# ADULT
## Glasgow Coma Scale

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<td>To Voice</td>
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**Qualifiers:**
- Patient Chemically Sedated
- Patient Intubated
- Obstruction to the Patients Eye
Trauma Guidelines
Stanford Hospital and Clinics
Lucile Packard Children’s Hospital Stanford
Training Programs

The protocols in this book are guidelines only. Individual cases may vary and clinical judgment should always be used. When in doubt, consult with the trauma attending on-call.

This manual reflects an abridged version of the Stanford/LPCHS Trauma Program documents.
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## Pediatric Trauma Guidelines

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### Trauma Clinic Main Line

650-723-6961

### Trauma/ICU Attendings

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<td>650-740-0708</td>
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<td>Tim Browder, MD</td>
<td>702-757-8276</td>
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<tr>
<td>Lisa Knowlton, MD</td>
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<td>Javier Lorenzo, MD</td>
<td>pager only</td>
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<tr>
<td>Paul Maggio, MD</td>
<td>650-521-7453</td>
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<td>Paul Mohabir, MD</td>
<td>650-804-4811</td>
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<tr>
<td>Aussama Nassar, MD</td>
<td>650-304-9548</td>
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<td>David Spain, MD</td>
<td>650-776-3912</td>
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<td>Kristan Staudenmayer, MD</td>
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<tr>
<td>Tom Weiser, MD</td>
<td>617-794-5887</td>
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<td>Sherry Wren, MD</td>
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<td>Trauma Advanced Practice Providers:</td>
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<tr>
<td>- Jesse Alfaro, NP</td>
<td>650-384-9507 (cell)</td>
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<tr>
<td>- Jessica Behrend, NP</td>
<td>650-850-2446 (cell)</td>
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<tr>
<td>- Ya-Chen Lee, NP</td>
<td>650-847-7154 (cell)</td>
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<td>- Gabe Araujo, NP</td>
<td>650-847-9971 (cell)</td>
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### Trauma Services Office:

- **650-723-7570 (main)**
  - Trauma Program Manager: Denise Greci Robinson 925-784-3259 (cell)
  - Trauma Nurse Coordinator: Jo Ann Schumaker-Watt 650-656-7979 (cell)
  - Trauma Program Director: Michelle Woodfall 650-521-7613 (cell)
  - Trauma Case Manager: Michelle Paw 650-561-5501 (cell)
  - Trauma Social Worker: Whitney Gaines 650-475-6908 (cell)

### Other Contacts

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<td>Speech</td>
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<td>Transfer Center</td>
<td>3-4696 or 800-800-1551</td>
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**Surgical Clinics:**

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<td>ENT Clinic</td>
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<td>Plastic Surgery Clinic</td>
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<tr>
<td>Vascular Surgery Clinic</td>
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Trauma Chief Resident (PGY-4):

Goals:
- Primary responsibility for the management of all patients admitted to or evaluated by the team in conjunction with the attending surgeon
- Function as the team leader, assuming direct responsibility for day-to-day care of patients on the service and coordinating care with consulting services
- Gain knowledge of surgical care through discussion on rounds with the attending and by independent reading
- Gain operative skills through pre-operative reading and preparation and by direct intra-operative teaching from attendings

Expectations:
- Function as a team leader for daily patient care
- Attends all Trauma 97 and 99 activations
- Function effectively as trauma captain or trauma resident (if ED resident is captain) for trauma resuscitations
- Ensures trauma resident documentation is complete and timely for trauma H&P’s, daily notes, & discharges
- Notify trauma attending of all Trauma 97 patients within 1 hour of evaluation and prior to any patient discharge from the ED
- Notify trauma attending if any acute change in patient condition including ICU admissions, patient deaths, admissions, or discharges
- Attends trauma clinic on Wednesday
- Attends General Surgery Clinic on Tuesday
- Prepare weekly case presentation for Monday trauma conference.
Trauma Junior Resident (PGY-1):

Goals:
- Develop knowledge & experience in the evaluation and management of critically injured and ill surgical patients
- Gain knowledge of surgical care through discussion on rounds with the team and by independent reading
- Refine procedural skills commonly required for these patients
- Experience and understand the day-to-day function of a busy surgical service.

Expectations:
- Interact with all members of team including ancillary and support staff in a productive, professional manner
- Execute the daily plans for the floor patients in a timely and efficient manner
- Assist in trauma resuscitations
- Maintain appropriate documentation
- Notify trauma chief resident of any significant change in patient condition immediately. If they are not available, notify the trauma attending
- Help coordinate discharge plans especially for patients without insurance with case management/social work
- Attends general surgery clinic on Tuesdays
- Attends trauma clinic on Wednesdays

Medical students - Medical students are an integral member of the team. They should assist in all aspects of patient care as dictated by the senior resident. This includes rounding daily on 2-3 floor patients, responding to all traumas in the ED, & attending the weekly Friday SICU conference. They may write patient notes, but these do not suffice for medical documentation, and thus cannot serve as the progress note in lieu of a resident note.
Trauma APP Schedule:
Monday through Saturday (12-hour shifts) 05:30-18:00 for Floor Coverage

Trauma APP Roles & Responsibilities:
- AM/Afternoon rounds with team, no pre-rounding
- Takes 1st call for all trauma patients on the floor
- Writes daily progress notes with or without TTS on those patients
- Updates and manages problem list for trauma patients
- Review all trauma patients for labs, orders, protocols
- Follows up throughout the day on labs, consults, additional studies
- Collaborates, communicates with and updates the Trauma senior resident, fellow and/or Trauma attending
- Communicates daily plan of care to patients, family members and consulting providers as able
- Responds to all Trauma 99 and 97 activations
- Communicates daily with social work and case management for disposition planning
- Assists with complex patient discharges and transfers
- Acts as contact person for communication to accepting MDs in other facilities
- Performs bedside procedures as needed
- Mentors residents during activations/procedures
- Independently rounds on Trauma patients in SICU to evaluate readiness for transfer out of ICU
- Writes transfers orders for SICU trauma patients
- Signs out pertinent patient issues to Trauma senior before leaving
- Attends monthly TMAC and PIPS/PPEC
In order to facilitate patient care and to eliminate potential misunderstandings between various services caring for trauma patients, the Trauma Committee has established the following guidelines regarding admission to and transfer of trauma patients between services:

- Patients with a mechanism for potential multiple system injuries should be evaluated by the Trauma Service.

- **Patients with multiple system injuries, hemodynamic instability, or spinal cord injuries will be admitted to the Trauma Service.**

- **Patients with isolated orthopedic or neurosurgical injuries requiring ICU care will be admitted to the Surgical ICU/Trauma Service.**

- Admission to the Trauma Service is appropriate if an ongoing evaluation for occult injuries is in progress.

- Patients with single system injuries, without a mechanism for multiple system injury shall be directly admitted to the appropriate service.

- Pre-existing medical conditions such as congestive heart failure, seizures, arrhythmias, diabetes, or COPD do not necessarily constitute reasons to remain on the Trauma Service with a single system injury.

- Once suspected occult injuries have been ruled out and the patient with single system injuries is stable, the patient may be transferred from the Trauma Service to the appropriate service.

- **Trauma Service will complete a tertiary survey within 24 hours of admission.**
EMERGENCY DEPARTMENT:
• When alerted of an incoming trauma, the ED RN confers with ED attending to determine trauma alert status, calls the direct line (211) to request appropriate trauma team activation, specifies adult or pediatric activation (99), alert (97), or notification (95), number of patients, & ETA.

TRAUMA TEAM RESPONSE:
• **Trauma 99** activations are seen by the trauma attending, chief, and junior resident.
• **Trauma 97** activations are seen by the trauma chief and junior resident.
• **Trauma 95** notifications are initially seen by **ED only**. If the patient is stable and an injury is identified, the ED will request a **Trauma Consult** as needed.
• Any patient that meets criteria for a higher level of activation can be upgraded at any time by any member of the trauma team.
• All residents should **sign in** with the recording nurse.

ACTIVATING BACK-UP PERSONNEL:
Decision for activating additional personnel is at the discretion of the Trauma Attending & Trauma Chief Resident. The Back-up team is expected to arrive within 30 minutes.

NOTIFICATION OF SPECIALITY CONSULTS:
When a specialty related injury is identified, timely consultation should be obtained especially in the event of a life-threatening, or extensive injury. The Trauma Chief Resident is responsible for notifying the consult service, but may be delegated to appropriate trauma/ED resident personnel. If the consultant does not arrive within 20 minutes, the chief resident of that service will be notified. If no response within 20 minutes, the attending will be contacted by the ED or trauma attending.
Full Trauma Team activation (Trauma 99) should occur with the following:

- Adults: Confirmed SBP <90 at any time.
- Child less than 6 years: SBP <60.
- Child greater than 6 years: SBP less than 90.
- Airway compromise/obstruction or pre-hospital intubation.
- Respiratory distress with a rate <10 or >29.
- Significant hypoxia at scene.
- - Pediatric: Nasal flaring, retraction, stridor, cyanosis
- Glasgow Coma Scale score (GCS) <9 with trauma mechanism.
- Gunshot wound/penetrating trauma
  - Head or neck
  - Chest, abdomen or pelvis
  - Extremities proximal to the knee or elbow
- Traumatic paraplegia or quadriplegia.
- Transfer-in patients receiving blood or vasopressors to maintain vital signs.
- Emergency Medicine discretion
Trauma Team Activation (Trauma 97) should occur with the following:

- High speed auto crash greater than 35 mph.
- Ejection.
- Cycle crash greater than 20 mph (e.g., bike, motorcycle, ATV) or rider thrown.
- Pedestrian vs. auto greater than 5 mph impact (e.g., thrown, run over).
- Adult fall greater than 15 feet or children greater than 10 feet.
- GCS 9 to 13 with trauma mechanism.
- Significant blunt injury to head, including pre-hospital witnessed neurological change.
- Major facial injuries (w/o airway compromise).
- Flail or crushed chest.
- Suspected pelvic fracture.
- Two or more long bone fractures (femur or humerus).
- Amputation proximal to wrist or ankle.
- Penetrating extremity injuries proximal to wrists or ankle.
- Burns <20% with significant trauma: then admit to Trauma Service/SICU
- Burns >20% with trauma: stabilize for Burn Center transfer.
- Pregnant woman >=20 weeks with a traumatic mechanism of injury
- Emergency Medicine discretion
Trauma 95 should be initiated when there is no significant anatomic injury other than extremity fractures distal to the knee or elbow, or abrasions, lacerations or contusions.

These will be initially seen by ED only.

No significant anatomic injury and with the following mechanisms:

- Rollover.
- Death of occupant of car.
- Prolonged extrication.
- Auto deformity greater than 20 inches or intrusion to space occupied by passenger.
- Consider risk based on age greater than or less than 5, or known cardiac, respiratory, metabolic disease or drug/alcohol influence.
- Adult fall less than 15 feet or children less than 10 feet.
- Emergency Medicine discretion.
TRAUMA TEAM MEMBERS

Trauma Attending:
- Oversees the trauma resuscitation and acts as a resource person for the Team Captain.
- Is the deciding voice.
- Has primary responsibility for overseeing all care rendered.

Emergency Medicine Attending:
- Interfaces with pre-hospital system.
- Initiates trauma activation/alert/consult.
- If no Trauma Attending present, assumes Trauma Attending duties until their arrival.
- Allocates Emergency Department (ED) resources.
- Is responsible for overseeing airway management.
Team Captain:
The Team Captain role is rotated between the Trauma Chief Resident, and the Emergency Medicine (EM) Resident PGY III based on published schedules.

- Assigns roles to team members.
- **NO HANDS ON PATIENT CARE**
  - ED thoracotomy if necessary will be performed by General Surgery Trauma Chief Resident
- Directs the trauma resuscitation and assigns residents roles
  - Directs fluid resuscitation.
  - Decides which tests to obtain.
  - Orders medications.
  - Requests consults.
- Discusses case and care plan with the ED and Trauma Attending.
- **Team captain role will be assigned by calendar schedule with alternative ED and Surgery service performing this role. Monthly calendar is posted in ED Resuscitation Room.**
- In the event that the Trauma Chief is not available (unable to leave the operating room), there must be clear assignment to the SICU surgical fellow or chief resident to oversee Trauma 99/97 activations.

Trauma Survey and Procedure Residents:

- **Survey Resident** performs primary/secondary survey
  - FAST if Procedure Resident is performing procedures
- **Procedure Resident**—lines, chest tubes
- Procedure Resident is either ED R2/3, R3 SICU or Surgery R2 resident
- Survey and procedure resident should include at least one resident from the service not functioning in the Team Captain role. During Tuesday (Surgery conference) and Wednesday (ED conference) mornings during each departments educational activities, survey and procedure residents will all be from the available respective service.
- ED thoracotomy will be performed by surgery trauma chief resident
**Trauma Advanced Practice Provider:**
- When possible responds to trauma activations and alerts
- Can function in the survey resident role, if necessary, to perform primary & secondary surveys and/or supervise junior resident performing secondary survey
- Able to perform procedures under the supervision of the trauma chief resident
- May accompany patient to procedures/transfers under direction of trauma captain
- Collaborate with trauma captain to determine plan of care

**Trauma Nurse Coordinator/Trauma Program Manager:**
- When possible, responds to trauma activations/alerts to collaborate with team members to ensure the quality and timeliness of care
- Assists with RN documentation as needed
- Assists with procedures as needed
- Serves to educate ED RN staff regarding trauma patient care principles and practices
- Assists with Rapid Infusion device set-up, if necessary
Emergency Department Resource Nurse:
• Consults with the ED Attending to determine the level of the trauma activation. Directs the Unit Secretary to activate the trauma beepers via emergency page operator when a trauma patient is en route.
• Ensures announcement of overhead intercom that a trauma is arriving with ETA and type of trauma.
• Assures adequate nursing, ancillary staffing.
• Maintains constant communication and awareness of resuscitation team efforts.
• Follows the procedure for telecommunication backup staffing PRN.
• Informs the Trauma Resuscitation Nurse when the patient’s family/friends have arrived in department, and directs visitation.
• Utilizes all support services to assist patient, family and friends (i.e. Social Worker, Chaplaincy, etc.).
• Arranges bed access and placement via the nursing supervisor if patient is to be admitted.
• Reports victims of violent crime to security services.
ED – RN A:
• Located on patient right side
• Prior to patient arrival, prepares resuscitation room (age specific equipment, IV line prep, special procedure trays, room temp, etc.)
• Functions as primary patient care RN during initial resuscitation and stabilization
• Establishes PIV access and draws labs
• Administers medications under direction of team captain
• Remains at patient bedside wearing a lead X-ray apron
• Guarantees compliance with RN guidelines for documentation (full vital signs with GCS)
• Communicates pertinent information to the Trauma RN Recorder (ED – RN D).

ED – RN B:
• Located on patient left side
• Places patient on monitors
• Establishes second PIV, if needed
• Initiates IVFs once IV established
• Assists with procedures

ED- RN C: (Only for Trauma 99’s)
• Located on patient right side
• Sets up and runs Rapid Infusion device
ED – RN D: (RECORDER)

- Located off to the left of the foot of the bed
- Receives patient status report from Resource RN
- Ensures lab tubes labeled correctly
- Records initial team patient assessment
- Documents all pertinent patient data and care rendered by trauma team in the EPIC TRAUMA NARRATOR
- Ensures full set of initial vital signs recorded (temp, BP, Pulse, Respirations, Oxygen sat & GCS) upon arrival
- Documents repeat VS (BP, HR, RR, sat) every 3-5 mins during initial assessment and continue if patient is receiving interventions for hemodynamic instability. Then every 15 min. x4, 30 min x2, then per admit orders.
- Orders initial trauma labs/studies using the Trauma order sets in the EPIC NARRATOR
- Directs other RNs and ED technician in patient care activities
- Accompanies patient to other services/procedure areas
- Functions as bedside RN once initial survey and interventions completed
- Keeps ED Resource RN informed of potential transfer of patient to other patient service areas
- Inventories trauma room at least every 8 hours

ED Technician:

- Located on patient right side
- Assists the ED – RN A with moving patients and reading the trauma resuscitation area prior to patient arrival
- Performs cardiac compressions if CPR needed
- Connects oxygen tubing to the flow meter
- Removes all patient’s clothing
- Connects to automated BP cuff to patient’s arm & sets for interval of every 5 minutes, until deemed stable.
- Measures and reports temperature, pulse, respiratory rate, O2 saturation and blood pressure
- Assists with setting up procedure supplies
ED Technician: (continued)

- Makes clothing list and removes, records and collects valuables in plastic zip-lock bag. Turns valuables over to Resource RN to be placed in locked storage.
- Assists with wound care as directed by primary RN
- Assists with preparing patient for transport (obtains oxygen tanks, consolidates IVs)
- Assists with actual patient transport
- Assists with immediate cleaning and restocking of trauma resuscitation room
- Prepares and sends trauma procedure trays to Central Reprocessing as soon as possible

Respiratory Care Technician:

- Carries the trauma beeper 24 hrs/day
- Pediatric RTs respond to pediatric major trauma alerts (less than 14 years of age)
- Institutes and maintains ventilation with a manual resuscitator per the instructions of the Trauma Captain
- Participates with other members of the Trauma Team in establishing an airway, CPR, intubation, airway clearance techniques, bronchial hygiene, administration of pharmacological agents, diagnostic and therapeutic respiratory care procedures, administration of medical gases, aerosols and humidity.
- At the time deemed appropriate by the physician team leader, connects the patient to a mechanical ventilator and adjusts the ventilator in accordance with the verbal or written physician’s orders.

X-ray Technician:

- Reports to the Trauma Resuscitation Room when trauma beeper is activated and waits for specific instructions.
- Performs Chest X-ray and Pelvic films promptly for all 99 Activations.
Computed Tomography (CT) Technologist:

- CT Scanner availability is coordinated by the Radiology Department with the commitment being 5-10 minutes for a “99” activation and 15-20 minutes for “97” alerts.
- Ensures that the Radiologist is available to immediately check images to determine type of exams needed (e.g., reconstruction views, additional imaging).

Transfusion Services:

- When a Trauma Team Activation (99) occurs and blood order placed in Epic, the Transfusion Services Charge Technician dispenses 2 units of uncross-matched universal donor blood O-negative or O-positive (depending on the gender/age recipient) Packed Red Blood Cells (PRBCs) and 2 units of AB+ liquid plasma into a cooler that is labeled with the patient’s trauma number.
- A Transfusion Services Technician delivers the cooler containing the blood products to the Trauma Resuscitation Room in the ED.
- Technician collects verification specimen from ED-RN.

Operating Room Charge Nurse:

- The OR has an in-house Trauma OR Team ready 24 hours a day.
  - OR Charge Nurse can be reached via pager (19502) or SpectraLink (4-4590).
  - Anesthesia can be reached via pager (19650) or SpectraLink (6-0249).
- Upon receiving a trauma page, calls the Trauma Resuscitation Room at extension 5-5096 for a status report, and periodically for updates, or responds to the ED to collaborate with the Trauma Surgeon to determine if an OR suite is needed.
- The Trauma Resuscitation Room is warmed, has the Level 1 Infuser ready and Trauma Cart in place.

Social Worker:

- Assists in ensuring family notification and contacting the primary medical doctor (PMD)/insurer for the past medical history (PMH).
**Trauma ED Order Sets**

- There are standard orders for traumas based upon activation level. The Recording RN should order these through the trauma narrator in EPIC. They are also available under order sets by the following names:
  
  - **“Trauma 97”: Initial ED Trauma 97 Automatic Orders**
    - Istat Cr, CBC, type and screen, CMP, Istat INR
    - CXR, Peripheral IV

  - **“Trauma 99”: Initial ED Trauma 99 Automatic Orders**
    - Istat Cr, Istat INR, Istat VBG/Lactate, CBC, type and screen, CMP, urine tox screen, serum volatile screen, UA
    - CXR, Pelvis Xray, Peripheral IV, Foley

  - **“Trauma Radiology” – NO automatic orders. Order set contains options** for initial common CT scans. *Please use these as the CTs are already protocoles.*

  - **“ED Trauma Medication”: NO automatic orders. Order set contains options for analgesics, anti-emetics, antibiotics and tetanus.**

*Note: For Female patients* - please ask RN to check pregnancy test in the order sets.
Clinical Trials:

- **START Trial** – randomized control trial of human mesenchymal stem cells (MSCs) for the treatment of moderate to severe ARDS (defined by P/F < 200 on at least 8 of PEEP). Phase II study with 2:1 randomization, primary inclusion is being within 96 hours of meeting criteria for ARDS.

- **EPVent 2** – phase II RCT comparing strategy of PEEP titration to end-expiratory transpulmonary pressure (measured by an esophageal balloon) vs. a high PEEP LPV strategy. Major inclusion criterion is moderate to severe ARDS (P/F < 200 on at least 5 of PEEP).

- **ROSE** – RCT of cisatracurium started within 72 hours of severe ARDS (p/f<150 on PEEP 8cm H2O) vs. standards care.
  - clinical coordinator for above studies Rosemary Vojnik (408) 772-3001

- **STOP-AKI** – Phase II Study: Safety, efficacy and tolerability of Human Recombinant Alkaline Phosphatase in patients with sepsis-associated Acute Kidney Injury. Inclusions: 2/4 SIRS criteria & sustained AKI by elevated Cr (>0.3) or Low Urine output. Treatment must start by 24hrs of AKI diagnosis. Major exclusions: CKD, immunocompromised, urosepsis

- **Euphrates** – Hemoperfusion using Polymyxin B cartridge vs. sham in adults with severe septic shock. Inclusions: pts on qualifying pressors for minimum 2hrs, multiple organ failure and high endotoxin levels-tested by research-must begin treatment within 30hrs of pressor
  - clinical coordinator for above studies Valerie Ojha (650) 518-9716

- **Stanford ICU Biobank** – blood, urine, and available respiratory secretions/left-over BAL specimens for genomic studies in critically ill patients with risk factors for ARDS, including trauma, sepsis, and aspiration. Email Angela Rogers ajrogers@stanford.edu

Prevention Programs:

- **FAREWELL TO FALLS** – ideally for elderly patients who have fallen and are being discharged from the ED. Some inpatients also qualify if going home without any home services (i.e. PT/OT Home safety evaluations)
  - Contact Ellen Corman via email: ecorman@stanfordhealthcare.org
Screening, Brief Intervention & Referral to Treatment (SBIRT) – is a comprehensive approach to the delivery of early intervention and treatment services for persons with substance use disorders, as well as those who are at risk of developing these disorders.

**Screening is to be performed on all trauma patients:**

1. Ask the patient: “When you drink alcohol, how many drinks do you drink?”
2. Patient’s blood alcohol level drawn in the ED?: Y  N  
   Level:_____
   • If BAL 0.08 or greater or patient drinks more than 2 drinks at a sitting, ask the CAGE questions.

**Check One:**

Alcohol CAGE Score:

- < 2
- 2 or more (refer to Social Work)

C = Have you ever felt you should cut down on your drinking?  
A = Have people annoyed you by criticizing your drinking?  
G = Have you ever felt bad or guilty about your drinking?  
E = Do you ever take a drink in the AM to steady your nerves or relieve a hangover?

