEEP. The delta (Δ) value indicates change above PEEP.

Example: "BiPAP™ of 10/5" would look like PEEP 5, ΔPsupport 5.

Pressure alarm settings however are always measured from zero, so PEEP is not factored.

Leak Compensation: All T1 modes are "leak compensated" so this is not a parameter that needs to be controlled.

2-9 Mechanical Ventilation- Ideal Body Weight Charts

Purpose:

- Provide reference of IBW for mechanical ventilation.
- The following charts should be used for reference only. When using the Hamilton T1 ventilator, the ventilator will calculate appropriate ventilation parameters based on patient information input by the operator.

Charts:

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

PBW and Tidal Volume for Females

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

PBW and Tidal Volume for Males

2-10 Mechanical Ventilation- Sedation/ Analgesia/ Paralysis

Purpose:

The use of sedatives and analgesics will be used with all intubated patients receiving mechanical ventilation. Outlines guidelines to optimize sedation, analgesia and paralysis in critically ill intubated patients receiving mechanical ventilation.

Sedation Bolus Medications:

- **Ketamine Bolus: 0.5- 1 mg/kg**
  - Maximum single dose: 100 mg
  - In patients with physiologic stress leading to concern for catecholamine depletion, consider lower dose (0.5 mg/kg)

- **Midazolam Bolus: 0.01 – 0.1 mg/kg** q 20min
  - Maximum single dose: 5 mg

- **Propofol Bolus: 0.1 - 1 mg/kg**
  - Maximum single dose: 100 mg
  - May only be used to facilitate movement of patient
  - May cause hypotension
  - Most effective using syringe. Draw up 1mg/kg in 10cc syringe, then slow push (1cc/2seconds) until desired effect achieved, or max dose reached.

- **Droperidol: 5 mg** slow IVP
  - Only given once, no repeat dosing
  - May only be used as adjunct sedative, not to be used as primary sedative option.

Sedation Infusion Medications:

- **Ketamine Infusion: 0.5-4 mg/kg/hr**
  - Titrate by 0.5- 1 mg/kg/hr until desired sedation is achieved
  - Ketamine also possesses potent analgesic properties, there is no need for concurrent opioid administration.

- **Propofol Infusion: 1 –75 mcg/kg/minute**
  - Titrate in increments of 5 mcg/kg/min until desired sedation is achieved if MAP > 65
  - Usual Maintenance is 20-50 mcg/kg/min in transport
  - If persistent hypotension, cut dose by half and reassess or change sedative.

2-10 Mechanical Ventilation- Sedation/ Analgesia/ Paralysis

Sedation Infusion Medications:

- **Midazolam Infusion: 0.04-0.2 mg/kg/hr** OR **0.5-5 mg/hr**
  - Titrate by 0.01 mg/kg/hr OR 0.1 mg/hr until desired sedation is achieved

- **Dexmedetomidine (Precedex): 0.2-1.5 mcg/kg/hr**
  - Titrate by 0.2 mcg/kg/hr q 10 minutes until desired sedation is achieved
  - Only provides light sedation. Intubated patients will likely require deeper sedation/analgesia than Dexmedetomidine provides
  - Do not bolus. Higher doses can cause hypotension.

Analgesia:

- **Fentanyl Bolus: 25-100 mcg**
  - Maximum single dose 100 mcg
  - Max total dose 300mcg

- **Fentanyl Infusion: 0.5 – 2.5 mcg/kg/hr** OR **25-200 mcg/hr**
  - Titrate by 0.1-0.5 mcg/kg/hr OR 10-20 mcg/hr

- **Hydromorphone (Dilaudid): 0.5 – 1 mg IV slow push q30 minutes**
  - Can repeat dose x 1 if no clinical response within 15-20 minutes
  - Consider half-dose in patients age > 65

Neuromuscular Blockade:

Any patient requiring continuous paralysis for transport requires consultation with ECPS medical direction.

- Appropriate bolus dosing of sedative should be exhausted prior to administration of paralytic. Ensure that appropriate sedation and analgesia is being provided for the patient as soon as possible if neuromuscular blockade is given.

For patients requiring continuous paralysis during transport to facilitate therapeutic interventions, or if needed to ensure patient or provider safety (e.g. threatened immediate extubation or harm to crew member that cannot otherwise be mitigated), consider administration of:

- **Vecuronium 1 mcg/kg/min**
- **Rocuronium 1 mg/kg (max 100 mg)**

PEDIATRIC

Purpose:

The use of sedatives and analgesics will be used with all intubated patients receiving mechanical ventilation. Outlines guidelines to optimize sedation, analgesia and paralysis in critically ill intubated patients receiving mechanical ventilation.

The following are general guidelines, contact medical direction if dosing parameters are outside of these ranges.

Sedation Bolus Medications:

- **Ketamine Bolus: 0.5- 1 mg/kg**
  - Maximum single dose: 100 mg
  - In patients with physiologic stress leading to concern for catecholamine depletion, consider lower dose (0.5 mg/kg)

- **Midazolam Bolus: 0.01 – 0.1 mg/kg q 20min**
  - Maximum single dose: 5 mg

Sedation Infusion Medications:

- **Ketamine Infusion: 0.5-4 mg/kg/hr**
  - Titrate by 0.5- 1 mg/kg/hr until desired sedation is achieved
  - Ketamine also possesses potent analgesic properties, there is no need for concurrent opioid administration.

- **Midazolam Infusion: 0.04-0.2 mg/kg/hr**
  - Titrate by 0.01 mg/kg/hr

- **Propofol Infusion: 1 –75 mcg/kg/minute**
  - Titrate in increments of 5 mcg/kg/min until desired sedation is achieved if MAP > 65
  - Usual Maintenance is 20-50 mcg/kg/min in transport
  - If persistent hypotension, cut dose by half and reassess, consider alternative sedative.

PEDIATRIC

Analgesia:

- **Fentanyl Bolus: 0.5-1 mcg/kg, IV/IO/IM,** q10-20 minutes PRN
  - Maximum single dose 100 mcg
  - Maximum total dose 3 mcg/kg

- **Fentanyl Infusion: 0.5 – 2.5 mcg/kg/hr**
  - Titrate by 0.1-0.5 mcg/kg/hr

- **Hydromorphone (Dilaudid): 0.015mg/kg IV slow push,** q30 minutes PRN
  - Maximum single dose 1mg
  - Maximum total dose 2mg

Neuromuscular Blockade:

Any patient requiring continuous paralysis for transport requires consultation with ECPS medical direction.

- Appropriate bolus dosing of sedative should be exhausted prior to administration of paralytic. Ensure that appropriate sedation and analgesia is being provided for the patient as soon as possible if neuromuscular blockade is given.

For patients requiring continuous paralysis during transport to facilitate therapeutic interventions, or if needed to ensure patient or provider safety (e.g. threatened immediate extubation or harm to crew member that cannot otherwise be mitigated), consider administration of:

- **Vecuronium 1 mcg/kg/min**
- **Rocuronium 1 mg/kg (max 100 mg)**

2-10 Mechanical Ventilation- Sedation/ Analgesia/ Paralysis

Purpose:

Provide validated tools to assess the ongoing effect and needs of sedation/ analgesia of the intubated patient

Richmond Agitation Sedation Scale (RASS)- Sedation:

- Transport goal: Score of -2 to -3

RASS score

Richmond Agitation & Sedation Scale			
Score	**Description**		
+4	Combative	Violent, immediate danger to staff	
+3	Very agitated	Pulls at or removes tubes, aggressive	
+2	Agitated	Frequent non-purposeful movements, fights ventilator	
+1	Restless	Anxious, apprehensive but movements not aggressive or vigorous	
0	Alert & calm		
-1	Drowsy	Not fully alert, sustained awakening to voice (eye opening & contact >10 secs)	Voice
-2	Light sedation	Briefly awakens to voice (eye opening & contact < 10 secs)	
-3	Moderate sedation	Movement or eye-opening to voice (no eye contact)	
-4	Deep sedation	No response to voice, but movement or eye opening to physical stimulation	Touch
-5	Un-rousable	No response to voice or physical stimulation	

Critical Care Pain Observation Tool (CPOT)- Analgesia:

- Transport goal: Score of <2

Table 2.
Critical Care Pain Observation Tool (CPOT)

Indicator	0	1	2
Facial description	No muscular tension observed: Relaxed, neutral	Presence of frowning, brow lowering, orbit tightening, and levator contraction: Tense	All of the above facial movements plus eyelid tightly closed: Grimacing
Body movements	Does not move at all (does not necessarily mean absence of pain): Absence of movements	Slow cautious movements, touching or rubbing the pain site, seeking attention through movements: Protection	Pulling tube, attempting to sit up, moving limbs/ thrashing, not following commands, striking at staff, trying to climb out of bed: Restlessness
Muscle tension (evaluation by passive flexion and extension of upper extremities)	No resistance to passive movements: Relaxed	Resistance to passive movements: Tense, rigid	Strong resistance to passive movements, inability to complete them: Very tense or rigid
Compliance with the ventilator (intubated patients), *OR*	Alarms not activated, easy ventilation: Tolerating ventilator or movement	Alarms stop spontaneously: Coughing but tolerating	Asynchrony: blocking ventilation, alarms frequently activated: Fighting ventilator
Vocalization (extubated patients)	Talking in normal tone or no sound	Sighing, moaning	Crying out, sobbing

2-11 Mechanical Ventilation- Zoll EMV +

Purpose:

Outline standard ventilation parameter's using the Zoll EMV + ventilator.

Modes of Ventilation:

- Volume Control ventilation:
  - Volume breaths administered with each set or initiated respirations (inspiration pressure varies)
    - Assist Control (A/C)
    - Synchronized Intermittent Mandatory Ventilation (SIMV)
      - With Pressure Support (PS) setting
- Pressure Control ventilation
  - Pressure setting to attain with each inspiration (volume varies)
    - Pressure Assist Control Ventilation - AC(P)
    - Synchronized Intermittent Mandatory Ventilation - SIMV(P)
  - CPAP - Can be true CPAP with set PEEP only, or "BiPAP" with addition of pressure support. Non-invasive mode with leak compensation
  - BiLevel - BL - Invasive or non-invasive mode, same as CPAP, no leak compensation.

FiO2:

- 100% FiO2 is acceptable for most patients immediately after intubation, titrate as able to prevent hyperoxygenation.
- Consider patient's underlying illness and oxygen demands.
- Ideally, should try to use lowest FiO2 necessary to maintain patient's oxygenation status.

Tidal Volume (Vt):

- 4 - 8 ml / kg PBW
- If ARDS/lung injury present, start at 6ml/kg
- If no lung injury present, starting at 8ml/kg can be reasonable
- Evaluate expired minute ventilation.

Respiratory Rate:

- Determined by ventilation requirements
- Consider set respiratory rate and spontaneous rate when setting.
- Utilize a higher I:E ratio for intubated asthmatic patients as needed to prevent additional air trapping and prolongation of exhalation.

2-11 Mechanical Ventilation- Zoll EMV +

PEEP- Positive End Expiatory Pressure:

- For patients not yet on mechanical ventilation, start with PEEP of 5cm H20, increase as needed.
- For patients already receiving mechanical ventilation, start with set PEEP settings.

- Indications for increasing PEEP requirement
  - Persistent hypoxia despite high FiO2 levels
  - ARDS
  - PEEP above 15 cmH20 requires ECPS medical direction consult.

Flow Rate:

- 40 - 60 L / min (tidal volume in liters/I-time x 60)

I Time:

- Normal I time is approximately 1 second in adults
- 0.4-0.9 seconds in children
- 0.3-0.4 seconds for infants
- Titrate to achieve optimal flow of 40-60 Lpm

Non-Invasive Positive Pressure Ventilation (NIPPV):

CPAP

- Settings: Select NIV mode. Set PEEP/EPAP as desired from 2-15.
  - Online medical direction required for PEEP >15.
  - Consider alternative treatment if PEEP >12.
- Titrate FiO2 as needed

BiPAP

- Settings: Typically expressed as Pressure support / PEEP.
  - Pressure support is added to PEEP for total inspiratory support setting.

- Titrate PEEP for increased oxygenation. Pressure support for inspiratory support.

- Adjust flow, trigger and cycling for patient comfort as needed.

2-12 Non- Invasive Ventilation- Hamilton T1- BiPAP

BILEVEL POSITIVE AIRWAY PRESSURE (BiPAP)

- Non-Invasive Positive pressure ventilation
- CPAP with pressure support = BiPAP
- Has apnea backup of PCV+

Procedure: (Adult/ Pediatric >10kg)

- Set Mode to NIV

- Set ventilation parameters based on patient values and relevant protocol and confirm:
  - Psupport (Pressure Support)
  - PEEP (Peak End-Expiratory Pressure)
  - Flow trigger 5.0 l/min
  - Oxygen (FiO2)
    - Adjust to achieve goal SpO2.
  - Note: Inspiratory Positive Airway Pressure (IPAP) = Psupport + PEEP

- Start ventilation and connect to patient
  - Check leak %
  - Adjust Pramp and ETS as needed for patient synchrony/comfort and leak compensation.
    - If leak greater than 45%, check patient interface or try different sized or style NIV mask.

Alarms:

- Within 1-2 min of initiating ventilation or when patient is stable on the ventilator, adjust alarms parameters as needed.
- Monitor ventilator alarms while adjusting Pinsp and PEEP and address any persistent alarms.

Documentation:

- **Settings:** Mode, Rate, Pinsp, PEEP, FiO2.
- **Parameters:** Ppeak, ExpMin Vol, Tidal Volume (VTE), Breaths per min (fTotal).
- If changes are made from the default settings, document TI (inspiratory time), I:E ratio, and flow trigger.

2-13 Non- Invasive Ventilation- Hamilton T1- CPAP

CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)

- Non-Invasive positive pressure ventilation
- Has apnea backup of PCV+

Procedure: (Adult/ Pediatric >10kg)

- Set Mode to NIV

- Set ventilation parameters based on patient values and relevant protocol and confirm:
  - Psupport (Pressure Support) Set to 0 (zero)
  - PEEP
  - Set the continuous pressure level, typical range 5-15 cmH2O.
  - FiO2
    - Adjust to achieve goal SpO2

- Start ventilation and connect to patient
  - Check leak %
  - Adjust Pramp and ETS as needed for patient synchrony/comfort and leak compensation.
    - If leak greater than 45%, check patient interface or try different sized or style NIV mask.

Alarms:

- Within 1-2 min of initiating ventilation or when patient is stable on the ventilator, adjust alarms parameters as needed.
- Monitor ventilator alarms while adjusting PEEP as per order and address any persistent alarms.

Documentation:

- **Settings:** Mode, Psupport, PEEP, FiO2.
- **Parameters:** Ppeak, ExpMin Vol, Tidal Volume (VTE), Breaths per min (fTotal).
- If changed from the default settings, document flow trigger.

2-14 Non- Invasive Ventilation- Hamilton T1- HFNC

HIGH FLOW NASAL CANNULA (HFNC)

- HFNC therapy is used as a form of non-invasive support providing up to 100% FiO2 for patients with acute respiratory disease. HFNC is common in pediatric management of RSV and similar type sequalae. While it does provide some degree of positive pressure, its main benefit comes from the heated and humidified supply of air/O2, which provides an anti-inflammatory effect and keeps secretions from drying and obstructing the airways. The result is increased ventilation, increased oxygenation, and decreased work of breathing.

- HFNC treatment during transport is only possible using the Hamilton T1 with the approved heater/ humidifier system – no other devices are approved for the transport environment, and shall not be used by ECPS.

- HFNC flow rates are given in Liters per min. No additional calculation for patient size, weight or Vt are required.

Respiratory Rate- Oxygenation (ROX) Index:

- ROX index, along with clinical presentation is a useful indicator of success or failure of HFNC.
- ROX index is obtained at 2, 6 and 12 hours after initiation of HNFC.

$$\frac{SpO_2 / FiO_2}{\text{Respiratory Rate}} = \text{ROX index}$$

Example at 6 hours
SpO_2 = **88%**
FiO_2 = **.70**
RR = **28** breaths/minute

$$\frac{88 / .70}{28} = 4.48$$

In the example above, the resulting score of 4.48 is greater than the score for predicted failure at 6 hours (3.47 as shown in the ROX Score table right). Therefore, continued NHF treatment should be considered.

ROX score margin for failure over time

Time Point (Hours of NHF use)	ROX Score	Positive Predictive Value %
2 hours	< 2.85	98
6 hours	**< 3.47**	98-99
12 hours	< 3.85	99
> 12 hours	< 4.88	80

Procedure: (Adult/ Pediatric >10kg)

On Hamilton T1 ventilator

- Set mode to HiFlow02
- Set flow to desired L/Min
- Set Fi02 to desired %
- Fill chamber with sterile water as directed
  - Place “high alert” sticker on bag of sterile water
- Start and connect to patient
- Set up heater/ humidifier for use in transport

Documentation:

- Settings: Mode, L/Min, Fi02, humidifier temperature, cannula size, ROX index score.

2-14 Non- Invasive Ventilation- Hamilton T1- HFNC

Oxygen Consumption Chart:

- Because actual volumes of O2 in tanks is not exact, conservative estimations must be used
- D tanks shall not be considered for transport oxygen consumption calculations.
  - D tanks shall only be used for calculation of oxygen consumption while moving the patient from bedside to ambulance at sending facility and ambulance to bedside at receiving facility.
- Take an appropriately sized NIV mask for all HFNC transports, in the event respiratory support needs to be escalated.

Oxygen calculation times on this chart are based on 1 full M tank *(Double the time for 2 full M tanks)*

	30%	40%	50%	60%	70%	80%	100%
30 L/min	15h 25m	6h 51m	4h 37m	3h 25m	2h 44m	2h 14m	1h 42m
35 L/min	13h 13m	5h 52m	3h 58m	2h 56m	2h 21m	1h 54m	1h 30m
40 L/min	11h 34m	5h 8m	3h 28m	2h 34m	2h 3m	1h 40m	1h 17m
45 L/min	10h 17m	4h 34m	3h 5m	2h 17m	1h 50m	1h 30m	1h 8m
50 L/min	9h 15m	4h 6m	2h 46m	2h 3m	1h 39m	1h 20m	1h 2m
55 L/min	8h 25m	3h 44m	2h 31m	1h 52m	1h 30m	1h 13m	0h 56m
60 L/min	7h 42m	3h 25m	2h 19m	1h 43m	1h 22m	1h 7m	0h 51m

- **Green** = Patient can be safely transported by ECPS. **One full M tank will be required.**
- **Yellow** = Patient can be safely transported by ECPS. **Two full M tanks will be required**.
- **Red** = ECPS can not transport HFNC. Patient will need to be transported on other NIV option.

Always check travel times and road conditions to ensure adequate oxygen.

2-14 Non- Invasive Ventilation- Hamilton T1- HFNC

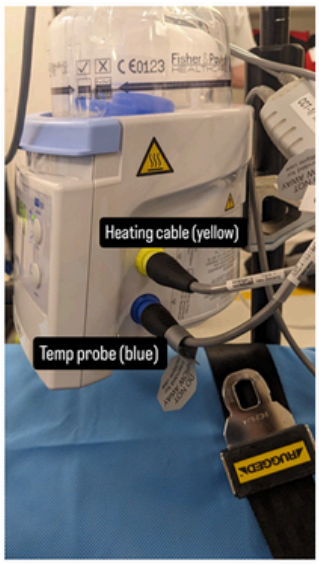
HFNC Set Up Reference:

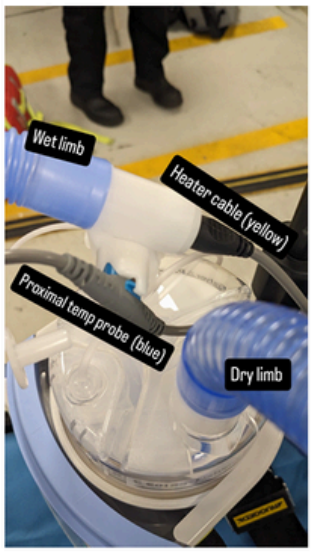
Step 1:

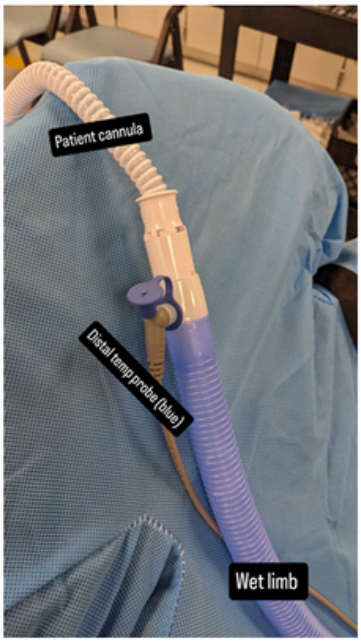
- Mount Hamilton and MR850 to stretcher
- Set up dry limb, wet limb, place humidifier pot in MR850 warmer and fill with sterile water.
- Place goal zero on back of stretcher, secure and plug in MR 850 to goal zero

Step 2:

- Attach heating cable (yellow) to yellow port
- Attach temperature probe (blue) to blue port
- Attach heater cable (yellow) to wet limb
- Attach proximal temp probe (blue) to wet limb
- Attach distal temp probe (blue) to patient end of wet limb







Step 3: Set settings on Hamilton T1 and apply to patient

2-15 Bronchospasm & Restrictive Airway Disease

Purpose:

Treatment of patients with signs and symptoms of acute respiratory distress from bronchospasm or restrictive airway disease:

Symptoms/signs may include:

- Wheezing
- Signs of respiratory infection (e.g. fever, nasal congestion, cough, sore throat).
- May have acute onset after inhaling irritants.

