



Tactical Emergency Casualty Care (TECC) Guidelines for Pediatric Patients



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PREAMBLE

In environments with real or perceived threat(s), traditional response paradigms prioritizing scene safety before patient care may result in treatment delays that negatively affect patient and rescuer outcomes.

To address this gap, the Tactical Emergency Casualty Care (TECC) guidelines describe patient care standards for persons of all age groups in an all-hazards, high-threat environment.

The TECC construct consists of three dynamic phases of care:

1. Direct Threat
2. Indirect Threat
3. Evacuation

These phases are intended to correlate directly with the contemporaneous threat level and are not solely geographic.

Paramount considerations to reduce mortality and morbidity throughout all phases of TECC are:

- Immediate access to the injured
- Rapid life-saving interventions at or near the point of injury
- Early extraction of those needing transport to definitive medical care

In addition to treating physical injuries, key principles for addressing the mental health needs of patients, survivors, and responders include:

- Limiting exposure of personnel to the incident
- Providing appropriate early psychological support

The TECC system of care is applied during incidents where operational threats (e.g., active violence, hazardous material, fire, structural instability, etc.) shape the medical response. This system of care is based upon principles, not protocols. While the TECC principles are universal, the application of the principles is agency, provider, practitioner, and resource specific.

The TECC guidelines are agnostic to specific commercial products, scope of practice dependent, and require a systems approach that accounts for the event's totality, including available resources and clinical capabilities. The Committee for Tactical Emergency Casualty Care does not endorse specific training programs or instructors but encourages all end users to employ these guidelines appropriately.

The Committee for Tactical Emergency Casualty Care was originally convened to speed the transition of military medical lessons learned from the battlefield to evidenced- and best-practiced based operational medical guidance for medical response and treatment of the injured during high risk and atypical civilian operational scenarios.

The Tactical Emergency Casualty Care (TECC) guidelines are a set of best practice recommendations for casualty management during civilian tactical and rescue operations. Based upon the principles of Tactical Combat Casualty Care (TCCC), TECC accounts for the differences in the civilian environment, resources, patient population, and scope of practice from the military combat environment of TCCC.



TECC Guidelines for Pediatric Patients

Disclaimer: These guidelines are intended primarily for the high-threat environment where traditional resources may not be available and competing safety, operational, and patient-care priorities exist. They do not supersede or substitute for departmental/agency operational protocols delivered by qualified providers under the guidance of direct or indirect medical oversight.

Why did C-TECC develop these guidelines? Children are at a disproportionate disadvantage when they become injured in the prehospital environment. This is especially true when their injuries involve hemorrhage, hypothermia, head injury, and severe emotional trauma. Responders need to recognize and mitigate these conditions proactively to optimize patient outcomes. These guidelines are complementary to the general *C-TECC Guidelines* and the principles of pediatric resuscitation. They are intended to be used as a tool for departments and agencies to prepare to respond to the needs of patients of all ages in unique high-threat environments.

Defining the pediatric patient: There is no consensus and a high degree of variability on the definition of a pediatric patient across healthcare systems worldwide. For operational simplicity, these guidelines define a pediatric patient as one who, by observation, does not appear to have reached puberty.

Direct Threat Care (DTC)/Hot Zone	
Primary Goals:	<ul style="list-style-type: none">• Accomplish the mission objectives while mitigating the risk to the injured, to responders, and to the public.
Operational Principles:	<ul style="list-style-type: none">• Threats and hazards in this environment are dynamic and require ongoing assessment and mitigation.• Minimal patient care interventions are warranted in this phase. CPR and other advanced interventions should not be performed in the Direct Threat environment.• Accessing and removing the injured from the threat should be a priority.• Mitigate the psychosocial impact to the pediatric victim by using simple, calm language (e.g., “I’m a police officer and I’m going to help you”).
Required Skill Set (applied per approved SOP/protocol only):	<ul style="list-style-type: none">• Direct pressure and hasty tourniquet application.<ul style="list-style-type: none">○ Primary, Alternate, Contingency, Emergency (PACE) methodology.○ Commercially available tourniquets.○ Field expedient tourniquets.• Methods for rapid and efficient patient extraction.• Rapid placement in recovery position.

I. Direct Threat Care (DTC)/Hot Zone Guidelines

- A. Execute a rescue plan to reduce the risk to the injured from ongoing direct threat by using one or more of these strategies:
 1. Direct the pediatric patient to self-extract to a safer position using simple, age-appropriate commands. Use simple phrases that are understandable by a child, and which are actionable (e.g., “Look at my face and crawl to me right now”).



2. Mitigate the risk to the patient and responders.
 3. Direct another person to assist with extricating the pediatric patient to a safer position.
 4. Consider a rescue plan for a patient who is unable to be extricated by other means (e.g., unresponsive, inaccessible, or otherwise unable to move).
- B. Stop life-threatening external hemorrhage.
1. Apply immediate, purposeful, focused manual pressure to the bleeding source.
 2. Apply junctional or proximal pressure if needed to supplement previous attempt.
 - a) Apply a tourniquet to the patient with uncontrolled severe extremity bleeding or an amputation. (Note: Some tourniquets may not function as intended on small limbs. Know your equipment limitations.)
 - b) Apply the tourniquet as high (proximal) on the limb as possible.
 - c) Apply to bare skin if possible.
 - d) If necessary, Apply a second tourniquet to an extremity that continues to bleed; apply proximal to the existing tourniquet if possible and apply to bare skin.
 3. Continue applying manual pressure to the source or a junctional location as needed.
- C. Support the airway.
1. Place or direct the patient to be placed into the best position to protect the airway (e.g., recovery position or sitting up).
 2. If needed, consider rapid, high-yield airway interventions, such as manual positioning and/or placement of an airway adjunct.



Indirect Threat Care (ITC)/Warm Zone	
Goals:	<ul style="list-style-type: none"> • Rapidly stabilize additional time-sensitive life-threatening injuries to permit safe extraction to more definitive care. • Threat(s) may remain that necessitate a need for heightened awareness regarding the safety and security of the responders and the patients.
Key Principles:	<ul style="list-style-type: none"> • Conduct a rapid patient assessment and initiate life-saving interventions. • Do not delay patient extraction for non-life-saving interventions. • Consider establishing a casualty (patient) collection point(s). • Attempt to document any care rendered. • Anticipate the possibility of extended/prolonged care.
Required Skill Set: (applied per approved SOP/protocol only):	<ul style="list-style-type: none"> • Hemorrhage Control: <ul style="list-style-type: none"> ○ Application of direct pressure ○ Application of tourniquet <ul style="list-style-type: none"> ▪ PACE methodology. ▪ Commercially available tourniquets. ▪ Field expedient tourniquets. ▪ Junctional tourniquets. ○ Perform wound packing with gauze or hemostatic agent. ○ Application of pressure dressing. • Airway: <ul style="list-style-type: none"> ○ Perform manual maneuvers (chin lift, jaw thrust, recovery position). ○ Insert nasal pharyngeal airway. ○ Placement of extraglottic (supraglottic) airway. ○ Placement of endotracheal tube under direct visualization. ○ Perform surgical cricothyrotomy. • Breathing: <ul style="list-style-type: none"> ○ Application of effective occlusive or non-occlusive (vented/channeled) chest seal. ○ Apply oxygen if available. ○ Recognize the symptoms of tension pneumothorax. ○ Perform needle thoracostomy (anterior chest location or lateral chest location). ○ Perform manual burp of vented seal. • Shock management/fluid resuscitation: <ul style="list-style-type: none"> ○ Recognize the symptoms of hemorrhagic shock. ○ Obtain intravenous and/or intraosseous access. • Hypothermia prevention: Apply available materials to prevent heat loss. • Wound management: Initiate basic burn treatment.

