### ADULT Glasgow Coma Scale

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<td>Localizes to pain</td>
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<td>Withdraws to pain</td>
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<td>Abnormal extension</td>
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**Qualifiers:**
- Patient Chemically Sedated
- Patient Intubated
- Obstruction to the Patients Eye
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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<td>David Gregg, MD</td>
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<td>Javier Lorenzo, MD</td>
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<td>Paul Maggio, MD</td>
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<td>Paul Mohabir, MD</td>
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<td>David Spain, MD</td>
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<td>Kristan Staudenmayer, MD</td>
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<td>Tom Weiser, MD</td>
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<tr>
<td>Sherry Wren, MD</td>
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<tr>
<td>- Jesse Alfaro, NP</td>
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<tr>
<td>- Jessica Behrend, NP</td>
<td>650-850-2446 (cell)</td>
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<tr>
<td>- Mickey Claudius, NP</td>
<td>650-213-6611 (cell)</td>
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<tr>
<td>- Ya-Chen Lee, NP</td>
<td>650-847-7154 (cell)</td>
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<tr>
<td>- Courtney Nelson, PA</td>
<td>650-847-9971 (cell)</td>
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| Trauma Case Manager (Michelle Paw) | 650-561-5501 |
| Trauma Social Worker (Kate Aragon) | 650-475-6908 |
| Trauma Nurse Coordinators | |
| - Denise Greci Robinson | 925-784-3259 (cell) |
| - Jo Ann Schumaker-Watt | 650-656-7979 (cell) |
| Trauma Program Manager – Shelly | 650-521-7613 (cell) |

| Trauma Clinic Main Line | 650-723-6961 |
| Trauma Services Office  | 650-723-7570 |

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</tr>
<tr>
<td>Ultrasound</td>
<td>3-3498</td>
</tr>
</tbody>
</table>
Main Operator 3-4000
Page Operator 3-6661
SHC Admitting 3-6221
Crisis Nurse 1-6542
ED Registration 3-2248
ED Resource RN 4-2243
ED Room 5 5-5096
Medical Records 3-5721
Nursing Supervisor Pager 1-6918
Nursing Supervisor Spectralink 6-1767
Peds Radiology Hotline
    07:00 – 17:00 days M-F 7-8757
    After-hours/Weekends 7-8758
PT/OT 8-7026
Speech 1-5087
Transfer Center 3-4696 or 800-800-1551

**Surgical Clinics:**
Trauma Clinic 3-6961
Orthopedic Clinic 3-5643
ENT Clinic 3-5281
Plastic Surgery Clinic 3-7001
Neurosurgery Clinic 3-6469
Vascular Surgery Clinic 5-5227
**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
- Functions 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:**
- Develops 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 Advanced Practice Provider Roles/Responsibilities

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 less than 90 at any time.
- Child less than 6 years: SBP less than 60.
- Child greater than 6 years: SBP less than 90.
- Airway compromise/obstruction or pre-hospital intubation.
- Respiratory distress with a rate less than 10 or greater than 29.
- Significant hypoxia at scene.
- Glasgow Coma Scale score (GCS) less than 9 with trauma mechanism.
- Gunshot wound/penetrating trauma (non-extremity) above the knee/elbow.
- Traumatic paraplegia or quadriplegia.
- Transfer-in patients receiving blood or vasopressors to maintain vital signs.
- Emergency Medicine discretion
- Adults: Confirmed systolic BP<90 at any time
  - Child >6 years: SBP <90
  - Child <6 years: SBP <60
- Airway Compromise/Obstruction or pre-hospital intubation
- Respiratory Distress <10 or >29
  - Pediatric: Nasal flaring, retraction, stridor, cyanosis
- GCS <9 with Trauma mechanism
- GSW/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 Alert (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 admit to Trauma Service.
- Burns >20% with trauma stabilize for Burn Center transfer.
- Pregnant woman >=20 ega with a trauma 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.

- 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.*

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

Airway Resident: (Only if extra resident available)
- Establishes airway under direction of ED attending
**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.
TRAUMA RESUSCITATION ROLES

**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 protocolled.*

  - **“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 8 cm 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

• 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:
• www.CDC.gov/mmwr/PDF/rr/rr5110.pdf
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:
- 2 units of uncrossed matched type O blood and universal donor liquid plasma will be delivered for all Trauma 99s automatically by the blood bank personnel. *(Not always O negative if a male patient.)*
- If the patient is experiencing life threatening hemorrhage, additional blood 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

Rev. 6/16
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: cefazolin and gentamicin until wound is closed

CHEST TUBE PLACEMENT
• 1-2% incidence of empyema
• Insufficient Level I data to support prophylactic antibiotics 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 closed facial fractures in patients receiving empiric antibiotics
• Chole et al. showed lower infection in patients who received one dose of cefazolin preoperatively and one dose eight hours later

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 1\textsuperscript{st} generation cephalosporin for 24hrs if synthetic graft used.