**Scoring:** If 2 or more “Yes” answers, patient is at risk of problem drinking or alcoholism.

**Plan:** If BAL 0.08 or if suspected of intoxication or if cage 2 or more, refer to Social Work
Guidelines:

• All lines placed in the field or ED are considered suspect and should be replaced as soon as feasible after admission. Exceptions include central lines placed utilizing full barrier precautions.

• Preferred site of central access during trauma resuscitation is the femoral vein
  • Femoral access should be utilized with caution in an unstable patient with severe pelvic fractures or likely vena caval injuries. Subclavian vein should then be considered
  • Femoral vein catheters should be removed as soon as possible to decrease the risk of DVT (if central access is still required, the femoral line should be replaced by a subclavian or internal jugular catheter).

• Patients with suspected cardiogenic shock or in need of central venous pressure monitoring should have a subclavian or internal jugular venous central line.

• ALL central lines should be placed under “full barrier precautions” defined as sterile gown and gloves, cap and mask, and FULL draping (3/4 sheet, lap drape, etc.). Chlorhexidine is the preferred prep agent. Cap and masks are recommended for those nearby, while full barrier precautions should be observed by those assisting.

• Central lines should be covered with chlorhexidine-impregnated dressings, which have been shown to reduce line infections threefold.

References:
What are the criteria for activating the MTG?

Adult patients
• requiring > 4 units of PRBCs in the first hour of resuscitation OR
• high likelihood of > 10 units of PRBCs within 12 hours of resuscitation

Pediatric patients
• requiring > 20 ml/Kg of PRBCs in the 1st hour of resuscitation OR
• high likelihood of > 0.1 units/Kg of PBRCs within 12 hours of resuscitation

When the MTG is activated, the following blood products are delivered:

Adult MTG Pack (> 50 Kg)
• 6 Units of PRBCs
• 4 Units of thawed plasma
• 1 Unit of apheresis platelets

Pediatric MTG Pack (≤ 50 Kg)
• 4 Units of PRBCs
• 2 Units of thawed plasma
• 1 Unit of apheresis platelets
HOW TO ACTIVATE THE MTG PROCESS:

General Steps:
1. Determine need for MTG
2. Place order for MTG
   • Use the appropriate mechanism for ordering based on patient location
     • EPIC MTG order set (ED or ICU patients)
     • Downtime paper form (OR patients)
3. Call Blood Bank to notify them of MTG order via phone (3-6445)
4. All products should be delivered through IV warming device except platelets
5. If additional blood is anticipated beyond the delivered MTG pack, the MTG must be re-ordered via same procedure

For patients in the ED:
• 10 units of uncrossed matched type O blood will be available in a refrigerator in the ED (universal donor liquid plasma will eventually be stocked as well).
• Use of pRBC in the refrigerator will prompt automatic delivery of AB plasma a refrigerator in the ED.
• If the patient is experiencing life threatening hemorrhage, additional blood (over 2-4U) can be ordered by activating MTG
• Use EPIC order set for MTG which will be found in the Trauma Narrator
• MTG blood will be delivered directly to trauma bay by blood bank personnel

For patients in the OR:
• Use the Downtime MTG paper order form. The form must have patient information via a patient label or addressograph to be a valid order
• Runner from OR takes copy of order form to transfusion services to obtain MTG pack that was ordered

For patients in the ICU:
• Order in EPIC using “MTG” Order set
• Runner from unit takes label with patient name and either MRN or DOB to obtain MTG pack from blood bank
BACKGROUND:
• Prophylactic antibiotics are frequently recommended by consulting services, but the data to support many of these recommendations is weak or nonexistent.
• Drug resistant infections attributable to antibiotic overuse are becoming more common and far more virulent.
• Antibiotics cannot overcome poor wound management

OPEN FRACTURES:
• Grade I: wound < 1cm long and clean
• Grade II: wound > 1cm without extensive soft tissue damage, flaps, or avulsions
• Grade III: either an open segmental fracture, open fracture with extensive soft tissue damage, or traumatic amputation

• Bacterial contamination can lead to cellulitis, osteomyelitis, and bony nonunion
• Best managed by debridement of devitalized tissue with concomitant antibiotic therapy
• Infection rate for Grade III open fracture is 24%
• Most difficult fracture to care for is Grade III tibial fracture

• Class I and II data for prophylactic antibiotics as soon as possible after injury for coverage of gram positive organisms.
  • Grade III fractures - add coverage for gram negatives
  • High dose penicillin added if concern for fecal/Clostridial contamination.

• Class I and II data for discontinuation of antibiotics 24hrs after wound closure for Grade I and II fractures. For Grade III wounds, antibiotics should be continued for only 72 hours after the time of injury or not more than 24 hrs after soft tissue coverage of the wound is achieved, whichever comes first.
OPEN FRACTURES
• **Grade I**: cefazolin (perioperative)
• **Grade II and III**: ceftriaxone 1g IV daily until wound is closed

CHEST TUBE PLACEMENT
• 1-2% incidence of empyema
• Insufficient Level I data to support prophylactic abx for duration of CT
• Level II data suggests a single dose of prophylactic antibiotics at time of placement may reduce risks of empyema

FACIAL FRACTURES
• No prospective study demonstrating a decreased incidence of infections after routine closed facial fractures in patients receiving empiric antibiotics
• Recommend empiric antibiotics for significant midface trauma including open wounds, or those with orbital, nasal bone, zygomatic and mandibular involvement
  • Augmentin 875 mg IV q8h preop, continue for 24 hrs post-op
  • If no surgical intervention planned, 2 days of above abx recommended

SKULL BASED FRACTURES
• No evidence to support routine prophylactic or empiric antibiotics in cases without meningitis, irrespective of CSF leak

VASCULAR INJURY
• Single dose of 1st generation cephalosporin for 24hrs if synthetic graft used.

PENETRATING ABDOMINAL TRAUMA
• Should be given as soon as technically possible
• Single preoperative dose of prophylactic antibiotics with cefazolin or ampicillin/sulbactam is sufficient
• In the absence of **contamination or spillage**, no further antibiotics are indicated and should be discontinued within 24hrs.

References:
• Hauser CJ, et al. Surgical Infections, 2006
• Rodriguez et al. JTACS 2014.
• Alleyne CH, et al. Neurosurgery, 2000
BACKGROUND: 1% of traumas requiring intubation need a surgical airway

RISKS: DIFFICULT BAG VALVE MASK (BVM)
- BMI > 26kg/m²
- Absent teeth
- Presence of a beard, facial disruption, or crusted blood on face
- Age > 55 years

RISKS: DIFFICULT INTUBATION
- Massive facial or neck trauma
- Receding mandible (<3 finger breadths from mandibular symphysis to hyoid bone)
- Short, thick neck (<3 finger breadths from sternal notch to thyroid cartilage)
- Narrow mouth opening
- Large or immobile tongue
- Immobilized cervical spine
- Inspiratory Stridor (upper airway compromise)

LMA
- Size 4 for patients < 70kg. Size 5 for patients >70kg
- Rests in hypopharynx over the laryngeal opening
- Risk of aspiration, particularly pregnant or obese patients

CRICOTHYROIDOTOMY:
- Does not mandate conversion to tracheostomy
- Use 6mm cuffed ETT or 4-6 tracheostomy tube
- Contraindicated in pediatric patients (<12 years, risk damage to cricoid and subsequent stenosis) or patients with laryngeal fracture. These patients should undergo tracheostomy
**AIRWAY MANAGEMENT**

**NOTES:**
# If multiple risk factors for difficult airway, airway management should be performed by senior staff (ED, surgical, anesthesia) 
If the patient has a high risk airway (laryngeal trauma, facial fractures, etc…) or is already going to the OR, discuss delaying intubation until the OR with the Trauma Attending. 
* RSI should be avoided in patients difficult to ventilate via BVM

---

**Need for Intubation**
- Manual in-line cervical immobilization
- Pre-oxygenation
- Rapid sequence intubation*

**Successful Intubation**
- **NO**
  - BVM
    - Adequate ventilation
    - SpO2 > 90%
  - **NO**
    - Repeat Intubation
      - Perform by senior staff (ED, surgical, anesthesia)
      - Optimize conditions (suction, different blade)
    - **NO**
      - LMA/Rescue airway or Cricothyroidotomy
      - **NO**
        - Cricothyroidotomy
      - **YES**
        - Confirm Placement
          - Auscultation
          - CO2 detector
          - CXR

---

**Repeat Intubation**
- **Success**
  - Confirm Placement
  - **NO**
    - Perform by senior staff (ED, surgical, anesthesia)
    - Optimize conditions (suction, different blade)
  - **NO**
    - LMA/Rescue airway or Cricothyroidotomy
  - **YES**
    - Cricothyroidotomy

---

**Decision for cricothyroidotomy**
should be made rapidly after failed airway (1-2mins)

---

**Rev. 6/16**
(1) POSSIBILITY OF SUCCESS (Anticipate Difficulty Airway)
- Examine airway, check anatomy

(2) PREPARATION
- Assemble staff (i.e. ED attending, nurse, respiratory therapist)
- Continuous monitoring of BP, ECG, SaO2
- Consult Anesthesiology if airway problems anticipated
- Prepare equipment

(3) PRE-OXYGENATION
- 100% O2. Bag mask ventilation PRN

(4) PRE-MEDICATION
- See Table 1

(5) INDUCTION
- See Table 2

(6) PARALYSIS
- See Table 3

(7) CRICOID PRESSURE (optional)

(8) INTUBATION
- Inline cervical immobilization
- Intubate orally
- Confirm ETT position with end-tidal CO2
- Release cricoid pressure after balloon is inflated

(9) CONFIRMATION

(10) POST-INTUBATION MANAGEMENT
- Secure Tube
- Re-secure cervical collar
- Sedation: Lorazepam (0.05-0.1 mg/kg) or Midazolam (0.2 mg/kg), or Propofol gtt (initial dose 0.3 mg/kg/hour)
- Paralysis: Rocuronium (0.4-1 mg/kg) or Vecuronium (0.1 mg/kg)
- Pain Management: Morphine (0.2 mg/kg) or Fentanyl (50mcg)
- Chest x-ray
### Table 1: Pre-medication Agents

<table>
<thead>
<tr>
<th>Drug</th>
<th>Indication</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lidocaine</td>
<td>↑ ICP, RAD</td>
<td>1.5mg/kg</td>
</tr>
<tr>
<td>Opioid (fentanyl)</td>
<td>↑ ICP, ischemic heart disease, aortic dissection</td>
<td>3-6mcg/kg</td>
</tr>
<tr>
<td>Atropine (optional)</td>
<td>Mitigates bradycardia from succinylcholine</td>
<td>2mg (adults)</td>
</tr>
</tbody>
</table>

### Table 2: Induction Agents

<table>
<thead>
<tr>
<th>Drug</th>
<th>Benefit</th>
<th>Precautions</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midazolam</td>
<td>Reversible, amnestic, anticonvulsant</td>
<td>Apnea, no analgesia, variable dosing</td>
<td>0.2-0.3 mg/kg</td>
</tr>
<tr>
<td>Etomidate</td>
<td>↓ICP, rarely ↓ BP</td>
<td>Myoclonic jerks, vomiting, no analgesia</td>
<td>0.3 mg/kg</td>
</tr>
<tr>
<td>Ketamine</td>
<td>↑BP, bronchodilator, dissociative amnesia</td>
<td>↑ secretions, ↑ ICP, Emergence phenomenon</td>
<td>1-2 mg/kg</td>
</tr>
<tr>
<td>Propofol</td>
<td>No dose adjustment for liver/renal disease</td>
<td>Profound hypotension</td>
<td>1-2 mg/kg</td>
</tr>
</tbody>
</table>

### Table 3: Paralytic Agents

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Succinylcholine</td>
<td>1.5-2 mg/kg</td>
</tr>
<tr>
<td>Rocuronium</td>
<td>1 mg/kg</td>
</tr>
<tr>
<td>Vecuronium</td>
<td>0.1 mg/kg</td>
</tr>
</tbody>
</table>
HEAD INJURY - INDICATIONS FOR CT

Canadian CT head Rule

CT recommended if GCS 13 – 15 and 1 of following:

**High Risk for Neurosurgical Intervention**
- GCS < 15 2 hours after injury
- Suspected open/depressed skull
- Signs of BOS
- ≥ 2 episodes of vomiting
- ≥ 65 years old

**Medium Risk for Brain Injury Detection by CT**
- Retrograde amnesia ≥ 30 minutes
- Dangerous mechanism:
  - *Pedestrian struck*
  - *Ejection from vehicle*
  - *Fall ≥ 3m or 5 stairs*

Exclusion criteria: GCS < 13, <16yo, warfarin therapy or bleeding diathesis

*Head CT should be done within 30 mins*

References:

Rev. 6/10, 12/17
Repeat head CTs:

- All patients with radiographic-proven traumatic brain injury (TBI) require repeat imaging within 6 hours.
- Coagulopathic patients without radiographic evidence of TBI but with mechanism of injury:
  - Should be observed for at least 6 hours prior to discharge
  - Consider repeat interval CT on a case-by-case basis

Monitoring of patients with head injuries:

- All patients will be admitted to the SICU or H1 (if they meet H1 admission criteria—see criteria) for 12 hrs, regardless of TBI severity.
- Patients with GCS<14: Practice should be consistent with Brain Trauma Foundation Guidelines and the ACS TQIP Best Practices in the Management of TBI guidelines.

Management of chemoprophylaxis for DVT:

- In general, chemoprophylaxis for DVTs may be initiated 72 hours after a repeat head CT is stable, unless the SICU attending states otherwise.
- If patient is deemed to be at high risk for bleeding from chemoprophylaxis and chemoprophylaxis is deferred, SICU documentation will reflect the reasoning for the deviation and the plans for timing institution of chemoprophylaxis.
- Chemoprophylaxis can be administered while an EVD is in place, but should be held for 12 hours prior to EVD placement or removal

Therapeutic systemic anticoagulation with heparin:

- Must be determined by Neurosurgical, NCC, and SICU attendings.
- Requires baseline CT prior to initiation of anticoagulation.
- Should be implemented using the high-risk protocol.
- Requires repeat head CT once therapeutic anticoagulation achieved

Reversal of medically-induced anticoagulation in TBI patients:

- Aggressive reversal of anticoagulation to be undertaken using protocols specific to the medication (i.e. warfarin and direct thrombin inhibitors).

All TBI patients with initial GCS<14 should receive a PM&R consult (Kara Flavin)
Admitting service:

- ICU: all TBI patients will be on the SICU service
- University Neurosurgery (NSG) will be consulted for all TBI cases, including patients who have PAMF coverage
- Neurocritical care (NCC) will be involved in all complicated and/or moderate to severe TBI cases as defined by:
  - GCS<14 with any type TBI injury
  - Mild TBI (GCS 14-15) if complicated by any other factor such as large size, high risk for worsening, unexplained coagulopathy, vascular injury, seizures, or unexplained neurologic findings
- TBI patients that undergo craniotomy:
  - Will be on the SICU unless there is an attending-level discussion between SICU and NSG that determines the patient would be better served as a primary NSG patient.
  - In patients who have undergone craniotomy, NCC will defer to NSG regarding peri-operative management decisions.

Floor-level care:

- Multisystem TBI patients: Trauma Service or Neurology Stroke Service
- *Isolated TBI:
  - S/P craniotomy: Neurosurgery service
  - No craniotomy: Trauma service or Neurology Stroke Service
- The Neurology Stroke Service will follow all TBI patients admitted to the floor for whom Neurocritical Care was actively managing in the ICU.

*Definition of “Isolated TBI”:

1. A patient for whom there are no other injuries at the time of admission other than the TBI, or
2. A patient who has other injuries, but the injuries require no further surgical management by any service (i.e. orthopedic surgery, ENT, trauma, etc...)

Note: A patient with isolated TBI whose course is complicated by active non-surgical medical issues (i.e. systemic infection such as pneumonia) is still considered an isolated TBI.
Patients with blunt head trauma who have an acute abnormality on head CT require close neurologic monitoring. Certain patients qualify for neurologic monitoring in a non-critical care setting.

Inclusion Criteria:
1. GCS 15, with normal neurologic exam to include normal sensorium (i.e. not intoxicated or delirious), not demented or developmentally delayed, and with no focal neurologic signs.
2. No other physiologic signs that would confound diagnosis of worsening head injury to include: nausea, vomiting, headache
3. Age <80
4. Normal coagulation status and normal platelets and not on any anti-coagulants or anti-platelet agents
5. Pattern of injury consistent with a small contusion(s) (<1mm) or SAH, skull fractures without intracranial injury, and with absence of extra-axial hemorrhage (SDH or EDH)
6. Hemodynamically normal, defined as being at baseline for both HR and blood pressure and , not requiring any IV infusions for blood pressure management (for either hypo- or hyper- tension)
7. Not requiring frequent IV medication for agitation (e.g. benzodiazepines) or pain control.
8. No acute alcohol or drug intoxication.
9. Not at known risk for drug or alcohol withdrawal.
10. Agreement and documentation by trauma and neurosurgical teams that patient is at low risk for progression and safe for admission to the floor TBI unit.
Physician Teams and Expectations:

- All patients will be admitted to the trauma service. The trauma attending will be primary attending of record and ultimately responsible for patient care.
- Neurosurgery consult team will co-follow all patients for at least the initial 12 hours of the hospitalization.
- A follow-up head CT will be obtained 4-6 hours from the original scan in all patients, regardless of exam.

Nursing Expectations:

- All patients will be admitted to H1 ward with neurosciences nursing expertise for at least the first 12 hours after injury.
- Patients will be a 2:1 patient-to-RN ratio.
- Neuro checks will be performed q1 hour for the initial 24 hours of hospitalization.
- **Neuro checks will include**: Glasgow Coma Scale, pupillary assessment (including size and reactivity), and an abbreviated NIHSS (level of consciousness, language, facial strength, motor and sensory exam in all four extremities, finger-to-nose/cerebellar function).
- Changes in neurologic function will prompt immediate call to trauma team. If the resident does not respond to page within 15”, trauma attending should be contacted. If trauma attending does not respond, then SICU attending should be contacted.
- RNs will accompany patient for follow-up head CT.
SIGNS & SYMPTOMS OF BCVI:
• Hemorrhage from mouth, nose, ears of potential arterial origin
• Large or expanding cervical hematoma (consider surgery)
• Cervical bruit in patient < 50
• Evidence of cerebral infarction on CT
• Unexplained or CT incongruous neurologic deficit
• Focal or lateralizing neurologic deficit
• Transient ischemic attack, or Horner’s syndrome
• Stroke on CT or MRI
• Major thoracic trauma

RISKS OF BCVI:
• Mechanism compatible with severe cervical hyperextension/rotation or hyperflexion, particularly if associated with complex facial fractures
• Near-hanging, seat belt abrasion, or other soft tissue injury of the anterior neck with significant cervical swelling
• High Risk associated injuries
  • Severe traumatic brain injury with GCS ≤ 8
  • Petrous bone fracture
  • Displaced mid-face (LeFort II/III) fractures
  • Mandibular fracture
  • Cervical spine fracture, particularly C1-C3
  • Cervical vertebral fracture, subluxation or ligamentous injury
  • Diffuse axonal brain injury
  • Occipital condyle fracture or basilar skull fracture involving the carotid canal
  • Scalp degloving
  • Upper rib fractures
BLUNT CEREBROVASCULAR INJURY (BCVI)

BCVI Signs & Symptoms OR Risk Factor(s)

CT Angio

Yes

No

TREAT OTHER INJURIES

Abnormal

Normal

• Grade I: Intimal irregularity; Dissection/Hematoma with < 25% stenosis.
  • Tx: Anti-platelet most commonly used, alternatively IV heparin
• Grade II: Intraluminal thrombus; raised intimal flap; Dissection/Hematoma with >= 25% stenosis.
  • Tx: Anti-platelet or IV heparin
• Grade III: Pseudoaneurysms
  • Tx: Anti-platelet or IV heparin
• Grade IV: Occlusions
  • Tx: Anti-platelet most commonly used, IV heparin used if presents with acute stroke
• Grade V: Transection
  • Tx: Controversial. Consider operative repair if survivable injury

• Heparin: no bolus; 15units/kg/hr; target PTT 1.5-2x normal
• Antiplatelet: ASA 325mg qday

CTA should be done as early as possible

References:
• Biffl WL et al. J. Trauma 2009; 67:1150

Rev. 11/17, 12/17
BACKGROUND:
• Rate of missed cervical spine injuries with plain films alone is unacceptably high (33%); therefore, the imaging study of choice in blunt trauma patients should be a cervical CT scan.

SCREENING CT SCAN:
• For all patients, the NEXUS screening criteria are used to determine who requires a CT scan for clearance of the C-spine.

ROLE OF MRI:
• If an awake patient complains of midline tenderness and has a normal CT of the c-spine, a MRI or flexion-extension films should be obtained to rule out ligamentous injury. These patients should be left in cervical collars until the MRI/Flex-ex report is available.
• For comatose patients, keeping patients in collars awaiting MRI has been associated with increased morbidity. Therefore, at Stanford MRI is NO LONGER routinely obtained in order to clear the C-spine of comatose patients. In general, if the CT is negative for injury and the patient can move all extremities, the spine can be cleared at the discretion of the attending.

• In the obtunded adult patient, suggest that flexion-extension imaging NOT be used to assess for a possible isolated ligamentous injury or SCIWORA of the cervical spine. While MRI remains the preferred test to rule out isolated ligamentous injury or SCIWORA of the cervical spine in the unconscious, unevaluable patient, there is increasing evidence supporting the use of advanced CT imaging with appropriate technique in this setting.
C-SPINE EVALUATION - ADULT

Any NEXUS Criteria?
- Midline neck tenderness
- Neurological deficit
- Distracting Injury*
- Intoxication with drugs or EtOH
- Altered Mental Status

Yes

CT C-spine

No

Clinical Exam

Normal & Non-tender

Remove C-collar

Normal & Tender

MRI, or Spine consult

Abnormal

Spine consult

* Distracting injury defined as injury to the head, neck, chest or upper extremity, or an injury that is so painful that it requires such doses of analgesics that the patient is unable to co-operate with a clinical examination

SCVMC PROTOCOL VARIATIONS:
- If normal CT C-spine, but have tenderness, obtain either MRI (within 48hrs) or flexion/extension plain films
- If normal CT C-spine, but patient cannot be clinically evaluated, obtain MRI or flexion/extension plain films

References:
- Mathen et al. J of Trauma 2007; 62(6):1427-31
- Como J, et al. J of Trauma 2007; 63(3):544-9
BACKGROUND:
• Thoracic/Lumbar/Sacral (TLS) spine fractures occur at about the same rate as cervical spine fractures (2-5% of blunt trauma)
• Although most patients present with pain and tenderness, up to 20% do not have associated pain and tenderness at presentation.

