Trauma Preambles

The role of EMS in the treatment of critical trauma is recognition, rapid transport, and injury stabilization while en route to the most appropriate facility.

I. SCENE TIME

For critical trauma, the standard of care is an on-scene time of less than 10 minutes. Life threatening injuries identified on primary survey should be managed immediately with rapid transport to a trauma center; the secondary survey should be performed in route. Make every effort possible to expedite transport to the trauma center in less than 10 minutes.

II. TRAUMA ASSESSMENT

Primary Assessment

The primary assessment of trauma is performed to identify life-threatening problems. The provider should also recognize other significant problems that if not promptly treated will become life-threatening. Each of these conditions should be managed as soon as they are identified. Additionally, information gathered from the scene assessment should help the provider anticipate possible internal injuries.

Components of the primary assessment can and should be performed simultaneously. Pearls of each include the following:

- Massive Hemorrhage
  - Though airway management is generally the first step of resuscitation, patients with obvious external bleeding should be treated using the MARCH framework – this places the primary focus on controlling hemorrhage.

    - Massive Hemorrhage
    - Airway
    - Respirations
    - Circulation
    - Head injury/hypothermia

- "The Street" is considered one of the major locations for traumatic blood loss. Immediately control any major points of bleeding to stem the flow of blood.
  - Hold pressure first
  - Apply tourniquets to limb wounds - "High and Tight"
  - Apply pressure dressings, wound packing, and/or topical hemostatic agents to head, neck, and torso wounds

- Airway (with cervical spine control)
  - Suspect laryngeal trauma if the patient has laryngeal tenderness/swelling/bruising, voice changes, stridor, or respiratory distress.
  - Anticipate the potential for progressive airway compromise in patients with trauma to head and neck, including patients who have suffered burns.
  - Consider providing an advanced airway for patients with an altered level of consciousness (GCS ≤ 8)

- Breathing
  - The conversion of a simple pneumothorax into a tension pneumothorax is dynamic and sometimes rapid. A simple pneumothorax is identified by decreased or absent breath sounds.

  - Signs and symptoms of a tension pneumothorax include:
    - Tachypnea and rapidly worsening respiratory distress.
    - Absent breath sounds on the affected side.
    - Hypotension
    - Tachycardia
    - Diaphoresis
    - Tracheal deviation (LATE SIGN)
    - JVD

  - Needle decompression is NOT indicated for simple pneumothorax. Medical Control consultation on needle decompression may be considered, but is not required, especially when the patient is in traumatic cardiac arrest. Should clinical presentation dictate a tension pneumothorax and Medical Control is unable to be reached, proceed with the treatment.

- Circulation:
  - Internal hemorrhage in the abdomen and pelvis are common unidentified sources of shock. The primary places that patients can bleed internally are (1) the thorax, (2) the abdomen, (3) the pelvis, and (4) the long bones. Monitoring vital signs closely and understanding compensated versus decompensated shock enables treatment of massive hemorrhage early.

• **Compensated shock:** the body is able to maintain a normal blood pressure and organ perfusion by increasing its heart rate and constricting its blood vessels.