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

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

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

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

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
(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>
INDICATIONS FOR HEAD CT

* Based from Canadian Guidelines

LOC or amnesia within 24hrs of event

GCS = 15

GCS < 15

NEXUS II: BEAN BASH

• B – Behavior abnormal
• E – Emesis intractable
• A – Age > 65
• N – Neurologic Deficit

• B – Bleeding Disorder
• A – Altered Mental Status
• S – Skull Fracture
• H – Hematoma scalp

No

Head CT

Observe x4hrs

Yes

Head CT

* Head CT should be done within 30 mins

References:

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
  - Consider repeat CT on a case-by-case basis

Monitoring of patients with head injuries:
- All patients require q1 hour neurologic examinations, and most will require ICU admission
- Patients with SAH or contusions who are GCS 15, are asymptomatic, and have no complicating factors may be considered for admission to H1 for q1 hour neuro checks. See following page to determine if patient qualifies for H1.

Neuro checks include: GCS, pupillary assessment, and an abbreviated NIHSS (level of consciousness, language, facial strength, motor and sensory exam in all four extremities, finger-to-nose/cerebellar function).

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, NSG, or NCC attendings states otherwise.
- Chemoprophylaxis can be administered while an EVD is in place, but should be held 12 hours prior to EVD placement or removal.

Therapeutic systemic anticoagulation with heparin:
- Need agreed upon by NSG, SICU, and NCC attendings.
- Obtain baseline CT prior to initiation.
- Use high-risk protocol (no bolus).
- Repeat head CT once PTT is therapeutic.
Inclusion Criteria for pts <65yo w contusions or SAH ONLY:

- GCS 15, no other neuro symptoms (e.g. lateralizing signs, agitation).
- No other physiologic signs that might indicate worsening head injury such as nausea, vomiting, headache
- Not on anti-coagulants or anti-platelet agents (including ASA), and with normal coagulation profile and platelets
- Absence of extra-axial hemorrhage (no SDH or EDH)
- Isolated head injury (i.e. absence of extra-cranial injuries)
- Hemodynamically normal
- Not requiring medication for agitation
- Not requiring opioid pain medication administration more frequently than q8 hours.
- No acute alcohol or drug intoxication.
- Not at known risk for drug or alcohol withdrawal.
- 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.

(Note: this is on a trial basis and will only affect a small number of patients per year.)

All patients will be admitted to the trauma service.
Neurosurgery consult team will follow for at least 24h.
A follow-up head CT will be obtained at 4-6 hours from the original scan in all patients, regardless of exam.

Nursing Expectations: 2:1 patient-to-RN ratio, neuro checks q1h for the first 24hrs, accompany pt to CT
Changes in neurologic function will prompt immediate notification of trauma team.
Admitting service:

- ICU: all TBI patients will be on the SICU service
  
  *Note:* patients who undergo craniotomy will be on SICU unless there is an attending-level discussion to transfer to NSG as primary, but NSG will drive decision-making for clinical care.

- H1: all TBI patients will be on the Trauma Service

Consulting Services

- University Neurosurgery (NSG) will be consulted in all of TBI cases, including PAMF patients

- NSG will follow all patients with initial GCS<14 or neurologic intervention (EVD, craniotomy, etc..) until there is an attending-level discussion deciding that NSG no longer needs to follow the patient.

- Neurocritical care (NCC) will be involved in TBI cases with GCS<14 with any type TBI injury or Mild TBI (GCS 14-15) if complicated by any other factor such as large size, high risk for worsening, vascular injury, seizures, or unexplained neurologic findings.
  
  - After transfer to the floor, the Neurology Stroke Service will continue to consult on patients who were managed by the NCC service in the ICU

Admitting service upon transfer to floor:

- Trauma Service
  
  - Multisystem injuries with TBI
  
  - Isolated TBI without craniotomy

- NSG Service: Isolated TBI after craniotomy.