ANY OF THE FOLLOWING?
• Back pain
• Tenderness
• Neurologic Deficit
• GCS < 15
• Major Injury

No
Observe

Yes
TLS X-ray

TLS films adequate

Observe

CT poorly visualized or abnormal areas

1 Hemothorax, flail chest, liver/spleen laceration, long bone fracture, pelvic fracture
2 CT scan may substitute TLS X-ray in patient already undergoing chest/abdomen scanning
3 Adequate TLS films:
   ● T1-T5 – anterior images of vertebral bodies are well seen and are normally aligned and without compression.
   ● T6 – sacrum – The full vertebral body is well seen, normally aligned and without compression. Additionally, posterior elements allowing for some overlap from rib and shoulder girdle structures appear intact
BACKGROUND:
- Multiple rib fractures (more than 4 ribs) in patients >45 yrs have been associated with increased morbidity
- The cornerstone of rib fracture management is early and adequate pain control to avoid complications from splinting (atelectasis, retained secretions, pneumonia)

**Multiple Rib Fractures**
- Patients > 45yrs with 4 or more fractures
- Patients > 65yrs with 2 or more rib fractures

- Admit for pain control
- **Recommend** ICU admission for any patient with 4+ rib fractures
- **Recommend** ICU admission for age>65 yo & >2 ribs fx. for first 24 hours

- Aggressive early and adequate pain control
- Epidural preferable, PCA as alternative
- Coach patient on coughing and breathing
- Aggressive deep breathing exercises, flutter
- Encourage patient ambulation
- Suctioning when necessary
- Consider rib fixation for flail chest, inability to wean from ventilator, unremitting pain

Rib fracture patients requiring admission to the SICU should be on a stable pain regimen for 24 hours that can be reproduced on the ward for 24 hours prior to transfer out of the SICU.
BACKGROUND:
- Geriatric (>65yrs) patients are especially susceptible to rib fractures due to ground level falls, and have twice the mortality of younger patients

MANAGEMENT:

**Epidural Placement or Alternatives**: Paravertebral blockade
Intercostal nerve blockade

Contraindications to Epidural Catheter Placement:
- Coagulopathy, or anticoagulated with warfarin, apixaban or rivaroxiban
- Systemic infection
- Spinal cord injury or spinal fracture near area of catheter placement
- Delirious, dementia with active behavioral disturbances or non-cooperative patient
- Body habitus (BMI>40) or unable to position the patient

Non-Pharmacologic Management During Admission

<table>
<thead>
<tr>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain scores to be evaluated in 3 ways:</td>
</tr>
</tbody>
</table>
- Resting
- With deep inspiration
- With deep cough
| RN to record resting pain scores on arrival and every 4 hours |
| MD to record all pain scores daily |
| Target: Score less than 4 in all pain categories |

Pulmonary Toilet (bedside nurse and respiratory therapist):
- Head of bed 30 degrees (unless contraindicated)
- Monitor O2 saturation (target >92%) (continuous in SICU, q6h on floor)
- Incentive spirometer or flutter q1h while awake (target >1.5L)
- PT evaluation for mobility (within 24 hrs of admission)
- Early mobilization Strict out of bed (OOB) TID unless unsafe
- CT evaluation (ADLs, non-pharmacologic pain techniques)
- Patient and family education re coughing and deep breathing exercises (Distribute educational flyer)
- RN to notify MD if unable to mobilize OOB or participate in breathing exercises during shift

Indications for Anesthesia Pain Services Consult:
- After 6 hours of multimodal analgesia or lidocaine gtt, poor inspiratory effort or pain scores (rest, inspiration, or cough) show no improvement or remain > 4
- >= 4 rib fractures and age ≥ 75
- Candidate for epidural placement or alternatives*
- Lidocaine gtt management (prior to ICU discharge or initiated on the floor)
- History of chronic pain or current pain medication use (*patient should be continued on their baseline analgesic regimen unless contraindicated)
- Clinical judgement (ex: patients with dementia)
RIB FRACTURE - GERIATRIC

MANAGEMENT (PHARMACOLOGIC):

- Special consideration must be given to modulation of pain in elderly (dosing, side effects, risk of polypharmacy)

**Pharmacologic Management on Admission**

Initial management with multimodal analgesia within 1 hour of arrival (should be continued throughout admission):

- Acetaminophen 1000mg PO or IV TID with meals (max 3g/24hr) (if no liver disease)

- Opioid (PO oxycodone 2.5-5mg po q4h prn or IV dilaudid 0.2mg IV q3h prn) or via PCA, titrate to effect

- For pain < 4 and good inspiratory effort, lidocaine patch to affected area for up to 12hrs per day

- For pain > 4 or poor respiratory effort, consider replacing patch with lidocaine IV 1mg/kg of ideal body weight (monitor lidocaine levels q8h)

- Celebrex 100mg PO BID [Max duration: 14 days then discontinue] [Hold if: TBI, spinal hematoma, stroke, GFR<40, CHF, recent history of GI bleed, on anticoagulation]

- Early consideration of epidural analgesia, especially for those with uncontrolled pain or who will not tolerate oral analgesia (Heparin S/C BID or TID may be continued as DVT prophylaxis, but consult APS early and discuss timing. See below for contraindications to epidural placement)

**Second-line agents (use with caution in the elderly)**

- Gabapentin 100mg PO qhs and increase as tolerated to max 300mg PO q8h [Avoid if baseline cognitive impairment, confused on admission, IV contrast within last 24 hours, GFR<60]

**De-Escalation Prior To Discharge**

Patient must stable for 24 hours on a pain control regimen prior to discharge from the ICU

Target discontinuation of PCA and IV-based medications by 48 hours

Patient may be considered for discharge from hospital only if analgesics have been de-escalated and:

- Pain controlled on oral medications for 24 hours
- No resting pain score > 4 in previous 24 hours
- Completed OT and/or PT evaluations as indicated by safe discharge recommendations in place and pain score <4 during functional mobility and ADLs/IADLs required for discharge
ZONES:
• Zone 1: clavicle to inferior border of cricoid cartilage
• Zone 2: cricoid to angle of mandible
• Zone 3: above angle of mandible to base of skull

EXAM FINDINGS:
• Active bleeding; Hypotension; Large or expanding hematoma; pulse deficits (carotid, brachial/radial), bruit
• Hemoptysis/hematemesis; SQ Emphysema; Hoarseness; Dysphagia
• Localizing Signs: Pupils, Limbs, CN’s
  • CN’s: Facial, Glossopharyngeal (midline position of soft palate); Recurrent Laryngeal (hoarseness, ineffective cough); Accessory (shoulder lift); Hypoglossal (midline position of tongue)
  • Horner’s: Myosis, Ptosis
• Brachial Plexus: Median (fist); Radial (wrist extension); Ulnar (abduction/adduction of fingers); Musculocutaneous (forearm flexion); Axillary (arm abduction)
Penetrating Neck Injury

- Airway Compromise
- Profuse Bleeding
- Persistent Shock
- Evolving Stroke
- Expanding Hematoma

No

Yes

GSW, transcervical, High risk trajectory?

OR

- Bronchoscopy
- Esophagoscopy
- Esophagography

Zone I or II

CT Angio

Neg

Positive

OPTIONS:
- OR
- IR, or
- Further diagnostic evaluation depending on hemodynamics and injury pattern

OBSERVE

Obtain CT within 30 mins

Zone III

CT Angio

Neg

Positive

OBSERVE

Yes

Angio ± Embolization

References:
BACKGROUND:
- BAI is the second most common cause of death in blunt trauma, following head injury.
- Deceleration forces cause aortic tearing at points of fixation: ligamentum arteriosum (80-85%), diaphragmatic hiatus (10-15%), and ascending aorta (5-10%).
- 85% of fatalities occur at the accident scene. Of the remainder, 25% occur within 24hrs and another 25% within one week.
- CT Angio is the diagnostic test of choice (specificity 100%)
- CAUTION: A normal CXR does NOT exclude BAI

CLASSIC CXR FINDINGS:
- Widened mediastinum
- Indistinct aortic knob
- Depression of left main stem bronchus
- Deviation of NG tube
- Opacification of aortopulmonary window
- Widening of paratracheal/paraspinous stripes
- Apical capping
- Scapular fracture or 1st/2nd rib fracture

MANAGEMENT:
- Consult immediately either:
  - Vascular Surgery in even months or
  - Cardiac Surgery in odd months
- Guidelines:
  - MAP 60-80 SBP<110
  - SBP<120 mandatory, <100 desired
  - HR 70-80
- Medication options once patient has been stabilized (other sources of bleeding assessed):
  - Esmolol (0.5 μg/kg - 300 μg/kg) - **1st line therapy
  - Nitroprusside (2-5 μg/kg/min) or Nitroglycerin (5 -10ug/min)
  - Nicardipine (5-15mg/hr)

*Polytrauma patients with head injury will require MAPs.
BLUNT AORTIC INJURY (BAI)

CXR

Findings Associated with BAI

No

Yes

Consider Mechanism

Low-Risk Mechanism

No further workup

High-Risk Mechanism

CT Angio Chest

CXR during primary survey (5-10 min)

CTA in ED after secondary survey (30-45 min)

References:

• Can result from blunt trauma to the thorax
• Significant complications from blunt cardiac injury include: arrhythmia requiring management, cardiogenic shock, and anatomic defects (valve, septum, or free wall rupture)
• Symptomatic blunt cardiac injury can be as high as 13% in blunt chest trauma; at risk patients should be recognized and monitored closely
• Manifestations occur within 24h of injury
  • Most common presenting symptoms is arrhythmias with sinus tachycardia being the most frequent
• Patients at risk for BCI should have ECG and troponin I level checked. **If both are normal, BCI is ruled out.**
• If either test is positive, the patient should be monitored for 24-48 hours in case the patient develops symptomatic blunt cardiac injury.
• ECHO should be performed in any patient with a new arrhythmia or hemodynamic instability.

References:
• EAST guidelines. www.east.org
RISK FACTORS FOR BCI:
- Multiple rib fractures
- Sternal fracture
- Scapula fracture
- Intrathoracic vascular injury
- > 20% lung contusion
- Chest seatbelt ecchymosis
- HTX/PTX requiring chest tube

Yes

12-lead ECG
• Serum troponin I

Either test abnormal?

No

Telemetry abnormalities during workup?

No

Discharge if no other injuries

Yes

ABNL ECG:
• Abnormal conduction
• ST elev/dep
• T-wave inversion
• Arrhythmia

Yes

TELE (or ICU) x 24h
• Manage arrhythmia
• Manage pump failure
• TTE for suspected anatomic lesion, shock, severe arrhythmia, or other hemodynamic instability

No
BACKGROUND:

- The “Box” = Borders of suprasternal notch, nipples, and costal margin
- Pericardiocentesis is unreliable in the acute trauma setting: 20% false positive and 20% false negative
- Most sensitive test for post-traumatic tamponade is (subxiphoid) pericardial window, but this requires general anesthesia in the OR.
- For patients who do not require general anesthesia for surgery following penetrating trauma, the best non-invasive test for cardiac or pericardial injury is 2D echocardiography. Sensitivity and specificity is 100% and 89%, respectively, for patients without hemothorax. Less accurate in the setting of hemothorax (56%, 93%)
- Penetrating cardiac injuries can occur without entrance or exit wounds in the “box.”

X = wounds that produce cardiac injuries
Penetrating Chest Trauma

HD Unstable

No

Injury within the “Box”

Yes

Patient Requires Surgery for associated trauma

Yes

Subxiphoid Window

Blood

No

Yes

Hemopericardium on US?

No

Yes

Median Sternotomy

• Admit & Observe
• Treat hemo-pneumothorax
• Consider repeat US or CT

OR decision within 5 min

Operating room or ED thoracotomy

Yes

• Admit & Observe
• Treat hemo-pneumothorax
• Consider repeat US or CT

References:
BACKGROUND:
• Variables to consider: mechanisms of injury (blunt, gunshot, stab); vitals; signs of life
  • Vitals (VS) = palpable pulse or BP
  • Signs of Life (SOL) = pupillary activity, respiratory effort, or narrow complex QRS
• Best outcomes occur in penetrating cardiac wounds
• Worse outcomes occur in blunt abdominal trauma.

GOALS OF EDT:
• Release pericardial tamponade
• Control cardiac and/or great vessel bleeding
• Control broncho-venous air embolism
• Perform open cardiac massage
• Limit intra-abdominal hemorrhage via aortic cross-clamping

TECHNIQUE:
• Ensure proper equipment and assigned roles within the team; exercise fluids and sharps precautions and communicate clearly
• Incise at 4 or 5th IC space from sternum to posterior axillary line (below nipple line in men, below inframammary crease in women)
• Initial incision through all subcutaneous tissue and down to chest wall.
• Intercostal muscles are incised with scissors
• Insert rib spreader. HANDLE toward the axilla.
• Sweep lung away
• Bluntly dissect mid-descending thoracic aorta circumferentially. NGT in the esophagus will help differentiate esophagus from aorta
• Place aortic cross clamp
• Make longitudinal pericardiotomy MEDIAL to phrenic nerve to deliver heart from pericardial cradle
• Temporize wounds with suture or foley
• Cardiac massage if necessary
• Cardioversion with 10-20J if necessary
SBP < 60

Mechanism

Blunt

Vital signs in ED
(palpable pulse or BP)

No

Yes

ED THORACOTOMY

Penetrating

Signs of Life in ED
(pupillary activity; respiratory effort; narrow complex QRS)

Yes

Yes

No

No further action

No further action

ED arrival to thoracotomy within 5 min

OUTCOMES

<table>
<thead>
<tr>
<th></th>
<th>ED: No SOL</th>
<th>ED: SOL, No VS</th>
<th>ED: VS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLUNT</td>
<td>1%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>GSW</td>
<td>1%</td>
<td>3-5%</td>
<td>10-15%</td>
</tr>
<tr>
<td>STAB</td>
<td>3-5%</td>
<td>10-15%</td>
<td>30-40%</td>
</tr>
</tbody>
</table>
BACKGROUND:

• Thoracic injuries are very common occurring in up to 60% of poly-trauma patients and represent 25% of all trauma deaths.
• Hemothorax is found in approximately 300,000 trauma patients per year.
• Most hemothoraces can be treated with simple chest tube drainage with a larger bore CT (32 French or larger).
• Complications from hemothoraces include empyema and retained hemothorax (rHTX). Patients with rHTX have a higher likelihood of empyema.
• If a hemothorax is not drained well by a single chest tube placement, early VATS is now preferred over placement of a second chest tube.
  • For high risk operative candidates or if the volume of retained hemothorax is small, alternative treatment with intrapleural thrombolytics (see TPA protocol below) is an alternative to try to avoid VATS.
• The ideal timing for VATs is between first 3-7 days which reduces the likelihood of conversion to thoracotomy.

TPA Protocol:

- TPA 6 mg mixed in 50 mL NS infused under sterile conditions into the CT. Clamp CT for 30 minutes and drain.
- If necessary, can be repeated Q8 hours x 3 doses.
**Hemothorax on initial CT or CXR > 300 mL**

Yes

- Place 32 French or larger CT
- Single dose of Kefzol at time of CT placement
- Follow up CXR after placement

---

**Hemothorax fully evacuated?**

Yes

- 20cm Suction
  - CXR after 24hrs on suction

No

- Consider VATS

---

**Any residual PTX or Hemothorax?**

Yes

- < 48 hrs
- > 48 hrs

No

- Water seal
  - CXR after 24 hrs

---

**Non-contrast Chest CT**

- Consider VATS if HTX >200-300 mL

---

**TPA Chest Tube**

- Any residual Hemothorax?

  Yes

  - Alternative

  No
BACK/FLANK:
- Defined: between the tips of the scapulae and posterior iliac crests, posterior to the mid-axillary line
- Physical exam alone is unreliable, and DPL is unable to evaluate the retroperitoneum
- Triple contrast (oral, rectal, and IV) CT has sensitivity of 89-100% and a specificity of 98-100% in diagnosing intra-abdominal and retroperitoneal injuries

THORACOABDOMINAL:
- Defined: between a circumferential line connecting the nipples and tips of the scapulae superiorly, and the costal margins inferiorly
- Occult diaphragmatic injury is problematic in this patient group.

ANTERIOR ABDOMEN:
- Defined: anterior to the mid-axillary line, from the xiphoid process to the pubic symphysis
- Although controversial, serial abdominal exams in a patient with HD stability and non-peritoneal signs may be employed.
TRUNK STAB WOUNDS (Back, Flank, Abdomen)

Truncal Stab Wound

- OR decision within 5-10min

OR decision within 5-10min

OR

Yes

- Shock
- Peritonitis
- Evisceration

No

- Back/Flank
  - Tripe-Contrast CT
  - OR if positive

- Left Thoracoabdominal
  - Risk of missed injury to bowel and diaphragm. (Right side less likely since liver).
  - Laparoscopy

- Anterior Abdomen
  - Admit
  - Serial Physical Exam
  - CBC q8hrs

- Peritonitis
- Hemodynamic Instability
- Drop Hg > 3 gms
- Leukocytosis
- Persistent abdominal pain

- Yes

- OR

- No

- Observe ≥ 12hrs
- Discharge

References:

BACKGROUND:
• Only 5-10% of patients admitted to trauma centers with suspected abdominal injury will have abdominal injury.
• Abdominal injury requiring operative intervention occurs in 5-10% of all trauma patients.
• Physical exam alone is an unreliable mode of detecting intra-abdominal injury.
• Delay in diagnosis results in marked morbidity and mortality.
• Negative FAST does NOT exclude intra-abdominal injury.

INDICATIONS for Abdominal/Pelvis CT

• Spinal cord injury, altered consciousness, intoxication, distracting injury, or unreliable exam
• Significant abdominal pain or tenderness
• Gross hematuria
• Pelvic fracture
• Unexplained tachycardia and/or transient hypotension (even with normal FAST)
• Significant chest trauma
  • pulmonary contusion
  • greater than 2 unilateral rib fractures
  • scapular fracture
  • mediastinal hematoma

References:
• Fernandez L, et al. J Trauma 1998;45:841-848
Non-operative management (NOM) has become the standard of care for hemodynamically stable patients with low to moderate grade injuries (Grade I – III) lacking a contrast blush on initial CT scan.

NOM includes bedrest, telemetry monitoring, Hg/Hct check q6hrs, documented serial abdominal exams x 24 hours.

Predictors of NOM failure are associated with:
- Hypotension in ED
- Grade III injuries with contrast blush
- Grade IV/V injuries

95% of NOM failures happen within 72 hrs of injury.

All patients undergoing splenectomy or at high risk for splenectomy (including those who undergo main splenic artery embolization) should have pneumococcal, meningococcal, and Hib vaccines prior to leaving the hospital.

A decrease in Hg of <2g or significant change in abdominal exam should prompt a repeat CT, unless the patient is HD unstable.

The grade of injury should be documented in the H&P and the grading scale can be found in the trauma manual appendix.

Table 4. Splenic Injury Grading Scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Capsular tear, parenchymal depth &lt;1 cm</td>
</tr>
<tr>
<td>II</td>
<td>Capsular tear that does not involve a trebeicular vessel, depth 1-3 cm</td>
</tr>
<tr>
<td>III</td>
<td>Laceration involving trebeicular vessels, parenchymal depth &gt;3 cm; ruptured subcapsular or parenchymal hematoma, intraparenchymal hematoma &gt;5 cm or expanding</td>
</tr>
<tr>
<td>IV</td>
<td>Laceration involving segmental or hilar vessels producing major devascularization, &gt;25% of spleen</td>
</tr>
<tr>
<td>V</td>
<td>Shattered spleen or hilar vascular injury that devascularizes spleen</td>
</tr>
</tbody>
</table>
BLUNT SPLENIC TRAUMA

HD Stable?

Yes

Abdominal CT

Yes

Splenic Injury

Grade I – III with No blush

Observe

Grade I – II with blush

Consider IR if >2g Hgb drop

Grade IV/V or Grade III with blush

Consider OR

• If continued bleeding and stable, consider repeat CT.
• If continued bleeding and unstable, then OR

• IR embolization is reasonable alternative especially if poor operative candidate

References:

• Crawford RS, et al. Surgery 2007;142:337-41

Rev. 6/10
BACKGROUND:
- CT scan is the best noninvasive test for diagnosing blunt bowel and mesenteric injury (BBMI), aka hollow viscus trauma.
- Oral contrast does not need to be routinely administered as it does not add to the specificity of the test at time of initial evaluation.
- High index of suspicion if “seatbelt sign” or lumbar spine anterior compression fracture (potential injury to duodenum, jejunum, or pancreas)
- A single CT finding suggestive of BBMI had 35% chance of having BBMI. Two CT findings were associated with BBMI in 80%.
- If patient has more than minimal free fluid without solid organ injury seen on CT scan, hollow viscus injury must be considered.
- In some instances of minimal to trace free fluid and suspicious mechanism, serial abdominal exams over 24 hours can be performed.
- Additionally, if repeat CT scan is performed following initial CT scan for concern of delayed presentation of hollow viscus injury, oral contrast should be administered.
CT Scan Findings

- Pneumoperitoneum
  - Extravasation of contrast

If Yes, OR

No

- Free fluid in the absence of solid organ injury
- Bowel wall thickening
- Mesenteric fat streaking
- Mesenteric hematoma

If NO, Observe

If 1 finding, OR

- Serial exams
- CBC q6hrs
- Consider repeat CT in 6hrs with oral contrast

If 2+ findings, OR

- Worsening exam
- Increased WBC
- Decreased Hg/Hct
- Fever
- Failure to clear acidosis
- Worsened CT findings

Secondary OR decision within 12-18 hrs

References:
BACKGROUND:
• Important to classify as intraperitoneal or extraperitoneal.
• Need to rule-out rectal injury in all transpelvic gunshot wounds and other penetrating pelvic injuries: digital rectal exam, proctosigmoidoscopy.
• Genitourinary tract injuries are often associated with rectal trauma. Hematuria should raise the level of suspicion for further workup.

ANATOMY:

INTRAPERITONEAL:
• Anterior and lateral surfaces of the upper 2/3 of the rectum (serosalized):

EXTRAPERITONEAL:
• Posterior surface and lower 1/3 of the rectum (no serosa)

MANAGEMENT:

INTRAPERITONEAL

• Management similar to colon injuries
• Primarily repaired with or without fecal diversion
• Broad spectrum antibiotics covering gram negative and anaerobes.

EXTRAPERITONEAL

• Leave untouched, diverting colostomy.
• If injury is easily visualized with minimal dissection, then primary repair
• Broad spectrum antibiotics covering gram negative and anaerobes.

References:
BACKGROUND:
• Force required to fracture pelvis is substantial
• Can be a source of significant blood loss
• Suspect lower GU trauma in all patients with displacement of pubic bone/pelvic ring

PRINCIPLES OF MANAGEMENT:
• Reduce pelvic volume: wrap pelvis (binder or sheet)
  • Level III recommendation – Recommended to do but no evidence to support this decreases blood loss or improves survival
• Control hemorrhage via IR techniques
  • Level I recommendations:
    • Hemodynamically unstable (ongoing transfusion and/or BD ≥ 4) with pelvis fracture and other causes excluded by CXR, FAST and/or DPL
    • HD stable patients with arterial blush on CT scan (> 2 cm and pelvic hematoma)
  • Level II recommendations:
    • Pts > 60 yo with major pelvic fractures (open book, butterfly segment, or vertical shear) irrespective of HD status
    • If repeat HD instability or continued hemoglobin drop following angiography with or without embolization, repeat angiography should be considered after other causes have been excluded
• FAST is good for ruling in bleeding in the presence of pelvic fracture but it is NOT good enough for ruling out bleeding with pelvis fractures in HD stable patients (Level I recommendation).
  • CT abdomen/pelvis is mandatory in HD stable patients with major pelvis or acetabular fractures (Level II recommendation).