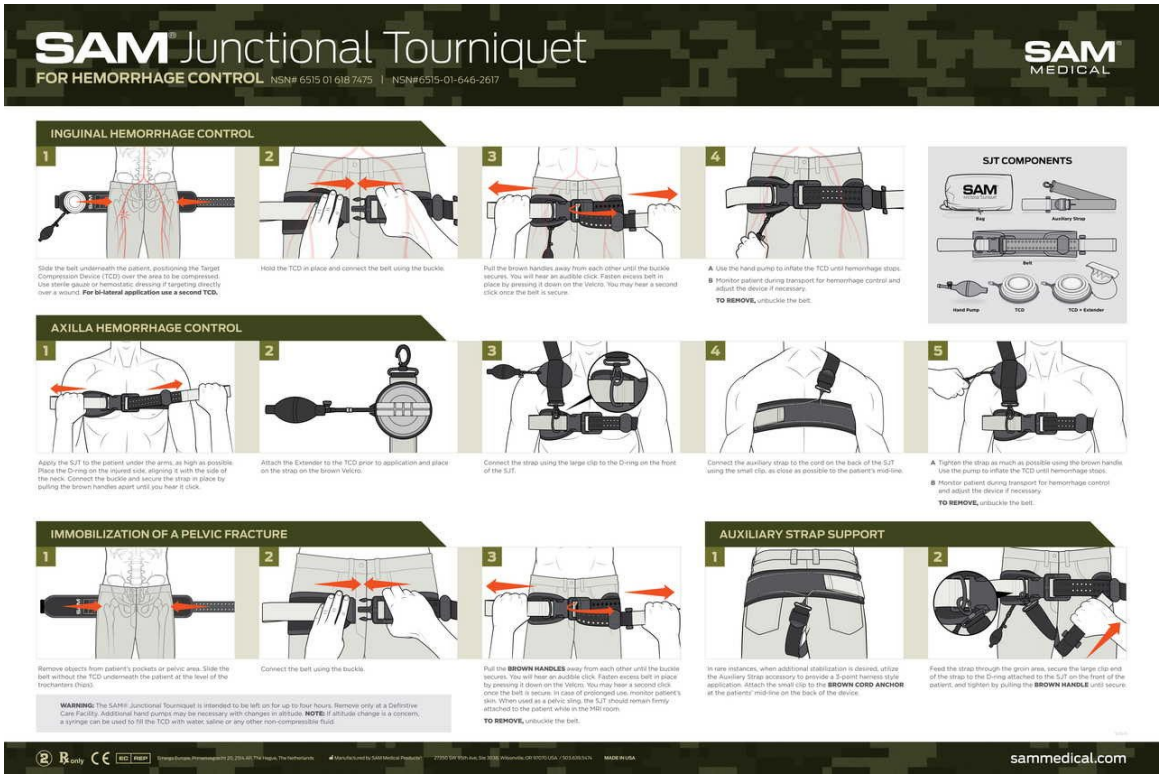
Signs and symptoms of compensated shock include:

- Tachycardia
- Narrowing pulse pressure
- Weak, thready peripheral pulses (ex. radial)
- Pallor or peripheral cyanosis

• **Decompensated shock:** the body is no longer able to maintain a normal blood pressure and organ perfusion is compromised. Signs and symptoms of decompensated shock include

- Hypotension
- Tachycardia
- Weak, thready central pulses (ex. femoral, carotid)
- Central cyanosis

- If the pelvis is unstable and the patient is hypotensive, apply a pelvic binder or sheet to stabilize the patient (pelvic binders offer no clinical benefit to controlling hemorrhage of isolated femur fractures).
- If available junctional tourniquets should be utilized for all exsanguinating junctional wounds.



Disability and Exposure are desired but not required parts of the primary trauma assessment. They should not be conducted until the ABCs have been assessed and managed.

Balanced Resuscitation & Permissive Hypotension

Excessive resuscitation with isotonic fluid in exsanguinating patients can increase blood pressure, disrupt unstable blood clots ("pop the clot"), and lead to worsening of bleeding.
Uncontrolled / Internal hemorrhage should be managed by "balanced resuscitation" ensuring that vital organs are perfused while not interfering with the body's own hemorrhage control. Only once bleeding is definitively controlled (i.e. surgery) should aggressive attempts be made to restore normal physiology and blood pressure.

It is recommended that a systolic BP of < 80mmHg, a change in mental status, or lost radial pulses be treated with 250ml incremental IV boluses while enroute to a trauma center. Patients who appear well perfused (ex. strong pulses, warm extremities) with a systolic BP of >80mmHg can be monitored closely and frequently without the administration of a crystalloid fluid bolus during transport.