*NOTE:* “Isolated TBI” refers to a patient for whom there are no other injuries at the time of admission, or patients with other injuries for which no further surgical management is warranted.
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 central or lateralizing neurologic deficit, transient ischemic attack, or Horner’s syndrome

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
  - GCS ≤ 6
  - Petrous bone fracture
  - Displaced mid-face (Lefort II/III) fractures
  - Cervical vertebral body or transverse foramen fracture
  - Any C1-3 fracture
  - Subluxation or Ligamentous injury
  - Diffuse axonal brain injury
  - Basilar skull fracture involving the carotid canal
Signs & Symptoms of BCVI

- No
- Yes, emergent

Risks of BCVI

- Yes, Urgent
- No

OBSERVE (NV checks)

CT Angio (16 slice scanner)

Abnormal

- **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

**References:**

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

**CTA should be done as early as possible**
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.
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
    - Flex-ex, 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\(^1\)

\[\text{No} \rightarrow \text{Observe} \quad \text{Yes} \rightarrow \text{TLS X-ray}^2 \]

\[\text{TLS films adequate}^3 \]

\[\text{Observe} \quad \text{CT poorly visualized or abnormal areas}\]

---

\(^1\) 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

Rev. 5/14
BACKGROUND:

- Multiple rib fractures (more than 4 ribs) in patients >45 yrs have been associated with increased morbidity
- Patients > 65 yrs who sustain blunt chest trauma with 2 or more rib fractures have twice the mortality and thoracic morbidity of younger patients with similar injuries.
- 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

![Within 2 hrs]

- Admit for pain control
- Consider ICU admission for any patient with 4+ rib fractures
- **Recommended** 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 use of incentive spirometer
- Encourage patient ambulation
- Suctioning when necessary
- Consider rib fixation for flail chest, inability to wean from ventilator, unremitting pain
ZONES:
• Zone 1: clavicle to cricoid
• Zone 2: cricoid to angle of mandible
• Zone 3: above angle of mandible

FIG. 73-8. Horizontal entry zones of the neck for penetrating injuries to the neck.

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 Trauma

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

Zone III

CT Angio

No

Yes

OBSERVE

Angio ± Embolization

Obtain CT within 30 mins

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 -10µg/min)
  - Nicardipine (5-15mg/hr)

*Polytrauma patients with head injury will require MAPs.*
CXR during primary survey (5-10 min)

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

Findings Associated with BAI

No

Yes

Consider Mechanism

Low-Risk Mechanism

High-Risk Mechanism

No further workup

CT Angio Chest

CXR

Rev. 6/11

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

Either test abnormal?

- 12-lead ECG
- Serum troponnin I

Telemetry abnormalities during workup?

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

- No
  - Discharge if no other injuries

ABNL ECG:

- Abnormal conduction
- ST elev/dep
- T-wave inversion
- Arrhythmia
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.”
PENETRATING CHEST TRAUMA to the “BOX”

Penetrating Chest Trauma

HD Unstable

Injury within the “Box”

Yes

Operating room or ED thoracotomy

No

Patient Requires Surgery for associated trauma

Yes

Subxiphoid Window

Blood

No

Hemopericardium on US?

Yes

Median Sternotomy

No

References:

- Admit & Observe
- Treat hemo-pneumothorax
- Consider repeat US or CT
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:
- 5th or 6th IC space from sternum to posterior axillary line (below nipple line in men, below inframammary crease in women)
- Initial incision should be 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 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
      - No further action
    - Yes
      - Signs of Life in **ED** (pupillary activity; respiratory effort; narrow complex QRS)
        - Yes
          - No further action
        - No
          - ED THORACOTOMY

- **Penetrating**
  - Signs of Life in **ED** (pupillary activity; respiratory effort; narrow complex QRS)
    - Yes
      - No further action
    - No
      - ED THORACOTOMY

**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><strong>BLUNT</strong></td>
<td>1%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td><strong>GSW</strong></td>
<td>1%</td>
<td>3-5%</td>
<td>10-15%</td>
</tr>
<tr>
<td><strong>STAB</strong></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**

**Hemothorax on initial CT or CXR > 300 mL**

- 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
  - Consider VATS

- No
  - Any residual PTX or Hemothorax?
    - Yes
      - < 48 hrs
        - Non-contrast Chest CT
        - Consider VATS if HTX >200-300 mL
      - > 48 hrs
        - Alternative
          - TPA Chest Tube
    - No
      - Water seal
      - CXR after 24 hrs
      - Any residual PTX or Hemothorax?
        - Yes
          - Remove CT
        - No
          - 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.
TRUNCAL STAB WOUNDS (Back, Flank, Abdomen)

**Truncal Stab Wound**

- **OR decision within 5-10min**
  - Yes
  - **OR**
  - No
    - **Shock**
    - **Peritonitis**
    - **Evisceration**

**Back/Flank**
- **Left Thoracoabdominal**
  - **Triple-Contrast CT**
  - **OR if positive**
  - **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**
  - **Persistant abdominal pain**
  - **Yes**
  - **OR**
  - **No**
    - **Observe ≥ 12hrs**
    - **Discharge**

References:

Rev. 6/12
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.