References:
• Cullinane DC, et al. J Trauma 2011; 71:1850-1868
PELVIC FRACTURE

Unstable Pelvic Fracture

HD Stable?

Yes

CT scan

No

- Resuscitate with 1L crystalloid & 2u PRBC and 2u Liquid Plasma
- Bind pelvis
- Place central line and a-line (if possible)
- Urgent Orthopedic consult

Evaluate Alternative Sites of Bleeding

- CXR
- FAST
- Consider DPL (if FAST equivocal)

Positive

Negative

HD Stable?

No

- Consult IR

Yes

- CT scan abd/pelvis
- Consider operative pelvic fixation

- Become unstable
- > 60 with major fx
- HD stable with blush > 2cm

Blush < 2cm

Blush > 2cm

HD stable

Observe

Consult IR

HD unstable

Consult IR

Angio/Embo

Rev. 6/12, 3/18
BACKGROUND:
• Limb salvage requires prompt diagnosis and timely reperfusion.

• Factors associated with high rates of limb loss include:
  • Treatment delay >6 hours
  • Blunt mechanisms (more transfer of kinetic injury)
  • Popliteal artery injuries
  • Associated injuries especially those with significant soft tissue loss, nerve injury, and/or bony fractures
  • High velocity gunshot (hunting/military weapons) or close-range shotgun wounds
  • Pre-existing vascular disease
  • Failure or delay in Fasciotomy
  • Presenting with frank ischemia
  • In profound shock on arrival to trauma bay

• Fasciotomy should be considered in all patients in whom time to reperfusion approaches 4-6 hours

• For any injury with potential for peripheral vascular injury, you must document a detailed vascular exam, neurologic exam (motor and sensory), and a soft-tissue exam.
  • Vascular exam includes documenting pulses proximal and distal to area of suspected injury.

• Vascular injuries associated with particular orthopedic injuries:
  • Knee dislocation/Tibial plateau fracture – Popliteal artery
  • Femur fracture – Superficial femoral artery
  • Supracondylar humerus fracture – Brachial artery
  • Clavicle fracture – Subclavian artery
  • Shoulder dislocation – Axillary artery

References:
PERIPHERAL VASCULAR INJURY

Suspected Injury – Perform Detailed Vascular, Neurologic, & Soft-Tissue Exam

Hard Sign of Injury:
• Absent pulse
• Active hemorrhage over vessel
• Expanding or pulsatile mass
• Thrill or bruit
• Distal ischemia (pain, pallor, paralysis, paresthesias, poikilothermia [cool])

Yes
Immediate OR & Vascular Consult

No
Perform ABI

If ABI normal - observe

Abnormal ABI (ABI <0.9) or wax/waning pulse: Consult Vascular Surgery

No immediate OR needed for other injuries
CT-Angio of affected limb with run-off

Immediate OR needed for other injuries
Place on Angio table in OR and start with on-table angiogram

Injury identified & Vessel Repaired

Time to revascularization <4hrs
ICU for Q1hr x 24 hrs for Vascular Checks

Time to revascularization >4hrs
Consider Fasciotomy

How to perform Ankle-Brachial Index (ABI):
• Use a doppler to identify the proximal and distal arterial signal around the area of suspected injury
• Measure the systolic blood pressure in the arm and ankle by doppler
• Compare the ankle SBP/brachial SBP in the affected limb to the unaffected limb

Rev. 6/12
BACKGROUND:
- Condition in which the perfusion pressure falls below the tissue pressure in a closed anatomic space, with subsequent compromise of tissue circulation and function
- As many as 45% of all cases are caused by tibial fractures
- Other causes include long-bone fracture, vascular injury, crush injury, drug overdose, and a tight cast or dressing.
- The earliest and most important symptom is pain greater than expected due to injury alone
- The 5 Ps (pain, pallor, paresthesias, paralysis, pulselessness) are usually late signs

ANATOMY COMPARTMENTS:
- Anterior: Deep peroneal nerve (dorsiflexion, sensation 1st and 2nd toes)
- Lateral: Superficial peroneal nerves (eversion, lateral foot sensation)
- Deep Posterior: Tibial nerve (planterflexions); posterior tibial artery, peroneal artery
- Superficial Posterior: Sural nerve

TECHNIQUE – MEASURE (STRYKER SYSTEM):
- Intercompartmental pressures greater than 30mmHg warrant decompression.
- “Normal” compartment pressures should not preclude fasciotomy in patients with obvious findings of compartment syndrome
- For Stanford Hospital, the Stryker can be found in the ortho cast room.
- Prep and drape extremity, knee 30° flexion, ankle 90° flexion
- Setup the transducer and follow instructions with the kit.
COMPARTMENT SYNDROME – EXTREMITY

**Risk Factors**
- Tibial shaft fracture
- Crush or Vascular injury
- Reperfusion injury
- Shock resuscitation
- Abdominal Compartment Syndrome

**Measure Compartment Pressure**
- **< 20mmHg**
  - Observe

- **20-30mmHg**
  - Assess Perfusion Pressure*

- **> 30mmHg**
  - *Perfusion pressure = MAP – compartment pressure
  - If < 40mmHg, then 4 compartment fasciotomy
  - If > 40mmHg, then serial measurements q2hrs until stable

**STRONG CLINICAL SUSPICION**
- No
- Yes
- 4 compartment fasciotomy

**Measure Compartment Pressure**
- Yes
- No

**Observe**
- Yes
- No

---

*Perfusion pressure = MAP – compartment pressure
- If < 40mmHg, then 4 compartment fasciotomy
- If > 40mmHg, then serial measurements q2hrs until stable
**TECHNIQUE – Fasciotomy:**

- Longitudinal lateral incision midway between the tibia and fibula overlying the intermuscular septum separating the anterior and lateral compartments. Incision extends from 1cm below the fibula head (to avoid injury to the common peroneal nerve) to above the ankle.
- Using Mayo scissors, open the fascia of both the anterior and lateral compartments.
- Longitudinal medial incision is made 2cm posterior to the tibia edge to decompress the superficial posterior compartment. Open the fascia overlying the superficial compartment. Avoid injury to the greater saphenous vein.
- Detach the soleus from the posterior surface of the tibia to decompress the deep posterior compartment. Avoid injury to the posterior tibia vessels.
- Early closure (5-7 days) reduces wound infection.
- Monitor for rhabdomyolysis. IV hydration to maintain adequate urinary output (at least 1-2 ml/kg/h), follow serial creatinine kinase (CK) levels.

**Incisions for four compartment lower extremity fasciotomy**

**Two incision leg fasciotomy**

The two incision four-compartment fasciotomy uses medial and lateral longitudinal incisions that are 12 to 20 cm in length. The lateral incision is centered between the fibular shaft and the spine of the tibia. The medial incision is placed 1 to 2 cm medial to the tibial margin. A single incision fasciotomy uses the lateral of these incisions.

The medial and lateral incisions are depicted. Arrows represent the subcutaneous flaps that will be developed to gain access to the respective compartments. The four compartments to be decompressed are outlined in color. The approximate location for the fascial incision for each compartment is represented by a black line.
BACKGROUND:
• Trauma is the leading cause of non-obstetrical maternal death
• Life threatening maternal trauma associated with 50% fetal loss
• Less severe injuries still have fetal loss rates of up to 5%

BLUNT TRAUMA:
• Placental Abruption: Over 50% of fetal losses are due to placental abruption (usually occurs within 6 hours of the event). Classic triad of frequent contractions, bleeding and abdominal pain occurs in fewer than half of cases. Ultrasound will identify placental clot only 50% of the time. If mother is hypotensive without a source, consider abruption.
• Uterine Rupture: Not common. Classic presentation is searing pain, and transabdominal palpation of fetal parts
• Fetal-Maternal Hemorrhage: Defined by fetal blood cells in the maternal circulation. All pregnant trauma patients with Rh (-) blood type should be considered for RhoGam within 72hrs.

PENETRATING TRAUMA:
• Associated with high fetal loss rates
• Cesarean section is frequently necessary

DETERMINING FETAL AGE:
• Evaluate fundal height
  • Below umbilicus – less than 20 EGA– NON-VIABLE
  • Above umbilicus – cm from pubis to fundus = weeks gestational age +/- 2 weeks

PERIMORTEM C-SECTION:
• Once there is maternal loss of vital signs, there should be an immediate consideration for the performance of a Cesarean section if the fetus is viable.
• Survival is optimized if performed within 4 minutes. If fetus is delivered >15 min after maternal death, fetal survival is only 5%.
INITIAL MANAGEMENT:
• Highest priority in a pregnant trauma victim is to evaluate and stabilize the mother

• Special considerations (ABC): Airway: mother increased risk for aspiration; Breathing: left shift fetal O₂ Hg dissociation curve, so minimal decreases in maternal SₐO₂ can compromise fetal oxygenation; and Circulation: a) mother can exhibit delayed manifestations of shock; b) supine positioning can compress IVC, thus position mother’s right hip on a pillow or IV bag to displace the uterus to the left

DETERMINING FETAL VIABILITY:
• Survival neonate delivered at 21 weeks is 0%; 25 weeks =75%.
• 50% of surviving newborns delivered < 25weeks have severe disabilities

RADIATION EXPOSURE:
• Rate of childhood leukemia increases from 1/3000 (background) to 1/2000 among children exposed to in-utero radiation

• Greatest potential risk is in the first trimester

• The concern for radiation, however, should not prevent medically indicated diagnostic x-rays from being performed on the mother.

<table>
<thead>
<tr>
<th>Estimated Fetal Exposure For Various Imaging Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plain Films</strong></td>
</tr>
<tr>
<td>Plain Films</td>
</tr>
<tr>
<td>Cervical spine</td>
</tr>
<tr>
<td>Upper or lower extremity</td>
</tr>
<tr>
<td>Chest (2 views)</td>
</tr>
<tr>
<td>Abdominal (multiple views)</td>
</tr>
<tr>
<td>Thoracic spine</td>
</tr>
<tr>
<td>Lumbosaecal spine</td>
</tr>
<tr>
<td>Pelvis</td>
</tr>
<tr>
<td>Hip (single view)</td>
</tr>
<tr>
<td><strong>CT scans (slice thickness: 10mm)</strong></td>
</tr>
<tr>
<td>CT scans (slice thickness: 10mm)</td>
</tr>
<tr>
<td>Head (10 slices)</td>
</tr>
<tr>
<td>Chest (10 slices)</td>
</tr>
<tr>
<td>Abdomen (10 slices)</td>
</tr>
</tbody>
</table>
OB Trauma Patient Response

- For any severe trauma (trauma 99) in a pregnant woman > 20 weeks the OB team should be called via the OB stat pager (call 211 and ask for an OB stat* to come to the ED)
  - The Stanford OB attending will cover all OB patients for code 99 until their primary OB can be contacted and present.
  - If the OB Stanford attending is not available the MFM (maternal fetal medicine physician) on call will be asked by the OB team to cover until the OB Stanford attending is available
  - Consider calling Neonatal Code Blue if emergent delivery will take place (call 211)

- For less severe trauma (codes 97,95) or in a patient < 20 weeks
  - The patient’s primary OB attending should be consulted via phone on the patient's arrival.
  - If the patient is a Stanford patient, the ED should call L&D, identify that the ED is calling for an OB trauma in a Stanford patient and ask to be connected to the OB attending on call immediately.

- If the OB Stanford attending is busy (in a c/s etc) they will delegate someone to respond.
  - An L&D nurse can be sent to the ED for fetal monitoring if indicated.

* OB stat will provide the following personnel: OB Stanford attending, OB chief resident, OB anesthesia attending, OB anesthesia resident, L&D Charge nurse, nursing supervisor
To ensure optimal patient care as well as a productive educational experience, the Trauma Critical Care staff have formulated the following guidelines. These policies cover the roles and responsibilities of each member of the Surgical Critical Care Team, specific policies regarding patient care, and other issues essential to the efficient running of the Surgical Critical Care Service.

The SICU is a closed ICU model and patients are transferred to the care of the critical care team on a full-time basis. Care is expected to be coordinated with the primary surgical and consulting care services, but patient management in the ICU, including order writing, formally resides exclusively within the domain of the ICU team.

Attendings are to be notified of all new admissions to the ICU.
Fellow/Resident/Medical Student Roles

*SICU fellow:* is the “team leader”, expected to function at the level of junior attending. As the most responsible physician on the team after the attending.

- SICU fellow is responsible for direct oversight of resident staff in the care of patients and in the performance of all procedures.
- The fellow is to perform an independent assessment of each patient admitted to the SICU, and develop a plan of care for each individual patient. In addition.
- SICU fellows are responsible for organizing monthly Surgical Critical Care journal clubs
- Attendance at M&M, TMAC, PPEC and PIPS is also required.
- They are encouraged to be involved in at least one research/quality improvement project.
- Each fellow will be provided a faculty mentor with whom they will meet on a quarterly basis.

The PGY-3 is the *Senior Resident* on the service.

- **Responsible for coordinating and leading rounds at the discretion of the attending or fellow**
- **Supervising and educating both residents and medical students.**
- Equitably divide workload among other residents and medical students.
- This includes running daily work rounds, review of the previous night’s work-ups including radiology studies and coordinating the care plan with the primary surgical and consulting services.
All residents are expected to participate in daily patient care, including independent assessment and documentation. **ICU progress notes must be documented using the Epic smart text, “IP ICU PROGRESS NOTE,” and all notes must be selected for attending co-signature. Under no circumstances is it acceptable to copy a medical student’s note in place of a resident’s progress note.**

**Fellow/Resident/Medical Student Roles**

Medical students will assist in all aspects of patient care as dictated by the senior resident. This includes patient assessment, documentation, and presentation during attending rounds. Students are also expected to deliver a Friday noon conference presentation on a critical care topic.

**Daily Rounds Structure**

- SICU and MICU fellows to divide the week and take turns to act as a “team leader” of the day
- Team leader to act as the junior attending, reviewing rounds with residents
- Fellows to give a bedside teaching point for each patient
- R3 resident is expected to review patient care plan with the fellows or attending after each patient encounter
- After conclusion of rounds, ideal to debrief and have the other fellow/s give feedback to the “team leader” fellow
- On-call night-shift resident to round and see each patient between 8-10pm and again at 4-6am to preemptively address any issues
Weekly Evaluation:
• Weekly evaluation in-person for both Fellows and residents to be performed by the SICU attending on Friday of each week.

Residents morning teaching sessions:
All residents are expected to attend mandatory MICU teaching sessions on Wednesday, Thursday and Friday from 8-830 am

General Policies
1. All residents will follow ACGME requirement for resident work hours
2. Attending rounds begin in the SICU at 10 am on Mondays and Tuesdays, and at 8 am Wednesdays through Fridays. Weekend times may vary, but must occur before 10 am
3. All admissions to and discharges from the ICU require approval of the ICU attending
4. Admission orders, except for patients admitted directly to the SICU, should be written by the primary surgical service and reviewed by a member of the SICU team
5. All transfer orders should be written by the accepting service and reviewed by a member of the SICU team prior to the patient leaving the ICU
6. Rounds must be conducted in the patient room at bedside.
7. Introductions must be done by team members on rounds, including identification and pager number of resident assigned to given patient.
8. The Daily Goal Sheet must be completed during rounds, preferably by the fellow. This document is meant to be used by all providers (physicians, nurses, respiratory therapists, and pharmacist), and is designed to improve communication and patient care
9. Available members from the SICU are expected to respond to all Trauma 99 activations
10. All trauma patients should have the tertiary survey form completed within the first 24 hours of patient admission
11. Unanticipated changes in patient condition must be communicated to the ICU attending and primary surgical services
12. All procedures performed in the ICU require documentation in Epic
11. For procedures in the ICU the hospital promotes the Universal Protocol to Prevent Wrong Site, Wrong Procedure and Wrong Person Surgery. It is expected, to the extent possible and appropriate, that the patient and team members will be involved in site marking and a “time-out” immediately before a procedure to verify the correct patient, procedure and site. For procedures requiring moderate sedation or anesthesia and a boarding pass must be completed by participating nursing staff. Invasive procedures not requiring sedation or anesthesia require only documentation of a time-out by the physician. Any exceptions, circumstances, etc. precluding the Universal Protocol MUST be documented in the medical record.

12. The Trauma Chief Resident is available at night for additional support in the ICU. If the Chief Resident is unavailable or more help is needed the fellow or ICU attending should be contacted.

13. All Trauma deaths must be referred to the coroner. Refer to the Epic “IP Death Certificate Worksheet,” for a complete list of indications.

14. A SICU representative is expected to attend the weekly multidisciplinary meeting to discuss patient needs. Meetings are held each Monday at 2 pm in the E2 conference room.

15. Conferences:
   - ICU Multidisciplinary Conference 2pm Mondays, weekly
   - Emergency Medicine/Trauma Conference, second Wednesday of the month, LKSC
   - Emergency Medicine/Critical Care Medicine Conference, third Wednesday of the month. LKSC
   - SICU RN/resident Journal Club, every other month
The following are a list of absolute indications for alerting the SICU attending:

- New admission or transfer to the ICU
- Unplanned intubation or respiratory failure requiring ventilator support
- Inability to oxygenate (pO2<60) or ventilate (acute increase in pCO2>10 mmHg)
- Unanticipated changes to a patient’s hemodynamic condition including persistent hypotension, new arrhythmia with hemodynamic instability, cardiac arrest, or CODE BLUE
- Development of a significant neurologic change (CVA, seizure, new onset paralysis)
- Medication or treatment errors requiring clinical intervention (invasive procedures, increased monitoring, new medications excepting Narcan)
- Unexpected blood product transfusions not previously discussed with attending, or activation of the Massive Transfusion Guidelines (MTG)
- Ongoing fluid resuscitation of greater than 4L crystalloid to maintain hemodynamic stability
- Initiation of new pressors, or continued escalation of pressor requirements (addition of an additional pressor, maximization of a single agent with ongoing hypotension)
- Any patient requiring an urgent operation (or return to OR) with any service

SICU CALL TREE

SICU Resident
5-3234

Senior Resident
Day ➔ Page SICU Senior Resident
Night ➔ Page Trauma Chief

Page SICU Fellow

SICU Attending*
*Attendings can be called at any time

ICU Rounds
Morning
10am Mon/Tue
8am Wed-Sun
Afternoon
4-6pm
Fellow check-in
9-10pm

Night check-in rounds w/ bedside nurses (resident)
8-10pm
Morning check-in rounds w/ bedside nurses (resident)
4-6am

Phone Numbers:
SICU fellow - pager
SICU attendings:
Spain 650-776-3912
Maggio 650-521-7453
Staud. 650-704-0631
Weiser 617-794-5887
Lorenzo 650-704-2825
Mohabir 650-804-4811
Browder 702-757-8276
Nassar 650-304-9548

Rev. 6/16
A number of order sets exist in EPIC for ICU patient care and these order sets should be utilized. They can be found under the following headings:

Use the following for admission orders:
- IP ICU Sur/Trauma ICU Admit

Use the following for ordering blood products:
- Massive Transfusion Adult (>50kg)
  - For massively hemorrhaging patients in the ED, OR, or ICU
- IP Emergency Release Blood Products
  - For hemorrhaging patients who can not wait for cross matched blood but do not require massive transfusion
- IP Lab Transfusion Service
  - For routine transfusion orders

Common additional routine order sets needed:
- IP ICU Electrolyte Replacement Scales (aka ICU)
- IP Insulin Continuous IV Infusion
- IP Insulin Transition Off IV Infusion
- IP Subcutaneous Insulin
- IP Gen Tube Feeding

Use the following for intubated patients:
- IP ICU Intubation
- IP ICU Sedation Vacation and Spontaneous Breathing Trial

Condition specific order sets:
- IP Neu Hypothermia After Cardiac Arrest
- IP ICU Sepsis Management
- IP ICU Pneumonia
- IP ICU COPD
- IP ICU Acute pancreatitis
- IP ICU GI Bleed
- IP ICU Rib Fracture (available soon)
EMERGENCY WARFARIN REVERSAL

Patient known or suspected to be on Warfarin with Life Threatening Hemorrhage

INR 1.4-1.6
- Vit K 5 mg IV + Liquid plasma 1-2 units

INR 1.7-1.9
- Vit K 10 mg IV + Liquid Plasma 1-2 units
- Re-check INR in 15-30 mins
- INR >1.4 @ 24 hrs, repeat Vit K 5 mg IV

INR ≥ 2.0
- Vit K 10 mg IV
- Kcentra: INR 2-4: 25 u/kg IV
- INR 4-6: 35 u/kg IV
- INR >6: 50 u/kg IV

INR ≤1.4
- INR q6hr until 2 consecutive readings ≤1.4

INR >1.4
- FFP if clinically indicated

option 1

option 2

1. Intracranial, intraocular, deep muscle with compartment syndrome, pericardial, active bleeding & shock

NB: repeat dosing with KCentra not recommended. Kcentra is contraindicated in patients with HIT.
General Care of Severe Head Injury (GCS 3-8):

1. Endotracheal Intubation/Mechanical Ventilation
   • Target:
     • $\text{PaO}_2 > 100 \text{ mm Hg}^\circ$
     • $\text{PaCO}_2 35-45 \text{ mm Hg}^*$
     • pH 7.35-7.45

2. Euvolemic Resuscitation – with NS.
   • Goal:
     • CVP 5-7 mm Hg
     • Na 135-145

3. Avoid hypotension (SBP<100 mm Hg)
   • Goal:
     • MAP ≥ 80 or SBP > 120 mm Hg

4. ICP Monitoring – ventriculostomy is preferred 
   • Goal:
     • CPP≥ 60 mm Hg

5. Seizure Prophylaxis (Phenytoin 1000 mg loading dose and 300 mg/day for 7 days in divided doses)

6. Normothermia (36.0-38.3°C)

7. Euglycemia (80-180 mg/dL)

8. Prophylaxis:
   • Stress ulcer prophylaxis
   • DVT Chemoprophylaxis by 72 hours with SQ heparin in the absence of contraindications

9. Short-acting sedatives/analgesics

10. Head of bed 30°

11. Avoid INR> 1.4, platelet count <75K and Hemoglobin <8 mg/dL

@ABG trumps O2 sat except when weaning. Goal $\text{SpO}_2$≥90%

*There is no role for prophylactic or prolonged hyperventilation to decrease ICP and it should be especially avoid in the first 24-28 hours.

#The guidelines recommend “ICP should be monitored with an EVD in all salvageable patients with GCS 3-8 after resuscitation with signs and symptoms of raised ICP, and considered in patients with severe head injury, normal CT scan, and two or more of the following on admission: age over 40 years, unilateral or bilateral motor posturing, or SBP < 100 mm Hg.”

The above interventions may be initiated in any appropriate order or simultaneously based on the clinical situation.
ICP MANAGEMENT

ICP Monitor

Target ICP ≤ 20, CPP ≥ 60

ICP ≥ 20 CPP < 60

ICP < 20 CPP < 60

Hypertonic Saline ± Mannitol\textsuperscript{a}
Norepinephrine or Phenylephrine

Norepinephrine or Phenylephrine

Yes

ICP/CPP Controlled

No

Further Sedation / Consider Paralysis \textsuperscript{b}

Yes

ICP/CPP Controlled

No

Hypothermia and/or Barbiturate Coma with Continuous EEG \textsuperscript{c}

Yes

ICP/CPP Controlled

No

Consider Decompressive Craniectomy \textsuperscript{d}

References

\begin{itemize}
\item \textbf{a.} 3\% Saline per hospital protocol.