This includes:

- Asthma exacerbation.
- COPD exacerbation.
- Wheezing from suspected or known pulmonary infection (e.g. pneumonia, acute bronchitis)

Treatment:

- **Albuterol 2.5 mg- 5 mg** nebulized
  - Repeat q15 minutes PRN

- **Ipratroprium** (**Atrovent**) **0.5 mg** nebulized
  - Repeat q30 minutes PRN

- **Levalbuterol** (**Xopenex**) **0.63- 1.25 mg** nebulized
  - Repeat q30 minutes PRN

- Albuterol, Ipratroprium and Levalbuterol may be given via in-line nebulizer for patients receiving invasive or non- invasive mechanical ventilation.

- **Methylprednisolone** (**Solu-Medrol**)**: 125mg IV**
  - Only to be administered if no prior steroid given at sending facility (24 hours for oral steroid, 6 hours for IV)

- **Magnesium Sulfate: 2 grams**
  - Dilute in 100 mL NS and administer over 15-20 minutes.
  - Can repeat x2 q 30 minutes for total of 6 grams.

2-15 Bronchospasm & Restrictive Airway Disease

If patient is in extremis or unresponsive to above therapy:

- **Epinephrine 0.5 mg IM** (0.5 ml of 1 mg/mL concentration)
- If refractory give **Epinephrine Push Dose 5-30 mcg IVP**
- If refractory to above, initiate **Epinephrine Infusion 1-30 mcg/min**
  - Caution in patients >50 years or with history of hypertension, angina or thyroid disease**.**

Considerations for Mechanical Ventilation:

- Initial Settings:
  - **Mode:** SIMV+ or (S)CMV+
  - **Tidal Volume Targets:** 6-8 mL/kg IBW
  - **Respiratory Rate:** 8-10
  - **I:E Ratio:** 1 : 4-5
  - **PEEP:** 3-6
  - **FiO2:** Set as clinically indicated to maximize oxygenation status

- Continue to treat underlying pathology as outlined above.

- Permissive hypercapnia (EtC02 >50 or PaC02 >60) is indicated in this patient population, prioritize efforts on maximizing oxygenation.

- Ketamine for sedation is strongly encouraged, see guideline ***2-10 Sedation/ Analgesia/ Paralysis.***

- For Air trapping/ Auto PEEP;
  - Decrease Respiratory Rate (to no less than 6 bpm) to increase expiatory phase.
  - Requires deeper sedation to minimize patient triggered breaths, consider narcotic boluses to decrease respiratory drive.

- For persistent air trapping/ auto PEEP, consider disconnecting ventilator circuit to allow for full exhale.

- In the event of cardiac arrest or sudden hemodynamic compromise, prioritize disconnecting ventilator circuit from patient to allow for full exhale.

PEDIATRIC

Purpose:

Treatment of patients with signs and symptoms of acute respiratory distress from bronchospasm or restrictive airway disease:

Symptoms/signs may include:

- Wheezing
- Signs of respiratory infection (e.g. fever, nasal congestion, cough, sore throat).
- May have acute onset after inhaling irritants.

This includes:

- Asthma exacerbation
- Wheezing from suspected or known pulmonary infection (e.g. pneumonia, acute bronchitis)

Treatment:

- **Albuterol 2.5 mg** nebulized
  - Repeat q15 minutes PRN

- **Ipratroprium** (**Atrovent**) **0.5 mg** nebulized
  - Repeat q30 minutes PRN

- **Levalbuterol** (**Xopenex**) **0.63 mg** nebulized
  - Repeat q30 minutes PRN

- Albuterol, Ipratroprium and Levalbuterol may be given via in-line nebulizer for patients receiving invasive or non- invasive mechanical ventilation.

- **Methylprednisolone** (**Solu-Medrol**)**: 2 mg**/**kg** (max 125 mg)
  - Only to be administered if no prior steroid given at sending facility (24 hours for oral steroid, 6 hours for IV).

- **Magnesium Sulfate: 25-50mg**/**kg** (max dose 2 grams)
  - Dilute in 100 mL NS and administer over 15-20 minutes.
  - Can repeat x2 q 30 minutes for total of 4 grams.

PEDIATRIC

If patient is in extremis or unresponsive to above therapy:

- **Epinephrine 0.01 mg/kg** up to 0.3mg IM
- If refractory give **Epinephrine Push Dose**
  - **Epinephrine Push dose: 0.5-1 mcg/kg,** max of 50mcg (10 mcg/mL concentration)
    - Repeat q 3-5 minutes PRN.
- If refractory to above, initiate **Epinephrine Infusion 0.05- 1 mcg/kg/min**

Considerations for Mechanical Ventilation:

- Initial Settings:
  - **Mode:** SIMV+ or (S)CMV+
  - **Tidal Volume Targets:** 6-8 mL/kg IBW
  - **Respiratory Rate:** 8-10
  - **I:E Ratio:** 1 : 4-5
  - **PEEP:** 3-6
  - **FiO2:** Set as clinically indicated to maximize oxygenation status

- **Continue to treat underlying pathology as outlined above.**

- Permissive hypercapnia (EtC02 >50 or PaC02 >60) is indicated in this patient population, prioritize efforts on maximizing oxygenation.

- Ketamine for sedation is strongly encouraged, see guideline ***2-10P Sedation/ Analgesia/ Paralysis.***

- For Air trapping/ Auto PEEP;
  - Decrease Respiratory Rate (to no less than 6 bpm) to increase expiatory phase.
  - Requires deeper sedation to minimize patient triggered breaths, consider narcotic boluses to decrease respiratory drive.
- For persistent air trapping/ auto PEEP, consider disconnecting ventilator circuit to allow for full exhale.

- In the event of cardiac arrest or sudden hemodynamic compromise, prioritize disconnecting ventilator circuit from patient to allow for full exhale.

2-16 Croup & Upper Airway Disease

Purpose:

Treatment of patients with signs and symptoms of stridor and cough from upper respiratory disease.

Symptoms/signs may include:

- Stridor
- Barking cough
- Drooling
- Unusual position of comfort (sniffing position, torticollis)
- Signs of respiratory infection (e.g. fever, nasal congestion, cough, sore throat)

Treatment:

- Avoid noxious stimuli (i.e., invasive tests or IV) and keep warm.
- Administer high flow oxygen/cool mist via blow by.
- Administer: **Racemic Epinephrine aerosol 0.5 mL 2.25% solution** (diluted in 2 mL NSS) inhaled; may repeat in 15 min.
- **Dexamethasone** (**Decadron**) **0.6 mg/kg** (max 10 mg; may use IV preparation orally).
- **Methylprednisolone** (**Solu-Medrol**) **2 mg/kg** (max 125 mg)

Additional Considerations:

- Allow child to assume position of comfort and do not restrain except to maintain safety on the stretcher.
- Transport parent with child (if possible). Ensure that both patient and parent are separately and properly restrained for transport.
    - **Patients cannot be transported being held by a parent who is secured to the stretcher**

- If need for airway management is anticipated due to worsening condition, strongly consider definitive airway management at sending facility prior to transport.

2-17 RSV & Bronchiolitis

Purpose:

Treatment of patients with signs and symptoms of lower airway disease, RSV, and Bronchiolitis.

Considerations:

- RSV is a family of viruses that can have a variety of presentations but mostly include cold/flu-like symptoms. It affects people of all ages, but small children/infants, elderly, or the immunocompromised are most vulnerable to more serious complications.

- Most common complications leading to hospitalization are pneumonia, bronchiolitis, and respiratory failure due to fatigue cause by increased work of breathing (most common in infants and small children).

Treatment: (**Adult**/ **Pediatric**)

- Supportive care
- Suctioning of secretions
- Humidified Oxygen supplementation
- Beta-agonists and steroid therapy are generally not indicated.

- Escalation of therapy as needed for worsening respiratory distress or respiratory failure:
  - ***2-14 Non- Invasive Ventilation- Hamilton T1- HFNC***
  - ***2-12 Non- Invasive Ventilation- Hamilton T1- BiPAP***
  - ***2-13 Non- Invasive Ventilation- Hamilton T1- CPAP***

- RSV is generally a lower airway disease vs alveolar or lung tissue disease, and *typically* does not require ventilation strategies used in ARDS or restrictive lung diseases.

Additional Considerations:

- Allow child to assume position of comfort and do not restrain except to maintain safety on the stretcher.
- Transport parent with child (if possible). Ensure that both patient and parent are separately and properly restrained for transport.
  - **Patients cannot be transported being held by a parent who is secured to the stretcher**

- If need for airway management is anticipated due to worsening condition, strongly consider definitive airway management at sending facility prior to transport.

2-18 Acute Respiratory Distress Syndrome (ARDS)

Purpose:

Outline treatment considerations and mechanical ventilation strategy of intubated patients diagnosed with ARDS. Prioritize oxygenation and lung protective strategies in this patient population.

Ventilator Settings:

- **Mode:** Choose mode based on patients presentation and needs.
  - For refractory hypoxia, consider pressure control ventilation with 1:1 I:E
    - Requires deeper sedation to minimize patient triggered breaths, consider narcotic boluses to decrease respiratory drive.
- **Tidal Volume Targets:** 4-8 mL/kg IBW, volumes of 4-6 mL/kg IBW may be required to adjust for increased Pplat and Driving Pressure.
- **Respiratory Rate:** 20-35
- **PEEP:** Minimum of 5mmHg
- **FiO2:** Set as clinically indicated to maximize oxygenation status to goal SP02

Oxygenation:

- Increasing PEEP to 10-15mmHg may be required.
  - Use driving pressure (PIP - PEEP) as a guide with a goal of ≤15 and Pplat of 30 or less.
  - PEEP >15mmHg requires ECPS medical director consult.
  - In severe ADRS cases, SP02 goals may be lower (85-90%) or Pa02 goals may be lower (55-80)

Permissive Hypercapnia:

- EtC02 >50 or PaC02 >60 may be indicated to prioritize efforts on maximizing oxygenation.

Patient Positioning:

- Ensure HOB is >30 degrees, consider up to 60 degrees.
- For ARDS with unilateral involvement consider left or right lateral placement of patient with affected side down.

Critical Hypoxia:

- Utilize ***hypoxia checklist*** to ensure correctable causes have been identified and fixed.
- In cases of critical refractory hypoxia (I.E peri- arrest), recruitment maneuvers may be utilized.

Section 3- Cardiovascular

3-1 Acute Coronary Syndrome

3-2 Arrhythmia

3-3 Aortic Emergencies

3-4 Cardiac Arrest

3-5 Post Resuscitation Care

3-6 Cardiogenic Shock

3-6P Cardiogenic Shock- Pediatric

3-7 Impella

3-8 Intra-Aortic Balloon Pump

3-9 Ventricular Assist Device

3-10 Transcutaneous & Transvenous Pacing

3-1 Acute Coronary Syndrome

Purpose:

Inter-facility treatment of patients diagnosed with acute coronary syndrome or patients diagnosed with an acute myocardial infarction.

General:

- Goal bedside time should be <15 minutes.
- **All patients with STEMI must have defib combo pads placed prior to departing bedside.**

Antiplatelet & Anticoagulation:

- **Aspirin: 324 mg** PO
- **Clopidogrel** (**Plavix**)**: 75-300 mg** PO.

- **Heparin Infusion: 100-2000 units/hr**
- **Eptifibatide** (**Integrilin**) **infusion: 1-2 mcg/kg/min.**
  - Hold Heparin or Integrilin infusion if any signs of bleeding are present.

Pain Control: (Hold Fentanyl and Nitroglycerin if SBP <100 mmHg)

- **Fentanyl: 25-100 mcg** (max single dose 100mcg, total max dose 300mcg)
- **Nitroglycerin: 0.4mg** SL q5 minutes.
- **Nitroglycerin infusion at 5- 200 mcg/min.**
  - Titrate by 10-20 mcg/min every 10 minutes.

Thrombolysis:

For patients experiencing a STEMI, if interfacility transport time is expected to be >1 hour and patient is being transported for primary PCI, discuss whether thrombolytics should be initiated for transport.

- **TNK- Tenecteplase**
  - Use manufacturer provided weight based dosing guidelines, not to exceed 50mg.
- **tPA- Alteplase** (**Activase**)**:**
  - **15 mg** over 1 minute, followed by;
  - **0.75 mg/kg** (**max 50 mg**) over 30 min, followed by;
  - **0.5 mg/kg max 35 mg**) over 60 min, followed by;
  - **Flush line with 100 mL NS at 60 minute rate**
- Alteplase (Activase) should be reconstituted with sterile water to 1 mg/mL prior to administration.
- Remove excess medication from bottle prior to initiating administration.

3-2 Arrhythmia

Purpose and Indications:

- For patients experiencing arrhythmia during critical care transport.
- For patients with ACS/ STEMI and persistent PVCs or arrhythmia
- Consult with receiving physician for specific treatment goals

Anti-dysrhythmics:

- **Amiodarone bolus: 150 mg**
  - Mix 150 mg / 3 mL Amiodarone with 17 mL Normal Saline and push or infuse over 10 min
- **Amiodarone infusion: 0.5- 1 mg/min**
  - If SBP <100 mmHg, stop Amiodarone infusion

Beta Blockers

- **Metoprolol: 5 mg** over 1-2 min
  - Max 25 mg total dose

- **Esmolol**
  - **Loading Dose: 500 mcg/kg bolus over 1 min** (can repeat once)
  - **Infusion Dose: 50 mcg/kg/min**
    - Titrate by 50 mcg/kg/min q4 min (max 300 mcg/kg/min)

Calcium Channel Blockers

- **Cardizem:**
  - **0.25 mg/kg bolus** (avg adult dose - 20 mg over 2 min)
  - If tolerated but inadequate response after 15 minutes, **0.35 mg/kg bolus**
  - If good response to the above bolus - start **infusion at 2.5-15 mg/hr**

Beta blocker and Calcium Channel Blocker Exclusion Criteria:

- Signs of pulmonary edema or cardiogenic shock, SBP <110 mmHg, AV block, heart rate <60 bpm, or already received beta-blocker or calcium-channel blocker within the previous 24 hours.

Post Thrombolytic Therapy Arrythmias:

- Patient's who have received thrombolytic therapy may exhibit reperfusion arrythmias - DO NOT TREAT these unless they are lethal (VT/VF) or persistent and the patient deteriorates clinically.

3-3 Aortic Emergencies

Purpose & Criteria:

- Define treatment pathways and considerations for aortic emergencies

Patient meets any of the following criteria:

- Known or suspected aortic dissection (most commonly in the thoracic aorta).
  - Type A involves the ascending aorta -- dissection proximal to the brachiocephalic artery.
  - Type B involves only the descending aorta -- dissection originating distal to the left subclavian artery

- Thoracic Aortic Aneurysm or Abdominal Aortic Aneurysm measuring ≥5 cm or any ruptured aortic aneurysm (most commonly in the abdominal aorta)

- Traumatic aortic disruption.

Assessment:

- Assess and document type of aortic emergency (Type A or B dissection, versus thoracic or abdominal aneurysm) and modality of diagnosis (e.g. CTA, U/S, MRI).
- Assess for neurological deficits, cardiac ischemia and shock.

Monitoring and Treatment Goals:

- Treatment goals include anti-impulse therapy, blood pressure control, analgesia, addressing coagulopathy and shock management.
  - Decreasing blood pressure and heart rate decrease shear forces and may prevent extension of the dissection.

- Parameters below are general guidance for goal SBP and HR unless otherwise ordered by the receiving physician.
  - Consult with the receiving physician if any questions regarding pharmacological management arise.

Anti-impulse Therapy (***Goal Heart Rate: < 65 bpm***)

- **Esmolol** (**Bolus & Infusion**):
  - Loading Dose: 500 mcg/kg bolus over 1 min (can repeat once)
  - Infusion Dose: 50 mcg/kg/min
  - Titrate by 50 mcg/kg/min q5 min (max 300 mcg/kg/min)

3-3 Aortic Emergencies

Blood Pressure Treatment and Goals:

- Aortic Dissection & Ruptured or Leaking Aortic Aneurysm: **Systolic Blood Pressure 100-110 mmHg**
- Non-Ruptured Aortic Aneurysm & Traumatic Aortic Disruption: Contact receiving physician for goal SBP

If SBP is above goal:

- **Nicardipine** (**Cardene**)- **Infusion: 5 mg/hr**
  - Titrate by 2.5 mg/hr q5 min (max 15 mg/hr)
  - Once goal achieved, consider reducing to maintenance rate of 3-5 mg/hr

For refractory or profound hypertension consider using Labetalol in concurrence with above therapies.

- **Labetalol 10-20 mg bolus**
  - Max of 300 mg total
  - Hold Labetalol if HR < 60 bpm

Analgesia:

- **Fentanyl: 25-100 mcg** (max single dose 100mcg, total max dose 500mcg)
  - Fentanyl is analgesic of choice in aortic emergencies. For refractory pain see guideline ***1-8 Pain management/ Analgesia***.

Coagulopathy:

If patient has active bleeding and patient is anticoagulated with INR ≥1.5, consider or continue;

- **Fresh Frozen Plasma** (**FFP**) per ***1-7 Blood Product Administration***
- **Kcentra** (**administer over 25 min**):
  - INR 2-3.9- 25 units/kg (max 2500 units)
  - INR 4-6- 35 units/kg (max 3500 units)
  - INR >6- 50 units/kg (max 5000 units)

- **Vitamin K 2.5-10 mg** (over 30 minutes)

Shock Management:

- For SBP <90 mmHg initiate or continue blood products per ***1-7 Blood Product Administration***
  - Contact receiving physician/ facility for additional guidance

3-4 Cardiac Arrest

Purpose:

Define operational considerations in the event a patient suffers cardiac arrest during inter-facility transport.

Treatment:

In the event of a cardiac arrest during inter-facility transport;

- Ambulance should be stopped and pulled over to a safe location
- Treat patient per ECPS Field Medical Protocols for cardiac arrest
- Identify and treat any reversible causes per appropriate guideline

If ROSC not obtained:

- If ROSC is not obtained, utilize ***1-3 Divert Policy*** for facility diversion guideline.

If ROSC is obtained:

- Treat per ***3-5 Post Resuscitation Care*** and ***3-6 Cardiogenic Shock***
- Contact the receiving facility and discuss the continuation of transport or diversion to different facility.

3-5 Post Resuscitation Care

Purpose:

Treatment of patient with return of spontaneous circulation (ROSC) after a medical caused cardiopulmonary arrest.

Assessment:

- Identify the underlying etiology of the preceding cardiac arrest and continue any treatments for underlying pathology.
- Obtain an arterial or venous blood gas and lactate level during initial assessment.
- Obtain initial temperature reading.
- If patient has GCS ≤8, cannot follow commands or is intubated:
  - *Assess body temperature every 30 min.*
  - Avoid temperature >38c

Management of Shock:

- **Maintain MAP goal of >65 mmHg or SBP >100mmHg**
  - Refer to guideline ***3-6 Cardiogenic Shock*** for interventions to manage shock, using this goal MAP.

Management of Hypoxia:

- **SP02 goal of >94%**
  - Refer to ventilator management guideline for interventions to meet SP02 goal in intubated patients.
  - In non- intubated patients, follow airway management protocols to maintain goal SP02.

Temperature Management:

- If Temporal temperature >38c or known core temperature >38c and not already administered, administer: **Acetaminophen 1 gram** or **15mg/kg** max 1 gram pediatric
  - Implement measures to avoid hyperthermia.
    - Increasing ambient ambulance temperature, packing groin/ axilla with ice packs.

Additional Considerations:

- Maintain head of bed at 30 degrees
- Maintain control of blood glucose between 120 mg/dl and 180 mg/dl

3-6 Cardiogenic Shock

Purpose:

Treatment of patient with cardiogenic shock.

Patient meets any of the following criteria:

- **Decrease in cardiac output related to any of the following:**
  - Acute Myocardial Infarction
  - Congestive Heart Failure
  - Congenital Heart Defects
  - Cardiomyopathy
  - Acute valve insufficiency
  - Post cardiac arrest

And with sign (s) of shock as evidence by any of the following:

- SBP <100 mmHg or MAP <65mmHg
- Heart rate > 120 beats per min
- Shock Index (HR/SBP) >0.9
- Lactate level ≥4 mmol/L
- Urine output < 30 ml/hr for 4 hours or more
- Changes in mental status or skin color

Volume Resuscitation:

- **250-500 mL Normal Saline or Lactated Ringers**
  - Use judiciously in patients with pulmonary edema
  - May repeat up to 1L total

Vasopressor:

Goal SBP of >100mmHg or MAP>65mmHg

- **Norepinephrine: 1-60 mcg/min**
  - Start at 1-5 mcg/min and titrate by 5-10 mcg/min
  - Once at 15-20 mcg/min with no improvement in MAP, consider 2nd line vasopressor and continue to titrate Norepinephrine.