II. Indirect Threat Care (ITC)/Warm Zone Guidelines

- A. Assess the patient using the Pediatric Assessment Triangle (Appendix 1) to identify major deficits in general appearance, work of breathing, and circulation to the skin.
- B. Massive Hemorrhage (Bleeding):
 1. Expose, assess for, and control any uncontrolled/unrecognized major bleeding.
 2. Expose skin and apply a tourniquet 2-3 inches above the wound for severe extremity bleeding if not already done (see Section I on DTC/Hot Zone).
 - a) Most commercial tourniquets will be adequate for most pediatric patients.



3. Use pressure dressings to control bleeding at the source.
 - a) If available, hemostatic trauma dressings are appropriate for pediatric patients. Apply them using a deep wound packing technique and place a pressure dressing over the packed wound.
4. Re-assess any tourniquets that were already applied to the patient.
 - a) Assess for continued bleeding or distal pulses on extremities with tourniquets applied and tighten the device if present.
 - b) Expose and clearly mark the tourniquet site with the time of application if possible.
5. For prolonged care under Indirect Threat, consider a tourniquet conversion if
 - a) The delay to definitive care will be longer than two hours and:
 - (1) The patient is not in hemorrhagic shock.
 - (2) The bleeding wound can be visualized and accessed.
 - (3) The tourniquet is not being used to manage a partial or complete amputation.
 - (4) The patient has not already had a tourniquet downgrade attempted.
 - b) Apply a new tourniquet proximal to the existing device and be prepared to tighten if necessary.
 - c) Expose and pack the previously bleeding wound site. Use a hemostatic (preferred) or other gauze dressing if available, apply requisite manual pressure post-packing, and apply a pressure dressing to the wound site.
 - d) Slowly remove the first tourniquet and continuously assess for bleeding. If bleeding recurs, tighten the new tourniquet until bleeding stops.

C. Airway Management:

1. Assess patient for adequacy of airway and respiratory effort; look, listen, and feel and consider pulse oximetry if available with a goal of over 94% on room air.
2. If necessary, intervene to open and maintain a patent airway. Consider these interventions:
 - a) Manually position the airway by head-tilt/chin-lift or manual jaw thrust (open mouth first.)
 - b) Suction airway. (Avoid putting fingers in mouth and use caution for vaso-vagal response from aggressively suctioning hypopharynx).
 - c) Allow the patient to assume the most comfortable position, which may be lateral recumbent (recovery) or sitting up. For recumbent infants and younger children, elevate the shoulders with gentle support (e.g., folded towel) to optimize airway positioning.
 - d) Maintain a high index of suspicion for potential airway worsening in a patient with inhalational burns or other injuries.
3. Support ventilation as needed.
 - a) A basic airway adjunct (NP or OP airway) and effective bag-valve-mask



- ventilation are the initial interventions. A PEEP valve and manometer on a bag valve mask should be used, if available.
- b) If unable to ventilate, consider more advanced airway support.
 - (1) Extraglottic (supraglottic) airway.
 - (2) If a surgical airway is indicated, needle cricothyroidotomy is recommended over the surgical approach for pediatric patients.
 - (3) Intubation if unable to manage airway with extraglottic airway.
 - c) Consider administering oxygen as soon as it is available.
 - d) Avoid overinflation and hyperventilation with assisted ventilation.
4. Consider the need to prevent or treat a tension pneumothorax in unstable patients with ineffective or deteriorating respiratory effort.
- a) Apply a seal to any open chest, back, or neck wounds, ideally a vented commercial chest seal.
 - b) Monitor the patient for possible development of tension pneumothorax, especially if a non-vented chest seal is applied.
 - c) Perform needle decompression on the side of the injury.
 - (1) Infants and smaller children require a smaller needle than adults for decompression. Consider a normal (1.5 inch/3.8 cm) 14 or 16g needle.¹
 - (2) Landmarks for insertion are the 5th intercostal space at the anterior axillary line (first choice) and the 2nd intercostal space at the mid-clavicular line (second choice).
 - d) Consider bilateral needle decompression for the patient in traumatic arrest or peri-arrest.
- D. Circulation (Shock Management/Resuscitation):
1. For a patient in suspected shock:
 - a) Ensure that external hemorrhage is being aggressively controlled.
 - b) Obtain IV/IO access promptly; warm fluids are preferred.
 - c) Consider blood products for a patient in suspected hemorrhagic shock, either:
 - (1) Transfuse with low-titer O-negative whole blood (LTOWB) 10 ml/kg in children one year or older.
 - (2) Transfuse a 1:1 ratio of packed red blood cells (PRBC) and plasma at 10 ml/kg each.
 - d) If blood is not available or there is suspected shock of non-hemorrhagic etiology, consider a bolus of 20 ml/kg normal saline or Lactated Ringer's solution.
 - e) If the patient still shows signs or symptoms of shock, Consider repeat boluses

¹ Mandt, M, Hayes, K., Severyn, and Adelgais, K. (2019). *Appropriate Needle Length for Emergency Pediatric Needle Thoracostomy Using Computed Tomography*. *Prehospital Emergency Care*, 23(5), 663-671, doi: 10.1080/10903127.2019.1566422



up to a maximum of 60 ml/kg.