\textbf{Mannitol} 0.5-1.0 gm/kg over 10-20 mins. Check serum Osm and Na q 6°

\item \textbf{b.} Sedation: propofol (maximum dose = 80 mcg/kg/min). Alternatives include midazolam and dexmedetomidine

\textbf{Paralytics:} cisatracurium or vecuronium

\item \textbf{c.} Hypothermia: mild = 35-37° C; moderate 33-35° C.

\textbf{Barbiturate Coma} should be considered a temporizing measure, or in those who are poor surgical candidates. EEG for burst suppression monitoring

\item \textbf{d.} Decompressive Craniectomy All decisions regarding surgical intervention should be discussed with the attending neurosurgeon. In general, early surgical interventions may improve clinical outcome
\end{itemize}
<table>
<thead>
<tr>
<th>Score</th>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td>Combative</td>
<td>Overly combative or violent. Immediate danger to staff.</td>
</tr>
<tr>
<td>+3</td>
<td>Very Agitated</td>
<td>Agitated Pulls/Removes tubes or catheters. Has aggressive behavior towards staff.</td>
</tr>
<tr>
<td>+2</td>
<td>Agitated</td>
<td>Frequent non-purposeful movement. Patient ventilator dyssynchrony.</td>
</tr>
<tr>
<td>+1</td>
<td>Restless</td>
<td>Anxious or apprehensive but movements Not aggressive or vigorous.</td>
</tr>
<tr>
<td>0</td>
<td>Alert &amp; Calm</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td>Drowsy</td>
<td>Not fully alert, but has sustained (&gt;10 sec) awakening with eye contact, to voice</td>
</tr>
<tr>
<td>-2</td>
<td>Light Sedation</td>
<td>Briefly (&lt;10 sec) awakens with eye contact to voice.</td>
</tr>
<tr>
<td>-3</td>
<td>Moderate Sedation</td>
<td>Any movement (but no eye contact) to voice.</td>
</tr>
<tr>
<td>-4</td>
<td>Deep Sedation</td>
<td>No response to voice, but any movement to physical stimulation</td>
</tr>
<tr>
<td>-5</td>
<td>Unarousable</td>
<td>No response to voice or physical stimulation</td>
</tr>
</tbody>
</table>
Patients with ALI/ARDS

Basic Lung Protective Strategies (1)

Failing? (2)

Consider: Recruitment Maneuvers

Failing? (2)

Spontaneously Breathing?

Yes

No

Consider APRV

Failing? (3)

Consider PCIRV

Failing? (3)

Consider Flolan*

Failing?

Yes

No

Yes

No

Rescue Strategies:

HFOV
Proning
ECMO

1. Basic LPVS
ARDSNet ventilation strategy:
- Assist Control
- Vt 5-7 ml/kg PBW
- PIP <30-35 cm H2O

2. Criteria for failing LPVS
On LPVS 24-72 hrs and PaO2 <55 torr on ≥ 70% oxygen & PEEP >15
On LPVS <24 hrs and PaO2 <55 torr on 100% oxygen & PEEP > 20

Recruitment Maneuvers
Use 30-40 cm H2O x 30-40 sec.

3. General Failure Criteria
- PaO2 < 55 torr
- SpO2 < 88%

APRV
Refer to RT Care policy

F holan
See Epic Flolan Order Set

*Inhaled Nitric Oxide
iNO is no longer used routinely for severe hypoxia, but may be consider if due to intra-cardiac shunt and bleeding risk with Flolan is too high.
iNO Test
-15 min test on 20 ppm
-Requires at least 10% increase in PaO2

Rescue Strategies:

HFOV
Refer to RT Care policy
Proning
Recent evidence points to improvements in oxygenation; hospital does not yet have a protocol for this
ECMO
Absolute contraindication: on vent >10 days pre-ECMO
Evaluate, but low survival (<10%) on vent 7-10 days pre-ECMO
Refer to ECMO protocol
EMPIRIC ANTIBIOTICS IN THE SICU - PNEUMONIA

- Obtain cultures prior to initiation of antibiotics. Bronch or miniBAL recommended
- De-escalate once cultures and susceptibilities are confirmed
- Use Epic “ICU Pneumonia” orderset

**EARLY PNEUMONIA/VAP WITHOUT RISK FACTORS FOR MDRs, ONSET < 48H, OR INTUBATED ≤ 4 DAYS**

- **Treatment duration:** 8 days

<table>
<thead>
<tr>
<th>Anti-pneumococcal beta-lactam</th>
<th>OR</th>
<th>Respiratory fluoroquinolone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceftriaxone</td>
<td>OR</td>
<td>Levofloxacin or Moxifloxacin* (*Moxi preferred if suspected aspiration pneumonia)</td>
</tr>
</tbody>
</table>

**LATE HCAP/VAP WITH RISK FACTORS FOR MDRs**

- **Treatment duration:** 8 days.
  - Consider 15 days for non-fermenting GNRs (pseudomonas, acinetobacter, stenotrophomonas), or severely immunocompromised

<table>
<thead>
<tr>
<th>MRSA coverage</th>
<th>PLUS</th>
<th>Anti-pseudomonal beta-lactam</th>
<th>± Aminoglycoside or Fluoroquinolone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
<td>+</td>
<td>Piperacillin-tazobactam (Zosyn)</td>
<td>± Levofloxacin</td>
</tr>
<tr>
<td>Linezolid</td>
<td></td>
<td>Cefepime</td>
<td>± Tobramycin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meropenem (if high suspicion of ESBL)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aztreonam (penicillin allergic patients)</td>
<td></td>
</tr>
</tbody>
</table>

**MDR Risk Factors**
- Duration of hospitalization > 5 days
- Intubated > 4 days
- Prior antibiotics within last 90 days
- Chronic dialysis/indwelling lines
- High frequency contact with healthcare facility

- For **aspiration pneumonia**, include anaerobic coverage (e.g. Zosyn, Unasyn (ampicillin/sublactam), moxifloxacin, meropenem, metronidazole, clindamycin)
- Avoid using two agents from the same class, e.g., two beta-lactams
- For **MSSA**, nafcillin (or other beta lactam, e.g. Unasyn, Zosyn, cefazolin, ceftriaxone, cefepime) is preferred over vancomycin

- ATS/IDSA Guidelines, Am J Respir Crit Care Med 2005
- Chastre, J etal, JAMA 2003 290:19
- Esposito S et al, JAC 2012; 67: 2570 – 2575
- Wunderink RG et al, CID 2012 Mar 1:54(5)
ABDOMINAL INFECTIONS: SECONDARY PERITONITIS (BOWEL PERFORATION, RUPTURED APPENDIX, RUPTURED DIVERTICULA)

* Obtain cultures prior to initiation of antibiotics
* De-escalate once cultures and susceptibilities are confirmed

<table>
<thead>
<tr>
<th>Mild to moderate</th>
<th>Severe</th>
<th>Optional coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ertapenem</td>
<td>Piperacillin-tazobactam (Zosyn)</td>
<td>- MRSA: In those at high risk (e.g. vancomycin, linezolid)</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>Meropenem (*if ESBL likely)</td>
<td>- Antifungal: Continued evidence of systemic infection while on antibacterial therapy, especially if colonized with candida (e.g. fluconazole)</td>
</tr>
<tr>
<td>Cefoxitin (*no enterococcus activity)</td>
<td></td>
<td>- VRE: Patients whom VRE has previously been recovered, previous receipt of antibiotics that select for <em>Enterococcus</em> species, immunocompromised/liver transplant patients (e.g. Linezolid)</td>
</tr>
</tbody>
</table>

Treatment duration:

<table>
<thead>
<tr>
<th>Description</th>
<th>Treatment Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Established infections</td>
<td>4 - 7 days</td>
</tr>
<tr>
<td>- If inadequate source control</td>
<td>Treat until afebrile and with normal WBC for 48 hours</td>
</tr>
<tr>
<td>- For culture-positive fungal infections or immunocompromised patients</td>
<td>14 - 21 days</td>
</tr>
<tr>
<td>Bowel injuries attributable to penetrating, blunt, or iatrogenic trauma that are repaired within 12 h</td>
<td>&lt; 24 hours</td>
</tr>
<tr>
<td>Intraoperative contamination of the operative field by enteric content</td>
<td>&lt; 24 hours</td>
</tr>
</tbody>
</table>

- Solomkin JS et al, CID 2010; 50:133–84
- Esposito S et al, JAC 2012; 67: 2570 – 2575
LINE (CATHETER-ASSOCIATED BLOODSTREAM) INFECTION

* Obtain cultures prior to initiation of antibiotics
* De-escalate once cultures and susceptibilities are confirmed

Short-term central venous catheter (CVC) or arterial catheter infection-related bloodstream infection

Complicated (suppurative thrombophlebitis, osteomyelitis, endocarditis, etc.)
- Remove line. Treat with systemic abx for 4 - 6 weeks; 6-8 weeks for osteomyelitis
- See abx choices under "Uncomplicated" section

Uncomplicated (bloodstream infection and fever resolves within 72 hours in a patient who has no intravascular hardware and no evidence of endocarditis or suppurative thrombophlebitis and for S. aureus is also without active malignancy or immunosuppression)
- S. aureus: nafcillin (2nd line: cefazolin or vancomycin)
- Enterococcus: ampicillin or gentamicin
- GNR: ceftriaxone
- Candida spp.: caspofungin or fluconazole (if susceptibility known)

MRSA: vancomycin
- Vancomycin susceptible: vancomycin ± gentamicin
- Vancomycin resistant CoNS: vancomycin

MISSA: nafcillin (2nd line: cefazolin or vancomycin)
- Ampicillin susceptible: ampicillin ± gentamicin
- Ampicillin resistant CoNS: nafcillin (2nd line: cefazolin or vanco)

E. coli and K. pneumoniae
- ESBL. Serratia or enterobacter: ertapenem or meropenem

VRE: linezolid or daptomycin

*Addition of gentamicin recommended for enterococcus endocarditis

**May use tobramycin or ciprofloxacin empirically for double coverage of pseudomonas until susceptibilities known, then de-escalate to single agent

Merani LA et al, CID 2009; 49:1–45
Complicated UTI and Urosepsis:
* Use Epic “IP Med/UTI/pyelonephritis” orderset
* Obtain cultures prior to initiation of antibiotics
* De-escalate once cultures and susceptibilities are confirmed

<table>
<thead>
<tr>
<th>COMPLICATED UTI AND/OR UROSEPSIS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community acquired UTI</td>
<td></td>
</tr>
<tr>
<td>• Ceftriaxone</td>
<td></td>
</tr>
<tr>
<td>• Ampicillin/sulbactam (Unasyn)</td>
<td></td>
</tr>
<tr>
<td>• Ciprofloxacin</td>
<td></td>
</tr>
<tr>
<td>• Levofloxacin</td>
<td></td>
</tr>
<tr>
<td>Nosocomial UTI</td>
<td></td>
</tr>
<tr>
<td>• Piperacillin/tazobactam (Zosyn)</td>
<td></td>
</tr>
<tr>
<td>• Cefepime</td>
<td></td>
</tr>
<tr>
<td>• Ceftazidime</td>
<td></td>
</tr>
<tr>
<td>• Ertapenem (*ESBL coverage)</td>
<td>Treatment duration:</td>
</tr>
<tr>
<td>• Meropenem (*ESBL coverage)</td>
<td>7 days if rapidly improvement</td>
</tr>
<tr>
<td>• Tobramycin</td>
<td>10-14 days if delayed response</td>
</tr>
<tr>
<td></td>
<td>May change to PO therapy once patient stabilizes (afebrile x24h)</td>
</tr>
<tr>
<td></td>
<td>- E.g. Ciprofloxacin, levofloxacin, Augmentin, Septra, ampicillin, cephalexin</td>
</tr>
<tr>
<td></td>
<td>Moxifloxacin and nitrofurantoin are not recommended</td>
</tr>
<tr>
<td>Candida (<em>yeast in urine DOES NOT necessarily indicate infection. Usually a colonizer. Do NOT treat if asymptomatic</em>)</td>
<td>When to consider treatment:</td>
</tr>
<tr>
<td>• Fluconazole (1st line)</td>
<td>- S/p renal transplant</td>
</tr>
<tr>
<td>• Amphot B ± fluocytosine</td>
<td>- Neutropenic</td>
</tr>
<tr>
<td>• AmpHOB bladder irrigation is generally not recommended but may be useful for fluconazole-resistant <em>Candida</em> species, especially <em>C. glabrata</em></td>
<td>- Urology patient with hardware</td>
</tr>
<tr>
<td></td>
<td>- High risk of dissemination</td>
</tr>
<tr>
<td></td>
<td>Treatment duration: 14 days</td>
</tr>
<tr>
<td></td>
<td>Caspofungin not recommended: low urine concentrations</td>
</tr>
</tbody>
</table>

Hooten et al, CID 2010; 50:625–663
EMPIRIC ANTIBIOTICS IN THE SICU – SEPSIS

* Obtain cultures prior to initiation of antibiotics
* Use Epic “ICU Sepsis” orderset

**Duration:**

- *Empiric antibiotics for 3–5 days:* Adjust/de-escalate once susceptibilities are available.
- **Duration of therapy typically 7–10 days;** longer courses may be appropriate in patients who have a slow clinical response, undrainable foci of infection, bacteremia with S. aureus; some fungal and viral infections or immunologic deficiencies, including neutropenia

- Treatment should be directed towards suspected source(s) of infection
- Avoid using two agents from the same class, e.g. two beta-lactams

<table>
<thead>
<tr>
<th>MRSA coverage</th>
<th>Anti-pseudomonal agent</th>
<th>±</th>
<th>Secondary agent for gram negative coverage</th>
<th>±</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
<td>Piperacillin-tazobactam (Zosyn)</td>
<td>±</td>
<td>Tobramycin</td>
<td>±</td>
<td>Depending on source, consider:</td>
</tr>
<tr>
<td>Linezolid</td>
<td>Cefepime</td>
<td></td>
<td>Levofloxacin (has atypical coverage)</td>
<td></td>
<td>Candida: Caspofungin</td>
</tr>
<tr>
<td></td>
<td>Meropenem (if high suspicion of ESBL)</td>
<td></td>
<td>Ciprofloxacin</td>
<td></td>
<td>Meningitis*: - Ampicillin+ceftiraxone - Acyclovir</td>
</tr>
<tr>
<td></td>
<td>Aztreonam (penicillin allergies)</td>
<td></td>
<td></td>
<td></td>
<td>*Use meningitis dosing</td>
</tr>
</tbody>
</table>

*Consider *empiric* double coverage in severely immunocompromised, shock, and/or those at high risk of MDR organisms.

**SHC 2012 susceptibilities (%)**

<table>
<thead>
<tr>
<th></th>
<th>Zosyn</th>
<th>Cefepime</th>
<th>Levofloxacin</th>
<th>Cipro</th>
<th>Meropenem</th>
<th>Tobramycin</th>
<th>Aztreonam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>94</td>
<td>87</td>
<td>76</td>
<td>79</td>
<td>88</td>
<td>93</td>
<td>76</td>
</tr>
</tbody>
</table>

Dellinger RP et al, CCM 2013;41(580-637)
DVT/PE Prophylaxis in Adults Following Multiple Trauma
Multiply injured trauma patients are at high risk for development of thromboembolic complications and should receive chemoprophylaxis as soon as it is safe. Without prophylaxis, the rate of VTE (venous thromboembolism) is as high as 58% in high risk trauma patients. Accurate assessment of VTE risk is critical for proper prophylaxis. High risk patients who receive early chemoprophylaxis have only a 5% risk of VTE, whereas delays in initiating prophylaxis result in a marked risk elevation that exceeds a threefold higher risk if delayed beyond 4 days. When indicated, anti-coagulation should be immediate and continuous. Duration of therapy is dictated by the period of immobilization and therapy should continue through rehabilitation until ambulation is achieved.

Although chemoprophylaxis is associated with a low risk of bleeding (1-3% depending upon agent utilized), the benefit outweighs the risk for most trauma patients. However, for select patient populations the risk exceeds the immediate benefit and therefore, absolute contra-indications to chemoprophylaxis exist. These include intracranial bleeding (<=24hrs. post injury), incomplete spinal cord injury associated with hematoma, uncorrected coagulopathy, and active hemorrhage. There currently is no universally accepted timeframe in which initiating prophylaxis for neurosurgical/spinal cord injuries is absolutely safe and therefore, our local standard mandates spine service or neurosurgery consultation to determine initiation timeframe. However, most experts agree that in this select group, DVT prophylaxis may commence as early as 48-72 hours post injury.

For major trauma patients, low molecular weight heparin (LMWH) is the most effective means of protecting against DVT. Use of prophylactic IVC filters should be reserved for high risk patients that have a contraindication to chemoprophylaxis. In minor trauma patients requiring hospitalization, sequential compression devices (SCDs) and early ambulation alone are recommended as the risk of VTE is extremely low. Routine screening duplex ultrasound is not recommended and should only be performed in patients who are at high risk of VTE who have received suboptimal chemoprophylaxis.
DVT/PE PROPHYLAXIS FOR HIGH-RISK PATIENTS

High Risk Categories

1. TBI with mechanical ventilation
2. Pelvic Fracture
3. Complex LE fx
4. SCI
5. Venus Injury
6. Femoral Line >24hrs

Note it is not necessary to hold dosing of chemo prophylaxis for Ortho or General Surgery procedure unless spinal anesthesia is being used.

**If Renal Insufficiency (Cr>=2.5 or CrCl<30mI/min)
Unfractionated Heparin 5000 units SQ Q 12 hrs

Anticipated Contraindication >7 days-
SCDs + q week Duplex
And
Consider IVC filter
*Order study through Vascular lab
(Found in Epic under Vaslab)

Rev. 12/17
The role of adequate and timely nutritional therapy in the ICU cannot be overstated. Early nutritional support has been associated with reduced disease severity, diminished complications, decreased ICU LOS, and improved patient outcomes.

All appropriate patients will have enteral nutrition initiated by 24-48 hours and caloric goal to be reached by 72 hours after initiation.

A nutrition consult should be obtained for all candidates of total enteral (TEN) or parenteral (TPN) nutrition therapy.

For adequately nourished patients who have relative contraindications to enteral nutrition, do NOT recommend initiating early parenteral nutrition (reassess clinical status daily). Do not initiate TPN if low nutritional risk and contraindications expected to persist for less than one week.

Relative contraindications to enteral feeds include:
- Peritonitis
- Intestinal obstruction/severe or protracted ileus
- Mesenteric ischemia
- Major GI bleed
- Complicated or high output enteroenteric fisula
- Severe malabsorptive state
- Patients requiring neuromuscular blockade
- Patient requiring ongoing resuscitation with fluids and vasoactive support to maintain MAP > 60 mmHg (inadequate tissue perfusion)
Enteral Access: All feeding tubes will be confirmed radiographically, not by auscultation alone. Gastric access (NGT/OGT) is adequate for most patients. Post-pyloric placement will be determined necessary by one of the following:

- Gastric outlet obstruction
- Gastroparesis despite pro-kinetic agents or recurrent emesis
- Open abdomen patient
- Unable to maintain head of bed at ≥ 30 degrees
- Attending physician preference

Selection of Appropriate Enteral Formulation: Osmolite 1.2 Cal (no fiber) or Jevity 1.2 Cal (fiber enriched) is adequate therapy for most. Consider Glutamine (Impact Glutamine) in burn and trauma patients (avoid severe sepsis). Patients with ARDS/ALI should be placed on an enteral formulation characterized by an anti-inflammatory lipid profile and antioxidants (Pivot 1.5).

Metabolic Requirements:
General initial recommendations: 25 kcal/day of calories and 1.5 grams of protein/kg/day

May be calculated using indirect calorimetry or predictive equations (ie, Harris-Benedict, Ireton Jones, or Penn State equations).

- Conditions to consider obtaining indirect calorimetry include:
  - Extremely obese patients (Class III – BMI > 40 kg/m2)
  - Multiple organ dysfunction syndrome (MODS) / ARDS
  - Multiple or neurologic trauma / Burns
  - Severe sepsis
  - HIV patients
  - Malnourished patients, amputees, severe thyroid disorders, failure to respond to medical therapy.
  - Postoperative organ transplantation
  - Large or multiple open wounds
Peri-Procedural Guidelines For Enteral Nutrition

Hold On-Call to OR/Procedure:

*Principals*: Patients must have a secure airway, no planned manipulation of the GI tract and no prone positioning

1. Intubated patients (orotracheal, nasotracheal or tracheostomy) with a post-pyloric feeding tube or feeding jejunostomy tube should have nutrition continued until the OR/procedure. Feeding held during procedure.

2. Intubated patients (OT, NT, Trach) with a OG or NG (with sump) should have nutrition continue until the OR/procedure. OG/NG placed to suction on-call for the procedure. Feeding held during the procedure.

3. Intubated patients with a single lumen NG (no sump, keofeed that is not post pyloric, PEG), nutrition should be stopped on call to the OR and aspiration of gastric contents should be done with a syringe.

Hold 6 hours Prior to OR/Procedure

1. Intubated patients undergoing a procedure that involves manipulation of the airway or GI tract (exchange of the ETT, tracheostomy, laryngectomy or any abdominal surgery), feeding should be discontinued 6 hours prior to the procedure. Feeding tube should be flushed and residual aspirated on call to OR.

2. Non-intubated patient on oral diet or receiving pre-pyloric tube feeding should have their tube feeding held 6 hour prior to the OR.

References:
1. Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient. ASPEN. JPEN, 2016;40(2);159-211
2. Pousman RM, et al. Feasibility of Implementing a Reduced Fasting Protocol for Critically Ill Trauma Patients Undergoing Operative and Nonoperative Procedures. JPEN, 2009;33;176
Critical Care Patients with Expected ICU LOS >2-3 Days

- Protein calorie malnutrition? (c)
  - Yes
    - NPO ≥ 7 days?
      - Yes
        - TEN(b)
          - Initiate at 20 ml/hr and advance by 20 ml/hr q 6 hr to goal
          - Obtain gastric residuals (GRV) and assess for signs of intolerance (SOI)(d) q 4 hr
          - Replace residual
          - Hold TF
          - Recheck GRV after 2 hr
        - GRV ≥ 400ml or SOI?(d)
          - Yes
            - Replace residual
            - Advance TF rate by 20 ml/hr or goal
            - Once at goal, check GRV q 4 hr x 24 hr
          - No
            - Replace residual
            - Restart TF at previous rate
            - Recheck GRV after 2 hr
  - No
    - Yes
      - Contraindication to EN(a)
      - TEN(b)
      - Replace residual
      - Hold TF
      - Recheck GRV after 2 hr

Consider Prokinetic:
- E-mycin 200 mg IV or per tube q 6 hr
- Metoclopramide 10 mg q 6 hr

If GRV persistently ≥ 400 and/or SOI consider:
- Gastroparesis, then SB access
- Ileus, then TPN

Standard (No TPN)
Definition: “An individual who has sustained irreversible cessation of all functions of the entire brain, including the brain stem, is dead.”