In the right setting, resuscitation also should involve the early use of blood products (instead of crystalloid fluids like NS or LR) in ratios resembling that of whole blood. Tailor all resuscitation with fluid to the clinical setting and suspected etiology of hypovolemic shock. Be certain to consider non-hemorrhagic causes of hypotension (i.e. cardiac tamponade, tension pneumothorax).

Permissive hypotension is currently contraindicated in children and in patients with traumatic brain injury.

III. TRAUMATIC BRAIN INJURY

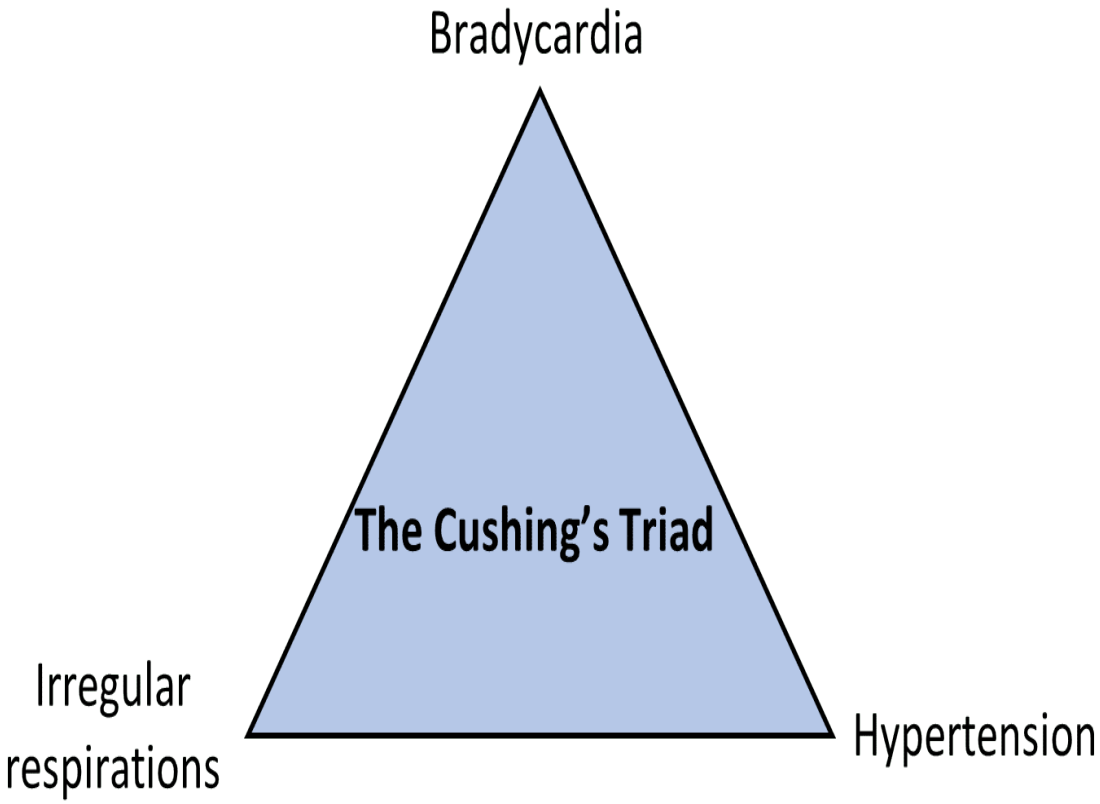
Common signs and symptoms of increased intracranial pressure include:

- Confusion
- Altered level of consciousness
- Dilated or unequal pupils
- Markedly increased systolic blood pressure
- Bradycardia
- Abnormal respiratory patterns

Priorities for the treatment of head injury patients include airway management, maintenance of adequate oxygenation & blood pressure as well as appropriate C-spine control & immobilization. Patient with suspected head injury should have the head of the bed elevated to 30^{o} during transport to decrease intracranial pressure (use reverse Trendelenburg if spinal precaution is needed).