- f) Continually assess patient and slow the rate of IV fluid administration if patient improves or recovers to minimal blood pressure range for age or recovers a strong peripheral pulse. Systolic BP goals: 60 mmHg <1 month of age, 70 mmHg + [2x age in years] in children 1 month to 10 years of age, 90 mmHg in children 10 years of age or older.
2. Consider the use of tranexamic acid (TXA) in patients with suspected or actual massive hemorrhage.
 - a) TXA use should only be undertaken in a pediatric trauma system-of-care setting where pre-event coordination with local medical infrastructure has occurred.
 - b) Suggested dose: 15mg/kg loading dose followed by 2mg/kg/hour for 8 hours.
 - c) Only initiate if less than 3 hours from the time of injury, but ideally within the first 30 minutes from the time of injury.
 - d) Consider administering TXA after resuscitation with whole blood has occurred.
 3. While hypocalcemia in the pediatric trauma patient is well established and likely correlates with increased mortality, there is extremely limited information about the use of calcium in pediatric field trauma resuscitation. The treatment of hypocalcemia is variable in the pediatric patient and can be complex. Consult local medical direction.
 4. Cardiopulmonary resuscitation (CPR) and defibrillation are typically not successful in patients of any age who have suffered traumatic cardiac arrest or blast injuries. In certain circumstances (e.g., electrical injuries, drowning, suffocation, etc.), CPR may be of benefit and should be considered in the context of available resources.
- E. Hypothermia Prevention:
1. Reduce heat loss from conduction with the ground.
 2. Remove wet clothing and dry the patient.
 3. Cover the patient with warm, dry, insulating material with a barrier to keep it dry.
- F. Hypoglycemia Prevention:
1. Check fingerstick blood glucose if possible, as low blood sugar is a common co-pathology in injured children. Consider using 70 mg/dl as the threshold for hypoglycemia in infants and children.
 2. Treatment could involve oral intake of high-carbohydrate food or IV administration of dextrose at 2 mg/kg. D10W is the preferred formulation for pediatric dosing.
- G. Analgesia:
1. Assess the pain level.
 2. Consider oral acetaminophen (15 mg/kg) every four hours for mild to moderate pain.
 3. In patients over 3 months old, consider ketamine for analgesia for moderate to



severe pain as it has a favorable risk profile.² Use weight-based dosing and administer slowly to mitigate possible side effects.

- a) Suggested oral (PO) dose is 0.2-0.5 mg/kg every 8 hours.
 - b) Suggested IM dose is 0.2-0.5 mg/kg.
 - c) Suggested IV dose is 0.1-0.2 mg/kg slow push.
4. In an infant, sugar is a proven analgesic. If the airway is patent and the child is awake, dip a pacifier or gloved finger into a sugary solution (not honey) and offer as often as needed.
5. Opioid pain medications are also appropriate for use in the pediatric population under local protocol guidance, with IV, IM, and intranasal (IN) options available. Use estimated weight-based dosing and ensure immediate access to the reversal agent naloxone. Suggested dosages:
- a) Fentanyl IM/IN: 1 mcg/kg (not to exceed 100 mcg).
 - b) Fentanyl IV/IO: 1 mcg/kg titrate to effect at a rate of 50 mcg/min slow IVP (not to exceed 100 mcg).
 - c) Morphine IM: 0.1 mg/kg.
 - d) Morphine IV/IO: 0.1 mg/kg titrate to effect at a rate of 2 mg/min slow IVP (not to exceed 20 mg).
 - e) Suggested naloxone initial dosages are 0.1 mg/kg IV or IN for infants and children < 5 years old. For older children, 2 mg IV or IN.
6. Consider the use of ondansetron if nausea or vomiting occurs .
- a) Suggested dose: 0.1 mg/kg IV for patients 1 month-12 years.
 - b) Suggested dose: 4 mg IV for patients over 12 years.
 - c) Suggested dose: 4 mg PO children 4-12 years.
 - d) Suggested dose: 8 mg PO children over 12 years.

H. Head Injury:

1. Consider use of a pediatric-modified GCS scale for infants and children in patients with traumatic head injuries (Appendix 2).³
 - a) Peds GCS \leq 12 suggests non-mild traumatic brain injury.
 - b) Peds GCS \leq 8 suggests need for airway support.
 - c) Peds GCS \leq 6 suggests need for surgical management of TBI.
2. Restrict cervical spine motion if indicated based on mechanism of injury; in the absence of commercial immobilization devices, consider manual stabilization, a

² Vadivelu, N., Schermer, E., Kodumudi, V., Belani, K., Urman, R. D., & Kaye, A. D. (2016). *Role of ketamine for analgesia in adults and children*. Journal of anaesthesiology, clinical pharmacology, 32(3), 298–306. <https://doi.org/10.4103/0970-9185.168149>

³ Children’s Hospital of Philadelphia (ND) Emergency Department Clinical Pathway for the Evaluation and Treatment of Children with Acute Head Trauma. Retrieved from: <https://www.chop.edu/clinical-pathway/head-trauma-acute-clinical-pathway>



towel roll, or other improvised technique.

3. Avoid hypoxia (see above).
 4. Avoid hyper- or hypoventilation- the goal is normocarbica (ETCO₂ of 35-40 mmHg).
 5. Consider elevating the head to about 30°.
 6. Treat aggressively for shock if present. Hypotension can double the mortality associated with traumatic brain injury.
 7. Avoid hypothermia.
- I. Prepare patient for movement:
1. Use a movement assistive device if possible (basket, portable stretcher, wheeled litter).
 2. Minimize unnecessary movement.
 3. Ensure patient is well secured and is ready for the anticipated mode of extraction.
 4. Prevent hypothermia.
- J. Minimize psychosocial impact:
1. As detailed above, it is important in children of all ages to express empathy—tell them the truth about what to expect, warn them if something will hurt, and describe what you are doing to help them.
 2. Encourage, reassure, and explain care. If not altered, awake, and able to follow commands, patient may drink clear liquids if conscious, can swallow, and there is a confirmed delay in evacuation to care.
 3. Talk to the child directly if possible.
 4. Keep the patient with the caregiver to the extent possible.

Evacuation Care (EC)/Cold Zone	
Goals:	<ul style="list-style-type: none">• Now that the patient and providers are removed from the probability of ongoing injuries from the threat, the top priority is the maintenance and improvement of the lifesaving interventions initiated during the Direct and Indirect Threat phases of care.• Additionally, a more comprehensive patient management approach can be taken to identify and treat any remaining threats to the patient's health.• The focus continues toward moving the patient to definitive care with minimal delays.
Key Principles:	<ul style="list-style-type: none">• Closely monitor the patient for changes in condition.• The medical management goals for this section overlap significantly with those from Indirect Threat.• Maintain situational awareness; in dynamic events, there are NO threat-free areas.
Required Skill Set (applied per approved)	<ul style="list-style-type: none">• Same as ITC/Warm Zone Care.