- **Epinephrine: 1-30 mcg/min infusion**
  - Titrate by 2.5-5 mcg/min

3-6 Cardiogenic Shock

Push Dose Vasopressor:

- **Push dose Epinephrine** can be given as a bridge to mixing vasopressor infusion, or if patient is in extremis
- **Epinephrine Push dose: 5-30 mcg** (**0.5-3 mL**) of 10 mcg/mL concentration
  - Repeat q 3-5 minutes PRN.

Inotrope Support:

- **Dobutamine: 5-20 mcg/kg/min**
  - Titrate by 5 mcg/kg/min every 5-10 min to obtain goal SBP.

PEDIATRIC

Purpose:

Treatment of patient diagnosed or suspected with cardiogenic shock.

Patient meets any of the following criteria:

- Decrease in cardiac output related to any of the following:
  - Acute Myocardial Infarction, Congestive Heart Failure, Congenital Heart Defects, Cardiomyopathy, Acute valve insufficiency, Post cardiac arrest and any one of the following;
- Pediatric age adjusted shock index -->

Age 4-6: >1.2	**Age 7-12:** >1.0	**Age >13:** >0.9

- Tachycardia or bradycardia (for age)
- Capillary refill >2 seconds
- Weak central pulses
- Poor skin color
- Hypotension (for age) -->

<1 month: SBP <60 mmHg	**1 month to 1 year:** SBP <70 mmHg	**>1 year:** SBP < [70 + (2 x age in years)] mmHg

Treatment:

- **Contact medical direction for treatment plan and goals. The following may be ordered or continued from the sending facility.**

- Treatment Goals unless otherwise specified:
  - **<1 month:** SBP >60 mmHg
  - **1 month to 1 year:** SBP >70 mmHg
  - **>1 year:** SBP > [70 + (2 x age in years)] mmHg

Volume Resuscitation:

- If no signs of volume overload or if indicated, **10ml/kg of NS or LR** may be ordered and administered, repeated up to total of 30ml/kg

Maintence Fluids:

- Consult for desired Maintence fluid volume.

Diuresis:

- If signs of volume overload are present, **Lasix 1mg/kg** may be ordered

PEDIATRIC

Inotrope:

The following may be ordered and administered;

- **Epinephrine 0.05- 1 mcg/kg/min**
- **Dopamine 1-20 mcg/kg/min**
- **Dobutamine 1-20 mcg/kg/min**

Vasopressor:

The following may be ordered and administered;

- **Norepinephrine 0.05- 0.5 mcg/kg/min**
- **Dopamine 10-20 mcg/kg/min**
- **Vasopressin 0.1-1 milliunits/kg/hr**

Push Dose Vasopressor:

- **Push dose Epinephrine** can be given as a bridge to mixing vasopressor infusion, or if patient is in extremis.
- **Epinephrine Push dose: 0.5-1 mcg/kg** max of 50mcg of 10 mcg/mL concentration.
  - Repeat q 3-5 minutes PRN.

3-7 Impella

Purpose:

Define treatment guidelines and considerations for patient on an Impella.

Indications:

- Cardiogenic failure likely to resolve with definitive treatment, typically:
  - Acute valve insufficiency
  - Acute myocardial infarction
  - Acute cardiogenic shock / ventricular insufficiency
  - Ventricular dysrhythmias refractory to typical treatment

Precautions / Complications:

- Limb ischemia may occur
- Device migration out of therapeutic position
- Thrombocytopenia

Procedure:

- Assess patient status
  - Mental status
  - Hemodynamics; Patient's native cardiac function may be altered, assessment of hemodynamic function should focus on Mean Arterial Pressure (MAP)

Circulation / Device Parameters:

- Make a note of pulsatile waveforms for both placement signal and motor current
- Some devices will show aortic and left ventricular pressures, others will only display pressure differences. Assess hemodynamic values and verify parameters with the sending physician.
- Make note of flow rate
- Make note of Purge system flow rate and Purge system fluid (D5-D20 with Heparin or 25mEq/l Sodium Bicarbonate is typical)
- Make note of total cardiac output (L/Min.) This number may not be present, that is ok.
- Make note of selected Performance Level (needed for some trouble shooting steps)
- Assess concurrent medical therapies (Vasopressors, Anticoagulation, etc.)
- Assess access site to ensure no bleeding or hematoma
- Ensure the head of the bed is no greater than 30 degrees
- Ensure catheter, cable and purge tubing are free from any obstacles to avoid kinking or pull
- Ensure fluid bags are hung above level of patient

3-7 Impella

Additional Clinical Considerations:

- All pulses should be normal
- MAP goal of 60-80mmHg
- May need need to titrate down vasopressors if adequate support is achieved from Impella
- Check pulses distal of insertion site. May need doppler
- The arterial pressure (placement signal) on the Impella console is a reflected pressure of the aorta (used for catheter positioning only) and not a "true" arterial pressure. Clinical decision making for interventions must be based on blood pressures recorded by the NIBP or arterial line only. There will be times where pulsatile is minimal and NIBP's will be inaccurate/ unobtainable; using the MAP's from the placement signal in this situation is acceptable

Additional Transport Considerations:

- During transport, display screen should remain on waveform screen
  - The screen should be visible to help determine the location of the Impella Catheter
- Continuously monitor for and address any alarms. Follow the on-screen prompts and guidance. Do not drop the Performance Level below P-2
- Maintain the head of bed no greater than 30°
- Use restraint and/or knee immobilizer on leg with catheter to maintain straight
- Keep the Abiomed Impella Controller (AIC) plugged in during transport and ensure adequate battery power
- Ensure the white pump cable and purge tubing is clear of any obstacles or kinking

Acceptable Purge Fluid:

- D5W
- D5W with Heparin
- D5W with 25mEq/L Sodium Bicarbonate

3-7 Impella

AIC to AIC Transfer:

- Confirm that the patient is stable and can tolerate not having support for about 15 seconds
- Confirm that there have not been any issues with the pump prior to disconnecting from support
- Confirm the new AIC is powered on and ready
- Disconnect and then immediately reconnect the yellow luer from the impella catheter
- Transfer the purge cassete/ solution to the new AIC
- Disconnect the white cable and reconnect to the new AIC
- Once the Impella catheter is connected to the new AIC, press *OK* to resume the previous P-level setting
- Press *Purge Menu* --> *Change Purge Fluid* and complete the procedure to get accurate purge values

To remove AIC from cart:

- Unlock the console bed mount by turning the two black knobs on the back of the AIC 90 degrees in either direction
- Lift the console off of the cart
- Place the silver bed mount over a bed rail to aid in transport. If not needed it can be retracted into the back of the console

CPR & Defibrillation:

- Reduce Impella flowrate to P2
- Preform chest compressions until pulse is regained
- Upon ROSC confirm that the motor current on the AIC is pulsatile, return to previous P level and confirm MAP is adequate
- If the motor current is not pulsatile, maintain P2 and manage the patient medically until placement can be assessed at hub hospital.
- If defibrillation is required during transport, defibrillate the patient.

3-7 Impella

Alarms/ Troubleshooting:

- For any alarms follow on-screen troubleshooting
- If unable to clear turn Performance Level to P2, manage medically and notify receiving facility of issue.
- Contact Impella support at Abiomed Clinical Support Center (**800-422-8666**)

Suction Alarm:

May indicate inadequate filling of the ventricle (preload)

Action:

- Decrease pump flow by two P-levels, but no lower than P-2.
- Assess volume status of patient.
- If hypovolemia suspected (e.g. CVP <10 mmHg), fluid bolus
- Once fluid bolus is complete, return to prior flow level.
- If fluid bolus does not correct alarm, contact receiving facility and Abiomed Clinical Support Center (**800-422-8666**)

Purge Alarm:

May indicate high or low purge pressure

Action:

- Purge Pressure High- Assess for kinks in purge tubing
  - Change purge cassette if available
- Purge Pressure Low- Assess for loose connections/ leaking
  - Change purge cassette if available
- If changing the purge cassette does not resolve the alarm, contact the receiving facility and Abiomed Clinical Support Center (**800-422-8666**)

Air in Purge System:

May indicate air or no flow in purge system

Action:

- Make sure purge fluid bag is not empty or inverted
- Press *Purge Menu* --> *De-Air Purge System* --> *Start*, follow on screen instructions
- If this does not resolve the alarm, contact the receiving facility and Abiomed Clinical Support Center (**800-422-8666**)

Positioning Alarm:

May indicate device migration into the ventricle or into the aorta

Action:

- **Immediately contact the receiving facility and Abiomed Clinical Support Center (800-422-8666) and begin the following steps:**
  - Drop to P2 and medically manage the patient.
  - Evaluate correct placement based on placement and/or home screen
  - Check the centimeter mark on the catheter and ensure Tuohy-Borst valve is tight
  - Immobilize the leg if the patient is overactive or uncooperative

Pump Stopped:

May indicate that the pump has stopped. Impella flow at 0 L/min

Action:

- **Immediately contact the receiving facility and Abiomed Clinical Support Center (800-422-8666) and begin the following steps:**
  - Immediately attempt to resume the pump at previous P level
  - If unsuccessful, attempt to restart at P-2 level
  - If unsuccessful, wait 1-2 minutes and attempt to restart at P-2 level
  - If the pump restarts, run at the lowest P-level to maintain stable hemodynamics and manage medically.
  - If the pump does not restart, manage the patient medically

Impella Transfer Checklist:

Paper copies are kept with the Impella supply bag

IMPELLA® TRANSFER OF CARE CHECKLIST

Provide completed checklist to Transport Team upon arrival

GENERAL INFORMATION:

Age:	Weight (kg):	Gender:	☐ Report called	☐ Family updated	Transferring MD:
Accepting Hospital/Phone #:			Accepting MD:		Accepting room number/location:
Overview of Condition/HPI:					

VITAL INFORMATION

Current IV Infusions:						
☐ Room Air	☐ Nasal Cannula Flow:		☐ NIPPV (settings):		☐ Ventilator (settings):	
BP:	MAP:	HR:	RR:	Temp:	Neuro Status: ☐ A ☐ V ☐ P ☐ U	EF%:

DEVICE INFORMATION

☐ Impella CP® with SmartAssist®	☐ Impella 5.5® with SmartAssist®	☐ Impella RP® with SmartAssist®	☐ Bipella™	☐ ECpella			
Time of Insertion:	Location of Insertion:	☐ Tuohy-Borst locked	CM Marker:	☐ Access Site Issues	☐ Distal Pulses		
Purge solution:	☐ Heparin OR ☐ Sodium Bicarbonate Added? amount:			Last ACT:	Time:		
Left Device	P-level:	Impella Flow: (LPM)	PS: (mmHg)	LVPS: (mmHg)	MC: (mA)	Purge Flow: (mL/hr)	Purge Pressure: (mmHg)
Right Device	P-level:	Impella Flow: (LPM)	PS: (mmHg)	CVPS: (mmHg)	MC: (mA)	Purge Flow: (mL/hr)	Purge Pressure: (mmHg)
Recent alarms:			☐ Echo confirmation of position		CPR/Defibrillation?		

TRANSPORT CREW PRE-DEPARTURE:

Useful Items for Transfer
☐ Carabiner (to hang purge solution)
☐ Back up purge cassette (request from sending)
☐ 250 mL bag D5W (purge fluid replacement)
☐ 4X4 gauze, dressing materials
☐ Doppler

Pre-Departure Checklist
☐ AIC Battery charged
☐ Purge fluid bag remains upright
☐ Impella extremity immobilized/HOB remains less than 30 degrees
☐ Confirmation/reconfirmation Tuohy-Borst valve locked
☐ Maintain access to red or blue Impella plug during transport

3-8 Intra-Aortic Balloon Pump

Purpose:

Patient requires or is receiving cardiac support via an intra-aortic balloon pump.

Procedure:

- **Assessment**
  - Assess patient status
  - Mental status
  - Hemodynamics
  - Assess IABP insertion site, catheter size and type.
  - Assess IABP settings with referring staff.
  - Assess augmented pressures and trigger mechanism with any changes in augmentation or trigger mechanism.
  - Assess radial pulses, pedal pulses and urine output. Loss of pulse or urine output <30 ml/hr may indicate a displaced catheter.
  - Print IABP summary and document arterial pressures in 1:2 augmentation with transport IABP at initiation and transfer of care.
  - Print IABP summary with any change in IABP settings.
  - Reassess IABP catheter placement with each movement of the patient.
  - Keep head of bed < 30 degrees

Secure Lower Extremity:

- Secure with a soft restraint the lower extremity on the same side as the balloon catheter insertion site. Prevent balloon flexion at the hip (do not sit patient up >30°; log-roll patient only). Assess the restrained limb, including neurovascular status every hour.

Prepare IABP for transport:

- Balloon is secured to patient's leg
- Catheter is not kinked
- IABP timing is set to fully automatic - (Fiber Optic IAB)
- No timing errors have been identified
- Adequate Helium is present
- Adequate Battery and power source for duration of transport
- Ensure IABP is plugged into the ambulance AC power source and that the inverter is working and "On"
- Secure the IABP, allowing access to the console and pump.

3-8 Intra-Aortic Balloon Pump

Ensure Proper Trigger:

- If fiberoptic trigger fails or is not available, the IABP will automatically select the best trigger for augmentation. Monitor and record the selected trigger. Most often, it will select the R wave of the ECG as the trigger. It is important to provide the IABP with a good ECG signal. The arterial pressure waveform or pacing spikes may also be used. If you need to change the trigger: Put into Operator Mode and select trigger, then it must stay in Operator Mode.
- If CPR is in progress, manually select arterial pressure (AP) as the trigger during resuscitation until spontaneous circulation is restored.

Ensure Proper Timing:

- SBP- Unassisted > Assisted
- DBP- Unassisted > Assisted
- MAP- Unassisted < Assisted
- AUG > Unassisted SBP

Calibrating Fiberoptic Catheter:

- Place IABP in 1:2.
- View Assisted and Unassisted MAP.
- Select AP Key.
- Press FOS Cal Key.
- Move < & > keys until FOS MAP is equal to Unassisted MAP.

Goal BP/ MAP:

- Goal blood pressure is an augmented MAP ≥65 mmHg. Refer to cardiogenic shock guideline if signs of hypoperfusion or shock with augmented pressures.

Anticoagulation:

Continue **Heparin infusion at 100-2000 units/hr**

IABP Failure:

- In the event of **IABP Balloon Failure** (e.g. blood in balloon catheter): Attach a 60 ml Luer Slip-Tip syringe to balloon catheter, aspirate any remaining gas and clamp tubing. Contact the receiving facility.
- In the Event of **IABP Pump Failure:** Attach a 60 ml Luer Slip-Tip syringe to balloon catheter and cycle the balloon manually once every 10 min. Contact the receiving facility.

3-9 Ventricular Assist Device

Purpose:

Care and assessment of a patient with an implanted Ventricular Assist Device

Criteria:

- Patient has a surgically implanted ventricular assist device (e.g. DuraHeart, Heartmate II, Heartmate III, HeartWare, HeartMate XVE, or Jarvik 2000).

Assess patient:

- Assess adequacy of perfusion based on mental status, capillary refill, and skin color. The absence of a palpable pulse is normal for patients with a functioning VAD; they may not have a palpable blood pressure.
- Obtain blood pressure using doppler (goal MAP 65 mmHg).
- Assess the insertion site for bleeding or hematoma.

Assess Pump:

- Check all cables and lines are connected
- Listen to the motor of the pump over the heart and/or left upper quadrant and assess that the controller is working properly.
- Check the drive-line exit site for bleeding or infection or cable damage. Make sure the drive-line is not twisted or kinked and that it is secured to the body.
- Document current VAD settings, flow rate, RPM, and battery life. Reassess pump and document flow rate every 15 min.

Prepare for Transport:

- Bring power unit and batteries during the transport.
- Check batteries for full charge.
- Call receiving facility or receiving facility VAD coordinator for additional troubleshooting.

3-10 Transcutaneous & Transvenous Pacing

Purpose:

Define guidelines for care and transportation of patients receiving transcutaneous or transvenous pacing.

Transferring Transcutaneous Pacer:

- Ensure electrical and mechanical capture on the referring pacer
- Place transport monitor electrodes on the patient beside the referring electrodes and the transport monitor pacer pads in an anterior and posterior position on the patient
- Set the transport pacer to fixed mode and set the referring pacer to demand mode.
- Set the rate on the referring pacer to 60 bpm
- Set the transport pacer to a rate of 80 bpm and the energy level 10 mA higher than the referring pacer setting
- Initiate pacing on the transport pacer and rapidly increase (over seconds) the mA on the transport pacer until there is electrical and mechanical capture on the transport pacer
- Decrease the mA on the referring pacer while continuing to assess the pulse rate for continued mechanical capture with the transport pacer
- Turn off the referring pacer once you confirm you have maintained electrical and mechanical capture with the transport pacer

Transvenous Pacing Maintenance:

- Examine insertion site, and note electrode depth / position
  - Do not touch the electrodes going into the pacer device as they are sensitive to static electricity

- Obtain patient report with notation of rate, pacing threshold, and sensitivity that have produced the most consistent desired clinical results for the sending facility

- Obtain target vitals / clinical goals from the sending physician

- Ensure device has appropriate battery capacity or power supply for the duration of transfer
  - Ensure spare battery is available during transport

- Titrate rate as needed to produce acceptable cardiac output

- Adjust (increase) mA (threshold) as needed to maintain capture

- Routine adjustment of sensitivity is not required. Confirm appropriate sensing prior to departure with sending facility staff. Reduce sensitivity if need to accommodate excess artifact (over sensing) in the transport environment
  - If it becomes necessary during transport to re-establish sensitivity threshold follow this procedure:
    - Set the rate 10 bpm below the patient's intrinsic rate
    - Set the output for pacing (mA) to the lowest setting
    - Decrease the sensitivity until the pacer fires continuously
    - Increase sensitivity until pacer stops firing - THIS VALUE IS THE SENSITIVITY THRESHOLD
    - Set the sensitivity to 1/2 (50%) of the sensitivity threshold value

- Monitor the patient for adequate hemodynamic output. Treat per appropriate CCT guideline

Section 4- Medical

- 4-1 Diabetic Ketoacidosis
- 4-1P Diabetic Ketoacidosis- Pediatric
- 4-2 Gastrointestinal Hemorrhage
- 4-3 Hypertensive Emergencies
- 4-4 Sepsis
- 4-4P- Sepsis- Pediatric
- 4-5 Alcohol Withdrawal
- 4-6 Arterial or Venous Thromboembolism
- 4-7 Shock & Refractory Hypoperfusion
- 4-7P Shock & Refractory Hypoperfusion- Pediatric
- 4-8 Toxicology
- 4-9 Metabolic Emergencies
- 4-10 Pregnancy Induced Hypertension (PIH)
- 4-11 Preterm Labor
- 4-12 Postpartum Hemorrhage

4-1 Diabetic Ketoacidosis

Purpose:

- Guideline for treatment of patient with diagnosis of diabetic ketoacidosis.

Clinical Considerations:

- The therapeutic goals of DKA management include the treatment of;
  - Volume status
  - Blood glucose and ketoacidosis
  - Electrolyte abnormalities

Assessment:

- Assess hospital provided lab values on initial patient contact, including CMP, CBC, UA, blood gas, blood cultures and lactate.

- Obtain POC labs, including blood glucose, BMP, lactate and blood gas at bedside if clinically indicated and then every 60 minutes during transport.

Fluid Resuscitation:

Administer IV fluids based on parameters below (in sequence).

- Include IV fluids administered prior to arrival for this condition.

- 1st: **20 mL/kg bolus with LR** or NS if LR is not available.

- 2nd: **Follow "two bag" method in table below** for a total fluid rate of 250 mL/hr (2x normal maintenance fluid rate).

- If **potassium level is <5.3 mEq**, continuous infusion should contain **Potassium 20- 40 mEq KCl per liter.** If **potassium level is <3.3**, hold or stop insulin infusion until potassium is >3.3.

- Administer Potassium Containing Solutions under the following guidelines;
  - Peripheral IV access: Administer at **max rate of 10 mEq/hr** in peripherial access site
    - Potassium containing solution may be administered at 10mEq/hr in up to two separate peripheral IV sites, for a total max rate of 20mEq/hr

- Central vascular access: Administer at rate of **10mEq/hr- 40mEq/hr** (max rate)

- If glucose decreases to <250 mg/dl, change to the continuous infusion rate (without further bolus) using D5NS or D5 1/2NS.

4-1 Diabetic Ketoacidosis

Two Bag Method:

- To be run concurrently with insulin infusion
- **Bag 1: 0.45% NaCl with or without 20meq potassium chloride** (K+ not indicated if >5.3)
- **Bag 2: D10, 0.45% NaCl with 20meq potassium chloride**
  - Exact potassium doses may vary slightly based on orders/specific patient requirements.

Hourly BGL	Bag 1 (ml/hr) (non-Dextrose fluid)	Bag 2 (ml/hr) (D10 fluid)	Total dextrose rate
>250	250	0	none
150-250	125	125	D5, 250ml/hr
<150	0	250	D10, 250ml/hr

Insulin:

- **Insulin infusion of 0.1 – 0.25 units/kg/hr** until BGL is <200 mg/dl and anion gap is closed.
  - Standard infusion concentration is 100 units/100 mL for 1 unit/mL concentration. This must be verified with sending RN at transfer of care.
  - Adults may receive a **one time Insulin bolus of 0.1 units/kg** (max 10 units) prior to starting infusion.
  - **Withhold or stop insulin until K+ >3.3.**
- Decrease insulin infusion rate to 0.05 units/kg/hr if altered mental status or signs of cerebral edema occur.