Patients with traumatic brain injury may deteriorate as intracranial swelling and hemorrhage increase. If mental status declines during transport, reassess ABCs, repeat their neurologic status assessment, including GCS, and manage accordingly. Cushing's response refers to the ominous combination of markedly increased arterial blood pressure and resultant bradycardia indicating cerebral herniation.

Patients presenting with Cushing's Triad should be considered critical. Providers should prepare for rapid deterioration.


Bradycardia
The Cushing's Triad
Irregular respirations
Hypertension

Hypoxia should be avoided in head injury, in order to maintain cerebral perfusion. Head trauma patients should receive oxygen to keep Sp02 > 95%, preferably via nonrebreather mask. Patients with poor respiratory effort may require ventilation with a BVM at 8-10 breaths/min. Hyperventilation is no longer recommended as prophylactic intervention immediately after severe TBI.

Additionally, hypotension should be avoided in head injury. Hypotension decreases cerebral perfusion and worsens brain injury and must be corrected. Treat for hypovolemic shock if the patient's systolic BP is < 110mmHg.

Glasgow Coma Scale/Score

GCS is used to assess level of consciousness and make field triage decisions. It is a component of vital signs during trauma resuscitation. GCS can reliably be used with children older than 5 years with no modification. A pediatric GCS has been developed for pediatrics.

	Adult	Pre-verbal Children	Score
Best Eye Opening	Spontaneous To speech To pain/pressure No response	Spontaneous To speech To pain only No response	4 3 2 1
Best Verbal Response	Oriented Confused Inappropriate words Incomprehensible sounds No response	Coos & babbles Irritable/cries Cries to pain Moans to pain No response	5 4 3 2 1
Best Motor Response	Follows commands Localizes pain Withdraws to pain Abnormal flexion Extension No response	Moves spontaneously & purposefully Withdraws to touch Withdraws in response to pain Flexion in response to pain Extension in response to pain No response	6 5 4 3 2 1

It is no longer recommended to assign 1 point to non-testable elements. Any aspect of the score that cannot be tested should be noted as “NT”, for non-testable. The total GCS should be documented as the combined score of testable components. For example, GCS: E2, V NT, M 4.

GCS Classification of TBI

Traumatic brain injury is often classified as follows:

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

* Patient with severe brain injury (GCS ≤ 8) may require advanced airway placement*

GCS measurement should be repeated 5 minutes after the first score is obtained.

IV. SPECIAL TRAUMA SCENARIOS

Traumatic Cardiac Arrest (TCA)

Persons who die in the prehospital setting have generally suffered high rates of bleeding in non-compressible areas. Survivors of traumatic cardiac arrest most frequently have pathologies that can be easily reversed once access to the patient is achieved. These pathologies include reversal of hypoxemia or hypoventilation, relief of tension pneumothorax, and immediate implementation of advanced life support in the group of patients who have sustained a "medical cardiac arrest" as part of or the cause of their "trauma episode."

Life-saving interventions (**HOT** interventions) during TCA address these reversible pathologies:

Hypovolemia:	• Control external hemorrhage • Splint pelvis/long bone fractures as needed • IV/IO fluid
Oxygenation/ Ventilation	• Airway management (BVM, endotracheal intubation, supraglottic airway) • EtCO2 monitoring
Tension ptx	• Bilateral needle decompression

External chest compressions may be delayed while treating reversible causes; however, they should not be considered futile, particularly if a medical cardiac arrest is suspected.

Patient Extrication & Transport

If extrication from a vehicle is required, providers should first apply a cervical collar to the patient while they are still in the vehicle (if safe to do so). When indicated, adults and children in a booster seat should be allowed to self-extricate. For infants and toddlers already strapped into a car seat with a built-in harness, providers should extricate the child while strapped in his/her car seat.

When in other situations requiring patient extrication, a long board (preferably padded) may be used for extrication using the lift and slide (rather than logroll) technique. Prolonged immobilization on spine board can be very uncomfortable for the patient and can lead to ischemic pressure injuries to the skin. If available all voids should be padded, but should not delay extrication, treatment, or transport.