SOP/protocol only):	<ul style="list-style-type: none">• Apply triage prioritization and appropriate destination/distribution of patients.• Simple spinal motion restriction as needed.• Familiarization with advanced monitoring equipment and techniques.• Implement damage control resuscitation.• Apply multimodal pain control principles.• Splinting as resources permit• Effective communication between non-medical, pre-hospital and hospital medical assets
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III. Evacuation Care (EVAC)/Cold Zone Guidelines

- A. Assess patient using the Pediatric Assessment Triangle (Appendix 1) to identify major deficits in general appearance, work of breathing, and circulation to skin.
- B. Massive Hemorrhage (Bleeding):
 1. Expose, assess for, and control any uncontrolled/unrecognized major bleeding.
 2. Apply a tourniquet if necessary.
 3. Use trauma dressings to control bleeding at the source.
 - a) Hemostatic trauma dressings are appropriate to use in pediatric patients if available. Apply using deep wound packing technique and place a pressure dressing over the packed wound.
 4. Re-assess any tourniquets that were already applied to the patient.
 - a) Assess for distal pulses on extremities with tourniquets applied and tighten device if present.
 - b) Expose skin and apply a tourniquet 2-3 inches above wound for severe extremity bleeding if not already done (see Section I on DTC/Hot Zone).
 - c) Expose and clearly mark tourniquet site with the time of application if possible.
 5. For prolonged care under Indirect Threat, consider a tourniquet conversion.
 - a) If the delay to definitive care will be longer than two hours and:
 - (1) The patient is not in hemorrhagic shock.
 - (2) The bleeding wound can be visualized and accessed.
 - (3) The tourniquet is not controlling bleeding from a partial or complete amputation.
 - (4) The patient has not already had a tourniquet downgrade attempted.
 - b) Apply a new tourniquet proximal to the existing device and be prepared to tighten if necessary.
 - c) Expose and pack the previously bleeding wound site. Use a hemostatic trauma dressing if available and apply a pressure dressing to the wound site.
 - d) Slowly remove the first tourniquet and continuously assess for bleeding. If



bleeding recurs, tighten the new tourniquet until hemostasis is obtained.

C. Airway Management and Breathing:

1. Assess patient for adequacy of airway and respiratory effort; look, listen, and feel and consider pulse oximetry if available with a goal of over 94% on room air.
2. If necessary, intervene to open and maintain a patent airway. Consider these interventions:
 - a) Manually position the airway by head-tilt/chin-lift or manual jaw thrust (open mouth first).
 - b) Suction airway (avoid putting fingers in mouth and use caution for vaso-vagal response from aggressively suctioning hypopharynx).
 - c) Allow the patient to assume the most comfortable position, which may be lateral recumbent (recovery) or sitting up. For recumbent infants and younger children, elevate the shoulders with gentle support (e.g., folded towel) to optimize airway positioning.
3. Support ventilation as needed.
 - a) A basic airway adjunct (NP or OP airway) and effective bag-valve-mask ventilation are the initial interventions. A PEEP valve and manometer on a BVM should be used, if available
 - b) If unable to ventilate, consider more advanced airway support.
 - (1) Extraglottic (supraglottic) airway.
 - (2) If a surgical airway is indicated, needle cricothyroidotomy is recommended over surgical approach for pediatric patients.
 - (3) Intubation if unable to manage airway with extraglottic airway.
 - c) Consider administering oxygen.
 - d) Avoid hyperventilation with assisted ventilations.
4. Consider the need to prevent or treat a tension pneumothorax in unstable patients with ineffective or deteriorating respiratory effort.
 - a) Apply a seal to any open chest, back, or neck wounds, ideally a vented commercial chest seal.
 - b) Monitor patient for possible development of tension pneumothorax, especially if a non-vented chest seal is applied.
 - c) Perform needle decompression on the side of the injury.
 - (1) Infants and smaller children require smaller needle than adults for decompression. Consider a normal (1.5 inch/3.8 cm) 14 or 16g needle.⁴

⁴ Mandt, M, Hayes, K., Severyn, and Adelgais, K. (2019). *Appropriate Needle Length for Emergency Pediatric Needle Thoracostomy Using Computed Tomography*. *Prehospital Emergency Care*, 23(5), 663-671, doi: 10.1080/10903127.2019.1566422



- (2) Landmarks for insertion are the 5th intercostal space at the anterior axillary line (first choice) and the 2nd intercostal space at the mid-clavicular line (second choice).

- d) Consider bilateral needle decompression for the patient in traumatic arrest or peri-arrest.

D. Circulation:

1. For a patient in suspected shock, ensure that external hemorrhage is being aggressively controlled and obtain IV/IO access promptly (warm fluids are preferred).
2. Consider blood products for a patient in suspected hemorrhagic shock, either:
 - a) Transfuse with low-titer O-negative whole blood (LTOWB) 10ml/kg in children one year or older.
 - b) Transfuse a 1:1 ratio of packed O-negative red blood cells (PRBC) and plasma at 10ml/kg each.
3. Consider the use of tranexamic acid (TXA) in patients with suspected or actual massive hemorrhage.
 - a) TXA use should only be undertaken in a pediatric trauma system-of-care setting where pre-event coordination with local medical infrastructure has occurred.
 - b) Suggested dose: 15mg/kg loading dose followed by 2mg/kg/hour for 8 hours.
 - c) Only initiate if less than 3 hours from the time of injury, but ideally within the first 30 minutes from the time of injury.
 - d) Consider administering TXA after resuscitation with whole blood has occurred.
4. While hypocalcemia in the pediatric trauma patient is well established and likely correlates with increased mortality, there is extremely limited information about the use of calcium in pediatric field trauma resuscitation. The treatment of hypocalcemia is variable in the pediatric patient and can be complex. Consult local medical direction.
5. If blood is not available or if shock of non-hemorrhagic etiology is suspected, consider a bolus of 20ml/kg normal saline or Lactated Ringer's solution.
6. If the patient still shows signs or symptoms of shock, consider repeating boluses up to a maximum of 60ml/kg.
7. Continually assess the patient and slow the rate of IV fluid administration if the patient improves or recovers to a minimal blood pressure range for age or recovers a strong peripheral pulse.
 - a) Systolic BP goals:
 - (1) 60 mmHg <1 month of age
 - (2) 70 mmHg + [2x age in years] in children 1 month to 10 years of age, 90 mmHg in children 10 years of age or older.
8. CPR and defibrillation are typically not successful in patients who have suffered from traumatic cardiac arrest or blast injuries. In certain circumstances (e.g.,



electrical injuries, drowning, suffocation, etc.) CPR may be of benefit and should be considered in the context of available resources.

9. Oral intake of fluids may be encouraged if the patient is conscious and the airway is patent.

E. Hypothermia Prevention:

1. As soon as possible, place the patient onto an insulated surface to decrease conductive heat loss to the cold ground.
2. Replace wet clothing with dry if possible.
3. Cover the patient with dry blankets, jackets, poncho liners, sleeping bags, commercial warming devices or anything that will retain heat and keep the patient dry.

F. Hypoglycemia Prevention:

1. Check fingerstick blood glucose, if possible, as low blood sugar is a common co-pathology in injured children. Consider using 70 mg/dl as the threshold for hypoglycemia in infants and children.
2. Treatment could involve oral intake of high-carbohydrate food or IV administration of dextrose at 2mg/kg. D10 is the preferred formulation for pediatric dosing.