Additional Considerations:

- Goal BGL reduction of no more than 100 mg/dl per hour.
- All infusions and fluid will be administered via an IV infusion pump

PEDIATRIC

Purpose:

- Guideline for treatment of patient with diagnosis of diabetic ketoacidosis.

Clinical Considerations:

- The therapeutic goals of DKA management include the treatment of;
  - Volume status
  - Blood glucose and ketoacidosis
  - Electrolyte abnormalities

Assessment:

- Assess hospital provided lab values on initial patient contact, including CMP, CBC, UA, blood gas, blood cultures and lactate.

- Obtain POC labs, including blood glucose, BMP, lactate and blood gas at bedside if clinically indicated and then every 60 minutes during transport.

Fluid Resuscitation:

Administer IV fluids based on parameters below (in sequence).

- Include IV fluids administered prior to arrival for this condition.

- 1st: **20 – 60 mL/kg LR or 0.9%NaCl.** Bolus based on clinical needs.

- 2nd: **Follow "two bag" method in table below** for a total of 1.5x the normal weight based maintenance rate.

- If **potassium level is <5.3 mEq**, continuous infusion should contain **Potassium 20- 40 mEq KCl per liter**. If **potassium level is <3.3**, hold or stop insulin infusion until potassium is >3.3
  - See guideline ***1-4 Patient Assessment & General Care- Potassium Containing Solution*** for administration rates.

- If **glucose decreases to <250 mg/dl**, change to the continuous infusion rate (without further bolus) using D5NS or D5 1/2NS.

PEDIATRIC

Two Bag Method:

To be run concurrently with insulin infusion

- **Bag 1:** 0.45% NaCl with or without 20meq potassium chloride (K+ not indicated if >5.3)
  - May contain potassium phosphate or potassium acetate rather than potassium chloride.
- **Bag 2:** D10, 0.45% NaCl with 20meq potassium chloride
  - May contain potassium phosphate or potassium acetate rather than potassium chloride.
- Total hourly fluid rate is 1.5x the maintenance fluid rate in ml/hr.

Hourly BGL	Bag 1 (ml/hr) (non-Dextrose fluid)	Bag 2 (ml/hr) (D10 fluid)	Total dextrose rate
>300	100%	0%	None
250-300	50%	50%	D5
200-250	25%	75%	D7.5
150-200	0%	100%	D10
<150 *Decrease insulin infusion to 0.05units/kg/hr at this time.	0%	100%	D10

Insulin:

- **Insulin infusion rate 0.1 units/kg/hr**
  - Standard infusion concentration is 100 units/100mL for 1 unit/mL concentration. This must be verified with sending RN at transfer of care.
  - Goal BGL reduction of no more than 100 mg/dl per hour.
  - **Withhold or stop Insulin until K+ >3.3.**
- Do not bolus insulin in pediatric patients.
- Decrease insulin infusion rate to 0.05 units/kg/hr if altered mental status or signs of cerebral edema occur.
- All infusions and fluid will be administered via an IV infusion pump
- If two bag method as listed above is not initiated as sending facility, contact Medical Direction at receiving facility for guidance.

4-2 Gastrointestinal Hemorrhage

Criteria:

- Patient is suspected of having gastrointestinal bleeding or diagnosed with gastrointestinal hemorrhage.

Pediatric: 

Consult with medical direction for treatment

Medication Continuation:

May continue or initiate the following for transport;

- **Pantoprazole** (**Protonix**) **40-80 mg IV bolus**
- **Pantoprazole** (**Protonix**) **8 mg/hr**
- **Octreotide 25-50 mcg/hr**

Blood Products Administration:

- If any of the following criteria are met;
  - **SBP < 100mmHg**
  - **MAP < 65mmHg**
  - **Hemoglobin < 7**
- Administer or continue blood products in accordance with ***1-7 Blood Product administration.***

- Target resuscitation goals:
  - **MAP of 65mmHg** or
  - **SBP of 100mmHg**

- Conservative use of crystalloid solutions should be used

- TXA is contraindicated in GI hemorrhage

Vasopressor Therapy:

Concurrent vasopressor therapy may be warranted in cases of severe gastrointestinal hemorrhage. Initiate or continue vasopressors if the patient remains in refractory shock despite blood product resuscitation and has an **SBP <100 mmHg or MAP <65 mmHg.**

- **Norepinephrine: 1-60 mcg/min**
  - Start at 1-5 mcg/min and titrate by 5-10 mcg/min

- **Vasopressin: 0.04 -0.08 units/min**

4-2 Gastrointestinal Hemorrhage

Coagulopathy:

If patient has active bleeding and is anti-coagulated with INR ≥5, consider;

- **Fresh Frozen Plasma** (**FFP**) per ***1-7 Blood Product Administration***

- **Kcentra** (administer over 25 min):
  - INR 2-3.9 25 units/kg (max 2500 units)
  - INR 4-6 35 units/kg (max 3500 units)
  - INR >6 50 units/kg (max 5000 units)

- **Vitamin K: 2.5-10 mg** over 30 minutes

Balloon Tamponade:

- If a balloon tamponade system (e.g. Sengstaken-Blakemore tube, Minnesota tube, or Linton-Nachlas tube) has been placed for management of esophageal bleeding:
  - Maintain the tube in place for transport.
  - Place the gastric suction port (if present) to low continuous suction.

4-3 Hypertensive Emergencies

General Indications for therapy:

- Hypertensive Emergency is acute, marked blood pressure elevation with associated signs of end organ damage/dysfunction.

- Acute findings can include the following:
  - Pulmonary edema, Cardiac ischemia, Neurologic deficits/encephalopathy, Acute renal failure

Hypertensive Emergency criteria must be met:

1) Severe Hypertension:

- Usually a MAP of at least >120 mmHG
- Need significant change above patients baseline if chronic hypertension (especially if uncontrolled)

2) End organ damage:

- Cardiac ischemia based on EKG findings
- Acute Pulmonary Edema, significant respiratory distress
- Hypertensive encephalopathy (acute AMS/delirium, seizures, visual changes) -- typically improves with acute BP control
- Acute kidney injury

Though the following are often seen in severe hypertension they do not qualify as end organ damage:

- Headache or Epistaxis

Secondary Hypertension:

- Hypertension mainly as a result of another treatable primary process such as:
  - ***Aortic Emergencies***
  - ***Cocaine/methamphetamine/drug intoxication***
  - ***Preeclampsia***
  - ***Ischemic Stroke***
  - ***Hemorrhagic Stroke***
  - ***Pain***

4-3 Hypertensive Emergencies

Monitoring and Treatment Goals:

- BP targets need to be individualized. Consider baseline BP and causative factor in determining how rapid the increase occurred.

- Chronic severe hypertension: Consider a more gradual approach -- only with signs of end organ damage

- Acute development of hypertension: More rapid reduction of BP

General BP Management:

- **Nicardipine** (**Cardene**)- **Infusion: 5 mg/hr**
  - Titrate by 2.5 mg/hr q5 min (max 15 mg/hr)
  - Once goal achieved, consider reducing to maintenance rate of 3-5 mg/hr

- Labetalol:
  - **Labetalol 20 mg** over 2 minutes, if the desired blood pressure is not achieved;
  - **Labetalol 40 mg** over 2 minutes, if the desired blood pressure is not achieved;
  - **Labetalol 80mg** over 2 minutes, every 10 minutes, until blood pressure goal is met.
    - Not to exceed a total of 300 mg.

- **Metoprolol**
  - **5 mg IV,** repeat as needed, max of 25 mg
  - **5-25 mg PO,** repeat as needed, max of 25 mg

4-4 Sepsis & Septic Shock

General Indications for therapy:

- Sepsis is defined as a patient with signs of Sepsis Related Organ Failure identified using the *quick Sepsis Related Organ Failure Assessment* (qSOFA)

quick Sepsis Related Organ Failure Assessment (qSOFA)	
Clinical Finding	**Points**
SBP <100	1
RR >22	1
GCS <15	1
• 0-1 points = not high risk, continue **sepsis** treatment • 2-3 points = High risk, treat per **septic shock** protocol	

And with sign (s) of shock as evidence by any of the following:

- SBP <100 mmHg or MAP <65mmHg
- Heart rate > 120 beats per min
- Shock Index (HR/SBP) >0.9
- Lactate level ≥4 mmol/L
- Urine output < 30 ml/hr for 4 hours or more
- Changes in mental status or skin color

Resuscitative goals/endpoints:

- Maintain MAP 65mmHg using appropriate volume resuscitation and vasopressors, MAP goals as high as 80mmHg may be indicated for some patients.
- Achieve source control - Appropriate antibiotics at the right dose and rate
- Maintain Shock Index < 0.7
  - (HR/SPB = SI)
- Prevention and treatment of hypoxia (Sp02 <90%)
- Maintain urine output of at least 0.5ml/kg/hr
- Maintain lactate <2 mmol/l
  - If lactate continues to increase outside the presence of vasopressor use, re-evaluate source control strategy and ensure hemodynamic resuscitation

4-4 Sepsis & Septic Shock

Volume Resuscitation:

- Initial bolus up to **30 mL/kg** in the first 3 hours is reasonable unless signs of fluid overload are present.
  - Lactated Ringers is the crystalloid of choice.
- Initiation of vasopressors during volume resuscitation is reasonable when MAP <65 mmHg

Source control strategy:

- Continue antibiotics as ordered
- See ***A-5 Antimicrobial Reference List***

Vasopressor therapy:

- Maintain MAP > 65-80 mmHg
- Multimodal vasopressors may be needed, maximizing benefits of each

Vasopressor Therapy:

- **Norepinephrine: 1-60 mcg/min**
  - Start at 1-5 mcg/min and titrate by 5-10 mcg/min
  - Once at 15-20 mcg/min with no improvement in MAP, consider 2nd line vasopressor and continue to titrate Norepinephrine.

- **Vasopressin: 0.04 u/min**
  - Typically not titrated but max of 0.08 u/min

- **Epinephrine infusion: 1-30 mcg/min**
  - Start at 1mcg/min and titrate by 2.5-5 mcg/min

- **Phenylephrine: 40-180 mcg/min**
  - Titrate by 5-10 mcg/min. Once MAP goal has been met, may titrate down to 40-90 mcg/min

Push Dose Vasopressor:

- **Push dose Epinephrine** can be given as a bridge to mixing vasopressor infusion, or if patient is in extremis
- **Epinephrine Push dose: 5-30 mcg** (0.5-3 mL) of 10 mcg/mL concentration
  - q3-5 minutes PRN

4-4 Sepsis & Septic Shock

Steroid Administration:

For patients in refractory shock despite continued therapy or with known or suspected adrenal insufficiency;

- **Hydrocortisone: 100 mg**
- **Dexamethasone 10 mg**
  - if Hydrocortisone is not available

Acidosis:

In cases of profound acidosis, PH <7.0 or Bicarbonate <4 **AND** patient is non- responsive to first **AND** second line vasopressor therapy:

- **Sodium Bicarbonate infusion at 200 mL/hr**
  - 150 mEq Sodium Bicarbonate in 1000 mL D5W

Antipyretic:

For persistent fever that is >38c

- **Acetaminophen: 1 gram** over 15 minutes, *not to exceed 3 grams in 24 hours*

Airway Management:

- Consider ***BiPAP***, ***CPAP*** or ***HFNC*** use for hypoxia and increased work of breathing
- If intubating, be prepared for rapid hemodynamic changes. Volume resuscitation and push dose vasopressor will be needed.

Point of Care Testing:

- POC lactate should be obtained at bedside if clinically indicated and then every 60 minutes during transport.

- Lactate can help guide effectiveness of ongoing treatment and progression of shock state.

PEDIATRIC

Purpose:

Treatment of patient diagnosed or suspected with septic shock.

Patient diagnosed with sepsis and meets any of the following criteria:

Decreased tissue perfusion as evidenced by any of the following:

- Pediatric age adjusted shock index -->

Age 4-6: >1.2	**Age 7-12:** >1.0	**Age >13:** >0.9

- Tachycardia or bradycardia (for age)
- Capillary refill >2 seconds
- Weak central pulses
- Poor skin color
- Hypotension (for age) -->

<1 month: SBP <60 mmHg	**1 month to 1 year:** SBP <70 mmHg	**>1 year:** SBP < [70 + (2 x age in years)] mmHg

Resuscitative goals/endpoints:

- Achieve source control - Appropriate antibiotics at the right dose and rate
- Prevention and treatment of hypoxia (Sp02 <90%)
- Maintain urine output of 1 ml/kg/hr
- Maintain goal SBP and MAP, based on age
- POC lactate should be obtained at bedside if clinically indicated and then every 60 minutes during transport.

Treatment:

- **Contact medical direction for treatment plan and goals. The following may be ordered or continued from the sending facility.**

Volume Resuscitation:

- Initial bolus of **LR or NS 20 mL/kg** up to total of 60 ml/kg, unless signs of fluid overload are present.
  - Lactated Ringers is the crystalloid of choice.

- Concurrent initiation of vasopressors during volume resuscitation is reasonable when patient is in septic shock.

Maintence Fluids:

- The preferred routine maintenance fluid is **5% Dextrose in 0.45% Sodium Chloride** and should be continued using ***4/2/1 Maintence Fluid Calculation***.

PEDIATRIC

Source control strategy:

- Continue antibiotics as ordered
- See ***A-5 Antimicrobial Reference List***

Vasopressor Therapy:

The following may be ordered and administered;

- **Epinephrine 0.05- 1 mcg/kg/min**
- **Dopamine 1-20 mcg/kg/min**
- **Norepinephrine 0.05- 0.5 mcg/kg/min**
- **Vasopressin 0.1-1 milliunits/kg/hr**
- **Dobutamine 1-20 mcg/kg/min**

Push Dose Vasopressor:

- **Push dose Epinephrine** can be given as a bridge to mixing vasopressor infusion, or if patient is in extremis.
- **Epinephrine Push dose: 0.5-1 mcg/kg** max of 50mcg of 10 mcg/mL concentration.
  - Repeat q 3-5 minutes PRN.

Steroid Administration:

For patients in refractory shock despite continued therapy or with known or suspected adrenal insufficiency;

- **Hydrocortisone** (**Solu-Cortef**) **2mg/kg** max 100mg

Antipyretic:

For persistent fever that is >38c

- **Acetaminophen: 15mg/kg**, max 1 gram over 15 minutes
  - Must be administered on IV pump

Airway Management:

- Consider ***BiPAP***, ***CPAP*** or ***HFNC*** use for hypoxia and increased work of breathing
- If intubating, be prepared for rapid hemodynamic changes. Volume resuscitation and push dose vasopressor will be needed.

4-5 Alcohol Withdrawal

Purpose:

Provide treatment considerations for patients experiencing acute alcohol withdrawal as a primary complaint or for patients who are at risk of developing alcohol withdrawal syndrome while undergoing care for a complaint that is not primarily alcohol withdrawal syndrome.

General Considerations:

In the critical care transport setting, patients with alcohol withdrawal can present with specific needs that should be considered. These may include need for higher dosages of sedatives, increased oxygen demand, adjustments in mechanical ventilation needs and multi-modal therapies for management of underlying pathology and alcohol withdrawal. For both patient populations, provide general supportive care and Individual or multi-modal treatments that may include the following:

For patients who are intubated see guideline ***2-10 Sedation/ Analgesia/ Paralysis***

Benzodiazepines:

- **Lorazepam 0.5-2mg** IV q 20-30 minutes or **Lorazepam Infusion 2.5-5mg/hr**
  - Titrate to RASS -1 & HR <120

  OR
- **Diazepam 5-10mg** IV q 20-30 minutes
  - Titrate to RASS -1 & HR <120

Antipsychotics:

- **Haldol 5mg** q1 hour for delirium symptoms

  OR
- **Droperidol 5mg** q1 hour for delirium symptoms

Antiepileptics:

- **Keppra** (**Levetiracetam**) **20 mg/kg** max 2000 mg
  - Diluted in 100 mL NS or D5W, infused over 15 minutes.

- Dilantin (Phenytoin) and Cerebyx (Fosphenytoin) are generally ineffective in treatment of alcohol withdrawal syndrome seizures.

Additional Medications:

- **Dexmedetomidine** (**Precedex**)**: 0.2-1.5 mcg/kg/hr**
  - Titrate by 0.2 mcg/kg/hr q 10 minutes. Titrate to RASS -1 & HR <120
  - Do not bolus. Higher doses can cause hypotension.

4-6 Arterial or Venous Thromboembolism

Criteria:

Patient meets either of the following criteria:

- Radiographic evidence of acute pulmonary thromboembolism by CTA, MRI, or VQ-scan.
- Radiographic evidence of venous or arterial thromboembolism by ultrasound, CTA, or MRI.

Pediatric: 

Consult with medical direction for treatment.

Continuing Anticoagulation:

For patients **already receiving Heparin infusion,** continue this infusion based on the following parameters:

- Dosing Range: **100-2000 units/hr.**
- Monitor for any signs of bleeding. If bleeding is identified, stop Heparin infusion.

Initiating Anti-coagulation:

- If patient is not receiving Heparin infusion, initiate
  - **Heparin:**
    - **Initial bolus: 80 units/kg** (max 10,000 units; round to closest 100 units).
    - **Infusion: 18 units/kg/hr** (max rate 1,600 units/hr; round to closest 100 units/hr).
- Monitor for any signs of bleeding. Stop infusion if present.

Thrombolysis:

- **TNK- Tenecteplase**
  - Use manufacturer provided weight based dosing guidelines, not to exceed 50 mg.

- **tPA- Alteplase (Activase):**
  - **100 mg** IV infusion over 2 hours, followed by
  - **Flush line with 100 mL NS at 2 hour rate**

  - Alteplase (Activase) should be reconstituted with sterile water to 1 mg/mL prior to administration. Remove excess medication from bottle prior to initiating administration.

4-6 Arterial or Venous Thromboembolism

Patients in shock state or extremis:

For patient diagnosed with PE and with sign (s) of shock as evidence by any of the following:

- SBP <100 mmHg or MAP <65mmHg
- Heart rate > 120 beats per min
- Shock Index (HR/SBP) >0.9
- Lactate level ≥4 mmol/L
- Urine output < 30 ml/hr for 4 hours or more
- Changes in mental status or skin color

Treatment:

- **Volume resuscitation:**
  - **250ml- 500 mL LR or NS**, repeat as needed up to 1L, however maintain low threshold for initiation of vasopressor support

Vasopressor Therapy:

Goal SBP >100mmHg or MAP >65mmHg

- **Epinephrine infusion: 1-30 mcg/min**
  - Start at 1 mcg/min and titrate by 2.5-5 mcg/min
  - Once at 15 mcg/min with no improvement in MAP, consider 2nd line vasopressor and continue to titrate Epinephrine.
  - Epinephrine is preferred vasopressor in patients with shock state due to Pulmonary Embolism.

- **Vasopressin: 0.04 U/min**
  - Typically not titrated but max of 0.08 U/min.

- **Norepinephrine: 1-60 mcg/min**
  - Start at 1-5 mcg/min and titrate by 5-10 mcg/min

Push Dose Vasopressor:

- **Push dose Epinephrine** can be given as a bridge to mixing vasopressor infusion, or if patient is in extremis.
- **Epinephrine Push dose: 5-30 mcg** (0.5-3mL) of 10mcg/mL concentration
  - q3-5 minutes PRN

4-6 Arterial or Venous Thromboembolism

Respiratory Distress:

- Non- invasive ventilatory management with HFNC is preferred.
  - BiPAP or CPAP may be utilized, however caution should be used and use of PEEP should be minimized.
  - ***2-14 Non- Invasive Ventilation- Hamilton T1- HFNC***
  - ***2-12 Non- Invasive Ventilation- Hamilton T1- BiPAP***
  - ***2-13 Non- Invasive Ventilation- Hamilton T1- CPAP***

- Use extreme caution if RSI of PE patient is indicated. This patient population is at increased risk of peri and post intubation cardiac arrest. Prepare with proper resuscitation prior to intubation and have push dose vasopressor readily available for use.

- Preferable to consult with medical direction prior to intubation to discuss intubation and post intubation strategy.

- Minimize use of PEEP pre and post intubation.

4-7 Shock & Refractory Hypoperfusion- Medical

Purpose:

Treatment of shock state not due to trauma.

Criteria:

Evidence of shock related to one of the following causes:

- Sepsis- ***4-4 Sepsis***
- Pulmonary Embolism- ***4-6 Arterial or Venous Thromboembolism***
- Cardiogenic Shock- ***3-6 Cardiogenic Shock***
- Toxic drug exposure- ***4-8 Toxicology***
- GI Hemorrhage- ***4-2 Gastrointestinal Hemorrhage***
- Postpartum Hemorrhage- ***4-12 Postpartum Hemorrhage***
- Anaphylaxis
- Adrenal crisis

And with sign (s) of shock as evidence by any of the following:

- SBP <100 mmHg or MAP <65mmHg
- Heart rate > 120 beats per min
- Shock Index (HR/SBP) >0.9
- Lactate level ≥4 mmol/L
- Urine output < 30 ml/hr for 4 hours or more
- Changes in mental status or skin color

Volume Resuscitation:

- See appropriate guideline, otherwise **500mL- 1L of LR or NS** or up to 30ml/kg as clinically indicated.