Children have disproportionally larger heads. When securing pediatric patients to a spine board, their body should be elevated approximately 1-2 cm to accommodate the larger head size and avoid neck flexion when immobilized. Additionally, children are abdominal breathers so immobilization straps should go across their chest and pelvis – not across their abdomen – when possible.

Protective Athletic Equipment & Suspected Spinal Injury

Helmets and shoulder pads are ONLY to be removed if they interfere with securing an airway or the ability to perform chest compressions.

Helmets should always be removed manually (rather than the use of an automated device). One provider should manually immobilize the neck while the other provider manipulates the helmet. The face mask portion of the helmet should be removed first, if able. Occipital and shoulder padding may be applied while the patient is in the supine position in order to maintain neutral cervical spine positioning. Removal should be performed with the help of the onsite athletic trainers.

Once the helmet is removed and a cervical collar is applied, padding that is part of the patient's uniform should also be removed. The helmet and pads should be considered one unit.

Facial/Dental Trauma

EMS providers should approach patients with facial and/or dental trauma by conducting **Routine Trauma Care** and prioritizing life-threatening injuries over the most apparently visible deformity. The primary assessment should focus on the patient's inability (or lack therefore) to keep their airway patent. Airway patency may be affected by an unstable midface (e.g. LeFort fracture), unstable mandible, or unstable dentition at risk of aspiration.

Providers should attempt to collect avulsed teeth or tissue, when able. Any lost teeth not recovered on scene may be in the patient's airway. Specific interventions include:

- Avulsed tooth
  (1) Avoid touching the root of the avulsed tooth. Do not wipe off the tooth.
  (2) Pick up the crown end of tooth. If dirty, rinse off under cold water or saline for 10 seconds. Do not scrub the tooth.
  (3) Place the tooth in milk or saline as the storage medium. Alternately, an alert and cooperative patient can hold tooth in their mouth using their own saliva as a storage medium.
- Eye trauma
  (1) Place eye shield for any significant eye trauma
  (2) If the globe is avulsed, do not put it back into socket. Cover with moist saline dressings and place a cup over it.
- Mandible unstable
  (1) Expect that the patient cannot spit/swallow effectively and have suction readily available.
  (2) Preferentially transport patient sitting up with emesis basin/suction available (at 30° if concern for spinal injury).
- Nose/ear avulsion
  (1) Recover tissue if it does not cause excessive scene time.
  (2) Transport tissue wrapped in dry sterile gauze in a plastic bag. Place plastic bag on ice if available (do not put ice directly into the bag with the avulsed tissue!)

- Epistaxis – have patient squeeze nose for 10-15 minutes continuously while leaning forward. **Patient should not be directed to drop head backward.**

Persons with dental or facial trauma are also at risk of cervical spine and traumatic brain injury – patients should be fully examined and monitored closely for these complications. Special re-examination geared toward airway and ability to adequately ventilated should also be performed.

Lightning Strike Injuries[1]

Lightning strikes most commonly occur in outdoor environmental conditions that may also place EMS providers at risk of injury. Scene safety should always be the priority. Most frequently people are injured through ground currents created by a nearby strike as opposed to a lightning bolt making direct contact with the victim. Repeat lightning strikes have been known to occur, but victims do not carry or discharge a current – the patient is safe to touch and treat.

Lightning strikes cause a very high voltage for a very short duration; this can lead to dysrhythmias including ventricular fibrillation and asystole caused by the simultaneous depolarization of all myocardial cells. Additionally, the sudden electrical stun can temporarily paralyze the medulla's respiratory center, leading to prolonged apnea. Persons who experience cardiopulmonary arrest after a lightning strike have a higher rate of successful resuscitation compared to the general population. In the event of multiple lightning strike victims, "reverse triage" is recommended where cardiac arrest patients are given highest priority.