The Uniform Determination of Death Act, AMA, 1980.

(1) Required criteria prior to diagnosis:
- Known mechanism of injury
- Normothermia (>34°C)
- Normotension (SBP >80mmHg)
- Absence of CNS depressants, paralytics or confounding drugs (ie., sedatives)
- Absence of significant metabolic and/or electrolyte abnormalities

(2) Loss of brain stem reflexes:
- pupillary reflex (check with magnifying glass if necessary)
- corneal reflex
- oculocephalic reflex (doll’s eyes)-no movement of eyes with fast turn of head
- oculovestibular reflex (cold calorics)-have HOB at 30 degrees, no movement of eyes after instilling ice water in ear, use 5 min interval between sides.
- cough reflex (gag not reliable)-test cough with deep ET suctioning (to carina)
- response to painful stimuli (excluding spinal reflexes)-supraorbital nerve, TMJ pressure or nail bed pressure
- spontaneous respirations
- If brainstem reflexes negative, proceed with apnea exam- may need to correct BP with fluid boluses or pressors in SBP < 90
- C-spine fracture above C4 may not have intact diaphragm function and may preclude a reliable apnea test therefore consider EEG or other test of cerebral blood flow.
Apnea exam:

- Adjust ventilator settings to normalize ABG, esp pCO₂ (35-45)
- Pre-oxygenate with 100% O₂ for 10-15 minutes
- Disconnect ventilator but oxygenate patient with 100% O₂ by T-piece***
- Observe for spontaneous respirations
- After 10 min of apnea, draw ABG
- Hyperventilate for 2 min then reconnect ventilator and return to previous settings

*** Abort if patient becomes unstable (SaO₂ <80%, hypotension, arrhythmias). Immediately draw an ABG, hyperventilate patient, and then reconnect to the ventilator.

DOCUMENTATION OF BRAIN DEATH:

- Two different licensed physicians (independent of the transplant service) should document brain death. Two notes are needed; however, only one documented apnea exam is necessary.
  - Stanford (attending and/or fellow, one physician must be from neurology or neurosurgery)
  - SCVMC -attending

- Clearly document the following: 1) absence of aforementioned brain stem reflexes, 2) pCO₂ > 60 during apnea exam, and 3) that “the patient is brain dead”
- The two brain death notes must have a date and time. Second note is the legal time of death.
- Consider alternative studies (e.g. EEG, CBF, and/or cerebral angiography) if unable to perform apnea exam (e.g. patient instability or pentobarbital coma).
ECMO can be used for respiratory (V-V) and/or cardiac (V-A) support.

**V-V Indications:**
1. Severe Respiratory Failure despite and after optimal treatment.
   • Must meet **ALL** of the following criteria:
     • Mechanical Ventilation <=7 days
     • PaO2/FiO2 <80 on 100% FiO2 –or-
       PaO2/FiO2 <100 on 100% FiO2 **with** PaCO2>100 mmHg for >1 hour
     • Murray Score >=3
   • Common causes of Severe Respiratory Failure include:
     • severe pneumonia, ARDS, acute lung (graft) failure after transplant, pulmonary contusion, smoke inhalation, status asthmaticus, and airway obstructions.
2. Bridge to lung transplant
   • Must already be active on transplant list –or-
     decompensate during the initial evaluation process
   • Absence of other established organ dysfunction including:
     • Renal failure
     • Severe liver failure
     • Systemic infection

**V-A Indications:**
1. AMI refractory to convention therapy including IABP
2. Post cardiac surgery – failure to wean from bypass
3. Myocarditis with significant heart failure
4. Early graft failure: post heart/heart-lung transplant
5. Massive PE
6. Bridge to VAD or cardiac transplantation
Contraindications to ECMO initiation:

- Absolute Contraindication to ALL forms of ECMO:
  1. Age > 65 years
  2. Non-recoverable cardiac disease
  3. Non-recoverable pulmonary disease
  4. Non-recoverable neurologic disease
  5. Active end-stage malignancy
  6. BMI>40
  7. Advanced liver disease or ESRD

- Relative Contraindications to ALL forms of ECMO:
  1. Trauma with multiple bleeding sites
  2. Multiple organ failure

- Absolute V-V ECMO Contraindications:
  1. Severe pulmonary hypertension (mPAP > 50mmHg)
  2. Severe right or left heart failure (EF<25%)
  3. Cardiac arrest

- Absolute V-A ECMO Contraindications:
  1. Aortic dissection
  2. Severe aortic valve regurgitation

ECMO Inclusion Criteria for Cardiogenic Shock

Major Comorbidities/Contraindications
- ESRD (on dialysis or Cr>3)
- Cirrhosis (any grade)
- Previous stroke or new deficit
- Severe PVD
- Age > 65 years old

CPR

- No
- Yes

Candidate for emergent ECMO

< 30 min of witnessed CPR

- No
- Yes

Unwitnessed CPR or > 30 min of CPR

- No
- Yes

Awake after CPR with negative neurologic exam

Not Candidate for emergent ECMO

When a Patient dies, you may be asked to pronounce the patient.

Death Exam and Pronouncing a patient
1. Check ID bracelet
2. Check pupils for position and response to light
3. Check response to tactile stimuli
4. Examine respectfully: No pinches or nipple twists
5. Check for spontaneous respirations
6. Check for heart sounds and pulses
6. Record time of death

Make sure to call the family and any teams that were taking care of the patient.

For documentation, go through the “Discharge as Deceased” tab in Epic. Fill out the “Death Certificate” flow sheet with all the relevant information. All deaths should be reported to the Coroner, and all the Traumas are Coroner’s cases. The phone number to call is (408) 793-1900. The nurse will call CTDN. Write a Death Summary and discharge the patient as deceased.
PEDIATRIC
Trauma Guidelines
Level I Pediatric Trauma Center

STANFORD

Trauma

Stanford
HEALTH CARE
STANFORD MEDICINE

Lucile Packard
Children’s Hospital
Stanford

March 2018
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Pediatric Surgery & Trauma Contacts

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May Casazza NP, Neurosurgery  pgr 18182
Megan Dombrowski NP, Pediatric Surgery  pgr 28107
Raji Koppolu NP, Pediatric Surgery  pgr 18426
Karley Mariano NP, Pediatric Critical Care  pgr 18746

**Pediatric Trauma Program Manager**
Melanie Stroud, RN  650-521-2904
Email: mstroud@stanfordchildrens.org

**Interim Pediatric Trauma Coordinator**
Brittney Bunnell, RN  714-330-9765
Email: bbunnell@stanfordhealthcare.org
LPCHS Contacts

**Pediatric Radiology Hotline:** For CT Scan Reads
- 0700 – 1700 Days, M-F 7-8757
- After-hours/Weekends 7-8758

**Lucile Packard Children’s Hospital Stanford**
LPCHS Nursing Supervisor 7-8430
LPCHS-OR 24/7 1-2820
LPCHS-OR RSN 1-2820
LPCHS Patient Placement (for beds) 5-7788
LPCHS Radiology Manager On-Call 24/7 18703 pgr
LPCHS Social Worker 7-8303
LPCHS Vascular Access 6-8417 ph 47422 pgr
LPCHS-Wound Care RN 650-815-5891
Pager 3-8222
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Pediatric Anesthesia Emergency 24/7 1-9706
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Pediatric ED Child Life 6-0896
Pediatric ED - desk 3-4422
Pediatric ED RSN 4-0057
PICU - desk 7-8850
PICU Fellow 1-9748
SCAN Consult 24/7 27226 pgr
Stanford ED - desk 3-7337
Stanford ED RSN 4-2243
Stanford Nursing Supervisor 6-1767
Stanford-OR 3-7251
Transfer Center 3-7342
PEDIATRIC TRAUMA ADMISSION REQUEST FROM OUTSIDE HOSPITAL

TRANSFER CENTER

TRANSFER CENTER WILL CONNECT REFERRING MD TO STANFORD TRAUMA SURGEON ON-CALL

STANFORD TRAUMA SURGEON TRIAGES CALL

Accepted?

YES

PT GOES TO ED FOR TRAUMA EVALUATION

TRANSFER CANCELLED

NO

DECISION TO ADMIT TO LPCHS (PICU bed always available)

Early alert and consult to Pediatric Neurosurgery for head/spine trauma

Trauma Service remains responsible for pediatric trauma patient throughout the ED phase of care

Pediatric Surgery assumes care of pediatric trauma patient at time of admission to LPCHS or at time of Trauma Attending to Pediatric Surgery

Attending face-to-face handoff
Admission determination:
• For admission to Stanford Health Care, pediatric patients must be at least 14 years of age and 80 pounds (36.4 kg)
• LPCHS admits pediatric patients <18 years of age and maternity patients

OR determination:
• Pediatric patients will transfer to LPCHS-OR from the ED for treatment.

• In the event that surgery is required immediately (less than 30 minutes from arrival in ED), and the Trauma Surgeon feels that transfer to the Stanford-OR is the most efficient plan of care for the patient, the Stanford-OR will receive the patient.

• In this case, the Pediatric Anesthesiologist and LPCHS-OR Team will come to the Stanford-OR to assist in the care of the pediatric patient.

• Care will be provided by the Stanford-OR Team until the LPCHS-OR Team arrives.

• The Stanford-OR Team will remain available to assist with patient care, as needed.
Pediatric Equipment available in Stanford-OR

• Broselow Code Cart
• Pediatric Trauma Cart
  o Pediatric downtime documentation pack
  o Pediatric cardiac pack
  o Pediatric neuro trauma pack
  o Pediatric general trauma pack
• Pediatric Anesthesia Cart

LPCHS-OR Response Team

• Circulating RN
• Surgical Tech
• Anesthesia Tech
• Pediatric Attending Anesthesiologist
• Pediatric Attending Surgeon

Stanford-OR needs to provide:

• For emergent pediatric Cardiac case
  o Slush drape & Slush machine
  o Internal defib paddles (Sizes 1.0, 1.6, 2.0, 2.7)
• For emergent pediatric Neurosurgery case
  o Craniotomy set
  o Midas drill
  o Solution warmer drape
Pediatric MTG Activation Criteria

- Pediatric patient requiring > 20 ml/kg of PRBCs in first hour of resuscitation.
- Pediatric patient with the high likelihood of requiring transfusion of > 0.1 units/kg of PRBCs within the first 12 hours of resuscitation.

Pediatric MTG Pack (<50 kg)

- 4 units of packed red blood cells (Blood group O or type-specific)
- 2 units of plasma
- 1 apheresis platelet stored at room temperature, NOT IN BLOOD COOLER

Process

- Have only one authorized provider place orders for emergency blood at a time, to prevent delays in releasing blood if duplicate/conflicting orders are placed.
- Place an Order for Emergency Blood *before* sending a courier for pickup
- Additional Information provided to Transfusion Service:
  - Type of emergency blood request
  - Minimum of two patient identifiers (patient name and medical record number or date of birth)
  - Name of responsible physician/surgeon
  - Location of nursing unit
  - Contact person and phone number
- Send courier for pick-up
Assemble equipment
• Utilize Broselow Tape and Cart
• Utilize Difficult Airway Cart for alternative airway supplies
• Call PEDIATRIC ANESTHESIA STAT at 211 for anticipated difficult airway

Airway/Alertness/Simultaneous C-spine stabilization
• Facial, cervical, laryngeal trauma
• Congenital anomalies and syndromes
• Maintain manual in-line c-spine immobilization
• The C-Collar can be opened during in-line-c-spine immobilization

Breathing and Ventilation
• Pre-oxygenate patient with 100% O2 by face mask.
• Assess chest rise
• Bag/valve/mask ventilate if no spontaneous breathing
• Use oral airway for unconscious patients to improve ventilation

Circulation with hemorrhage control
• Obtain intraosseous (IO) access if two peripheral IVs cannot be rapidly placed

Monitor
• Continuous cardio-pulmonary monitoring, cardiac rhythm and rate, pulse oximetry, and frequent BPs
Sedation and muscle relaxation:

**Vagolytic**
- Atropine 0.02 mg/kg IV
  - Consider using atropine as pre-medication when there is higher risk of bradycardia (e.g., when giving succinylcholine for neuromuscular blockade during intubation)

**Sedative**
- Etomidate 0.3 mg/kg IV
  - Decreases ICP, minimal CV effects
- Ketamine 1.5 mg/kg IV
  - Bronchodilator, increases BP and HR
  - Does not increase ICP

**Paralytic**
- Succinylcholine 2 mg/kg IV
  - Contraindications: glaucoma, penetrating eye injuries, skeletal muscle myopathies, history of malignant hyperthermia or pseudocholinesterase deficiency, patients with known hyperkalemia (recent laboratory results), or severe burns or crush injuries beyond the acute phase (>1 day old)
- Rocuronium 1 mg/kg IV
  - May have slower onset of action (30-90 vs 30-60 seconds) and is longer acting (28-60 vs 3-12 minutes) than succinylcholine
Intubation

- Utilize laryngeal manipulation (BURP maneuver) to visualize cords as needed
- Await full paralysis
- Intubate orally
  - Depth of intubation: 3 x ETT size
- Confirm ETT placement with auscultation and end-tidal CO2 device
- If second intubation attempt is required, hand over the procedure responsibility to a more experienced provider
- For multiple intubation attempts:
  - Call PEDIATRIC ANESTHESIA STAT at 211 for difficult airway
  - Consider airway alternatives from the Difficult Airway Cart (Bougie, Frova, Glide Scope, Endoscope, LMA, surgical cricothyrotomy, etc.)

Post-intubation

- Continuous end-tidal CO2 capnography
- Confirm proper placement of ET tube by CXR
- Maintain sedation
  - Propofol
  - Dexmedetomidine
  - Benzodiazepines and opioids

References

Pediatric RSI Flow Diagram for ED

Rapid Sequence Intubation for Pediatric Patients

- Pre-oxygenate
  - BVM if no spontaneous respirations

- Consider: Atropine Sulfate 0.02 mg/kg IV

- Sedation
  - Utilize laryngeal manipulation (BURP maneuver) to visualize cords as needed

- Etomidate 0.3mg/kg IV or Ketamine 1.5mg/kg IV

- Paralysis
  - Succinylcholine Chloride 2mg/kg IV or Rocuronium 1mg/kg IV

- Intubate, inflate cuff, check tube position

Approved: Pediatric ED Medical Director and Trauma Liaison
Pediatric Surgery Response to Trauma

Pediatric Trauma 99
• Stanford Trauma Service is responsible for pediatric trauma patient throughout the ED phase of care
• Pediatric Surgery assumes care of pediatric trauma patient at time of admission to LPCHS or at time of Trauma Attending to Pediatric Surgery Attending face-to-face handoff
• Pediatric Surgery Attending/Fellow will respond to the ED within 30 minutes (for children age ≤14 years)
• Pediatric Surgery Resident will respond to the ED within 30 minutes (for children age ≤14 years)

Pediatric Trauma 97
• Stanford Trauma Service is responsible for pediatric trauma patient throughout the ED phase of care
• Pediatric Surgery Team will assess Trauma 97 patients within 30 minutes of admission to PICU
• Pediatric Surgery Attending will assess Trauma 97 patients within 16 hours of admission to Acute Care

Documentation
• Trauma Flow Sheet – MD Name and ED arrival time stamp (Stanford-EPIC)
  • Tell the Recording RN your name and role upon arrival to ED
• Stanford Trauma H&P by Trauma Service (Stanford EPIC)
• Pediatric Trauma H&P by Trauma Resident with admission update (LPCHS-EPIC)

Trauma Tertiary Survey within 24 hours of admission
• All trauma patients admitted to PICU
• All Trauma Activations admitted to Acute Care
• Upon request of Admitting Sub-specialty Service for isolated injury
• All suspected Non-Accidental Trauma patients

Approved: Trauma PIPS, Pediatric Surgery Division, and Pediatric Trauma Medical Director, 2/16
Rev. 6/17
To facilitate patient care and to eliminate potential misunderstandings between various services caring for trauma patients, the Pediatric Trauma Service established the following guidelines regarding admission to and transfer of trauma patients between services.

- Patients with a mechanism for potential multiple system injuries should be evaluated by the Pediatric Surgical Services.
- Patients with multiple system injuries, hemodynamic instability, or spinal cord injuries will be admitted to the Pediatric Surgery Service.
- Admission to the pediatric surgical service is appropriate if an ongoing evaluation for occult injuries is in progress.
- Patients with single system injuries, without a mechanism for multiple system injury shall be directly admitted to the appropriate service.
- Once suspected occult injuries have been ruled out and the patient may be transferred from the Trauma Service to the appropriate Service.
Neurosurgery will respond to the ED within 30 minutes for the following:

- Significant penetrating injury to head
- Acute intracranial hematoma with >4mm midline shift
- Obvious, severe open cranial injury
- Comatose patient with unilateral fixed, dilated pupil
- Patient with traumatic intracranial or spinal injury needing emergent operative management

Approved: Pediatric Neurosurgery Division, 3/16

Orthopedic Surgery will respond to the ED within 30 minutes for the following injuries:

- Fractured or dislocated extremity without a pulse
- Any dislocation that could not be reduced

Approved: Orthopedic Surgery Division, 3/16
Roles & Response to Pediatric Trauma 99

**Emergency MD**
- Confers with ED RN to determine trauma activation status
- Initiates trauma survey and care

**ED-RSN or designee**
- Sends out pediatric trauma page by calling 211
- If Trauma 99, provides notification call with basic ring-down info to LPCHS-OR RSN (1-2820)
  - Age, mechanism, and known injuries
- Contacts Transfer Center (3-7342) to request Pediatric Critical Care Transport for transfers to LPCHS-OR or PICU, if needed

**Adult Trauma Surgeon**
- Responds to ED
- Leads trauma survey and resuscitation

**Pediatric Trauma Surgeon/Fellow**
- Responds to the ED for Pediatric Trauma 99 (for children age ≤14 years)
- Provides resuscitation consultation
- If emergent OR needed, provides notification call to LPCHS-OR ARC (1-9706 or 1-2820)

**PICU Fellow**
- Responds to the ED for Pediatric Trauma 99
- Role: Provides airway back-up assistance or supervision to ED Resident, as needed
- Remains in ED if patient requires active management
  - PICU Attending responds within 30 minutes to cover PICU
  - If assistance with active patient management is not needed, PICU Fellow returns to PICU
- Provides concurrent status updates to PICU and OR
- Transports unstable patient to LPCHS-OR
- Provides face-to-face IPASS hand-off to OR Team

Approved: 11/14 Pediatric Trauma Task Force, Stanford Trauma Service, Pediatric ED Medical Director, Pediatric Anesthesia Medical Director, PICU Trauma Liaison, and PICU Surgical Director
Roles & Response to Pediatric Trauma 99

PICU RSN or designee

- Receives Pediatric Trauma 99 page
- Ensures PICU Fellow and Attending are notified
- Works with PICU Fellow and Attending to plan for potential trauma admission, including:
  - Staffing
  - Bed availability
  - Pre-admission orders
  - Room preparation
- Coordinates PICU admission with ED or OR

Pediatric Anesthesia Attending

- Responds to the ED for Pediatric Trauma 99
  - Evaluates airway in conjunction with ED Physician and PICU Fellow
  - Coordinates with OR
- Receives IPASS hand-off from Surgical Team or PICU Fellow
- After-hours:
  - Attending receives page from OR RSN and responds to OR within 30 minutes
  - Calls PICU Fellow for update (1-9748)
  - Checks with OR RSN for Trauma Notification info

Anesthesia Resource Coordinator (ARC)

- Receives trauma page or call from OR RSN
- Alerts Anesthesia Attending to respond to ED
- Works with OR RSN to book case and designate OR room
- If no LPCHS-OR availability, calls Stanford ARC (6-0249)
Pediatric Anesthesia Resident or Fellow
- Available 24/7 to respond to ED
- Responsible for emergent OR room set-up
- After-hours: May start an emergent case under supervision of OB Anesthesia Attending prior to Pediatric Anesthesia Attending arrival

OB Anesthesia Attending
- After-hours:
  - Remains in contact with OR Desk to assist prior to Pediatric Anesthesia Attending arrival

LPCHS-OR RSN
- Receives Pediatric Trauma 99 page
- Receives Notification Call from ED RSN
- Works with ARC to book case and designate OR room
- After-hours: Pages OR Call Team via 222 system to document timing and sends text page

LPCHS-OR RN Call Team
- Receives call from LPCHS-OR RSN
- Sets up OR to receive trauma patient
- After-hours:
  - Receives page from OR RSN and responds to OR within 30 minutes
  - Provides Omnicell access for OB Anesthesiologist prior to Pediatric Anesthesia Attending arrival

LPCHS-OR Anesthesia Tech
- Receives call from LPCHS-OR RSN
- Sets up OR to receive trauma patient
- After-hours:
  - Receives page from OR RSN and responds to OR within 30 minutes
ED to LPCHS-OR Notification Phone Call

Call: 1-9706, Backup: 1-2820

I-PASS: Notification Phone Call to LPCHS-OR
Trauma/Surgical Attending to LPCHS-OR

ILLNESS SEVERITY
☐ Critical    ☐ Stable

PATIENT SUMMARY
Brief Intro:
Name, age, weight (if available), traumatic mechanism, known major injuries/emergent medical condition, Operation planned.
A. Airway (Compromised, difficult, intubated)
B. Breathing (PTX, HemoTX, chest tubes, O2 sats)
C. Circulation (most recent vitals, ACCESS, blood products given/ordered/MTG)

ACTION LIST
PREOPERATIVE PREPARATION
• What do you plan to do in ER prior to coming to the OR, including studies?
• ETA to OR?
• What do you think we will have to do in OR prior to start (Major lines/tubes)?

SITUATION AWARENESS
OPERATIVE PLAN
• Operation, anticipated surgical complications and blood loss

SYNTHESIS by receiver
• Does the receiver verbally accept the notification phone call?
I-PASS: Surgical Team or PICU Fellow to Operative Team
Face to Face Hand-off

ILLNESS SEVERITY
☐ Critical       ☐ Stable

PATIENT SUMMARY
Brief Intro: Age, weight, traumatic mechanism, known major injuries/emergent medical condition

A. Airway - Intubation in ER, difficulty with intubation, C-spine, facial fractures, etc.
B. Breathing - PTX, hemoTX, other chest findings, oxygenation/ventilation requirements
C. Circulation/hemorrhage control - Most recent vitals, resuscitation given thus far, blood products available and on order/MTP, IV Access and attempted access
D. Disability - GCS score, spine precautions, intracranial injury if any

Other injuries:
• Head to toe
AMPLE History, if available
• Allergies
• Medications at baseline and administered since arrival
• PMH/PSH
Recent lab values, pertinent pending labs
Lines and tubes:
• What patient has, what is needed

ACTION LIST
PREOPERATIVE PREPARATION
• Antibiotics
• Blood products

SITUATION AWARENESS
OPERATIVE PLAN
• Operation
• Blood loss
• Anticipated surgical complications

SYNTHESIS by receiver
Does the receiving OR team verbally accept and understand the handoff?
Pediatric Trauma Admission to LPCHS: Impact of Name Change on Blood Product Availability

- Pediatric Major Trauma 99 arrives in ED
- Patient is assigned “Doe” name and MRN
- O-neg blood & FFP is brought to bedside in ED prior to patient arrival

- If unstable patient transfers to LPCHS-OR or PICU:
  - O-neg blood & FFP transfers with patient from ED to LPCHS-OR or PICU
  - O-neg blood & FFP remains with patient until stabilized
  - Keep Doe Name & MRN until patient is stabilized

**Alert:**
- For patients new to LPCHS, access to the patient medical record and ability to place orders may be delayed while the Doe name and MRN are changed to patient given name during the admission process

- For least impact to downstream processes such as Lab and Transfusion Services, change the name after the patient transfers to the PICU and is stabilized post-op; confirm with PICU Attending prior to initiating name change

- Current EPIC processes do not allow charts to merge until after patient discharge.