Vasopressor Therapy:

- **Norepinephrine: 1-60 mcg/min**
  - Start at 1-5 mcg/min and titrate by 5-10 mcg/min
  - Once at 15-20 mcg/min with no improvement in MAP, consider 2nd line vasopressor and continue to titrate Norepinephrine.

- **Vasopressin: 0.04 U/min**
  - Typically not titrated but max of 0.08 U/min.

- **Epinephrine infusion: 1-30 mcg/min**
  - Start at 1 mcg/min and titrate by 2.5-5 mcg/min

- **Phenylephrine: 40-180 mcg/min**
  - Once MAP goal has been met, may titrate down to 40-90 mcg/min

4-7 Shock & Refractory Hypoperfusion- Medical

Push Dose Vasopressor:

- **Push dose Epinephrine** can be given as a bridge to mixing vasopressor infusion, or if patient is in extremis
- **Epinephrine Push dose: 5-30 mcg** (0.5-3mL) of 10 mcg/mL concentration
  - q3-5 minutes PRN

Additional Vasopressor Support:

- **Dopamine: 2-20 mcg/kg/min**
  - Titrate by 2.5-5 mcg/kg/min every 5-10 min to obtain goal SBP.

Inotrope Support:

- **Dobutamine: 5-20 mcg/kg/min**
  - Titrate by 2.5-5 mcg/kg/min every 5-10 min to obtain goal SBP.

Steroid Administration:

For patients with known/ suspected adrenal insufficiency, known to be on long term steroid therapy, or in refractory shock despite continued therapy with multiple vasopressors, consider;

- **Hydrocortisone: 100 mg**
- **Dexamethasone 10 mg** is also reasonable if hydrocortisone is not available

Acidosis:

In cases of profound acidosis, PH <7.0 or Bicarbonate <4 **AND** patient is non-responsive to first **AND** second line vasopressor therapy:

- **Sodium Bicarbonate infusion at 200 mL/hr**
  - 150 mEq Sodium Bicarbonate in 1000 mL D5W

Point of Care Testing:

- POC lactate should be obtained at bedside if clinically indicated and then every 60 minutes during transport.

- Lactate can help guide effectiveness of ongoing treatment and progression of shock state.

PEDIATRIC

Purpose:

Treatment of shock state not due to trauma or hemorrhage.

Criteria:

Evidence of shock related to one of the following causes:

- Sepsis- ***4-4P Sepsis***
- Pulmonary Embolism- ***4-6 Arterial or Venous Thromboembolism***
- Cardiogenic Shock- ***3-6P Cardiogenic Shock***
- Toxic drug exposure- ***4-8 Toxicology***
- GI Hemorrhage- ***4-2 Gastrointestinal Hemorrhage***
- Anaphylaxis
- Adrenal crisis

And any of the following;

- Pediatric age adjusted shock index -->

Age 4-6: >1.2	**Age 7-12:** >1.0	**Age >13:** >0.9

- Tachycardia or bradycardia (for age)
- Capillary refill >2 seconds
- Weak central pulses
- Poor skin color
- Hypotension (for age) -->

<1 month: SBP <60 mmHg	**1 month to 1 year:** SBP <70 mmHg	**>1 year:** SBP < [70 + (2 x age in years)] mmHg

Treatment:

- **Contact medical direction for treatment plan and goals. The following may be ordered or continued from the sending facility.**

Volume Resuscitation:

- See appropriate guideline, otherwise **20ml/kg of crystalloid** up to total of 60mL/kg as clinically indicated.

Maintence Fluid:

- The preferred routine maintenance fluid is **5% Dextrose in 0.45% Sodium Chloride** and should be continued using ***4/2/1 Maintence Fluid Calculation.***

PEDIATRIC

Inotrope Support:

The following may be ordered and administered;

- **Epinephrine 0.05- 1 mcg/kg/min**
- **Dopamine 1-20 mcg/kg/min**
- **Dobutamine 1-20 mcg/kg/min**

Vasopressor:

The following may be ordered and administered;

- **Norepinephrine 0.05- 0.5 mcg/kg/min**
- **Dopamine 10-20 mcg/kg/min**
- **Vasopressin 0.1-1 milliunits/kg/hr**

Push Dose Vasopressor:

- **Push dose Epinephrine** can be given as a bridge to mixing vasopressor infusion, or if patient is in extremis.
- **Epinephrine Push dose: 0.5-1 mcg/kg** max of 50mcg of 10 mcg/mL concentration.
  - Repeat q 3-5 minutes PRN.

Steroid Administration:

- For patients in refractory shock despite continued therapy or with known or suspected adrenal insufficiency;
  - **Hydrocortisone** (**Solu-Cortef**) **2mg/kg** max 100mg

Point of Care Testing:

- POC lactate should be obtained at bedside if clinically indicated and then every 60 minutes during transport.
- Lactate can help guide effectiveness of ongoing treatment and progression of shock state.

4-8 Toxicology

Purpose:

Define treatment pathways for patients with a toxic ingestion or exposure.

General Treatment:

- Treat general symptoms (e.g., hypotension) and provide supportive care using pertinent treatment guidelines and refer to the appropriate toxidrome for specific treatment guidance.

Pediatric: 

Unless otherwise specified, consult with medical direction for treatment.

Anticholinergic Treatment:

  - (e.g., antihistamines, antispasmodics, antidepressants, antipsychotics)
- Promote hyperthermia prevention by providing a cool environment and considering antipyretics.
- Maintain hydration by administering **NS bolus** as needed.
- Manage agitation or seizure activity per the respective guidelines.
- Administer **Sodium Bicarbonate 100 mEq** for widening QRS.
- Consider establishing a **Sodium Bicarbonate infusion 150 mL/hr** and titrate for a serum pH of 7.45–7.5

Cholinergic Treatment:

  - (e.g., organophosphates)
- **Atropine 2 – 5 mg** every 3 – 5 minutes as needed noting that higher doses may be required to obtain desired effect.
- **Ipratropium Bromide0.5 mg** Nebulized continuous
- **Pralidoxime** (**2-Pam**) **600 mg IM**
  - Repeat q15 minutes if needed to mild symptoms
  - Severe symptoms should be treated with with 3 600 mg injections in rapid succession.

Sympathomimetic Treatment:

  - (e.g., cocaine, amphetamines)
- Supportive care per appropriate guideline
- Treat arrythmias or ACS per guideline
- Ongoing volume resuscitation per guideline
- Treatment of seizures or agitation per guideline
- Prevention and management of hyperthermia, including antipyretic if clinically indicated.

Narcotic / Sympatholytic Treatment:

- (e.g., heroin, methadone)
- Supportive care per appropriate guideline
- **Naloxone 0.2-4 mg IV/IM/IN** every 2-3 minutes as needed
- **Naloxone infusion 100-800 mcg/hr**

Beta Blocker/ Calcium Channel Blocker Treatment:

- Supportive care per appropriate guideline
- In the setting of hypotension; **Epinephrine infusion: 1-30mcg/min**
  - Start at 1 mcg/min and titrate by 2.5-5 mcg/min
    - **Push dose Epinephrine** can be given as a bridge to mixing vasopressor infusion, or if patient is in extremis **Epinephrine Push dose: 5-30 mcg** (**0.5-3mL**) of 10mcg/mL concentration.
- See guideline ***4-7 Shock/ Refractory Hypoperfusion*** for additional escalation of vasopressor therapy.

- **High Dose Insulin Therapy** may be initiated by sending facility. If started continue at rate as directed by sending or receiving facility.

- **Glucagon 5 mg** IV over 60 seconds, if no response after 10 minutes;
- **Repeat Glucagon 5mg** If effective;
- Consider a **Glucagon infusion at 2 – 5 mg/hr.**

Acetaminophen Ingestion Treatment:

N-ACETYLCYSTEINE—(**MUCOMYST**)

- **Adult Dose- Patient weight >40 kg:**
  - Loading dose: 150 mg/kg; mix in 200 mL of D5W and infuse over 1 hour
  - Second dose: 50 mg/kg in 500 mL D5W over 4 hours
  - Third dose: 100 mg/kg in 1000 mL D5W over 16 hours

- **Children and adolescents weighing 21 to 40 kg:**
  - Loading Dose: 150 mg/kg in 100 mL of diluent infused over 1 hour
  - Second Dose: 50 mg/kg in 250 mL of diluent infused over 4 hours
  - Third Dose: 100 mg/kg in 500 mL of diluent infused over 16 hours

- **Infants and children weighing 5 to 20 kg:**
  - Loading Dose: 150 mg/kg in 3 mL/kg of diluent infused over 1 hour
  - Second Dose: 50 mg/kg in 7 mL/kg of diluent infused over 4 hours
  - Third Dose: 100 mg/kg in 14 mL/kg of diluent infused over 16 hours

4-9 Metabolic Emergencies

Purpose:

- Define treatment pathways and considerations for metabolic emergencies

Considerations and General Care:

- The following are general guidance on standard care pathways for treating of a metabolic emergencies. **The following guidelines all fall under on-line medical control and shall be discussed with the sending or receiving care team.** Discuss desired use of POC labs with medical direction or obtain as clinically indicated.

- Metabolic emergencies are typically a result of a underlying pathology or condition and are rarely in isolation. They often accompany other derangements of metabolic systems and values.

- Any correction of a metabolic system emergency should be done with careful consideration of other impacted systems or underlying pathologies.

Pediatric: 

Unless otherwise specified, consult with medical direction for treatment.

Hypocalcemia:

- Consider underlying cause. If known Hypocalcemia in the presence of blood product administration or rapid transfusion of blood products, see guideline ***1-7 Blood Product Administration***

- For Calcium <7.5 mg/dl **with** EKG changes *(VT, Torsade's, prolonged QTc)* administer **3 grams Calcium Gluconate over 20 minutes** or **1 gram Calcium Chloride** slow IVP.

- For Calcium <7.5 mg/dl **without** EKG changes, check ionized Calcium, if ionized Calcium <3.2 mg/dl: **6 grams IV Calcium Gluconate over 3 hours** or **2 grams Calcium Chloride over 3 hours** may be ordered.

Hypercalcemia:

For Calcium >14mg/dl or ionized Calcium >10 mg/dl the following treatments may be ordered or continued: volume resuscitation with **2 L of NS.** Followed by Maintence **NS at 250 mL/hr.**

- Avoid use of LR as this is a calcium containing solution.
- Most patients with Hypercalcemia will require 4-6 L of NS in the first 24 hours of care.

4-9 Metabolic Emergencies

Hypokalemia:

K+ >3.5 with or without EKG changes *(QTc prolongation, U waves, T wave changes, ST Depression)* the following treatments may be ordered or continued:

- Ongoing **Potassium replacement IV or PO**.
- Consult medical direction for specific dose range and Potassium containing solution or preparation.
- See guideline ***1-4 Patient Assessment & General Care- Potassium Containing Solution*** for administration rates.

Hyperkalemia:

K+ > 6.5 with EKG changes *(Peaked T waves, Wide QRS, Lost P waves (junctional rhythm) New bradycardia, New block, Ischemia pattern)* the following goals of care and treatments may be ordered or continued:

- Cardiac stabilization:
  - **3 grams Calcium Gluconate** or **1 gram Calcium Chloride.**

- Intracellular shift (rapid):
  - **10 units of regular insulin** IV
  - **50 grams of D50**
  - **20 mg Albuterol Sulfate** nebulizer

- Intracellular shift (gradual):
  - **20 units of regular insulin** IV infusion
  - **D10 infusion**
  - **20 mg Albuterol Sulfate** nebulizer

- Elimination of K+ in the Hypovolemic patient:
  - If patient is has no findings of metabolic acidosis, **Lactated ringers**
  - If patient has findings of metabolic acidosis, **Isotonic bicarbonate** (**150mEq in 1L D5W**) **at 200- 250 mL/hr** over 4-6 hours.

- Elimination of K+ in the Euvolemic or Hypervolemic patient:
  - **Furosemide 40-100 mg** IV
    - If given prior to transport or anticipated to be given during transport, ensure foley is placed prior to departing sending facility.

4-9 Metabolic Emergencies

Hypomagnesemia:

- Magnesium <1.5 with symptoms *(Weakness Confusion, Seizures, Coma, Dysphasia, CHF, Hypotension)* or EKG changes *(Prolonged QTc, Widened QRS, frequent PACs/PVCs, PR prolongation, Torsades)* the following treatments may be ordered or continued:
  - **Magnesium Sulfate 2 grams** IV bolus
  - Followed by **Magnesium Sulfate 2 gram** infusion
  - Followed by **Magnesium Sulfate 2-4 grams at 1 gram/hr** IV infusion

Hypermagnesemia:

- Magnesium >4 and symptomatic, the following treatments may be ordered or continued:
- *4.8 - 7.2 mg/dl: nausea, flushing, headache, drowsiness, diminished DTRs*
- *7.2 - 12 mg/dl: somnolence, absent DTRs, hypotension, bradycardia*
- *>12 mg/dl: muscle paralysis, apnea, respiratory failure, cardiac arrest*
  - Volume resuscitation
  - **3 grams Calcium Gluconate** or **1 gram Calcium Chloride**
  - **Furosemide** may be ordered

Rhabdomyolysis:

- Identify and treat or stop underlying cause
- Avoid nephrotoxic medications (Acetaminophen, Ketorolac)
- Goal urine output is 300 mL/hr.

- Creatinine Kinase Level 1000-5000: the following treatments may be ordered or continued:
  - Volume resuscitation, **1-2 L of LR** over 1 hour, **followed by LR at 400 mL/hr**

- Creatinine Kinase Level <5000: the following treatments may be ordered or continued
  - Volume resuscitation, **1-2 L of LR** over 1 hour, **followed by LR at 400 mL/hr**

  - If severe metabolic acidosis (HCO3 <12): **Isotonic Bicarbonate infusion at 200 mL/hr** (150mEq Sodium Bicarbonate in 1L D5W)

  - In severe cases of Rhabdomyolysis, **Mannitol** may be ordered by medical direction.

4-10 Pregnancy Induced Hypertension (PIH)

Purpose:

Define treatment pathways for pregnancy induced hypertension.

Criteria:

Patient meets any of the following criteria:

- **Mild Preeclampsia:** Pregnancy greater than 20 weeks' gestation and any of the following:
  - SBP > 140/90 mmHg
  - Proteinuria, >300 mg/24 hours.

- **Severe Preeclampsia**: Pregnancy greater than 20 weeks' gestation and any of the following:
  - BP >160 mmHg systolic or >110 mmHg diastolic
  - CNS dysfunction: visual changes, worst headache ever, altered mentation
  - Hepatic abnormality
  - Thrombocytopenia (Plts < 100,000/microL)
  - Renal abnormality (serum Creatinine > 1.1 mg/dL)
  - Pulmonary edema
  - HELLP (Hemolysis, Elevated Liver Enzymes, Low Platelets)

- **Eclampsia**
  - Preeclampsia with seizure activity. Eclampsia may not always be precipitated by Preeclampsia.

Treatment:

- Ensure the following during transport:
  - Adequate airway
  - Oxygenation
  - Ventilation
  - Circulatory support

- Control hypertension
  - **SBP goal of 140-150 mmHg**
  - **DBP goal of 90-100 mmHg**

- Seizure prophylaxis and seizure treatment

- **Consult with sending and receiving physicians for specific guidance. Treatment pathways below are general recommendations.**

4-10 Pregnancy Induced Hypertension (PIH)

General Management:

- Obtain Maternal History:
  - Estimated Date of Confinement, Gravida/ Parity, Gestational age, Previous pregnancies (C-section or vaginal), OB physician.

- Administer supplemental Oxygen to maintain SpO2 95%-99%

- Infuse **LR at 125 ml/hr** or to maintain **urine output of 0.5 - 1 mL/kg/hr**
  - Foley catheter placement is strongly encouraged to monitor urine output.

- Monitor FHT every 30 minutes if possible. Note changes from baseline.

Hypertension Management:

- If SBP >160 mmHg or DBP >110 mmHg
  - **Labetalol 20 mg** over 2 minutes, if the desired blood pressure is not achieved;
  - **Labetalol 40 mg** over 2 minutes, if the desired blood pressure is not achieved;
  - **Labetalol 80mg** over 2 minutes, every 10 minutes, until blood pressure goal is met.
  - Not to exceed a total of 300 mg.

4-10 Pregnancy Induced Hypertension (PIH)

Seizure Prophylaxis:

- **Magnesium Sulfate 4 grams** over 20 minutes, followed by;
- **Magnesium Sulfate infusion at 2 grams/hour**

    - For patients receiving Magnesium Sulfate, monitor patient for decreased respiratory rate, diminished deep tendon reflexes (DTRs) and hypotension.

Seizure Activity:

If previous Magnesium Sulfate loading dose is greater than 30 minutes or no previous Magnesium Sulfate loading dose, administer;

- **Magnesium Sulfate 4 grams** over 10 minutes, followed by;
- **Magnesium sulfate infusion at 2 grams/hour**

    - For patients receiving Magnesium Sulfate, monitor patient for decreased respiratory rate, diminished deep tendon reflexes (DTRs) and hypotension.

If persistent or recurrent seizure after Magnesium Sulfate loading dose has been completed, administer;

- **Lorazepam** (**Ativan**) **4 mg IV**

OR

- **Midazolam** (**Versed**) **5 mg IV** or **10 mg IM**

followed by;

- **Levetiracetam** (**Keppra**) **60mg/kg,** max dose of 4500mg

4-11 Preterm Labor

Purpose:

Define treatment pathways and operational considerations for transport of a patient diagnosed with preterm labor.

Criteria:

- Preterm labor is defined as the onset of labor between 20 – 36+6 weeks gestation.
- Labor is defined as regular, painful, frequent uterine contractions causing progressive effacement and dilatation of the cervix.
- True labor typically presents as contractions with increasing frequency, intensity, and duration. False labor typically presents with mild irregular contractions without cervical changes.

Exclusion Criteria:

Patients meeting **ANY** of the following criteria will not be transported by ECPS:

Criteria	Yes	No
Organized contractions less than 5 minutes apart		
Organized contractions greater than 45 seconds in duration		
Premature Rupture Of Membranes with organized contractions as defined above.		
Cervical dilation greater than 5cm		
Tocolytics have been up titrated by sending facility in the last 30 minutes		
Non-reassuring fetal heart rate tracing at sending facility		
Active vaginal bleeding		
Patient diagnosed with Placenta Previa		
Patient diagnosed with Placental Abruption		
Breech Presentation		
If any of the above "YES" criteria are met, ECPS can not complete the transport.		

Patients with complex obstetric history including previous precipitous delivery, multigravida, known fetal abnormalities or multifetal gestation should warrant further discussion with the transport crew, sending and receiving facility to determine appropriateness of transport.

Cervical exam, consisting of cervical dilation and effacement measurements, to be performed by sending facility provider no less than 15 minutes prior to transport.

4-11 Preterm Labor

Prior to Transport:

- **Cervical exam, consisting of cervical dilation and effacement measurements, to be performed by sending facility provider no less than 15 prior to transport.**

- Patients with complex obstetric history including previous precipitous delivery, multigravida, known fetal abnormalities or multifetal gestation should warrant further discussion with the transport crew, sending and receiving facility to determine appropriateness of transport.

- Pre-departure assessment and stabilization is critically important for the pregnant patient. Once enroute few options are available, either diagnostically or therapeutically.

- In the event of patient decompensation requiring a clinical diversion, the only appropriate facilities for this patient population are Presbyterian St Luke's, Lutheran Medical Center and Denver Health.

General Care and Transport Monitoring:

- Obtain Maternal History:
  - Estimated Date of Confinement, Gravida/ Parity, Gestational age, Previous pregnancies (C-section or vaginal), OB physician/ prenatal care, known or expected complications.

- Administer supplemental oxygen as needed to maintain SPO2 >94%.

- Transport mother in left lateral tilt position.

- Administer **500 mL of LR or NS** over 20 - 30 minutes, followed by infusion of **NS or LR at 125 ml/hr**.

- Continue antibiotics if initiated by sending facility.

- Ensure a Foley catheter is placed prior to transport to reduce stimulation of contractions by distended bladder and to monitor urine output.

- If viable pregnancy, monitor and document Fetal Heart Tones every 30 minutes via doppler and uterine contractions (frequency, intensity, duration).

4-11 Preterm Labor

Treatment:

Consult with sending and/ or receiving physicians for specific guidance. Treatment pathways below are general recommendations.

Tocolytic:

- **Nifedipine 10-30mg** PO or SL
  - Repeat as ordered from sending facility.

- **Terbutaline 0.25 mg** subcutaneous.
  - Repeat as ordered by sending facility
  - Hold if maternal HR >120
    - May repeat every 15 minutes x 3 doses.
    - May be preferred to control contractions greater than 10 minutes apart.
    - May be added when Magnesium Sulfate infusion failing to control contractions.