Patients frequently have fixed and dilated pupils after a lightning strike due to overstimulation of the autonomic nervous system and subsequent autonomic dysfunction – this clinical finding should not be confused as a sign of death or impending death. Neurologic insult may also cause stroke-like findings, seizure, lower extremity paralysis and memory deficits. Patients may also have cardiovascular and respiratory symptoms, including respiratory paralysis, apnea, and cardiac arrest.

Lightning strike patients also frequently experience thermal burns – these should be managed as per the **Burn Care** protocol. Lichtenberg figures ("ferning" or "feathering" on the skin) are a unique finding on the skin that is pathognomonic for lightning injury – they generally appear within one hour and last less than 24 hours.

It is not always immediately apparent that a patient has been a victim of lightning strikes; providers should remember to look for the more subtle findings and injury patterns.

Conducted Electrical Weapons (e.g. TASER) – aka Electronic Control Devices (ECDs)

Conducted electrical weapons deliver an electric shock with the intent to cause pain and/or disrupt muscle function. A TASER device is the most commonly used ECD by law enforcement agencies to quickly stop a subject from resisting or fighting. TASERs may be used one of two ways:

1) In the *probe* mode an officer maintains distance from the subject and launches two tiny probes (i.e. barbs) that attach to a person's clothing or skin. These barbs allow a circuit of electricity to deliver a shock that incapacitates neuromuscular groups.

2) In *drive-stun* mode, the officer is in close contact with the subject and the TASER applies a direct shock, but no probe is fired – this mode causes pain but is not incapacitating.

Under certain circumstances EMS will be summoned to evaluate and treat TASER victims. These instances include:

1. The person requests EMS
2. Person was unconscious, even for a short period
3. Person had a visible seizure outside of when Taser© was discharged
4. Person has obvious significant injury from a fall or take-down
5. Person volunteers that they are having chest pain or trouble breathing
6. Person has persistent confusion or altered mental status for more than one minute after application of conducted electrical weapon
7. Person is displaying signs concerning for hyperactive delirium with severe agitation (see below)
8. Victim of a TASER used by a member of the public (i.e. non-police use)
9. TASER probe is embedded in a sensitive area (head, neck, hands, feet, groin, or female breast)
10. If an officer has any doubt as to the health of the person based on:
    a. the officer's training
    b. the officer's previous use of a TASER
    c. the subject exhibits any of the conditions and/or symptoms above
    d. the subject exhibits any unusual behavior

Whenever possible, law enforcement officers should accompany patients under custody in the transporting unit to the hospital.

[1] https://www.emra.org/emresident/article/when-lightning-strikes/

Patient Management after TASER Injury

THIS IS A COMPLEX PATIENT. During the evaluation of a TASER victim, one should question why the individual first required apprehension. Typically, it is not an ECD itself that leads to the need for transport to a hospital - it is rather the underlying pathology that led to the officer deploying the ECD. Hyperactive delirium with severe agitation, toxic substance use, medical disease (ex. DKA, hypoglycemia), or mental illness are common examples.

Police officers should provide EMS personnel with as much information as possible about (a) the events leading up to TASER deployment, (b) specifics of the TASER deployment [mode(s) used, how many TASER cartridges were used, length of shock], and (c) changes in the victim's behavior after being shocked. Medical documentation should include the location of all barbs removed, regardless of whether removed by Police or EMS. Documentation should also include securing techniques used by both Police and EMS to restrain the patient. Patients should not be restrained in a prone, face-down, or hog-tied position – these increase the risk of respiratory compromise and compressional asphyxia.

- Trauma Care:
  - Patients who have received an ECD may have already been involved in a physical confrontation or sustained a fall during device discharge. Routine trauma care and thorough evaluation for polytrauma is necessary.
  - EMS may provide wound care (i.e. cleaning and bandaging the area) for barbs removed prior to their arrival.
  - TASER barb removal is an authorized EMS procedure as per the JPASD Protocol included in this document. After EMS evaluation and removal, the patient MUST be transported to an appropriate ED unless law enforcement signs a guardian refusal and assumes responsibility for the patient. EMS providers should not perform a "medical clearance" assessment for law enforcement. **Providers should always advocate for the patient's physical health and recommend hospital transport if they feel it is indicated.**