G. Analgesia:

1. Assess the pain level.
2. Consider oral acetaminophen (15 mg/kg) every four hours for mild to moderate pain.
3. In patients over 3 months old, consider ketamine for analgesia for moderate to severe pain as it has a favorable risk profile.⁵ Use weight-based dosing and administer slowly to mitigate possible side effects.
 - a) Suggested oral (PO) dose is 0.2-0.5 mg/kg every 8 hours.
 - b) Suggested IM dose is 0.2-0.5 mg/kg.
 - c) Suggested IV dose is 0.1-0.2 mg/kg slow push.
4. In an infant, sugar is a proven analgesic. If the airway is patent and the child is awake, dip a pacifier or gloved finger into a sugary solution (not honey) and offer as often as needed.
5. Opioid pain medications are also appropriate for use in the pediatric population under local protocol guidance, with IV, IM, and intranasal (IN) options available. Use weight-based dosing and ensure immediate access to the reversal agent naloxone. Suggested dosages:
 - a) Fentanyl IM/IN: 1 mcg/kg (not to exceed 100mcg).
 - b) Fentanyl IV/IO: 1 mcg/kg titrate to effect at a rate of 50mcg/min slow IVP (not

⁵ Vadivelu, N., Schermer, E., Kodumudi, V., Belani, K., Urman, R. D., & Kaye, A. D. (2016). Role of ketamine for analgesia in adults and children. *Journal of anesthesiology, clinical pharmacology*, 32(3), 298–306. <https://doi.org/10.4103/0970-9185.168149>



- to exceed 100 mcg).
- c) Morphine IM: 0.1 mg/kg.
 - d) Morphine IV/IO: 0.1 mg/kg titrate to effect at a rate of 2mg/min slow IVP (not to exceed 20mg).
6. Consider the use of ondansetron if nausea or vomiting occurs in a child over 8kg.
- a) Suggested dose: 0.1 mg/kg IV for patients 1 month-12 years.
 - b) Suggested dose: 4 mg IV for patients over 12 years.
 - c) Suggested dose: 4 mg PO children 4-12 years.
 - d) Suggested dose: 8 mg PO children over 12 years.
- H. Antibiotics:
1. Consider the use of antibiotics for patients with penetrating trauma, including eye injuries, if not contraindicated.⁶
 2. For situations where extraction will be delayed beyond several hours, consider the one-time administration of an antibiotic under local protocol guidance to reduce the risk of infectious complications.
 - a) Cefazolin 30mg/kg IV (up to 2 g) for open extremity or thoracic injuries.
 - b) Levofloxacin 16mg/kg IV/PO (up to 750 mg) for penetrating eye injuries.
 - c) Cefazolin (as above) plus metronidazole 15 mg/kg IV loading dose for maxillofacial trauma or involvement of the esophagus, stomach, or gut.
- I. Head Injury:
1. Consider use of a pediatric-modified GCS scale for infants and children in patients with traumatic head injuries (Appendix 2).⁷
 - a) Peds GCS \leq 12 suggests non-mild traumatic brain injury.
 - b) Peds GCS \leq 8 suggests need for airway support.
 - c) Peds GCS \leq 6 suggests need for surgical management of TBI.
 2. Restrict cervical spine motion if indicated based on mechanism of injury; in the absence of commercial immobilization devices, consider manual stabilization, a towel roll, or other improvised technique.
 3. Avoid hypoxia (see above).
 4. Avoid hyper- or hypoventilation- the goal is normocarbica (ETCO₂ of 35-40 mmHg).
 5. Consider elevating the head to about 30°.

⁶ Jones, TW, Brady, S., and Schafermeyer, R (2020) Infections and Prophylaxis in Pediatric Trauma Patients. Pediatric Emergency Medicine Reports. Retrieved at: <https://www.reliasmedia.com/articles/146252-infections-and-prophylaxis-in-pediatric-trauma-patients>

⁷ Children's Hospital of Philadelphia (ND) Emergency Department Clinical Pathway for the Evaluation and Treatment of Children with Acute Head Trauma. Retrieved from: <https://www.chop.edu/clinical-pathway/head-trauma-acute-clinical-pathway>



6. Treat aggressively for shock if present. Hypotension can double the mortality associated with traumatic brain injury.
7. Avoid hypothermia.

J. Burns.

1. Aggressively monitor airway and respiratory status.
2. Have a low threshold for intubation if airway burns are suspected.
3. Apply high-flow oxygen via non-rebreather mask if carbon monoxide toxicity is suspected.
4. Have a low threshold for suspecting cyanide toxicity.
 - a) Symptoms are non-specific and may be similar to CO toxicity in cases that occur indoors. Patients may have a *cherry red* appearance to their skin.
 - b) Treatment includes oxygen and the use of an antidote:
 - (1) Cyanide Antidote Kit—in pediatric patients consider using only the sodium thiosulfate component of the kit at 1.5ml/kg up to 50ml IV. The other components of the kit contain nitrates which can cause complications in children with smoke inhalation.
 - (2) Hydroxocobalamin is frequently and effectively used off-label in children at a dose of 70mg/kg up to 5g IV over 15 minutes.
5. Manage burns. Use the *rule of 9's* in infants and children (Appendix 3) or estimate burned surface area using the surface area of the patient's palm, which represents approximately 1% of the body surface area.
 - a) Cover burned areas with dry, clean dressings (sterile if possible).
 - b) Aggressively mitigate hypothermia (see above).
 - c) For burns >20% TBSA, begin fluid resuscitation. A suggested strategy is:
 - (1) If the patient is suffering from hemorrhagic shock as well, this condition takes priority for fluid resuscitation strategy (see above).
 - (2) For TBSA \geq 20% and Weight < 30 kg, calculate estimated intravenous fluid needs:
 - (a) For >10 kg use Lactated Ringers and for < 10kg use D5LR.
 - (b) $(3\text{ml}) \times (\text{weight in kg}) \times (\% \text{TBSA})$
 - (c) Include previously administered fluids in the total fluid amount.
 - (d) Administer half of calculated amount over the first 8 hours post burn (from time of injury) and administer remaining amount over the next 16 hours.
 - (e) In addition to burn resuscitation fluid requirements, also infuse maintenance IVF of D5LR. Administer 4ml/kg/hr for the first 10kg of body weight, then 2ml/kg/hr for the next 10kg of body weight, then 1ml/kg/hr for the remaining kg of body weight.
 - d) Proactively monitor and maintain normal blood sugars.



- e) For children >30kg, use adult strategy for burn resuscitation.

K. Prepare patient for movement:

1. Ensure that proper restraints are fully applied to the victim before initiating air or ground transport:
 - a) Forward/deceleration restraints over the shoulders should be included.
 - b) Infants and very young children should be transported in a car safety seat if stable.
 - c) Providers should be restrained as well.
 - d) Equipment must be secured.
2. Arrive safely. Be judicious with the use of lights and sirens as they are a significant cause of patient and provider injuries and fatalities.⁸
3. When considering atypical transport platforms:
 - a) Address preventable causes of death prior to initiating transport.
 - b) If possible, patient should remain under care by a rescuer or responder (other than the vehicle operator) during transport. Maintain any lifesaving intervention initiated during prior phases.
 - c) Ideally, patient transport platform is enclosed and optimizes safety and minimizes environmental threats to the patient.
 - d) Patient and provider should be safely restrained to the extent possible, and equipment secured.
4. Consider the most appropriate receiving facility and notify them.