Additional Treatment:

- **Magnesium Sulfate 4 grams** over 20 minutes followed by;

  - **Magnesium Sulfate infusion** at **2 grams/hour**
    - Infuse **LR or NS at 75 mL/hr** for total fluid volume of 125 ml/hr

  - Titrate rate to 3 grams/hr if contractions persist
    - Infuse **LR or NS at 50 mL/hr** for total fluid volume of 125 ml/hr

- If patient on Magnesium Sulfate, monitor and document Deep Tendon Reflexes every hour.

- **Corticosteroids**
  - Document referring facility administration of **Betamethasone** for fetal pulmonary maturation. Betamethasone administration should be considered prior to transport of any patient after 24 weeks and less than 37 weeks gestation. This is an IM injection given by the sending facility prior to transport.

4-12 Postpartum Hemorrhage

Purpose:

- Define treatment pathways and considerations for postpartum hemorrhage.

Criteria:

- Patient with cumulative blood loss of >1000 mL or bleeding associated with signs of hypovolemic shock with in 24 hours of birth process.

Hemorrhage Control:

- Fundal massage

- **Oxytocin** (**Pitocin**)
  - **10 units IM** followed by;
  - **10-40 units** diluted in 1000ml NS or LR
    - Infused at 500-1000 mL/hr until hemorrhage control is achieved.

- **Tranexamic Acid 1 gram** over 10 minutes
  - If bleeding continues after 30 minutes, administer **Tranexamic Acid 1 gram** over 10 minutes for maximum total dose of 2 grams.

Volume resuscitation:

If SBP is <100 mmHg or HR > 120 beats per minute

- Begin transfusion of **Packed Red Blood Cells or Whole Blood**
  - Use of whole blood, if available should be prioritized over PRBC's
  - If need for more than 2 units of blood product is anticipated during transport, discuss need for additional blood products with sending physician. Consider adding FFP at a 1:1 ratio of FFP and PRBC.
  - Refer to ***1-7 Blood product administration guideline***

- Care should be given to limit crystalloid volume resuscitation to <1L.

Section 5- Neurological

5-1 Seizures & Status Epilepticus

5-1P Seizures & Status Epilepticus- Pediatric

5-2 Non- traumatic Intercranial Hemorrhage

5-3 Ischemic CVA without Thrombolytic Therapy

5-4 Ischemic CVA with Thrombolytic Therapy

5-5 NIHSS Stroke Scale

5-1 Seizures & Status Epilepticus

General Indications for therapy:

Status epilepticus should be considered in those patients who exhibit (one of the following):

- Generalized tonic-clonic seizures lasting > 5 minutes
- Multiple occurrences without complete mental status recovery in between
- Focal seizure with impaired awareness that lasts >10 minutes.

- Generalized tonic-clonic seizures should cause diffuse motor activity and complete loss of consciousness (often times hypoxia)
- Self-terminating seizures will generally stop within <5 minutes
- Spontaneous termination becomes less likely in seizures lasting >5 min, and the longer the seizure continues, the more difficult it is to control the seizure with antiepileptic drugs and the greater the degree of neuronal damage.

Consider alternative diagnoses and seizure "look a-likes":

- Hypoglycemia (Always check a BG in seizures and any AMS)
- Drug overdose
- Electrolyte abnormalities (Hyponatremia)
    - Especially consider in overexertion and heat related scenarios

Monitoring and Treatment Goals:

- Ensure adequate airway, oxygenation, and ventilation during the transport of these patients, treating with benzodiazepines and anti-epileptic medications if not self-terminating.

Consider endotracheal intubation if:

- Significant respiratory distress exists - especially with the possibility of aspiration
- Status Epilepticus.
- Significant respiratory depressants effecting respiratory drive

General medical management:

- Ensure oxygen, monitoring, IV access and blood glucose.
- Evaluate CMP, CBC, tox screen and anticonvulsant levels as indicated
- Ensure definitive airway management if indicated.

5-1 Seizures & Status Epilepticus

Purpose:

Outline pharmacologic treatment pathways for seizures and status epilepticus.

First line treatment:

- **Ativan** (**Lorazepam**) **4 mg IV OR Versed** (**Midazolam**) **5 mg IV or 10 mg IM**

If seizure terminates after first line medication, consider **Keppra** (**Levetiracetam**) for additional seizure prophylaxis.

- **Keppra** (**Levetiracetam**)
  - **20 mg**/**kg** max 2000 mg
    - Diluted in 100 mL NS or D5W, infused over 15 minutes.

Secondary Refractory Treatment:

For seizure activity that has not terminated after first line medication administration, repeat benzodiazepine

- **Ativan** (**Lorazepam**) **4 mg IV OR Versed** (**Midazolam**) **5 mg IV or 10 mg IM**
-

Followed with one of the following infusions: (*More than one of the following may be ordered and given).*

- **Keppra** (**Levetiracetam**)
  - **60 mg**/**kg** max 4500 mg
    - Diluted in 100 mL NS or D5W, infused over 15 minutes
    - In transport, give max dose of medication supply
    - If any dosage of Keppra has already been delivered, deliver remaining dose up to 4500 mg max.

OR

- **Dilantin** (**Phenytoin**)
  - **20 mg**/**kg** max 2000 mg
    - Diluted in 100 mL NS or D5W, infused over 15 minutes.

OR

- **Cerebyx** (**Fosphenytoin**)
  - **20 Phenytoin Equivalents** (**PE**)/ **kg** max 2000 mg
    - Diluted in 100 mL NS or D5W, infused over 15 minutes.

Tertiary Refractory Treatment:

- If patient continues to display seizure activity after second line medications, anticipate need for intubation, while preparing tertiary refractory treatment. For seizure activity that has not terminated after second line medication administration, repeat benzodiazepine;
- **Ativan** (**Lorazepam**) **4 mg IV OR Versed** (**Midazolam**) **5 mg IV or 10 mg IM**

Followed with one of the following infusions: (More than one of the following may be ordered and given along with above listed second line infusion).

- **Midazolam Infusion**
  - **Bolus: 0.1 mg/kg** followed by;
  - **Infusion: 0.1 mg/kg/hr**
    - Titrate by 0.1 mg/kg/hr up to max 1 mg/kg/hr

OR

- **Propofol**
  - **Bolus: 2 mg/kg** followed by;
  - **Infusion: 20 mcg/kg/min**
    - Titrate by 10-20 mcg/kg/min up to max 60 mcg/kg/min

OR

- **Ketamine**
  - For status epilepticus patients who are also intubated, Ketamine may be considered.
  - The desired Ketamine dosing may be different than they typical dosing structure used for intubated patients.
  - **Consult with receiving facility for bolus and infusion dosing.**

Seizures due to Hyponatremia:

- Hyponatremic seizures are a medical emergency and may be refractory to anticonvulsants; do not delay sodium correction.
  - Treat with with 3% Sodium Chloride and concurrent treatment pathways listed above.

- If serum **Na <125 mEq/L** and patient has had or is experiencing a seizure;
  - **3% Sodium Chloride 2mL/kg** up to 100 mL over 10 minutes, may repeat up to 3 doses for total of 300 mL
    - Administer on infusion pump.

PEDIATRIC

First line treatment:

- **Ativan** (**Lorazepam**) **0.1 mg**/**kg** max 4mg IV

OR

- **Versed** (**Midazolam**) **0.2 mg**/**kg IM** max of 10 mg **OR 0.2 mg**/**kg IV** max of 5 mg

If seizure terminates after first line medication, consider **Keppra** (**Levetiracetam**) for additional seizure prophylaxis.

- **Keppra** (**Levetiracetam**
  - **20mg**/**kg** max 1000 mg
    - Diluted in 100 mL NS or D5W, infused over 15 minutes.

Secondary Refractory Treatment:

For seizure activity that has not terminated after first line medication administration, repeat benzodiazepine.

- **Ativan** (**Lorazepam**) **0.1 mg**/**kg** max 4mg IV

OR

- **Versed** (**Midazolam**) **0.2 mg**/**kg IM** max of 10 mg **OR 0.2 mg**/**kg IV** max of 5 mg

Followed with one of the following infusions: (*More than one of the following may be ordered and given).*

- **Keppra** (**Levetiracetam**) **60 mg**/**kg** max 4500 mg
  - Diluted in 100 mL NS or D5W, infused over 15 minutes
  - In transport, give max dose of medication supply
  - If any dosage of Keppra has already been delivered, deliver remaining dose up to 4500 mg max.

OR

- **Dilantin** (**Phenytoin**) **20 mg**/**kg** max 2000 mg
  - Diluted in 100 mL NS or D5W, infused over 15 minutes.

OR

- **Cerebyx** (**Fosphenytoin**) **20 Phenytoin Equivalents** (**PE**)/ **kg** max 2000 mg
  - Diluted in 100 mL NS or D5W, infused over 15 minutes

PEDIATRIC

Tertiary Refractory Treatment:

If patient continues to display seizure activity after second line medications, anticipate need for intubation, while preparing tertiary refractory treatment. For seizure activity that has not terminated after second line medication administration, repeat benzodiazepine;

- **Ativan** (**Lorazepam**) **0.1 mg**/**kg** max 4mg IV

OR

- **Versed** (**Midazolam**) **0.2 mg**/**kg IM** max of 10 mg **OR 0.2 mg**/**kg IV** max of 5 mg

Followed by one of the following third line infusions: (More than one of the following may be ordered and given along with above listed second line infusion).

- **Midazolam Infusion**
  - **Bolus: 0.1 mg**/**kg** followed by;
  - **Infusion: 0.1 mg**/**kg**/**hr**
    - Titrate by 0.1 mg/kg/hr up to max 1 mg/kg/hr

OR

- **Ketamine**
  - For status epilepticus patients who are also intubated, Ketamine may be considered.
  - The desired Ketamine dosing may be different than they typical dosing structure used for intubated patients.
  - **Consult with receiving facility for bolus and infusion dosing.**

Seizures due to Hyponatremia:

- **Contact medical direction for treatment plan and goals. The following may be ordered or continued from the sending facility.**

- Hyponatremic seizures are a medical emergency and may be refractory to anticonvulsants; do not delay sodium correction.
  - Treat with with 3% Sodium Chloride and concurrent treatment pathways listed above.
- If serum **Na <125 mEq**/**L** and patient has had or is experiencing a seizure;
  - **3% Sodium Chloride 3mL**/**kg** up to 100 mL over 20 minutes
    - Administer on infusion pump

5-2 Non- Traumatic Intracranial Hemorrhage

Criteria:

- Patient diagnosed with intracranial hemorrhage and no recent trauma.

Management of Hypoxia:

- Avoid hypoxia and maintain SP02 >94%

Positioning:

- Elevate head of bed 30°

Blood Pressure Treatment Goals:

- **Systolic Blood Pressure** (**SBP**) **< 160mmHg or 20% less than initial MAP if SBP >200mmHg**
  - Or goal SBP from receiving facility

If SBP is above goal:

- **Nicardipine** (**Cardene**)**- Infusion: 5 mg/hr**
  - Titrate by 2.5 mg/hr q5 min (max 15 mg/hr)
  - Once goal achieved, consider reducing to maintenance rate of 3-5 mg/hr

For refractory or profound hypertension consider using Labetalol in concurrence with above therapies.

- **Labetalol 10-20 mg IV bolus**
  - Max of 300 mg total
  - Hold Labetalol if HR < 60 bpm

Temperature Management:

- If Temporal temperature >39c or known core temperature >38c and not already administered, administer **Acetaminophen 1 gram**
  - Implement measures to avoid hyperthermia.

Antiepileptic:

- If patient has a CT-confirmed intracranial hemorrhage and a antiepileptic has not already been administered, consider;
  - **Levetiracetam** (**Keppra**) **20 mg/kg** max 2000 mg over 15 min.
  - If patient has HR <60, SBP <110 mmHg, hold infusion.

- If a **Phenytoin** (**Dilantin**), **Fosphenytoin** (**Cerebyx**), or **Levetiracetam** (**Keppra**) infusion has been initiated for CT-confirmed intracranial hemorrhage and SBP ≥100 mmHg, continue this infusion.

- If persistent seizure activity, treat per ***5-1 Seizures/ Status Epilepticus***

5-2 Non- Traumatic Intracranial Hemorrhage

Coagulopathy:

If patient has a CT-confirmed intracranial hemorrhage and INR ≥1.5, following treatments may be initiated or continued.

- **Fresh Frozen Plasma** (**FFP**) **per** ***1-7 Blood Product Administration***

- **Kcentra** (administer over 25 min):
  - INR 2-3.9 25 units/kg (max 2500 units)
  - INR 4-6 35 units/kg (max 3500 units)
  - INR >6 50 units/kg (max 5000 units)

- **Vitamin K 2.5-10 mg** over 30 minutes

Treatment of Elevated Intracranial Pressure/ Herniation:

- If patient displays signs of decompensation:
  - Change in level of consciousness (GCS <10 or a decrease in GCS >2 points)
  - Unequal or fixed pupils
  - Decerebrate/decorticate posturing
  - Unilateral deficit
  - Rising blood pressure with decreasing heart rate (Cushing's reflex)

- Intubate if not already done

- If intubated, ventilate to maintain **ETCO2 of 35-45mmHg and SPO2 of >94%**

- Maintain **SBP <160mmHg but >110mmHg**

Administer one of the following if signs of herniation are present:

- **Hypertonic Saline 3% 3ml/kg** max 250ml over 10 minutes

OR

- **Mannitol 1gm/kg** max 100grams over 5 minutes

Pediatric: 

Consult with medical direction for treatment.

5-3 Ischemic CVA without Thrombolytic Therapy

Purpose:

Treatment of Ischemic Cerebral Vascular Accident patients who **have not** received thrombolytic therapy (tPA or TNK)

Blood Pressure Treatment & Goals:

- Systolic Blood Pressure <220 mmHg
- Diastolic Blood Pressure <110 mmHg
- Or BP goal from receiving facility

If BP is above goal:

- **Nicardipine** (**Cardene**)**- Infusion: 5 mg/hr**
  - Titrate by 2.5 mg/hr q 5min (max 15 mg/hr)
  - Once goal achieved, consider reducing to maintenance rate of 3-5 mg/hr

For refractory or profound hypertension consider using Labetalol in concurrence with above therapies.

- **Labetalol 10-20 mg IV bolus**
  - Max of 300 mg total
  - Hold Labetalol if HR < 60 bpm

Large Vessel Occlusion:

- Maintain Systolic Blood Pressure >150 mmHg, <185mmHg
  - May require vasopressor support to maintain SBP goal. Contact receiving facility to discuss SBP goal and vasopressor of choice.

- Receiving facility may order zero degree patient positioning during transport.
  - If patient is unable to manage secretions, consider increasing positioning to as minimal of a degree as possible that allows for patient to better manage secretions.

NIHSS:

- Perform neurologic assessment (NIHSS) - every 30 minutes to monitor for neurological deterioration.

Pediatric: 

Consult with medical direction for treatment.

5-4 Ischemic CVA with Thrombolytic Therapy

Purpose:

Treatment of Ischemic Cerebral Vascular Accident patients who **have** received or **are** receiving thrombolytic therapy (tPA or TNK)

Thrombolytic Therapy:

- **TNK- Tenecteplase**
  - Use manufacturer provided weight based dosing guidelines, not to exceed 50mg.

- **tPA- Alteplase (Activase):**
  - **0.9 mg/kg-** max 90mg total treatment dose, followed by;
  - **10% of total treatment dose as bolus over 1 minute,** followed by;
  - **Remaining treatment dose over 60 minutes,** followed by;
  - **Flush line with 100 mL NS at 60 minute rate**
    - Alteplase (Activase) should be reconstituted with sterile water to 1 mg/mL prior to administration. Remove excess medication from bottle prior to initiating administration.

Blood Pressure Treatment & Goals:

For patients who have received or are receiving tPA or TNK, use the following treatment goals:

- Maintain SBP < 185 mmHg and >120 mmHg
- Maintain DBP < 110 mmHg
- Or BP goal from receiving facility

If BP is above goal:

- **Nicardipine (Cardene)- Infusion: 5 mg/hr**
  - Titrate by 2.5 mg/hr q 5min (max 15 mg/hr)
  - Once goal achieved, consider reducing to maintenance rate of 3-5 mg/hr

For refractory or profound hypertension consider using Labetalol in concurrence with above therapies.

- **Labetalol 10-20 mg IV bolus**
  - Max of 300 mg total
  - Hold Labetalol if HR < 60 bpm

5-4 Ischemic CVA with Thrombolytic Therapy

During and post tPA/TNK therapy:

- Perform neurologic assessment (NIHSS) - every 15 minutes during the hour infusion to monitor for neurological deterioration. Then every 30 minutes.

- Continue to monitor for bleeding.

- Blood pressure should be monitored every 10 minutes during infusion and every 20 minutes after infusion. Blood pressure should be controlled accordingly.

- If already established on antihypertensive infusion, continue as tolerated

- If unable to appropriately control blood pressure with multimodal treatment, stop the TPA

Adverse effects and consideration of discontinuation:

- Development of worsening neurologic deficits or extreme headache

- Angioedema is a rare complication of thrombolysis. If thrombolytic is still being infused, the infusion should be discontinued immediately. Most will improve over time - However, if angioedema is worsening and threatening the airway, continue based on airway management guidelines.
  - Contact medical direction for treatment guidance.

- Seizures have < 10% incidence in these patients. If you notice convulsive activity, stop infusion and continue per ***5-1 Seizures/ Status Epilepticus***.

- If any signs of increased ICP or acute herniation, stop infusion immediately and treat per increased ICP guideline with immediate medications for reduction.

Pediatric:

Consult with medical direction for treatment.

5-5 NIHSS Stroke Scale

Category	Score/Description		Date/Time Initials	Date/Time Initials	Date/Time Initials	Date/Time Initials	Date/Time Initials
1a. **Level of Consciousness** (Alert, drowsy, etc.)	0 = Alert 1 = Drowsy 2 = Stuporous 3 = Coma						
1b. **LOC Questions** (Month, age)	0 = Answers both correctly 1 = Answers one correctly 2 = Incorrect						
1c. **LOC Commands** (Open/close eyes, make fist/let go)	0 = Obeys both correctly 1 = Obeys one correctly 2 = Incorrect						
2. **Best Gaze** (Eyes open - patient follows examiner's finger or face)	0 = Normal 1 = Partial gaze palsy 2 = Forced deviation						
3. **Visual Fields** (Introduce visual stimulus/threat to pt's visual field quadrants)	0 = No visual loss 1 = Partial Hemianopia 2 = Complete Hemianopia 3 = Bilateral Hemianopia (Blind)						
4. **Facial Paresis** (Show teeth, raise eyebrows and squeeze eyes shut)	0 = Normal 1 = Minor 2 = Partial 3 = Complete						
5a. **Motor Arm - Left** 5b. **Motor Arm - Right** (Elevate arm to 90° if patient is sitting, 45° if supine)	0 = No drift 1 = Drift 2 = Can't resist gravity 3 = No effort against gravity 4 = No movement X = Untestable (Joint fusion or limb amp)	Left					
		Right					
6a. **Motor Leg - Left** 6b. **Motor Leg - Right** (Elevate leg 30° with patient supine)	0 = No drift 1 = Drift 2 = Can't resist gravity 3 = No effort against gravity 4 = No movement X = Untestable (Joint fusion or limb amp)	Left					
		Right					
7. **Limb Ataxia** (Finger-nose, heel down shin)	0 = No ataxia 1 = Present in one limb 2 = Present in two limbs						
8. **Sensory** (Pin prick to face, arm, trunk, and leg - compare side to side)	0 = Normal 1 = Partial loss 2 = Severe loss						
9. **Best Language** (Name item, describe a picture and read sentences)	0 = No aphasia 1 = Mild to moderate aphasia 2 = Severe aphasia 3 = Mute						
10. **Dysarthria** (Evaluate speech clarity by patient repeating listed words)	0 = Normal articulation 1 = Mild to moderate slurring of words 2 = Near to unintelligable or worse X = Intubated or other physical barrier						
11. **Extinction and Inattention** (Use information from prior testing to identify neglect or double simultaneous stimuli testing)	0 = No neglect 1 = Partial neglect 2 = Complete neglect						
	TOTAL SCORE						

INITIAL	SIGNATURE	INITIAL	SIGNATURE	INITIAL	SIGNATURE

Section 6- Trauma

6-1 Traumatic Intracranial Hemorrhage

6-2 Pneumothorax & Hemothorax

6-3 Shock & Refractory Hypoperfusion

6-3P Shock & Refractory Hypoperfusion- Pediatric

6-4 Partial REBOA (pREBOA)

6-5 Burns

6-5P Burns- Pediatric

6-1 Traumatic Intracranial Hemorrhage

Purpose:

Define treatment of patients diagnosed with a traumatic intracranial hemorrhage.

Pediatric: 

Consult with medical direction for blood pressure goals and treatment.

Management of Hypoxia:

- Avoid hypoxia and maintain SPO2 >94%

Positioning:

- Elevate head of bed 30°, maintain spinal motion restriction if applicable

Blood Pressure Management (Hypotension):

- Maintain minimum **SBP of 120mmHg or MAP 80mmHg**
  - Initiate **Norepinephrine: 1-60 mcg/min,** Start at 1-5 mcg/min and titrate by 5-10 mcg/min

Blood Pressure Management (Hypertension Without Signs of Herniation:)

- For **SBP 180- 200 mmHg** contact receiving facility for possible treatment.