Approved: Pediatric Trauma Task Force, 11/15
Revised 9/16
<table>
<thead>
<tr>
<th>Emergency Department</th>
<th>LPCHS Admitting Surgeon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pediatric Trauma with disposition LPCHS</td>
<td>If PICU</td>
</tr>
<tr>
<td></td>
<td>• Pediatric Surgery</td>
</tr>
<tr>
<td></td>
<td>• Neurosurgery</td>
</tr>
<tr>
<td></td>
<td>If Floor</td>
</tr>
<tr>
<td></td>
<td>• Pediatric Surgery</td>
</tr>
<tr>
<td></td>
<td>• Neurosurgery</td>
</tr>
<tr>
<td></td>
<td>• Orthopedic Surgery</td>
</tr>
<tr>
<td></td>
<td>• Other surgical service</td>
</tr>
</tbody>
</table>

Approved: Pediatric Trauma Task Force, Pediatric Trauma Medical Director, Pediatric Emergency Medical Director, Pediatric Trauma Neurosurgery Liaison, and PICU Trauma Liaison, 4/16
**Trauma patients are co-managed by the PICU and Pediatric Surgery or Neurosurgery.**

- Pediatric Surgery admits all injured children requiring PICU level of care and consults the appropriate subspecialty surgeons, as needed.
- Neurosurgery may admit injured children with confirmed isolated head or spine trauma.
- Evaluate need for Suspected Child Abuse and Neglect (SCAN) consult.
- The PICU manages the day to day needs and coordinates surgical consults and recommendations for care of the trauma patient.
- The PICU is the first responder in case of patient deterioration and manages appropriate resuscitative efforts.
- All major and critical decisions regarding patient clinical management are made collaboratively involving both the PICU and the admitting surgical specialty surgeons.

All trauma patients admitted to the PICU must have a Surgical/Trauma H&P as well as a Medical/PICU H&P authored by the respective team.

All trauma patients admitted to PICU must have a Trauma Tertiary Survey by Pediatric Surgery.

**Outside hospital trauma transfers:**

- Outside Hospital ED patients transferring for higher level of care must first transfer to the Stanford-ED for Primary and Secondary Trauma Surveys before admitting to the PICU
- Outside Hospital in-patients transferring for higher level of care must admit directly to PICU
  - Direct admits <24 hours post-injury require a full trauma evaluation by an ATLS certified Pediatric Surgery Attending, Fellow, or Resident within 30 minutes of arrival
  - Direct admits >24 hours post-injury require a full trauma evaluation by an ATLS certified PICU or Pediatric Surgery Attending or Fellow or Resident within 30 minutes of arrival
- The Transfer Center will direct requests for transfer of injured children to the Trauma Service in the ED; however, occasionally requests for direct transfer of injured patients from an Outside Hospital ED to the PICU slip through. Please refer these calls back to the Trauma Service through the Transfer Center.

C-spines are cleared by Neurosurgery or Pediatric Surgery Attendings or Fellows.
## Trauma Hand-off for T99 & T97

<table>
<thead>
<tr>
<th>ED discharge Home</th>
<th>Pediatric Trauma 97 Hand-off</th>
<th>Pediatric Trauma 99 Hand-off</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Stanford Trauma Service responsible for patient</td>
<td>• Stanford Trauma Service responsible for patient</td>
</tr>
<tr>
<td></td>
<td>• Call Peds Sx Fellow/Sr Res to arrange follow-up</td>
<td>• Call Peds Sx Fellow/Sr Res to arrange follow-up</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PICU or OR Admission</th>
<th>Trauma Resident to Peds Sx Fellow/Sr Res</th>
<th>Trauma Attending to Peds Sx Attending AND PICU Attending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Care Admission</td>
<td>Trauma Resident to Peds Sx Fellow/Sr Res</td>
<td>Trauma Attending to Peds Sx Attending</td>
</tr>
<tr>
<td>Pediatric Surgery Evaluation&lt;sup&gt;1&lt;/sup&gt;</td>
<td>≤16 hours if admitted to Acute Care by Attending&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Seen in ED by Attending</td>
</tr>
<tr>
<td></td>
<td>≤30 minutes if admitted to PICU by Trauma team</td>
<td></td>
</tr>
</tbody>
</table>

- Early alert and consult to Pediatric Neurosurgery for head/spine trauma
- Trauma Service remains responsible for pediatric trauma patient throughout the ED phase of care
- Pediatric Surgery assumes care of pediatric trauma patient at time of admission to LPCHS or at time of Trauma Attending to Pediatric Surgery Attending face-to-face handoff
- Utilize Trauma Service hand-off attestation via Stanford-EPIC dot phrase (.pedstrauma) to document hand-off to Pediatric Surgery AND PICU for any injured patient requiring PICU admission
- Pediatric Surgery will complete a tertiary survey within 24 hours of admission for all trauma activations.

---

<sup>1</sup> Applies to patients admitted to Pediatric Surgery trauma service

<sup>2</sup> Pediatric Surgery Attending to determine shorter time period for evaluation as dictated by patient clinical condition
Any Head Injury/Trauma with:

- Loss of Consciousness or seizure
- Abnormal findings on head CT
- Concussive symptoms with or without Loss of Consciousness
  - GCS <14
  - Agitation
  - Somnolence
  - Repetitive questioning
  - Slow response to verbal communication
  - Severe headaches
  - Vomiting
- Spine injury
- Consider Pediatric Neurosurgery consult for any patient <3 months of age

Reference:
Pediatric Emergency Care Applied Research Network (PECARN): Pediatric Head Injury/Trauma Algorithm

Approved: Pediatric Trauma Task Force and Pediatric Neurosurgery Trauma Liaison, 1/15
Revised: 3/16
**HIGH RISK**
- GCS ≤ 13
- Palpable skull fracture
- Altered Mental Status
  - Agitation
  - Somnolence
  - Slow response
  - Repetitive questioning

**MODERATE RISK**
- Scalp hematoma (excluding frontal)
- LOC or amnestic
- Change in behavior (subjective)
- Severe mechanism of injury
  - Fall > 3 feet
  - MVA with/ejection, rollover, or fatality
  - Bike/ped vs. vehicle w/o helmet
  - Struck by high-impact object

**LOW RISK**
- CT not indicated
- Observation

---

**Reference Radiation Level Designations**

<table>
<thead>
<tr>
<th>Relative Radiation Level*</th>
<th>Adult Effective Dose Estimate Range</th>
<th>Pediatric Effective Dose Estimate Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 mSv</td>
<td>0 mSv</td>
</tr>
<tr>
<td>☒</td>
<td>&lt;0.1 mSv</td>
<td>&lt;0.03 mSv</td>
</tr>
<tr>
<td>☒☒</td>
<td>0.1-1 mSv</td>
<td>0.03-0.3 mSv</td>
</tr>
<tr>
<td>☒☒☒</td>
<td>1-10 mSv</td>
<td>0.3-3 mSv</td>
</tr>
<tr>
<td>☒☒☒☒</td>
<td>10-30 mSv</td>
<td>3-10 mSv</td>
</tr>
<tr>
<td>☒☒☒☒☒</td>
<td>30-100 mSv</td>
<td>10-30 mSv</td>
</tr>
</tbody>
</table>

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as “Varies”. 

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References:
If the child is stable, conscious and communicative and has no high-risk mechanism or distracting injuries per NEXUS/CCR criteria, the ED/Trauma/Pediatric Surgery/Neurosurgery Attending or Fellow may assess for midline posterior c-spine tenderness and ROM.

If no tenderness, range of motion is full, and the child is neurologically intact, the ED/Trauma/Pediatric Surgery/Neurosurgery Attending or Fellow may clear the C-spine without X-rays. The child should not be taking any medications or drugs to alter neuro exam.

If the child is crying, moving all limbs, and moving the neck, they may have “cleared themselves”, in absence of painful distracting injury.

If the child is < 3 years old, developmentally delayed, or unable to communicate, consider pediatric neurosurgery consult if unsure NEXUS/CCR criteria are met.

If the child is unconscious, has distracting injuries, presents with motor or sensory deficits, or is inconsolable, place the child in rigid c-collar, if not already done. Proceed with neuroimaging (CT c-spine if stable) and consult pediatric neurosurgery.

- CT c-spine is more sensitive than plain film x-rays and is preferred if range of motion is limited.
- C-spine clearance will require CT c-spine and MRI to rule out ligamentous injury.

If positive for neurological deficit, high suspicion for spinal shock, or evidence of c-spine injury on imaging, child must be immobilized with a rigid c-collar and c-spine precautions must be used during transport. Consult pediatric neurosurgery.

All children with c-spine injury should be managed in PICU. Maintain normal BP, MAP or CPP goals for spinal cord perfusion.

References

Child in cervical collar

If patient is non-verbal or difficult to assess, consider Pediatric Neurosurgery consult

Meets ALL of NEXUS/CCR Criteria:
1. Normal level of alertness
2. No evidence of intoxication, no sedating drugs
3. No posterior midline cervical-spine tenderness
4. No focal neurologic deficit
5. No painful distracting injuries
6. No dangerous mechanism of injury (a)
7. Moves head in flex/ex and 45 degrees to both sides without pain

CT C-spine with 3D reconstruction OR X-ray 3 views (AP/LAT/OD) (b)

Type of imaging at discretion of practitioner based on clinical exam.

C-SPINE cleared by ED/Trauma/PSx/NS Attending or Fellow

NATIONAL NEUROSURGERY CONSULT

Recheck range of motion
Consider Flex/Ext X-ray

(a) Dangerous Mechanism is considered
- Fall from ≥ 3 feet or 5 stairs
- Axial load to the head (i.e. diving)
- MVC at high speed or rollover or ejection
- Collision involving a recreational vehicle or a bicycle

(b) 3 views of c-spine are considered adequate if C1-T1 are visualized and open-mouth odontoid view visualizes dens and C1 lateral masses. If inadequate or unable to perform plain films, obtain CT scan of C spine with 3D reconstructions.
Pediatric Blunt Cerebrovascular Injury

SIGNS AND SYMPTOMS OF BCVI
• Seat belt abrasion or soft tissue injury of the anterior neck resulting in significant swelling or altered mental status
• Cervical bruit
• Expanding cervical hematoma
• Focal neurologic deficit

RISKS OF BCVI
• Mechanism compatible with severe cervical hyperextension/rotation or hyperflexion, particularly if associated with
  • Displaced midface or complex mandibular fracture
  • Closed head injury consistent with diffuse axonal injury
• Near hanging resulting in anoxic brain injury
• Cervical spine fracture patterns: subluxation, fractures extending into the transverse foramen, fractures of C1-C3
• Basilar skull fracture with carotid canal involvement
• Diffuse axonal injury with GCS ≤ 6

IMAGING for BCVI
• Noninvasive imaging with CT angiography or MR angiography is considered the first-line imaging for arterial injury: Imaging is indicated for patients with any clinical sign or symptoms of BCVI, unexplained neurologic symptoms and asymptomatic patients with any of the mechanisms of injury.
• CTA: provides high spatial resolution and rapid assessment but exposes the patient to ionizing radiation
• MRA: can evaluate intracranial vasculature without radiation and be performed in conjunction with MRI for evaluation of hemorrhage and ischemia (lengthy study, may be difficult in emergent situation)

References:
**Pediatric Blunt Cerebrovascular Injury**

Adapted from adult protocol

**Grading Scale**

- Grade I – irregularity of vessel wall or a dissection/intramural hematoma with < 25% narrowing
- Grade II – intraluminal thrombus, dissection or intramural hematoma > 25% narrowing
- Grade III - pseudoaneurysm
- Grade IV – vessel occlusion
- Grade V – Transection or hemodynamically significant arteriovenous fistulae

*For Urgent MRI/MRA refer to Urgent Pediatric MRI for Trauma Guideline*
Urgent Pediatric MRI for Trauma (After-Hours)

ED/Trauma determines need for urgent Pediatric MRI

Ensures:
- Adequate resuscitation
- IV access
- Admission to LPCHS
- Transfer to LPCHS MRI
- Hand-off to MRI staff

Admit to LPCHS
- Pediatric Surgery – any trauma
- Neurosurgery – isolated head/spine

LPCHS Admitting MD must request after-hour inpatient exam by:
1. Place order in LPCHS-EPIC
2. Contact Radiology Resident/Fellow On Call via page operator for approval
3. Complete NPO instructions and Consent
4. Radiology Resident/Fellow must confirm approval with Radiology Attending

Approved by Radiology Attending

MRI cancelled

Estimated time 2-4 hours

Questions?
- Refer to LPCHS Procedure: After Hours Imaging Exams with Anesthesia
- Contact LPCHS Radiology Manager On Call at pager 18703

LPCHS MRI Tech contacts:
1. Pediatric Anesthesiologist On Call via pager operator
2. LPCHS Radiology Manager On Call at pager 18703
3. LPCHS OR Front Desk at 1-2820 to confirm availability of resources (Anes Tech, PACU)
4. LPCHS Nursing Supervisor at 7-8430

2021-1-5

Pediatric Trauma Medical Director, Pediatric ED Medical Director and LPCHS Radiology Manager
ABDOMINAL TRAUMA?
Any of the following?
- Abdominal Pain or Kehr's Sign on Exam
- Hypovolemic Shock
- Abd wall ecchymosis or abrasions
- History suggestive of abdominal injury
- Hematuria
- Unable to cooperate with exam
- Unconscious/MS changes

No

Further workup & treatment as clinically indicated

Yes

HCT, Type & Cross
Abdominal CT
With Grading of Injury

Liver/Spleen
Grade I – IV
Care Per Protocol

Grade I–II
Admit to Floor
Advance care per protocol

Grade III
Admit to PICU/Floor
Advance care per protocol

Grade IV
Admit to PICU
Advance Care per protocol

Liver/Spleen
Grade V or VI

Manage based upon
Clinical Assessment &
Potential for OR

Discharge Criteria Met?

D/C Home

Evaluate for eligibility for Lumason study within 48 hours of admission

Discharge Criteria
- Physiologically stable
- Adequate oral intake
- Independent to bathroom
- Pain controlled with oral meds
- Discharge teaching completed with family participation
- Return clinic appointment

Rev. 7/17
Pediatric Surgery Division and Pediatric Trauma Medical Director
## Pediatric Trauma Blunt Spleen/Liver Management

### Care Protocol Based Upon Grade

<table>
<thead>
<tr>
<th>CT GRADE</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>PICU LOS</td>
<td>NONE</td>
<td>NONE</td>
<td>24 HOURS*</td>
<td>24 HOURS</td>
</tr>
<tr>
<td>HOSPITAL LOS</td>
<td>24 – 48 HOURS</td>
<td>48 – 72 HOURS</td>
<td>72 – 96 HOURS</td>
<td>96 – 120 HOURS</td>
</tr>
<tr>
<td>PRE- OR POST- DISCHARGE IMAGING</td>
<td>NONE</td>
<td>NONE</td>
<td>NONE</td>
<td>NONE</td>
</tr>
<tr>
<td>DIET</td>
<td>NPO x 8hrs, clears then ADAT</td>
<td></td>
<td>NPO x 24hrs, clears then ADAT</td>
<td></td>
</tr>
<tr>
<td>RESTRICTED ACTIVITY/ F/U VISIT</td>
<td>2 WEEKS/ 2 WEEKS</td>
<td>3 WEEKS/ 2 WEEKS</td>
<td>5 WEEKS/ 2 WEEKS</td>
<td>6-8 WEEKS/ 2 WEEKS</td>
</tr>
<tr>
<td>BEDREST</td>
<td>8h</td>
<td>24h</td>
<td>24h</td>
<td>48h</td>
</tr>
<tr>
<td>HCT</td>
<td>Admission and 4 hours post ambulation (includes Grade III admitted to floor)</td>
<td>Q6-8h until stable, then q12hx2, then q24h</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Delayed clinical findings may present ≥ 48h post trauma

*Grade III – PICU/Floor depending on clinical stability

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Rev. 6/17
Pediatric Surgery Division and Pediatric Trauma Medical Director
Pediatric Blunt Renal Trauma Management

Suspected Blunt Renal Trauma?
H&P
Labs (HCT, UA)
CT w/contrast

Determine Grade of Injury

Admit to Pediatric Surgery/Trauma*  

Grade I-II (Stable III)  
Admit to Floor

Grade III-IV  
Admit to PICU

Grade V  
Bleeding
Hemodynamic instability
OR or IR and
Admit to PICU

Discharge Criteria
- HCT stable
- Tolerate diet
- PO pain meds
- Ambulate

- Consider Consult to Urology
- Evaluate for eligibility for Lumason study within 48 hours of admission

Approved Pediatric Trauma Task Force, 4/15; Revised, 2/16
<table>
<thead>
<tr>
<th>CT Grade</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admit to</td>
<td>Floor</td>
<td>Floor</td>
<td>Floor/PICU for 24 hours (depending on clinical stability) then floor if stable</td>
<td>PICU for 24 hours then floor if stable</td>
</tr>
<tr>
<td>Hospital LOS</td>
<td>Based on discharge criteria: HCT stable, tolerate diet and PO pain meds and ambulate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-discharge imaging</td>
<td>NONE</td>
<td>NONE</td>
<td>NONE</td>
<td>RUS for urinary extravasation</td>
</tr>
<tr>
<td>Post-discharge imaging</td>
<td>NONE</td>
<td>NONE</td>
<td>NONE</td>
<td>RUS as needed</td>
</tr>
<tr>
<td>Post-discharge activity</td>
<td>3 weeks</td>
<td>3 weeks</td>
<td>4 weeks</td>
<td>5 weeks</td>
</tr>
<tr>
<td>Bed rest</td>
<td></td>
<td>Ambulate when patient is able</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCT</td>
<td>12 hours post injury</td>
<td>12 hours post injury</td>
<td>12 hours and 36 hours post injury</td>
<td>6 hours, 18 hours, 40-48 hours post injury</td>
</tr>
</tbody>
</table>

Approved Pediatric Trauma Task Force, 4/15

J Pediatric Surgery 2014; 49: 198-201
J Pediatric Urology 2014; 10: 815-818
J Pediatric Surgery 2010; 45: 1311-1314
Admit to LPCHS*

- Admit to Pediatric Orthopedic Surgery if isolated injury
- Admit to Pediatric Surgery if polytrauma
- Timing and sequence of long bone fracture repair for multiply injured patients are managed on an individual basis and require multi-disciplinary discussion with Pediatric Surgery, Orthopedic Surgery, PICU and Neurosurgery
- If Trauma 97 or Trauma 99 activation or requiring PICU admission, provide hand-off to PICU AND Pediatric Surgery

Concern for Child Abuse? → Contact Social Worker

Pain Management A/P & Lateral Xrays Consult Pediatric Ortho

Neurovascular compromise? Compartment Syndrome? Open or Closed Fracture?

Operative Management?

Operative Management?

ED Management?

As indicated
- Reduce
- Immobilize
- Post-reduction Xrays
- Repeat neurovascular assessment

Admit to LPCHS* vs DC home with follow-up

Determine Urgency
- Emergent – next case
- Urgent – within 24h
- Add on today
- Admit & schedule tomorrow

LPCHS-OR or Stanford-OR

If open fracture, ensure updated tetanus vaccine

Approved: Pediatric Trauma Task Force, Pediatric Trauma Orthopedic Liaison, 11/15
Pediatric Extremity Fracture

May consider Stanford-OR if 
≥14y and ≥80 lbs (36.4 kg) 
AND 
Adult-type fracture with skeletal maturity

Open Fractures
IV Antibiotic: one dose pre-op
• Cefazolin 30mg/kg q8h x 24h
• If Penicillin allergy: Clindamycin 10mg/kg q6h x 24h
Time to OR: Emergent, next case

Supracondylar fracture, displaced
• Closed reduction and percutaneous pinning with 2-3 lateral pins; if other, document reason
• Open reduction internal fixation

Femur fractures
<6 months
• Pavlik harness
• Spica cast
>6 months to 5 years
• Spica cast
5 to 11 years
• Flexible intramedullary nail
• Rigid intramedullary nail
• Sub-muscular plate
• If other, document reason

Documentation Guidelines
• Concern for Non-accidental trauma or Child Abuse
• Mechanism of injury
• Assessment
• ED procedures
• Plan of care
• Hand-off

Discharge Criteria
• Tolerating regular diet
• Pain controlled with PO meds
• Cleared by PT for safe DC home

Discharge Instructions
• Pain management
• Return precautions
• Cast care
• Durable medical equipment use
• Follow-up Ortho Clinic appointment

References:
• Treatment of Pediatric Diaphyseal Femur Fractures. 2015. American Academy of Orthopaedic Surgeons.

Neurovascular Assessment
• Distal pulses and perfusion
• Sensation
• Supracondylar fractures:
  Nerve  Motor  Sensory
  Median (AIN) “OK” sign and “Thumb’s up” sign
  Radial (PIN) thumb abduction Dorsal web space
  Ulnar Scissors” Small finger

Compartment Syndrome Assessment
Increasing agitation or anxiety
Increasing analgesia requirement
Palpation or measurement of compartment pressures
Pediatric Pelvic Fracture

**Background Principals**
- Due to pediatric anatomy, pelvic fractures are rare
- Assume high energy mechanism injuries that are more likely than the pelvic fracture to be life-threatening

Pelvic fracture <18y

Skeletally Immature

Avulsion fracture? 

Follow adult pelvic fracture guidelines 

*Skeletally Mature 

No 

Hemodynamically stable? 