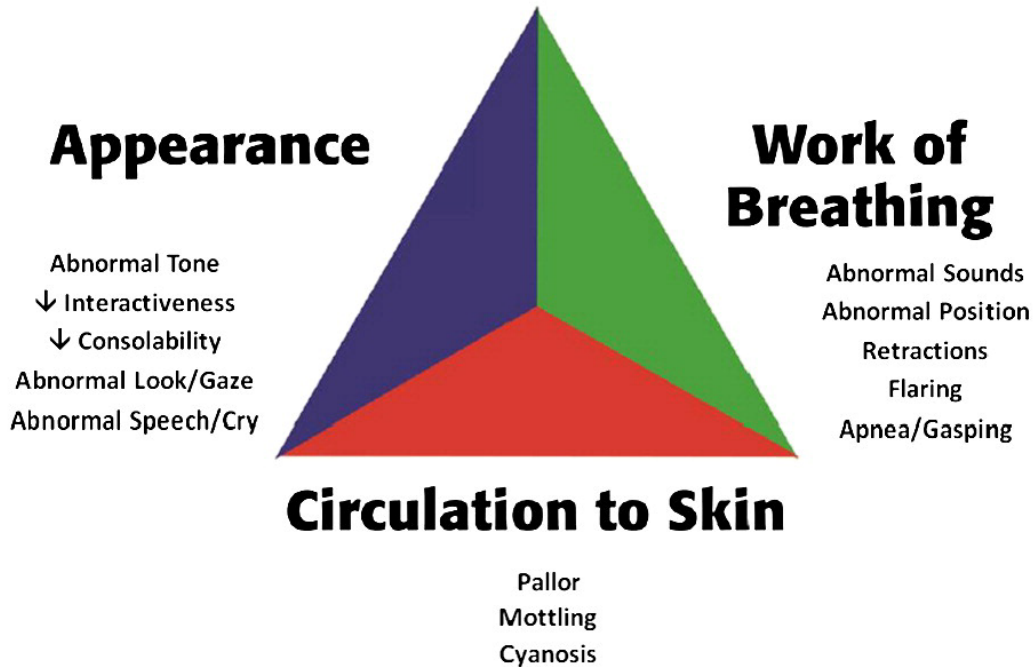
L. Minimize Psychosocial Impact:

1. With all children of all ages it is important to express empathy—tell them the truth about what to expect, warn them if something will hurt, and describe what you are doing to help them.
2. Talk to the child directly if possible.
3. Keep the patient with the caregiver to the extent possible. Contact the caregiver if they are not with the child
4. Use techniques of distraction as needed. For infants, use keys, a penlight, a pacifier, or blanket. For older children, use conversation, a toy, jokes, and electronic devices.
5. Don't make promises you can't keep.
6. Be calm around the patient.

⁸ Murray B, Kue R. The use of emergency lights and sirens by ambulances and their effect on patient outcomes and public safety: A comprehensive review of the literature. *Prehosp Disaster Med.* 2017;32(2):209-216. doi:10.1017/S1049023X16001503



IV. Appendix 1: Pediatric Assessment Triangle⁹



⁹ Horeczko, T., Enriquez, B., McGrath, N. E., Gausche-Hill, M., & Lewis, R. J. (2013). *The Pediatric Assessment Triangle: Accuracy of Its Application by Nurses in the Triage of Children*. *Journal of Emergency Nursing*, 39(2), 182–189. <https://doi.org/10.1016/j.jen.2011.12.020> Useful resource: <https://www.health.ny.gov/professionals/ems/pdf/pediatricreferencecard-04.pdf>



VI. Appendix 2: Pediatric Glasgow Coma Scale¹⁰

Table 1. Pediatric Glasgow Coma Scale (pGCS) score^[10]

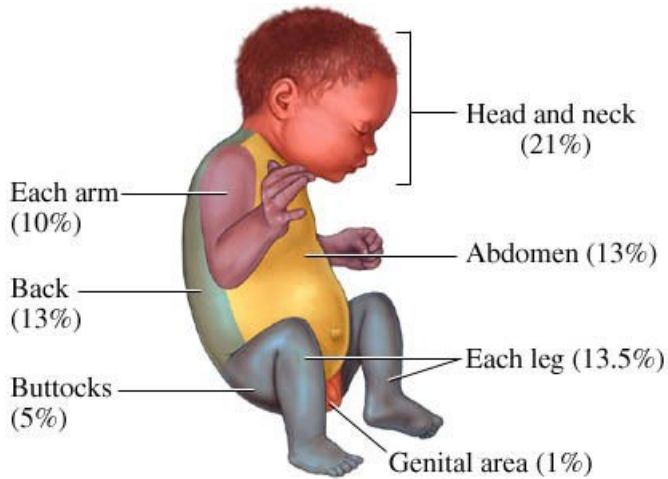
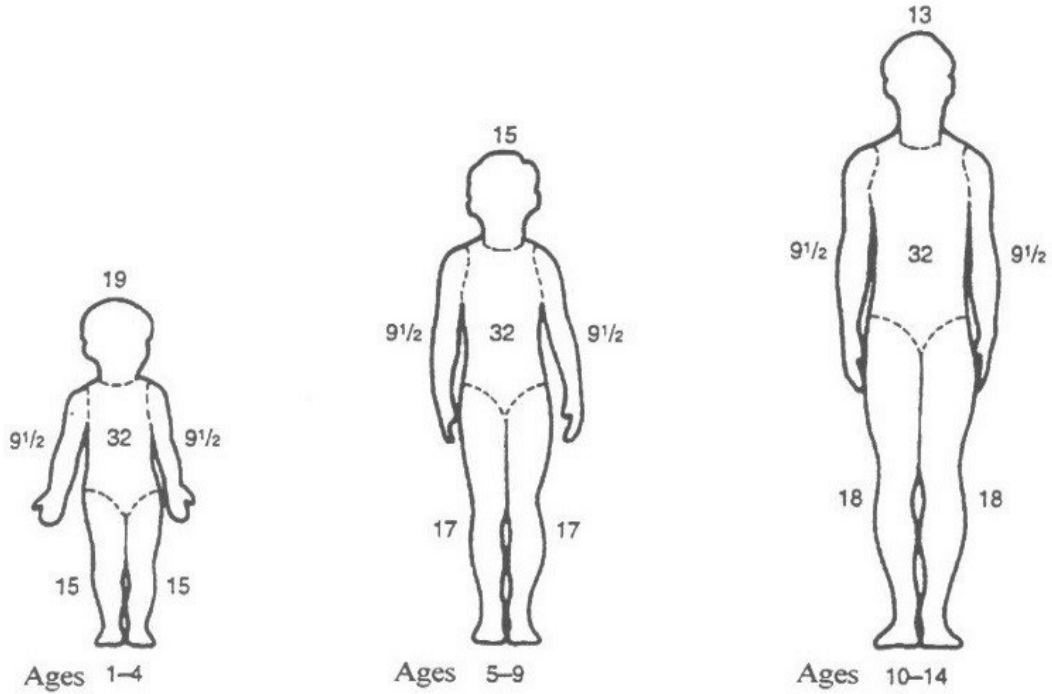
	>1 year		<1 year	
Eye opening	4	Spontaneously	Spontaneously	
	3	To verbal command	To shout	
	2	To pain	To pain	
	1	No response	No response	
Best motor response	6	Obeys	Spontaneous movements	
	5	Localizes pain	Localizes pain	
	4	Flexion-withdrawal	Flexion-withdrawal	
	3	Abnormal flexion	Abnormal flexion	
	2	Abnormal extension	Abnormal extension	
	1	No response	No response	
	>5 years		2–5 years	0–23 months
Best verbal response	5	Oriented and converses	Appropriate words and phrases	Coos and smiles appropriately
	4	Disoriented and converses	Inappropriate words	Cries
	3	Inappropriate words	Cries and/or screams	Inappropriate crying and/or screaming
	2	Incomprehensible sounds	Grunts	Grunts
	1	No response	No response	No response