- For **SBP >200mmHg**
  - **Nicardipine (Cardene)- Infusion: 5 mg/hr**
  - Titrate by 2.5 mg/hr q5 min (max 15 mg/hr)
  - Once goal of **initial MAP reduction by 20%** is achieved, consider reducing to maintenance rate of 3-5 mg/hr
- Avoid rapid changes in blood pressure

Temperature Management:

- If Temporal temperature >39c or known core temperature >38c and not already administered, administer **Acetaminophen 1 gram.**
  - Implement measures to avoid hyperthermia.

Antiepileptic:

- If patient has a CT-confirmed intracranial hemorrhage and a antiepileptic has not already been administered, consider;
  - **Levetiracetam (Keppra)**
    - **20 mg/kg** max 2000 mg over 15 min.
    - If patient has HR <60, SBP <110 mmHg, hold infusion.

- If a **Phenytoin (Dilantin)**, **Fosphenytoin (Cerebyx)**, or **Levetiracetam (Keppra)** infusion has been initiated and SBP ≥110 mmHg, continue this infusion.

- If seizure activity, treat per ***5-1 Seizures/ Status Epilepticus***

6-1 Traumatic Intracranial Hemorrhage

Coagulopathy:

If patient has a CT-confirmed intracranial hemorrhage and INR ≥1.5, following treatments may be initiated or continued.

- **Fresh Frozen Plasma** (**FFP**) per ***1-7 Blood Product Administration***

- **Kcentra** (administer over 25 min):
  - INR 2-3.9 25 units/kg (max 2500 units)
  - INR 4-6 35 units/kg (max 3500 units)
  - INR >6 50 units/kg (max 5000 units)

- **Vitamin K 2.5-10 mg** over 30 minutes

Treatment of Elevated Intracranial Pressure/ Herniation:

- If patient displays signs of decompensation:
  - Change in level of consciousness (GCS <10 or a decrease in GCS >2 points)
  - Unequal or fixed pupils
  - Decerebrate/decorticate posturing
  - Unilateral deficit
  - Rising blood pressure with decreasing heart rate (Cushing's reflex)

- Intubate if not already done

- If intubated, ventilate to maintain **ETCO2 of 35-45mmHg and SPO2 of >94%**

- Maintain **SBP <180mmHg but >120mmHg**

If **SBP is > 180 mmHg:**

- **Nicardipine** (**Cardene**)- **Infusion: 5 mg/hr**
  - Titrate by 2.5 mg/hr q5 min (max 15 mg/hr)
  - Once goal achieved, consider reducing to maintenance rate of 3-5 mg/hr

For refractory or profound hypertension consider using Labetalol in concurrence with above therapies.

- **Labetalol 10-20 mg IV bolus**
  - Max of 300 mg total
  - Hold Labetalol if HR < 60 bpm

Administer one of the following if signs of herniation are present:

- **Hypertonic Saline 3% 3ml/kg** max 250ml over 10 minutes

OR

- **Mannitol 1gm/kg** max 100grams over 5 minutes

6-2 Tension Pneumothorax & Hemothorax

Purpose:

- Define treatment of tension pneumothorax or tension hemothorax.
- For non- tension pneumothorax or hemothorax, see ***A-4 Chest tube maintenance***

Criteria:

- Patient meets all the following criteria:
  - Known or suspected Pneumothorax or Hemothorax
  - Decreased breath sounds (unilateral or bilateral).

- One of the following criteria:
  - Difficulty ventilating (i.e., shortness of breath or elevated peak inspiratory pressures, increased resistance to bag-valve ventilation).
- Hypotension
- Subcutaneous emphysema of chest or neck.
- Jugular venous distention (JVD). *(Late and unreliable finding)*
- Tracheal deviation. *(Late and unreliable finding)*

Assessment:

Assess for alternate reasons for asymmetrical lung sounds (e.g. ETT placement, chest tube placement or leak) If tension pneumothorax is suspected, proceed with procedures below without delay.

Treatment:

Once recognized or suspected, a tension pneumothorax should be treated promptly, without delaying to complete other tasks.

- **Needle decompress** affected side at the **second** (**2nd**) **intercostal space at mid-clavicular line** OR **fourth** (**4th**) **intercostal space, anterior axillary line.**
  - Avoid use of blood control catheters as they may prevent air release.
- Regardless of the result, leave the catheter (without needle) in place.
- If there are recurrent signs or symptoms of tension Pneumothorax, repeat the procedure.

- If patient is in cardiac arrest or peri arrest state, proceed with **Simple Thoracostomy** of affected side.

6-3 Shock & Refractory Hypoperfusion- Trauma

Purpose:

Define treatment of patient with traumatic shock who meets the following criteria:

- Suspected or known blood loss related to trauma with suspected or known hemorrhage and **any one** of the following:
  - SBP <100mmHg or MAP <65mmHg
  - HR >120 bpm
  - Adult shock index (HR/SBP) >0.9
  - Modified shock index (HR/MAP) >1.3

General Treatment:

- Control external blood loss
- Keep patient actively warm, utilize commercial devices if necessary.
- If not already given, **Tranexamic Acid 2 gm IVP,** age 15 and older for if <3 hours from onset.

Volume resuscitation:

- If patients meets any of the above criteria:
  - Begin transfusion of **Packed Red Blood Cells or Whole Blood.**
    - Use of whole blood, if available should be prioritized over PRBC's
    - If need for more than 2 units of blood product is anticipated during transport, discuss need for additional blood products with sending physician. Consider adding FFP at a 1:1 ratio of FFP and PRBC.
    - Refer to ***1-7 Blood product administration guideline***.
    - Treatment **Goal SBP of 100 mmHg**
- Care should be given to limit crystalloid volume resuscitation to <500mL.

Permissive Hypotension:

- In setting of damage control resuscitation for ongoing hemorrhage, Permissive hypotension (MAP 55-65 mmHg or SBP 80-90mmHg) may be considered.
  - Permissive hypotension may not be utilized in patients with concurrent or isolated head injury or spinal cord injury.

6-3 Shock & Refractory Hypoperfusion- Trauma

Spinal Cord Injury:

- Maintain spinal motion restriction, head of bed may be elevated to 15-30 degrees. Discuss with sending physician.

- Depending on level of injury, be prepared for airway management and need for respiratory support.

- Maintain **SBP of >120mmHg or MAP of 80mmHg**

- Manage shock with volume resuscitation if indicated. If not indicated or non- responsive to volume resuscitation, initiate vasopressor support.

Spinal Cord Injury Treatment:

- **Norepinephrine 1-60 mcg/min**
  - Start at 1-5 mcg/min and titrate by 5-10 mcg/min

- **Phenylephrine: 40-180 mcg/min**
  - Once SBP goal has been met, may titrate down to 40-90 mcg/min

- **Vasopressin: 0.04 U/min**
  - Typically not titrated but max of 0.08 U/min.

Point of Care Testing:

- **POC lactate and Hematocrit** (if hemorrhagic shock) should be obtained every 60 minutes during transport.
  - **Do not delay transport or delay time at bedside to obtain POC labs.**

- Lactate can help guide effectiveness of ongoing treatment and progression of shock state.

PEDIATRIC

Purpose:

Define treatment of patient with traumatic shock who meets the following criteria:

- Suspected or known blood loss related to trauma with suspected or known hemorrhage and **any one** of the following:
- Pediatric age adjusted shock index -->

Age 4-6: >1.2	**Age 7-12:** >1.0	**Age >13:** >0.9

- Tachycardia (for age)
- Capillary refill >2 seconds
- Weak central pulses
- Poor skin color
- Hypotension (for age) -->

<1 month: SBP <60 mmHg	**1 month to 1 year:** SBP <70 mmHg	**>1 year:** SBP < [70 + (2 x age in years)] mmHg

General Treatment:

- Control external blood loss
- Keep patient actively warm, utilize commercial devices if necessary.
- If not already given, **Tranexamic Acid 15mg/kg** max 1 gram over 10 minutes , age 14 and younger if <3 hours from onset.

Volume resuscitation:

- If patients meets any of the above criteria:
  - Begin transfusion based on the following guidelines:
    - **Whole Blood: 10ml/kg**
    - **Packed Red Blood Cells: 10-20 mL/kg**
    - **Fresh Frozen Plasma: 10-20 mL/kg**
    - **Platelets/ Cryoprecipitate: 0.1 units/kg**
  - Use of whole blood, if available should be prioritized over PRBC's
  - If need for more than 2 units of blood product is anticipated during transport, discuss need for additional blood products with sending physician. Consider adding FFP at a 1:1 ratio of FFP and PRBC.
  - Refer to ***1-7 Blood product administration guideline.***
    - Treatment Goals:
      - **<1 month:** SBP >60 mmHg
      - **1 month to 1 year**: SBP >70 mmHg
      - **>1 year: SBP** > [70 + (2 x age in years)] mmHg

PEDIATRIC

Spinal Cord Injury:

- **Contact medical direction for treatment plan and goals. The following may be ordered or continued from the sending facility.**

- Maintain spinal motion restriction, head of bed may be elevated to 15-30 degrees. Discuss with sending physician.

- Depending on level of injury, be prepared for airway management and need for respiratory support.

- Manage shock with volume resuscitation of **20ml/kg of crystalloid,** repeated up to total of 60ml/kg, if indicated. If not indicated or non- responsive to volume resuscitation, initiate vasopressor support.

Spinal Cord Injury Treatment:

- **Norepinephrine 0.05-0.5 mcg/kg/min**

- **Epinephrine 0.05- 1 mcg/kg/min**

- **Vasopressin 0.1-1 milliunits/kg/hr**

Point of Care Testing:

- POC lactate and Hematocrit (if hemorrhagic shock) should be obtained every 60 minutes during transport.
  - **Do not delay transport or delay time at bedside to obtain POC labs.**

  - Lactate can help guide effectiveness of ongoing treatment and progression of shock state.

6-4 Partial REBOA (pREBOA)

Purpose:

- Define guideline for transport of patient with partial Resuscitative Endovascular Balloon Occlusion of the Aorta.

- pREBOA is a technique utilized to temporize non-compressible torso or junctional hemorrhage in the unstable patient. After damage control measures and insertion at the sending facility, the critical-care paramedic will be responsible for arterial line monitoring, maintenance of the pREBOA sheath and catheter, as well as titration of the balloon to achieve desired clinical parameters outlined below or by physician order.

Indications:

- pREBOA is indicated for non-compressible torso or lower junctional hemorrhage as an alternative to resuscitative thoracotomy to maintain adequate proximal perfusion while allowing partial distal flow to extend balloon occlusion times and decrease ischemic complications.

Procedure:

- For all patients:
  - Ensure sheath and catheter have been secured with sutures and appropriate balloon position has been confirmed with imaging.
    - Document catheter insertion depth

  - Continuous arterial line monitoring at the proximal tip of the catheter is essential.

  - Distal (femoral sheath) arterial pressure transduction is preferred if feasible with equipment, however not essential during transport.

  - Arterial line on pREBOA catheter and sheath requires flushing q15 minutes while in place to avoid catheter or sheath thrombus and occlusion.

  - Monitor continuous EKG and arterial waveform. Monitor urinary catheter output, and lower extremity neurovascular checks at 30 minute intervals.

  - With any patient hand-off, note desired zone of occlusion, catheter insertion depth, and vocalize all inflation and deflation time. Utilize attached pREBOA flowsheet.

6-4 Partial REBOA (pREBOA)

pREBOA Balloon Titration Parameters:

- **Zone 1:** goal of < 2 hours of inflation time.
- **Zone 3:** goal of < 4 hours of inflation time.
- Despite improved inflation times with pREBOA allowing for partial distal flow and decreased end organ ischemia, minimizing total inflation time is still imperative.
- Optimal **Proximal MAP should be targeted at 60 mmHg** unless otherwise specified by sending/receiving facility or if one of the following patient conditions exist:
- **Special Circumstances:**
  - Concomitant **Traumatic Brain Injury: MAP 65 mmHg or systolic> 100 mmHg**
  - Concomitant **Aortic Injury: SBP < 100 mmHg**
- If arterial pressure monitoring of the distal sheath is feasible, ideal **distal MAP should be >20 mmHg;** however, maintenance of proximal MAP is the priority and should not be compromised to provide increased distal pressure.
- If proximal MAP is at desired target and distal pressure remains< 20 mmHg, consider increasing rate of blood product and fluid administration to facilitate resuscitation and perfusion pressures.
- For on-going blood product administration and resuscitation guidelines see:
  - ***1-7 Blood Product Administration guideline***
  - ***6-3 Shock/ Refractory Hypoperfusion- Trauma***
- Vasopressor use may be **ordered by receiving/ sending physician or on-line medical direction**, this may include:
  - **Norepinephrine: 1-60 mcg/min**
  - **Phenylephrine: 40-180 mcg/min**
  - **Vasopressin: 0.04 U/min**

6-4 Partial REBOA (pREBOA)

pREBOA Balloon Titration Procedure:

- Ensure appropriate proximal arterial line monitoring
- Hold and manually stabilize catheter at sheath insertion to ensure the catheter does not migrate with balloon inflation or deflation.
- Using a 10 cc syringe with sterile saline, slowly inflate or deflate balloon to achieve desired central arterial pressure.
- There is no maximum balloon volume, the overflow valve will not allow over inflation of the balloon.
- Document all times of inflation or deflation and pre & post systolic blood pressure and MAP on the attached pREBOA flowsheet and leave flowsheet with receiving facility.

Balloon Deflation Procedure: (**On-Line Medical Direction Only**)

- If patient condition improves and full deflation of the balloon is directed by medical direction:
  - Using a 30 cc syringe, slowly deflate balloon with two aspirations of 5 seconds in duration.
  - Maintain standard of care with resuscitation and monitoring parameters as above.
  - Continue to flush catheter and sheath arterial lines q15 minutes.
  - Leave catheter and balloon in place for remaining duration of transport.
  - Monitor for signs of acidosis (hypercapnia, hyperkalemia, lactic acidemia) and treat accordingly.
  - pREBOA should not create the metabolic washout that is seen in fREBOA. If metabolic washout is suspected or anticipated, discuss treatment with On-Line Medical Direction prior to complete balloon deflation.

6-4 Partial REBOA (pREBOA)

pREBOA Flowsheet:

- This flowsheet document should be started by the sending facility.
- This document must be updated during transport and be given to the receiving facility.
- A copy will need to be attached to the ECPS ePCR.

Partial Resuscitative Endovascular Balloon Occlusion of the Aorta (pREBOA)

Insertion Documentation by Primary RN *form must follow patient

Provider performing procedure: _____ Primary RN: _____

Department: _____ Date: _____ Start time: _____ Stop time: _____

Approach (☐ Right ☐ Left) Common femoral artery

5 Fr sheath insertion: ☐ Yes / ☐ No Start time: _____ Completion time: _____

7 Fr sheath insertion: ☐ Initial / ☐ Upsizing Start time: _____ Completion time: _____

☐ **Zone 1:** Insertion depth: _____ cm ☐ **Zone 3:** Insertion depth: _____ cm

Vital signs (Immediately after sheath insertion)

Time	BP	Heart Rate
	/ mmHg	/ min

☐ Line Adjustments _____

_____

Balloon Inflation, Adjustments & Art Line Flushes

☐ Post-procedure CXR time _____

Initial Inflation Time: _____ Initial Inflation Volume: _____ (approx) mls ☐ Complete occlusion ☐ Partial occlusion

Time	Minutes Balloon Up	ABOVE Balloon BP	BELOW Balloon BP	Adjustments	Art Line Flush (q15- 30 mins & prn)	
		/	/	☐Inflated ☐ Deflated	_____ Time ☐ Flushed	_____ Time ☐ Flushed
		/	/	☐Inflated ☐ Deflated	_____ Time ☐ Flushed	_____ Time ☐ Flushed
		/	/	☐Inflated ☐ Deflated	_____ Time ☐ Flushed	_____ Time ☐ Flushed
		/	/	☐Inflated ☐ Deflated	_____ Time ☐ Flushed	_____ Time ☐ Flushed
		/	/	☐Inflated ☐ Deflated	_____ Time ☐ Flushed	_____ Time ☐ Flushed

Total Inflation Time: _____ **mins** **Complete Occlusion Time :** _____ **mins** **Partial Occlusion Time:** _____ **mins**

Original – Medical Record Copy – Originator

6-5 Burns

Purpose:

Define treatment of burns during interfacility transport.

Burn Center Consultation:

- For any patient being transported to burn center, consult with the accepting physician prior to departing the bedside at the sending facility to ensure care plan priorities for transport.

Fluid Replacement (first 8 hours):

- Fluid replacement includes fluids administered prior to transport, first 8 hrs.
  - Over volume resuscitation is more consequential than under volume resuscitation.

- If <20% TBSA burns and no signs of shock, administer maintenance fluids

≥20% TBSA thermal or chemical burns:

- (**2 mL**)(**% TBSA**)(**Weight in kg**)/ **16 = mL/hr** LR or NS

Urine Output:

- For interfacility patients (especially >8 hours post-burn) Foley catheter placement to monitor urinary output is encouraged.

- Fluid resuscitate to **goal urine output of 0.5 mL/kg/hour.**

≥20% TBSA electrical burns:

- (**4 mL**)(**% TBSA**)(**Weight in kg**)/ **16 = mL/hr** LR or NS
  - Fluid resuscitation to maintain urine output of 1 – 1.5 mL/kg/hr

For electrical injuries with urine myoglobin (red or brown urine) consider the following:

- **Sodium Bicarbonate infusion at 200 mL/hr**
  - (150 mEq Sodium Bicarbonate in 1000 mL D5W)

If ECG changes consistent with hyperkalemia are present

- **Calcium Chloride (10%) 1 gm**
  OR
- **Calcium Gluconate (10%) 3 gm**

Frostbite:

- **tPA- Alteplase** (**Activase**)**:**
  - **3 mg bolus** (**30 mL of 0.1 mg**/**mL- solution**) **followed by infusion of 1 mg**/**mL** (**10 mL**/**h**) until specialists (eg, vascular, burn, radiology) recommend discontinuation.

  - Consult with written orders or receiving facility for specific dosing.

- The goal of thrombolytic therapy in frostbite injury is to lyse and clear microvascular thromboses. For deep frostbite injury with potential significant morbidity, angiography and use of either IV or intra-arterial tissue plasminogen activator (tPA) within 24 h of thawing may salvage some or all tissue at risk.

PEDIATRIC

Purpose:

Define treatment of burns during interfacility transport.

Burn Center Consultation:

- **Contact medical direction for treatment plan and goals. The following may be ordered or continued from the sending facility.**

Fluid Replacement (first 8 hours):

- Fluid replacement includes fluids administered prior to transport, first 8 hrs.
  - Over volume resuscitation is more consequential than under volume resuscitation.

- If <20% TBSA burns and no signs of shock, administer maintenance fluids.

>20% TBSA thermal or chemical burns:

- (3 mL)(% TBSA)(Weight in kg)/ 16 = mL/hr LR or NS+ Maintenance fluid (D5½NS, D5NS, or D5LR)

Urine Output:

- For interfacility patients (especially >8 hours post-burn) Foley catheter placement to monitor urinary output is encouraged.

- Fluid resuscitate to maintain following goals:
  - **Infants:** 1.0–2.0 mL/kg/hour
  - **Children under 30 kg:** 1.0–1.5 mL/kg/hour
  - **Children over 30 kg:** 0.5–1.0 mL/kg/hour

≥20% TBSA electrical burns:

- (4 mL)(% TBSA)(Weight in kg)/ 16 = mL/hr LR or NS + Maintenance fluid (D5½NS, D5NS, or D5LR)

For electrical injuries with urine myoglobin (red or brown urine) consider the following:

- **All ages:** 2mL/kg/hr

Appendix

A-1 Standard Concentrations

A-2 Chest Tube Maintenance

A-3 Arterial Blood Pressure Monitoring

A-4 Central Line Access and Maintenance

A-5 Antimicrobial Reference List

A-6 Notification Matrix

A-7 Critical Care Documentation Guide

A-8 Standard & Acceptable Abbreviations

A-1 Standard Concentrations

Drug	Concentration	Notes
Bicarbonate Infusion (Isotonic Bicarb)	• 150 mEq 8.4% Sodium Bicarbonate (3 amps) in 1 liter D5W • (0.13 mEq/mL)	• Isotonic crystalloid solution. Likely will need to purge air out of bag prior to adding medication. • 1150ml total volume once bicarb is added
Epinephrine Infusion	• 1 mg/250 mL • (4 mcg/mL)	• Predominately inotropic effect at 1-10 mcg/min
Ketamine	Analgesia: 100mg/ 100mL NS Sedation: 250 mg/ 250 mL NS or 500 mg/500 mL NS	• If up titrating, give bolus, then titrate. Mix concentration to be thoughtful of conserving medication as boluses.
Levetiracetam (Keppra)	Full dose diluted in 100mL D5W	• Typically infused over 10-20 minutes.
Nicardipine (Cardene)	25 mg/250 mL D5W (0.1 mg/mL)	• Initiate infusion at 2.5 mg/hr, consider increasing infusion by 2.5 mg/hr q5-10 minutes until goal BP is achieved, then set infusion to 3-5 mg/hr maintenance.
Norepinephrine (Levophed)	4 mg/250 mL D5W (16 mcg/mL) or 8 mg/250 mL D5W (32 mcg/mL) *Use 8mg/250ml if concerns for volume overload*	• Start at 1-5 mcg/min and titrate
3% NaCl	500 mL	• Bolus over 5-10 minutes

A-2 Chest Tube Maintenance

Indications:

- Patients requiring interfacility transport with a chest drainage system in place.