- Medical Care:
  - **All patients should receive cardiac monitoring and 12-lead EKG assessment.** The voltage delivered by an ECD, in combination with toxins/drugs, patient's underlying disease(s), excessive physical exertion and trauma may precipitate arrhythmias.
  - Patient's neurologic status should be assessed and recorded frequently to recognize sudden changes and acute decompensation.
  - Monitoring of the patient must take place until the patient is released to a receiving facility.
  - Pay special attention to signs and symptoms that suggest hyperactive delirium with severe agitation. Patients with hyperactive delirium with severe agitation who are restrained by law enforcement have a heightened risk of mortality in the prehospital setting.

Field Amputation

If a field amputation is needed **contact the Trauma Center** as early as possible to allow for resource mobilization. This includes deployment of a clinician to the scene to perform this procedure.

V. TRAUMA CENTER DESIGNATION[2]

Trauma centers are verified by the American College of Surgeons. The different levels refer to the types of resources available in the trauma center and the number of patients admitted yearly. Within Region 8, there are 2 level III Trauma Centers, St. Francis Medical Center and Ochsner Monroe Medical Center. Ochsner Shreveport Medical Center is a Level I Trauma Center with Level II Pediatric; Children's Hospital New Orleans is a Level I Pediatric Trauma Center.

Level I

A Level I Trauma Center can provide total care for every aspect of injury – from prevention through rehabilitation. Some of the required elements for Level I Trauma Center verification include:

- 24-hour in-house coverage by general surgeons, and prompt availability of care in specialties such as orthopedic surgery, neurosurgery, anesthesiology, emergency medicine, radiology, critical care, plastic surgery, oral and maxillofacial surgery, internal medicine, and pediatrics.
- Referral resource for communities in nearby regions

Level II

A Level II Trauma Center can initiate definitive care for all injured patients. Some of the required elements for Level II Trauma Center verification include:

- 24-hour immediate coverage by general surgeons, as well as coverage by the specialties of orthopedic surgery, neurosurgery, anesthesiology, emergency medicine, radiology, and critical care.
- Tertiary care needs such as cardiac surgery, hemodialysis and microvascular surgery may be referred to a Level I Trauma Center.

Level III

A Level III Trauma Center has demonstrated the ability to provide prompt assessment, resuscitation, surgery, critical care, and stabilization of injured patients. Some of the required elements for Level III Trauma Center verification include:

- 24-hour immediate coverage by emergency medicine physicians and prompt availability of general surgeons and anesthesiologists.
- Transfer agreements for patients requiring more comprehensive care at a Level I or Level II Trauma Center.

Level IV

A Level IV Trauma Center has demonstrated an ability to provide advanced trauma life support (ATLS) prior to transfer of patients to a higher-level trauma center. It provides evaluation, stabilization, and diagnostic capabilities for injured patients. Some of the required elements for Level IV Trauma Center verification include:

- Basic emergency department facilities to implement ATLS protocols and 24-hour laboratory coverage. Available trauma nurse(s) and physicians available upon patient arrival.
- May provide surgery and critical-care services if available.
- Has developed transfer agreements for patients requiring more comprehensive care at a Level I or Level II Trauma Center.

Level V

A Level V Trauma Center provides initial evaluation, stabilization and diagnostic capabilities and prepares patients for transfer to higher levels of care. Some of the required elements for Level V Trauma Center verification include:

- Basic emergency department facilities to implement ATLS protocols.
- Available trauma nurse(s) and physicians available upon patient arrival.
- After-hours activation protocols if facility is not open 24-hours a day.
- May provide surgery and critical-care services if available.
- Has developed transfer agreements for patients requiring more comprehensive care at a Level I through III Trauma Centers.

When uncertain, transport to the higher level of care is the safest and recommended approach. Medical Control may also be consulted for triage support.

[2] https://www.amtrauma.org/page/traumalevels