¹⁰ Lulla A, Lumba-Brown A, Totten AM, et al. Prehospital guidelines for the management of traumatic brain Injury - 3rd Edition. Prehosp Emerg Care. 2023;27(5):507-538.



VII. Appendix 3: Estimating Burns

Estimating burns in the context of total body surface area (TBSA) for infant, younger child, older child, and adolescent. *Courtesy of the American Burn Association.*





IX. Appendix 4: Limiting Factors for Pediatric Care

Direct Threat phase:

- Data is extremely limited as to the comparative effectiveness of commercial tourniquet use in the pediatric population.
- A 2021 American Heart Association consensus statement suggests the use of a windlass tourniquet for life-threatening bleeding in the pediatric population but does not recommend for or against other styles of tourniquet. For children with extremities that do not allow adequate tightening of a windlass tourniquet, the recommendation is for direct manual pressure and the use of hemostatic dressing.¹¹
- A 2021 systematic review found that commercial windlass tourniquets were typically able to obtain hemostasis in children as young as 2 years old with minimal arm circumference of 13 cm (5.1 in).¹²

Indirect Threat phase:

- Some EMS systems have discontinued the use of pediatric intubation given the availability of less invasive airway management options that pose less risk to the patient, such as bag-valve-mask ventilation with or without airway adjuncts such as nasopharyngeal and oropharyngeal airways, or supraglottic airways.
- Observational studies have repeatedly documented that both in-hospital and field EMS providers tend to hyperventilate patients of all ages when they are supporting ventilations mechanically. Hyperventilation can worsen the physiologic response to trauma and decrease survival through mechanisms such as increasing intrathoracic pressure, diminishing venous return, decreased coronary perfusion pressure, and vomiting.

Evacuation phase:

- Whole blood transfusion continues to be validated as safe for pediatric trauma in >1 year old in a 2021 review by the American Association of Blood Banks Clinical Transfusion Medical Committee. Recent observational data provides a rationale for current limited use with a trend toward superior outcomes.^{13,14}
- While infants <1 year do routinely receive PRBC and FFP in the neonatal ICU for

¹¹ Wyckoff, M. H., Singletary, E. M., Soar et al (2022). 2021 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations: Summary from the Basic Life Support; Advanced Life Support; Neonatal Life Support; Education, Implementation, and Teams; First Aid Task Forces; and the COVID-19 Working Group. *Circulation*, 145(9). <https://doi.org/10.1161/cir.000000000001017>

¹² Charlton, N. P., Goolsby, C. A., Zideman, D. A., Maconochie, I. K., Morley, P. T., & Singletary, E. M. (2021). Appropriate Tourniquet Types in the Pediatric Population: A Systematic Review. *Cureus*, 13(4), e14474. <https://doi.org/10.7759/cureus.14474>

¹³ Sloniewsky, D. Concise critical appraisal: prehospital transfusions and mortality in pediatric trauma. *Society of Critical Care Medicine*. Accessed on December 1, 2023. <https://sccm.org/Blog/July-2023/Prehospital-Transfusions-and-Mortality-in-Pediatric>

¹⁴ Allen, E. S., Cohn, C. S., Bakhtary, S., Dunbar, N. M., Gniadek, T., Hopkins, C. K., Jacobson, J., Lokhandwala, P. M., Metcalf, R. A., Murphy, C., Prochaska, M. T., Raval, J. S., Shan, H., Storch, E. K., & Pagano, M. B. (2021). Current advances in transfusion medicine 2020: A critical review of selected topics by the AABB Clinical Transfusion Medicine Committee. *Transfusion*, 61(9), 2756–2767. <https://doi.org/10.1111/trf.16625>



catastrophic bleeding, there is very limited data about the resuscitation of infants with whole blood or PRBCs, especially in the setting of traumatic injuries.

- Evidence for or against the pediatric use of tranexamic acid (TXA), a plasminogen inhibitor, is limited for pediatric patients, especially in the prehospital setting. A 2021 meta-analysis found that TXA use in pediatric trauma patients did not significantly affect in-hospital outcomes and is associated with a higher risk of seizures and a trend towards lower risk of thromboembolism.¹⁵ However, a military study from 2014 demonstrated that TXA was used in about 10% of 766 pediatric combat trauma patients and was associated with decreased mortality with no adverse complications identified.¹⁶ A small randomized clinical trial intending to explore the feasibility of a larger study was published in 2022 and demonstrated no statistical significance of measured clinical outcomes.¹⁷
- While hypocalcemia in the pediatric trauma patient is well established and likely correlates with increased mortality, there is extremely limited information about the use of calcium in pediatric field trauma resuscitation. The treatment of hypocalcemia is variable in the pediatric patient and can be complex.¹⁸ Consult local medical direction.