Yes 

Resuscitate per APLS guidelines 
Place pelvic binder 
R/O alternative source of bleeding 

Physical Exam:
- High index of suspicion for open fracture
- AP Pelvis
- CT vs MRI (controversial)
- CONSULT PEDIATRIC ORTHOPEDIC SURGERY

Admit to LPCHS Pediatric Surgery/Trauma 
HAND-OFF: Trauma Attending to Pediatric Surgery & PICU Attending
**Pediatric Pelvic Fracture**

*Admit to Stanford if*
- $\geq 14$y and $\geq 80$ lbs (36.4 kg)
  - AND
- Adult-type fracture with skeletal maturity
  - Operative pelvic ring fracture
  - Lumbopelvic dislocations
  - Operative acetabular fracture
  - Operative spine fracture with neurological deficits
- Consult Orthopedic Trauma Association Fellow

**Documentation Guidelines**
- Mechanism of injury
- Assessment
- ED procedures
- Plan of care
- Hand-off

**Discharge Criteria**
- Tolerating regular diet
- Pain controlled with PO meds
- Cleared by PT for safe DC home

**Discharge Instructions**
- Pain management
- Return precautions
- Cast care, if applicable
- Durable medical equipment use
- Follow-up Ortho Clinic appointment

**References:**
High-energy pediatric pelvic and acetabular fractures.

Approved: Pediatric Trauma Task Force, Pediatric Orthopedic Surgery Trauma Liaison and Orthopedic Surgery Division Chief, 2/16
Rev. 7/17

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**VTE RISK FACTORS***

**Trauma:**
- >1 lower long bone fracture
- complex pelvic fractures
- spinal cord injury
- operative intervention > 2 hours
- transfusion > 4 units PRBC

Acute infection
Central line (tunneled or temporary)
History of venous thrombosis)
Inflammatory disease (eg IBD, SLE)
Major lower extremity orthopedic surgery
Medications: asparaginase, estrogen
Nephrotic Syndrome
Obesity (BMI > 95th percentile for age)
Oncologic diagnosis
Pregnancy
Thrombophilia (personal or family history)

**CONTRAINDICATIONS TO ANTICOAGULATION**

**Neurosurgical procedure or TBI requires**
*Multidisciplinary Discussion with Neurosurgery Team*

**Absolute:**
- Bleeding disorder
- Hemorrhage (evidence of or at high risk for)
- Platelet count unable to sustained >50,000/mm³

**Relative:**
- Acute stroke
- Uncorrected coagulopathy
- Intracranial mass/neurosurgical procedure
- Lumbar puncture or epidural catheter removal in prior 12 hrs

**PHARMACOLOGIC PROPHYLAXIS***

**Enoxaparin:**
- Patients ≤ 18 years old and < 50kg: 0.5mg/kg/dose SQ q12hrs or 1 mg/kg/dose DAILY
- Patients ≤ 18 years old and > 50kg: 40mg SQ daily (for CrCl < 30, 30mg SQ daily)
- Monitoring not necessary unless concerned about clearance with renal dysfunction

**Heparin gtt:**
- Patients ≤ 18 years old: 10 units/kg/hr
- Do NOT elevate HAL > 0.3 or PTT above 50 seconds
Does not meet criteria for routine prophylaxis. If ≥ 18 years eligible for adult guidelines

Hospitalized patient age ≥10 years

Altered mobility > 48hrs?

Other VTE risk factors*?

Other VTE risk factors*?

Contraindications to anticoagulation**?

Yes

No

No

Yes

No

Yes

Early ambulation

Early ambulation AND Mechanical Prophylaxis

Early ambulation AND Mechanical Prophylaxis AND Pharmacologic Prophylaxis +/- Hematology Consult

Early ambulation AND Mechanical Prophylaxis

References:

LOW Risk

MODERATE Risk

HIGH Risk

Approved: Pediatric Trauma Task Force, PICU Trauma Liaison and PICU Surgical Director, 3/16
Prevent peripheral vasoconstriction or vasospasm
- Thrombosis secondary to vasospasm or clot is the most common cause of early replant failure
- Room temperature >75°F
- Use Bair hugger
- Ensure adequate hydration or fluid resuscitation to avoid hypotension
- Provide pain control and anxiolytics to prevent fight or flight response related vasoconstriction
- Avoid caffeine, chocolate, and nicotine

Replant monitoring
- Pulse oximetry
  - < 94% and/or loss of a waveform on pulse oximetry indicates potential vascular compromise
- Check skin for color, capillary refill and turgor

Anticoagulation
- No consensus on appropriate postoperative anticoagulation
- The surgery team will prescribe aspirin, low-molecular weight dextran, or heparin depending on the case
- Thrombolytics: primarily used for salvage; not indicated for prophylaxis

Contact the Hand Surgery/Plastics Surgical Team prior to:
- Manipulating or repositioning the extremity
- Changing, loosening or reinforcing the dressing
Assessment

- **Arterial Insufficiency**
  - Signs/Symptoms:
    - Decreased Capillary Refill Time (<2sec)
    - Decreased tissue turgor
    - Decreased temperature
  - Treatments:
    - Contact the Hand Surgery/Plastics Surgical Team, who may:
      - Release constricting bandages
      - Place extremity in dependent position
      - Consider heparinization
      - Early surgical exploration if previous measures unsuccessful

- **Venous Congestion**
  - Signs/Symptoms:
    - Increased Capillary Refill Time (>2sec)
    - Increased tissue turgor
    - Increased bleeding from wound edges
  - Treatments:
    - Contact the Hand Surgery/Plastics Surgical Team, who may:
      - Elevate extremity
      - Consider leech therapy
        - Releases hirudin (powerful anticoagulant)
        - *Aeromonos hydrophila* or *Serratia marcescens* infection can occur (prophylax with Bactrim or ciprofloxacin)
      - Use heparin soaked pledgets if leeches are not available

References


Approved: 5/17 Dr. James Chang, Chief, Division of Plastic & Reconstructive Surgery, Dr. Amy Ladd, Professor & Chief, Robert A. Chase Hand Center, and Dr. Stephanie Chao, Pediatric Trauma Medical Director
Social Work Consults and CRAFFT Screening for Pediatric Trauma Patients

All Patients admitted to the Pediatric Trauma Service should have a Social Work Consult
All Children ages 12 years and older admitted to the Pediatric Trauma Service should have a CRAFFT screening completed in the Tertiary phase of care and Social Work Consulted if Screening is positive.

CRAFFT SCREEN: Indicated for patients ≥ 12 years old

Part A
During the Past 12 Months, did the patient:
1. Drink any alcohol (more than a few sips)? no
2. Smoke any marijuana or hashish? no
3. Use anything else to get high? (Includes illegal drugs, over the counter and prescription drugs, and things that you sniff or huff) no

If all questions in Part A were answered “no”, only ask question 1 in Part B. If any of the questions in Part A were answered “yes”, ask all 6 questions in Part B.

Part B (Questions to be answered by the patient)
1. Have you ever ridden in a car driven by someone (including yourself) who was high or had been using alcohol or drugs? no
2. Do you ever use alcohol or drugs to relax, feel better about yourself, or fit in? no
3. Do you ever use alcohol or drugs while you are by yourself, alone? no
4. Do you ever forget things you did while using alcohol or drugs? no
5. Do your family or friends ever tell you that you should cut down on your drinking or drug use? no
6. Have you ever gotten into trouble while you were using alcohol or drugs? no

Total number of "Yes" responses in Part B: 0
If the total number of "Yes" responses in Part B is > 2, it is a positive screen, and it is recommended that a Social Worker is consulted for additional assessment. Will Discuss with Social Worker: no
Be alert to possible abuse when there is a discrepancy in the reported history and physical findings.

Contact Social Work for CPS report and SCAN Team referral.

Consult a child abuse pediatrician for the following physical examination findings:

- Bruising in non-mobile children
- Bruising of the torso, neck, or ears in children <4y
- Injury ascribed to household accidents without trauma history
  - Head trauma in children <2y
  - Long bone fractures in children <2y
- Burns
  - Patterned
  - Widely separated, especially bilateral
  - With different stages of healing
  - In unusual areas such as backs of hands, torso, or buttocks
- Any thin, holohemispheric subdural hemorrhage in children <2y
- Any widespread retinal hemorrhage

Board Certified Child Abuse Pediatrician
  - Consult 24/7, pager 2-SCAN (2-7226)
Basic principles to consider when caring for the injured child:

- Use of a commercial length-based resuscitation tape (Broselow) expedites care by providing appropriate weight-based equipment sizes and medication dosages.

- Children have narrow airways which can occlude easily with edema or foreign bodies. Keep a low threshold for initiating endotracheal intubation and for requesting support from pediatric anesthesia or PICU.

- Children may not show a change in systolic blood pressure until >45% of the blood volume is lost.

- Tachycardia in the presence of normothermia and controlled pain, suggests cardiovascular compensation.

- Children are susceptible to heat loss due to a high ratio of body surface area to body mass, large head, and small amount of subcutaneous tissue.

- Eighty percent of pediatric trauma death is associated with head injury. Involve pediatric neurosurgery early.

- The estimated total blood volume of a child is 75-80ml/kg. Resuscitation goals for hypovolemic shock:
  - Obtain intraosseous (IO) access if two peripheral IVs cannot be rapidly placed
  - Administer warmed crystalloid fluid bolus (20ml/kg); repeat 1-2 times
  - If signs of shock persist, administer 10ml/kg warmed PRBCs (type specific or O-negative).
  - Monitor intake and urinary output:
    - Newborn and infant 2ml/kg/hour
    - Toddler 1.5ml/kg/hour
    - Older child through adolescence 1ml/kg/hour

- Acute compartment syndrome indicators include increasing:
  - Analgesic requirement
  - Anxiety
  - Agitation

Trauma Patients

- Any Trauma 95/97/99 ED patient requiring admission to LPCHS
- Any patient with isolated injury requiring admission to LPCHS
  - NOTE: The ED may choose not to activate some injured patients as a Trauma 95/97/99; however, any injured patient requiring admission to LPCHS is considered a trauma patient

Inter-facility transfers

- Outside Hospital ED patients transferring for higher level of care must first transfer to the Stanford-ED
- Outside Hospital in-patients transferring for higher level of care must admit directly to PICU
- Direct admissions to PICU require both an accepting PICU Physician and an accepting Surgeon

Admitting Service

- Trauma patients must admit to a Surgical Service
- Pediatric General Surgery is the primary admitting service for trauma patients
- Trauma patients admitting to PICU should have both a PICU and Pediatric Surgery Attending
- Non-Accidental Trauma patients needing ICU care must admit to PICU and Pediatric Surgery
- Patients with isolated injury needing Acute Care, may admit to any surgical service, for example:
  - Neurosurgery – isolated head injury
  - Orthopedic Surgery – isolated extremity injury
  - Exception: General Pediatrics may admit:
    - Ocular/Eye injuries since Ophthalmology is not an admitting service
    - Non-Accidental Trauma patients only needing Acute Care

Most Appropriate Unit

- All trauma patients needing ICU level of care must admit to PICU regardless of age; PICU has committed to always make a trauma bed available
- PCU 350 is the preferred Acute Care Unit for trauma patients
  - Best choice for head and/or spine injured patients
  - Best choice for any poly-trauma patient (multi-system injury)
Lund-Browder Burn Percentages

Consider Transfer to Burn Center for deep partial (2\textsuperscript{nd} degree) or full thickness (3\textsuperscript{rd} degree) burns \geq 10\% Body surface Area
<table>
<thead>
<tr>
<th>Age</th>
<th>Weight</th>
<th>SBP</th>
<th>HR</th>
<th>Respirations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lbs</td>
<td>kg</td>
<td>(mmHg)</td>
<td></td>
</tr>
<tr>
<td>Newborn</td>
<td>7</td>
<td>3.5</td>
<td>50 - 70</td>
<td>90-160</td>
</tr>
<tr>
<td>1-6 mos</td>
<td>7</td>
<td>3.5</td>
<td>70 - 95</td>
<td>100-160</td>
</tr>
<tr>
<td>6 mos</td>
<td>15</td>
<td>7</td>
<td>80 - 100</td>
<td>90-120</td>
</tr>
<tr>
<td>1 year</td>
<td>22</td>
<td>10</td>
<td>80 - 100</td>
<td>90-120</td>
</tr>
<tr>
<td>3 years</td>
<td>33</td>
<td>15</td>
<td>80 - 110</td>
<td>80-120</td>
</tr>
<tr>
<td>6 years</td>
<td>40</td>
<td>18</td>
<td>80 - 110</td>
<td>70-110</td>
</tr>
<tr>
<td>10 years</td>
<td>60</td>
<td>28</td>
<td>90 - 120</td>
<td>60 - 90</td>
</tr>
</tbody>
</table>

**PEDIATRIC NORMAL VITAL SIGNS**
<table>
<thead>
<tr>
<th>AGE</th>
<th>BOYS</th>
<th>GIRLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 MONTHS</td>
<td>5.9</td>
<td>5.4</td>
</tr>
<tr>
<td>6 MONTHS</td>
<td>7.8</td>
<td>7.2</td>
</tr>
<tr>
<td>1 YEAR</td>
<td>10.1</td>
<td>9.5</td>
</tr>
<tr>
<td>2 YEARS</td>
<td>12.3</td>
<td>11.8</td>
</tr>
<tr>
<td>3 YEARS</td>
<td>14.6</td>
<td>14.1</td>
</tr>
<tr>
<td>4 YEARS</td>
<td>16.6</td>
<td>15.9</td>
</tr>
<tr>
<td>5 YEARS</td>
<td>18.6</td>
<td>17.6</td>
</tr>
<tr>
<td>8 YEARS</td>
<td>25</td>
<td>24.8</td>
</tr>
<tr>
<td>10 YEARS</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>14 YEARS</td>
<td>50</td>
<td>50</td>
</tr>
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</table>
### Estimated Circulating Blood Volume

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Volume Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonates</td>
<td>85 – 90 ml/kg</td>
</tr>
<tr>
<td>Infants</td>
<td>75 – 80 ml/kg</td>
</tr>
<tr>
<td>Children</td>
<td>70 – 75 ml/kg</td>
</tr>
<tr>
<td>Adolescent/Adult</td>
<td>65 – 70 ml/kg</td>
</tr>
<tr>
<td>AGE</td>
<td>NG TUBE SIZE</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Infant 3 – 9 kg</td>
<td>5 – 8 Fr</td>
</tr>
<tr>
<td>Small Child 10 – 11 kg</td>
<td>8 – 10 Fr</td>
</tr>
<tr>
<td>Child 12 – 14 kg</td>
<td>10 Fr</td>
</tr>
<tr>
<td>Child 15 – 18 kg</td>
<td>10 Fr</td>
</tr>
<tr>
<td>Child 19 – 22 kg</td>
<td>12 – 14 Fr</td>
</tr>
<tr>
<td>Young adult 24 – 28 kg</td>
<td>14 – 18 Fr</td>
</tr>
<tr>
<td>Young adult 30 – 36 kg</td>
<td>16 – 18 Fr</td>
</tr>
<tr>
<td>Age Of Patient</td>
<td>Laryngoscope Blade</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------</td>
</tr>
</tbody>
</table>
| Term Infant    | Miller 0 – 1 Wis-Hipple 1 | Age (yrs) + 16 
4 | 3 x ETT size | 2 x ETT size |
| 6 months       |                    | 3.5 cuffed, 3.5 uncuffed | 9 – 10 | 6 – 8 |
| 1 year         | Miller 1 Wis-Hipple 1½ | 4.0 cuffed & uncuffed | 10.5 – 12 | 8 |
| 2 years        | Miller 2 Macintosh 2-3 | 4.5 & 4.0 cuffed | 13.5 | 8 |
| 4 years        |                    | 5.0 & 4.5 cuffed | 15 | 10 |
| 6 years        |                    | 5.5 & 5.0 cuffed | 16.5 | 10 |
# PEDIATRIC Laryngoscope blades, ETT, Suction

<table>
<thead>
<tr>
<th>Age Of Patient</th>
<th>Laryngoscope Blade</th>
<th>Endotracheal Tube Size (Internal Diameter In mm)</th>
<th>Distance From Mid Trachea To Lips (cm)</th>
<th>Suction Catheter Size (French)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Age (yrs) + 16 4</td>
<td>3 x ETT size</td>
<td>2 x ETT size</td>
</tr>
<tr>
<td>8 years</td>
<td>Miller 2</td>
<td>6.0 cuffed</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Macintosh 2-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 years</td>
<td></td>
<td>6.5 cuffed</td>
<td>19.5</td>
<td>12</td>
</tr>
<tr>
<td>12 years</td>
<td>Macintosh 3</td>
<td>7.0 cuffed</td>
<td>21</td>
<td>12</td>
</tr>
<tr>
<td>Adolescent</td>
<td>Macintosh 3</td>
<td>7.0, 8.0 cuffed</td>
<td>21</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Miller 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injury Type</td>
<td>Description of injury</td>
<td>AIS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>-----</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Hematoma: Subcapsular, &lt;10% surface area</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Laceration: Capsular tear, &lt;1 cm parenchymal depth</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Hematoma: Subcapsular, 10% to 50% surface area; intraparenchymal, &lt;5 cm in diameter; minor; superficial; nonexpanding</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Laceration: Capsular tear, 1-3 cm parenchymal depth that does not involve a trabecular vessel; minor; superficial</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Hematoma: Subcapsular, &gt;50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma ≥ 5 cm or expanding; major</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Laceration: No hilar or segmental parenchymal disruption or destruction; parenchymal depth &gt;3 cm or involving trabecular vessels; moderate</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Laceration: Laceration involving segmental or hilar vessels producing major devascularization (&gt;25% of spleen) but no hilar injury; major</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Laceration: Completely shattered spleen; tissue loss; avulsion; stellate; massive</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vascular: Hilar vascular injury that devascularizes spleen</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Advance one grade for multiple injuries up to Grade III*
<table>
<thead>
<tr>
<th>Injury Type</th>
<th>Description of injury</th>
<th>AIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hematoma Subcapsular, &lt;10% surface area</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Laceration Capsular tear, &lt;1 cm parenchymal depth</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>Hematoma Subcapsular, 10% to 50% surface area; intraparenchymal, &lt;10 cm in diameter</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Laceration Capsular tear, 1-3 cm parenchymal depth, &lt;10 cm in length</td>
<td>2</td>
</tr>
<tr>
<td>III</td>
<td>Hematoma Subcapsular, &gt;50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma &gt; 10 cm or expanding; blood loss &gt;20%; major</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Laceration Parenchymal depth &gt;3 cm; major duct involvement; blood loss &gt;20%; moderate</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>Laceration Parenchymal disruption involving 25% to 75% hepatic lobe or 1-3 Couinaud’s segments; multiple lacerations &gt;3 cm deep; “burst” injury; major</td>
<td>4</td>
</tr>
<tr>
<td>V</td>
<td>Laceration Parenchymal disruption involving &gt;75% of hepatic lobe or &gt;3 Couinaud’s segments within a single lobe</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Vascular Juxtahepatic venous injuries (i.e., retrohepatic vena cava/central major hepatic veins); massive; complex</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Vascular Hepatic avulsion (total separation of all vascular attachments)</td>
<td>6</td>
</tr>
</tbody>
</table>

*Advance one grade for multiple injuries up to Grade III*
<table>
<thead>
<tr>
<th>Injury Type</th>
<th>Description of injury</th>
<th>AIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Contusion</td>
<td>Microscopic or gross hematuria, urologic studies normal</td>
<td>2</td>
</tr>
<tr>
<td>Hematoma</td>
<td>Subcapsular, nonexpanding without parenchymal laceration</td>
<td>2</td>
</tr>
<tr>
<td>II Hematoma</td>
<td>Nonexpanding perirenal hematoma confined to renal retroperitoneum; minor; superficial</td>
<td>2</td>
</tr>
<tr>
<td>Laceration</td>
<td>Parenchymal depth of renal cortex (&lt;1.0 cm) without urinary extravasation; minor; superficial</td>
<td>2</td>
</tr>
<tr>
<td>III Hematoma</td>
<td>Subcapsular; &gt;50% surface; major; large</td>
<td>3</td>
</tr>
<tr>
<td>Laceration</td>
<td>Parenchymal depth of renal cortex (&gt;1.0 cm) without collecting system rupture or urinary extravasation; moderate</td>
<td>3</td>
</tr>
<tr>
<td>IV Laceration</td>
<td>Parenchymal laceration extending through the renal cortex, medulla, and collecting system</td>
<td>4</td>
</tr>
<tr>
<td>Vascular</td>
<td>Main renal artery or vein injury with contained hemorrhage; major</td>
<td>4</td>
</tr>
<tr>
<td>V Laceration</td>
<td>Completely shattered kidney</td>
<td>5</td>
</tr>
<tr>
<td>Vascular</td>
<td>Avulsion of renal hilum which devascularizes kidney (total destruction of organ)</td>
<td>5</td>
</tr>
</tbody>
</table>

*Advance one grade for bilateral injuries up to Grade III*
<table>
<thead>
<tr>
<th>Injury Type</th>
<th>Description of injury</th>
<th>AIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Contusion</td>
<td>Minor; superficial; no duct involvement</td>
<td>2</td>
</tr>
<tr>
<td>Laceration</td>
<td>Minor; superficial laceration without duct injury</td>
<td>2</td>
</tr>
<tr>
<td>II Hematoma</td>
<td>Major contusion without duct injury or tissue loss</td>
<td>2</td>
</tr>
<tr>
<td>Laceration</td>
<td>Major laceration without duct injury or tissue loss</td>
<td>3</td>
</tr>
<tr>
<td>III Laceration</td>
<td>Distal transection or parenchymal injury with duct injury; moderate with major duct involvement</td>
<td>3</td>
</tr>
<tr>
<td>IV Laceration</td>
<td>Proximal transection or parenchymal injury involving ampulla†; moderate if involving ampulla; major if multiple lacerations; major if involving ampulla</td>
<td>4</td>
</tr>
<tr>
<td>V Laceration</td>
<td>Massive disruption of pancreatic head; avulsion; complex; rupture; stellate; tissue loss</td>
<td>5</td>
</tr>
</tbody>
</table>

*Advance one grade for multiple injuries up to Grade III
†Proximal pancreas is to the patient’s right of the superior mesenteric vein
# PEDIATRIC
## Modified Glasgow Coma Scale

<table>
<thead>
<tr>
<th>CHILD</th>
<th>Eye Opening</th>
<th>INFANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous</td>
<td>4</td>
<td>Spontaneous</td>
</tr>
<tr>
<td>To speech</td>
<td>3</td>
<td>To speech</td>
</tr>
<tr>
<td>To pain only</td>
<td>2</td>
<td>To pain only</td>
</tr>
<tr>
<td>No response</td>
<td>1</td>
<td>No response</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHILD</th>
<th>Verbal Response</th>
<th>INFANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oriented, appropriate</td>
<td>5</td>
<td>Coos and babbles</td>
</tr>
<tr>
<td>Confused</td>
<td>4</td>
<td>Irritable cries</td>
</tr>
<tr>
<td>Inappropriate words</td>
<td>3</td>
<td>Cries to pain</td>
</tr>
<tr>
<td>Incomprehensible sounds</td>
<td>2</td>
<td>Moans to pain</td>
</tr>
<tr>
<td>No response</td>
<td>1</td>
<td>No response</td>
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</table>

<table>
<thead>
<tr>
<th>CHILD</th>
<th>Motor Response</th>
<th>INFANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obeys commands</td>
<td>6</td>
<td>Spontaneous, purposeful</td>
</tr>
<tr>
<td>Localizes to pain</td>
<td>5</td>
<td>Withdraws to touch</td>
</tr>
<tr>
<td>Withdraws to pain</td>
<td>4</td>
<td>Withdraws to pain</td>
</tr>
<tr>
<td>Abnormal flexion</td>
<td>3</td>
<td>Abnormal flexion</td>
</tr>
<tr>
<td>Abnormal extension</td>
<td>2</td>
<td>Abnormal extension</td>
</tr>
<tr>
<td>No response</td>
<td>1</td>
<td>No response</td>
</tr>
</tbody>
</table>

**Qualifiers:**
- Patient Chemically Sedated
- Patient Intubated
- Patient Eye Obstruction