Procedure:

- Obtain report from sending facility with respect to type of chest tube, and type and rate of output – note any deviation from baseline that occurs during transport
- Inspect system starting at the patient, working back to the collection chamber
- Ensure that all water chambers are filled properly, and that all suction indicators indicate negative pressure
- Follow the F.O.C.A.L. system for assessment as noted below
- Trouble shoot air leaks as noted.

F.O.C.A.L. – Fluctuation, Output, Color, Air leak, Levels:

Fluctuation:

- None is bad – fluctuation indicates a patent tube

Output:

- Check the amount and consistency of drainage

Color:

- Check color, be alert to empyema with cloudy, purulent drainage

Air leak:

- Troubleshoot and repair

Levels:

- Ensure proper water levels in chamber
- Ensure proper negative pressure levels 15- 25cm/H2O is routine
- Change out the drainage unit as needed

Perform systematic check of all equipment ensuring all connections are secure:

- Chest tube
- Water seal tubing
- Collection chamber
- Water seal chamber
- Wall suction/ suction tubing

Check chest tube patency:

- Clamp chest tube (pinch or use padded clamp) close to patient
- If water stops bubbling, the patient has an air leak
- If bubbling continues the leak is in the drainage system
- Systematically move clamp down the system until bubbling goes away and the leak has been located
- Repair the leak

A-3 Arterial Blood Pressure Monitoring

Indications:

- Critically ill patients where an arterial line has already been placed by the sending facility.
- Where precise blood pressure is an advantage in monitoring or managing the patient.
- When vasoactive medications are being managed.
- If not placed by sending facility, consider discussion with sending facility about placement if patient meets above criteria.

Precautions / Complications:

- Dislodgement
- Infection

Procedure:

- Prime the flush system.
- Connect transducer to monitor.
- Level with patient's phlebostatic axis.
  - Use commercially available transducer armband during transport.

- Zero during transport after any patient movement and as necessary.
- Calibrate transducer waveform if monitor does not auto-scale

Transducer Calibration:

- 1. Ensure tubing is primed and free of air bubbles
- 2. Ensure transducer is secured at the level of the phlebostatic axis
- 3. Turn Stopcock "OFF" to the patient/open to air
- 4. Remove Yellow Cap
- 5. Select the P1 area of the monitor, Select "ZERO" from the menu, wait
- 6. The message "P1 Zeroed" appears when zeroing is complete.
- 7. Turn Stopcock "ON" to the patient/"OFF" to air
- 8. Replace Yellow Cap

Flushing the Transducer:

- 1. Depress white tabs on transducer toward each other
- 2. Watch waveform for "square" or flat line to appear, release white tabs
- 3. Watch waveform for oscillations after the square wave, before returning to tracing

A-3 Arterial Blood Pressure Monitoring

Overdamped waveform:

- Will cause falsely low SBP and falsely high DBP

Troubleshooting overdamped Waveforms

- Transducer position
- Scale on monitor
- Air in line
- Kinked, bent, pinched tubing
- Pressure and fluid levels in bag
- Partially turned stopcock
- Catheter position
- Thrombus
- Transducer position
- Re- Zero transducer

Underdamped waveform:

- Will cause falsely high SBP and falsely low DBP

- Troubleshooting Underdamped Waveforms
  - Transducer position
  - Air in line
  - Hyperthermia, tachycardia, high CO states
  - Re- Zero transducer
  - Remove any extra tubing & stopcocks

A-4 Central Line Access

Indications:

- CCT providers may encounter indwelling catheters in during interfacility transport of patients.
- Catheters will vary in type and use – tunneled catheters (long term), Porta-cath (long-term, subdermal ports), non-tunneled Central Lines (short term), PICC lines (short term).
- CCT providers may maintain these lines, and use them for vascular access in emergencies or continue use if already accessed.
- Follow patients pre-existing care regimen for flushing and access whenever possible.

Precautions / Contraindications:

- Use strict aseptic techniques
- Do not use lines if their distal termination is in an uncertain location
- Do not use scissors around indwelling lines
- Use only Huber (non-coring needles to access Porta-cath ports)
- Long catheters have low flow rates (not useful for fluid resuscitation)

Maintenance:

- Follow procedures for regular IV maintenance
- Flush catheter as needed with 10-15 mL of normal saline to maintain flow (do not use excessive force or smaller than 3 ml syringe)

Access:

- Note patient's type of catheter and be sure that its distal termination matches the intended use
- Use only non-coring/Huber needles for Porta cath access
- Observe strict aseptic technique
- Access previously used ports/lumens (it is preferable to leave unused ports/lumens sterile)
- Flush with 10-15 mL of normal saline to ensure flow – do not use excessive force or smaller than 3 mL syringe
- Apply appropriate tubing and set flow rate

A-5 Antimicrobial Reference List

Name	Type	Dose	Time
Acyclovir sodium (Zovirax)	Antiviral	5 – 10 mg/kg	60 min
Ampicillin (Omnipen)	Penicillins	1 – 2 gm	30 min
Ampicillin/Sulbactam (Unasyn)	Penicillins	1.5 – 3 gm	30 min
Azithromycin (Zithromax)	Macrolides	500 mg	60 min
Aztreonam (Azactam)	Other	0.5 – 2 gm	30 min
Cefazolin (Ancef)	Cephalosporins	0.25 – 2 gm	30 min
Cefepime (Maxipime)	Cephalosporins	0.5 – 2 gm	30 min
Cefotaxime (Claforan)	Cephalosporins	0.5 – 2 gm	30 min
Cefotetan (Cefotan)	Cephalosporins	0.5 – 3 gm	30 min
Cefoxitin (Mefoxin)	Cephalosporins	1 – 2 gm	30 min
Ceftazidime (Fortaz, Tazicef)	Cephalosporins	0.5 – 2 gm	30 min
Ceftriaxone (Rocephin)	Cephalosporins	1 – 2 gm	30 min
Cefuroxime (Zinacef)	Cephalosporins	0.75 – 1.5 gm	30 min
Ciprofloxacin (Cipro)	Fluroquinolones	200 – 400 mg	60 min
Clindamycin (Cleocin)	Other	300 – 900 mg	30 min
Doxycycline (Vibramycin)	Tetracyclines	100 mg	60 min
Ertapenem (Invanz)	Carbapenems	1000 mg	30 min
Fluconazole (Diflucan)	Antifungal	200 – 800 mg	200 mg/hr

A-5 Antimicrobial Reference List

Name	Type	Dose	Time
Gentamycin (Garamycin)	Aminoglycosides	1 – 7 mg/kg	30 min
Levofloxacin (Levaquin)	Quinolones	250 – 500 mg or 750 mg	60 min or 90 min
Linezolid (Zyvox)	Other	600 mg	60 min
Meropenem (Merrem)	Carbapenems	500 – 1000 mg	30 min
Metronidazole (Flagyl)	Other	250-750 mg	60 min
Moxifloxacin (Avelox)	*Quinolones*	400 mg	60 min
Nafcillin (Nafcil, Unipen)	Penicillins	0.5- 2gm	30 min
Oxacillin (Bactocill, Prostaphilin)	Penicillins	0.25- 2 gm	30 min
Penicillin G Potassium/Sodium	Penicillins	2 – 6 million units or 24 million units	60 min or Daily
Piperacillin/Tazobactam (Zosyn)	Penicillins	3.375- 4.5 gm	30 min
Ticarcillin/Clavulanate (Timentin)	Penicillins	3.375 – 4.5 gm	30 min
Tigecycline (Tygacil)	Other	50- 100mg	60 min
Tobramycin	Aminoglycosides	1 – 7 mg/kg	30 min
Trimethoprim/Sulfamethoxasole (Bactrim, Septra)	Sulfonamides	10 – 20 mg/kg	60 min
Vancomycin Hydrochloride	Other	0.5 – 1 gm or 1.5- 2 gm	60 min or 120 min

A-6 Notification Matrix

While the risks of unplanned events can be mitigated during critical care transport, they cannot be eliminated. In the event of an unplanned clinical or operational event, timely notification is important to ensure prompt information gathering and allowing prompt attention to be given to system/ process improvement and clinician feedback.

Below is the notification matrix of what clinical and operational unplanned events need to be reported, in what time frame, via what method and to whom.

- Additional phone notifications beyond EMS 10 can be made by the shift supervisor.

Event	Call EMS 10	Incident Report	Additional Notification
Diversion to facility other than accepting	Y	Y	Clinical Administrator
Cardiac arrest or CPR performed during transport	Y	Y	Clinical Administrator
Medical equipment or device failure	Y	Y	Clinical Administrator
Employee injury or exposure (minor)	Y	Y	See Policies and Procedures manual for additional notifications
Employee injury or exposure (serious)	Y	Y	See Policies and Procedures manual for additional notifications
Motor vehicle incident with patient on board	Y	Y	See Policies and Procedures manual for additional notifications
Motor vehicle incident without patient on board	Y	Y	See Policies and Procedures manual for additional notifications

A-6 Notification Matrix

Event	Call EMS 10	Incident Report	Additional Notification
Any patient injury	Y	Y	Clinical Administrator
Interaction issue with sending or receiving facility	Y	Y	Clinical Administrator
Medication error or Adverse drug event	N/A	Y	Clinical Administrator
Unplanned dislodgement of therapeutic device	N/A	Y	Clinical Administrator
Any other near miss or serious reportable event (SRE)	N/A	Y	N/A
Bedside time at sending facility > 1 hour	N/A	Y	N/A
Use of lights or sirens during transport	N/A	Y	N/A
Crew unable to return to district (planned or unplanned)	Y	Y	N/A

All events complied from GAMUT and ACCT tracking metrics

A-7 Critical Care Documentation Guide

Purpose:

Outline general guidelines for critical care documentation in the EHR.
Complete and cohesive documentation is important in the critical care transport setting.

Incident:

- **Run Type:** Hospital to Hospital Transfer
- **Unit Capability:** Ground Transport (Critical Care Equipped)
- **Units Level of Care:** Specialty Critical Care
- **EMD Complaint:** Transfer/ Interfacility/ Palliative Care
- **Requested By:** Physician
- **Scene:** Hospital, Free type specific hospital unit in Apt/ Suite/ Room

Vital Signs:

- For any patient patient receiving invasive mechanical ventilation, non-invasive mechanical ventilation (HFNC, CPAP, BiPAP), any vasoactive medications or multi- system etiology, the following vital signs will be obtained and documented **every 5-10 minutes.**
  - Heart Rate
  - Blood Pressure
  - SPO2
  - ETCO2 (if applicable)

- All other patients will have the following vital signs obtained and documented **every 10-15 minutes.**
  - Heart Rate
  - Blood Pressure
  - SPO2
  - ETCO2 (if applicable

- The following will be obtained and documented upon arrival at bedside, with any clinically significant change or treatment and upon arrival at receiving facility.
  - GCS
  - RASS (if applicable)
  - Pain Score
  - EKG rhythm

A-7 Critical Care Documentation Guide

Flow Chart:

- All interventions from arrival to patient side to arrival to receiving facility are documented in the flow chart.
- All medications started by the sending facility and continued during transport are documented in the flow chart using the arrival at bedside time.

Ventilator Flowchart:

In the Flow Chart choose either *Advanced Ventilator Management* or *Ventilator Care/Adjustment* based on the following criteria and document the listed items depending on what mode you use.

Advanced Ventilator Management

- For any mode change
- For initial vent settings at sending facility
- For handoff of care settings at receiving faclity
- Document the following:
  - IBW (kg)
  - Mode

Ventilator Care/Adjustment

- For any small adjustments after initial settings (PEEP, FiO2 etc.)

Modes of Ventilation:

Adaptive Support Ventilation

- % Minute Volume (in comments)
- IBW (kg)
- PEEP
- FiO2
- Spontaneous Breath Rate
- VTe Expired Tidal Volume
- Minute Volume
- PIP
- Pplat

Pressure Control Modes

- Mode type
- IBW (kg)
- Rate
- PEEP
- Pressure Support
- FiO2
- iTime
- Spontaneous Rate
- Vte
- Minute Volume
- PIP
- Pplat

A-7 Critical Care Documentation Guide

Modes of Ventilation:

Volume Control Modes

- Mode type
- IBW (kg)
- Rate
- PEEP
- Pressure Support
- Volume
- FiO2
- iTime
- Spontaneous Rate
- Vte
- Minute Volume
- PIP
- Pplat

NIV

- IBW (kg)
- PEEP
- Pressure Support
- FiO2
- Spontaneous Rate
- Minute Volume
- PIP
- % Leak

HFNC

- This has its own flowchart item.
- Fill Out All Fields

Airway Flowchart:

- **Endotracheal Tube Monitoring:** Documented at minimum at arrival at bedside and arrival at receiving facility.
  - Date / Time of intubation
  - ETT tube size
  - Depth at teeth
  - Secured with commercial device
  - Cuff pressure monitoring

- **NG/OG:** Documented at arrival at bedside, unless placed during transport.
  - Size
  - Depth
  - Under suction or capped
  - If under suction, describe return (e.g. bilious stomach contents vs bloody fluid)

Vascular Access Flowchart:

- **IV Monitoring:** Documented at arrival at bedside
  - Site/ Gauge
  - Fluid/ NS lock

- **Central Line:** Documented at arrival at bedside
  - Site
  - Document each port
  - Visual inspection of site
  - Fluid or capped

A-7 Critical Care Documentation Guide

Medication Flowchart:

- All medications initiated PTA and continued transport are documented at the arrival at bedside time.
  - Dose
  - Rate of infusion
  - Concentration of infusion

- All medication titrations are documented in the flow chart as they are made.
  - Dose
  - Rate of infusion
  - Concentration of infusion

- Any medications given PTA but not continued as an infusion for transport are documented in the narrative.

Blood Products Flowchart:

- If blood is administered, documentation occurs in flow chart.

- If blood is not administered, documentation occurs in narrative.
  - Product name (e.g. packed red blood cells, fresh frozen plasma, platelets)
  - Expiration date
  - Blood recipient's type and Rh factor & blood band number
  - Blood product type and Rh factor
  - Blood Product Number
  - Volume

Critical Care Flowchart:

- **Arterial Line Care:** Documented at arrival at bedside and as needed during transport.
  - Location/ Site
  - Secured
  - Zeroed to monitor
  - Visual Inspection of site

- **Chest Tube Monitoring:** Documented at arrival at bedside and as needed during transport.
  - Site
  - Size
  - Placed at, in centimeters
  - Suction

A-7 Critical Care Documentation Guide

Critical Care Flowchart:

- **Foley Catheter:**
  - Size
  - Output, volume, color

- **Balloon Pump Care:**
  - Catheter size
  - Insertion site
  - Balloon size (cc)
  - Trigger source (Fiber Optic, ECG, Arterial pressure)
  - Assist ratio (1:1, 1:2, 1:3) (Documented q20 minutes)
  - Augmentation MAP (Documented q20 minutes)
  - Unagumented MAP (Documented q20 minutes)
  - Distal perfusion status (Documented q20 minutes)

- **pREBOA:** (attach to PCR, pREBOA flow sheet from sending facility)
  - **Any changes in transport, document the following;**
    - Balloon inflation volume (mL)
    - Inflation adjustments made
    - Times of adjustments
    - Balloon secured
    - Catheter depth at skin (cm)
    - Marker position unchanged throughout transport
    - Distal perfusion status

Lab Values:

Use Critical Care flow chart to document all pertinent PTA labs and any labs obtained during transport.

- Following fields exist:
  - Lab Values- Blood Gases
  - Lab Values- Cardiac
  - Lab Values- CBC
  - Lab Values- CMP
  - Lab Values- Coagulation

A-7 Critical Care Documentation Guide

Defib- Cardio Flowchart:

- **Pacing:**
  - Use for Transvenous pacing or Transcutaneous pacing. Fill out all fields and note method of pacing.

Other Flowchart:

- **Patient Restraint:** Soft wrist restraints placed and documented during transport. Document distal CMS every 1 hour.

- **Consult:** Documented any time a physician consultation occurs. This can be at the sending facility or during transport.

Medication Documentation:

- **Pertinent medications given prior to arrival:** Document in narrative

- **Non- Controlled medication infusions started prior to arrival to continue during transport:** Document in flowchart using the timestamp when you arrived at the bedside.
  - Add comment "continued for transport" in the flowchart comment section.

  - Propofol and Precedex are non-controlled medications.

- **Controlled medication infusions mixed from ECPS stock:** Document medication infusion in flowchart with note in comments "mixed from ECPS stock."
  - Document the waste in the flowchart.

  - Do not turnover any controlled medication infusions to the receiving facility, waste any remaining infusion.

- **Controlled medications received from the sending facility for transport:**
- Document as you would any other medication infusion continued for transport and add note in comments "from hospital, continued for transport."
  - Do not turnover any controlled medication infusions to the receiving facility. waste any remaining infusion and document waste in narrative.

  - Any unused bags of controlled medications we receive, return to VH and document in your narrative.

A-7 Critical Care Documentation Guide

Narrative Template:

- **Dispatch:**
  - Medic X requested for emergent specialty critical care transport of **X** year old patient from Vail Health **ICU**/ **PCU**/ **ED**/ **OR** to **RECEIVING FACILITY & UNIT.**

- **Transfer Summary:**
  - Sending facility diagnosis and reason for transfer.
  - "Patient is being transferred for **XXX SPECIALTY**/ **INTENSIVE CARE** not available locally at Vail Health.

- **HPI:**
  - HPI and report from the sending facility.
  - Sending facility interventions prior to arrival.
  - Include imaging or diagnostics performed prior to arrival.

- **Assessment:**
  - Documented in narrative or in assessment tab of EHR.
  - Use ongoing assessment tab for any changes in transport.

- **Pertinent Medications Prior to Arrival:**
  - Document any pertinent medications that were administered prior to arrival.

- **Transfer Consult:**
  - Document transfer orders, care plan and any consult with the sending physician.

- **Transport Summary**
  - Document overall summary of transport and overview of interventions, do not double document specifics of interventions performed in the flow chart.

A-8 Standard and Acceptable Abbreviations

AAA- Abdominal aortic aneurysm
ABG- Arterial blood gas
ACT- Activated Clotting Time
Afib - Atrial fibrillation
AICD- Automatic implantable cardioverter-defibrillator
aPTT- Activated partial thromboplastin time
ATV- All-terrain vehicle
ASV- Adaptive Support Ventilation
BiVAD- Biventricular assist device
BP- Blood pressure
BVM- Bag valve mask
C- Celsius
CABG- Coronary artery bypass graft
CHF- Congestive heart failure
cm- Centimeter
COPD- Chronic obstructive pulmonary disease
CPAP- Continuous positive airway pressure
CPR- Cardiopulmonary resuscitation
CT- Computerized tomography
CVA- Cerebrovascular accident
CVP- Central venous pressure
D5NS- Dextrose 5% in normal saline
D5W- Dextrose 5% in water
DNR- Do not resuscitate
ECMO- Extracorporeal membrane oxygenation
ED- Emergency department
ECG/EKG- Electrocardiogram
EMS- Emergency medical service
ETA- Estimated time of arrival
EtCO2- End-tidal carbon dioxide
ETOH- Ethyl alcohol
ETT- Endotracheal tube
F- Fahrenheit
FiO2- Fractional inspired oxygen concentration
GCS- Glasgow coma score/scale
G or gm- Gram
Hct- Hematocrit
Hgb- Hemoblogin
hr- Hour
IABP- Intra-aortic balloon pump
IBW- Ideal body weight
ICP - Intracranial pressure
ICU- Intensive care unit
IM- Intramuscular
IO- Intraosseous
IV- Intravenous
JVD- Jugular vein distention
kg- Kilogram
LR- Lactated ringers
LVAD- Left ventricular assist device
MAP- Mean arterial pressure
mcg- Microgram
MD- Physician
mEq- Milliequivalent
mg- Milligram
MI- Myocardial infarction
min- Minute
ml- Milliliter
MV- Minute ventilation
MVC- Motor vehicle crash
NIHSS- National Institutes of Health Stroke Scale
NPA- Nasopharyngeal airway
NSS- Normal saline solution
OPA- Oropharyngeal airway
PaO2- Arterial oxygen pressure
PCO2- Carbon dioxide pressure
PCU- Patient care unit
PEEP- Positive and end pressure
PIP- Peak inspiratory pressure
PRBC- Packed red blood cells
PT- Prothrombin time
PTT- Partial thromboplastin time
PTA- Prior to arrival
PVC- Premature ventricular contraction
RN- Registered nurse
SpO2- Oxygen saturation
SBP- Systolic blood pressure
SIMV- Synchronous intermittent mandatory ventilation
SQ- Subcutaneous
STEMI- ST-elevation myocardial infarction
SUV- Sports-utility vehicle
SVT- Supraventricular tachycardia
TBSA- Total body surface area
TV- Tidal volume
V-fib- Ventricular fibrillation
V-tach- Ventricular tachycardia