¹⁵ Al-Jeabory, M., Gasecka, A., Wieczorek, W., Mayer-Szary, J., Jaguszewski, M. J., & Szarpak, L. (2021). Efficacy and safety of tranexamic acid in pediatric trauma patients: Evidence from meta-analysis. *The American Journal of Emergency Medicine*, 49, 404–405. <https://doi.org/10.1016/j.ajem.2021.02.009>

¹⁶ Eckert, Wertin, T. M., Tyner, S. D., Nelson, D. W., Izenberg, S., & Martin, M. J. (2014). Tranexamic acid administration to pediatric trauma patients in a combat setting: the pediatric trauma and tranexamic acid study (PED-TRAX). *The Journal of Trauma and Acute Care Surgery*, 77(6), 852–858. <https://doi.org/10.1097/TA.0000000000000443>

¹⁷ Nishijima, VanBuren, J. M., Linakis, S. W., Hewes, H. A., Myers, S. R., Bobinski, M., Tran, N. K., Ghatti, S., Adelson, P. D., Roberts, I., Holmes, J. F., Schalick, 3rd, Dean, J. M., Casper, T. C., & Kuppermann, N. (2022). Traumatic injury clinical trial evaluating tranexamic acid in children (TIC-TOC): a pilot randomized trial. *Academic Emergency Medicine*. <https://doi.org/10.1111/acem.14481>

¹⁸ Cornelius, B. G., Clark, D., Williams, B., Rogers, A., Popa, A., Kilgore, P., Cvek, U., Trutschl, M., Boykin, K., & Cornelius, A. (2021). A retrospective analysis of calcium levels in pediatric trauma patients. *International Journal of Burns and Trauma*, 11(3), 267–274. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8310872/>



X. Appendix 5: CTECC Best Practice Recommendations

Direct Threat Care:

- Responders must be familiar with the limitations and use of the equipment they carry and have a PACE plan for exsanguinating hemorrhage in a patient with small extremities, such as applying direct or circumferential pressure with:
 - Primary: Use commercial windlass tourniquet.
 - Alternate: Use commercial elastic tourniquet.
 - Contingency: Use a tightly stretched elastic or polymer compression bandage (e.g., ACE[®] bandage).
 - Emergency: Apply direct pressure and hemostatic dressing.
- Patient age, coping skills, and maturity level will determine their ability to take direction and share information in a life-threatening crisis. Some children will not be able to follow even the simplest directions under extreme conditions, and responders must be prepared to assume positive control over the situation. Other children may be highly capable of assisting themselves or others.

Indirect Threat Care:

- Do not delay the initiation of ventilatory support to set up supplemental oxygen equipment. It is far more important to immediately begin respiratory support if needed using room air. Oxygen can be added later if need be.
- Use of length-based tapes to estimate patient weight for medication dosing as provider and parent estimates of pediatric patient weight are often inaccurate.
- Ketamine is gaining popularity for analgesia in trauma patients of all ages (> 3 months), including those with head injuries given its favorable side effect profile. Ketamine should not be used in patients 3 months or younger.¹⁹

Evacuation Care:

- If a department or agency has a blood transfusion or TXA administration protocol in place for prehospital providers, consider including pediatric patients.

¹⁹ Morgan M, Perina D, Nicole M. Acquistio, Fallat M, et al (2021) Ketamine Use in Prehospital and Hospital Treatment of the Acute Trauma Patient: A Joint Position Statement, Prehospital Emergency Care, 25:4, 588-592, DOI: 10.1080/10903127.2020.1801920



XI. Appendix 6: Skills Sets and Information to Reinforce with Training

Direct Threat:

- Application of size-appropriate tourniquet using commercial and field-expedient devices.
- Rapid positioning of patient to protect airway.
- Casualty extraction to definitive care.

Indirect Threat:

- While these guidelines include some interventions that are dependent on availability of certain medical equipment, the priority here is still on basic lifesaving interventions using simple skills.
- Pediatric patients can compensate for shock differently than adults—they may appear to be well for longer and then rapidly deteriorate.
- Infants and children have a smaller circulating blood volume than adults.
 - A 4 kg (9 lb) infant has about 350 ml (12 oz) total blood volume.
 - A 35 kg (80 lb) child has about 2500 ml (just over ½ a gallon).
 - For comparison, an adult has about 5000 ml (just under 1½ gallons).
- Infants and young children have different normal respiratory rates (faster) based on age²⁰ so it is important to rely on a more holistic assessment of breathing adequacy.
- Altered mental status and the presence of a delayed (>2 second) capillary refill time are important indicators of likely shock in the pediatric patient. Consider assessing capillary refill time on the forehead as well as extremities.
- Infants and young children are at an extreme risk for hypothermia due to an increased surface to body ratio. Hypothermia decreases the chance for a successful outcome in trauma patients of all ages, but especially in younger children.
- D10, D25, and D50 can all be used as a source for IV dextrose. Where possible, infants typically receive D10. Children can receive D25. If necessary, dilute D50 prior to administration to reduce the risk of a serious injury if an IV infiltration occurs.
- Head injuries are common in pediatric patients. Infants and younger children have relatively large and heavy heads that can predispose them to injuries during falls, accidents, and violent incidents.
- A GCS <9 or deteriorating GCS is suggestive of a serious traumatic brain injury.

Skills Sets to Reinforce If Clinically Indicated.:

Hemorrhage Control	<ul style="list-style-type: none">• Apply tourniquet• Apply direct pressure• Apply pressure dressing• Apply wound packing
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²⁰ Fleming S, Thompson M, Stevens R, et al. (2011) Normal ranges of heart rate and respiratory rate in children from birth to 18 years of age: A systematic review of observational studies. Lancet 2011; 377:1011. Reference information available at: <https://www.uptodate.com/contents/image/print?imageKey=EM%2F78097>



	<ul style="list-style-type: none"> • Apply hemostatic agent
Airway	<ul style="list-style-type: none"> • Apply manual airway maneuvers (chin lift, jaw thrust, recovery position, shoulder elevation) • Insert nasopharyngeal airway • Insert supraglottic device • Perform tracheal intubation • Perform needle cricothyrotomy
Breathing	<ul style="list-style-type: none"> • Application of effective occlusive chest seal • Assist ventilations with Bag Valve Mask • Apply oxygen • Apply nonocclusive (vented) seal • Perform needle chest decompression
Circulation	<ul style="list-style-type: none"> • Gain intravascular access • Gain intraosseous access • Apply saline lock • Calculate and administer IV/IO medications and IV/IO fluids
Wound Management	<ul style="list-style-type: none"> • Apply eye shield • Apply dressing for evisceration • Apply extremity splint • Apply pelvic binder
Burns	<ul style="list-style-type: none"> • Initiate basic burn treatment
Traumatic Brain Injury	<ul style="list-style-type: none"> • Initiate treatment for traumatic brain injury
Prepare Casualty for Evacuation	<ul style="list-style-type: none"> • Move casualty (drags, carries, lifts) • Apply spinal immobilization devices • Secure casualty to litter • Initiate hypothermia prevention
Other Skills	<ul style="list-style-type: none"> • Perform hasty decontamination • Blood glucose monitoring • Initiate casualty monitoring • Establish casualty collection point • Perform triage • Use length-based tapes for weight estimation and medication dosing

Evacuation:

- CO toxicity symptoms are non-specific. The most common are headache, nausea, vomiting, and altered mental status. Serious cases can result in coma, arrhythmia, and seizures.
- Pulse oximetry is not useful for screening for CO toxicity, but pulse CO-oximetry is a new capability on some devices in the field, and it is useful for screening for possible CO toxicity and monitoring recovery.