References:

BLUNT ABDOMINAL TRAUMA

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
IMPORTANT POINTS:

• 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.

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

• NOM includes
  • Bedrest
  • Telemetry monitoring
  • Hg/Hct check q6hrs
  • Documented serial abdominal exams x 24hrs

• 95% of NOM failures happen within 72 hrs of injury. Thus, there is little utility monitoring NOM patients beyond 3-5 days unless they have another reason to remain hospitalized

• 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.
BLUNT SPLENIC TRAUMA

HD Stable?

Yes

Abdominal CT

Yes

Splenic Injury

Grade I – III with No blush

Observe

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

Grade I – II with blush

Consider IR if >2g Hgb drop

Grade IV/V or Grade III with blush

Consider OR

• IR embolization is reasonable alternative especially if poor operative candidate

No

Laparotomy

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

Yes → OR

No

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

NO → Observe

1 finding

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

OR

2+ findings

- 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)

**References:**

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 get large amount of bleeding
- Consider if patient in shock without other source of bleeding
- Consider lower GU trauma in all patients with displacement of pubic bone/pelvic ring toward bladder or with gross hematuria.

PRINCIPLES OF MANAGEMENT:
- Reduce pelvic volume: wrap pelvis, external fixation
  - 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 with pelvis fracture after other causes excluded by FAST or DPL
    - HD stable patients with evidence of arterial hemorrhage on CT scan
  - Level II recommendations:
    - Pts > 60 yo with major (open book, butterfly segment, or vertical shear) pelvic fractures 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 fracture or acetabular fractures (Level II recommendation).
PELVIC FRACTURE

Unstable Pelvic Fracture

HD Stable?

Yes

CT scan

No

Bind pelvis and start transfusion (5-10min)

- Resuscitate with 2L crystalloid & 2U PRBC’s
- Bind pelvis
- Place CVP line
- Urgent Orthopedic consult

Rule Out Alternative Sites of Bleeding

- CXR
- FAST (Level I recommendation)
- Consider DPL (Level II recommendation)

Positive

Negative

HD Stable?

No

Activate MTG

Yes

IR Angiography

- CT scan abd/pelvis
- Consider operative pelvic fixation

References:

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:

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])

Immediate OR & Vascular Consult

Yes

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

Immediate OR needed for other injuries

CT-Angio of affected limb with run-off

Place on Angio table in OR and start with on-table angiogram

Injury identified & Vessel Repaired

Time to revascularization <4hrs

Time to revascularization >4hrs

ICU for Q1hr x 24 hrs for Vascular Checks

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

Yes

No

If ABI normal - observe
**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.

**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):**
- 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 per instructions with the kit.
COMPARTMENT SYNDROME – EXTREMITY

STRONG CLINICAL SUSPICION

Risk Factors

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

No

Measure Compartment Pressure

- < 20mmHg: Observe
- 20-30mmHg: Assess Perfusion Pressure
- > 30mmHg: Observe

Yes

Observe

4 compartment fasciotomy

Yes

Risk Factors

No

Measure Compartment Pressure

- < 20mmHg: Observe
- 20-30mmHg: Assess Perfusion Pressure
- > 30mmHg: Observe

*Perfusion pressure = MAP – compartment pressure

- If < 40mmHg, then 4 compartment fasciotomy
- If > 40mmHg, then serial measurements q2hrs until stable

Rev. 6/10
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.
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 wga – 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 $O_2$ Hg dissociation curve, so minimal decreases in maternal $S_AO_2$ 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 < 25 weeks 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.

### Estimated Fetal Exposure For Various Imaging Methods

<table>
<thead>
<tr>
<th>Plain Films</th>
<th>Fetal dose (rads)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical spine</td>
<td>0.002</td>
</tr>
<tr>
<td>Upper or lower extremity</td>
<td>0.001</td>
</tr>
<tr>
<td>Chest (2 views)</td>
<td>0.00007</td>
</tr>
<tr>
<td>Abdominal (multiple views)</td>
<td>0.245</td>
</tr>
<tr>
<td>Thoracic spine</td>
<td>0.009</td>
</tr>
<tr>
<td>Lumbosacral spine</td>
<td>0.359</td>
</tr>
<tr>
<td>Pelvis</td>
<td>0.040</td>
</tr>
<tr>
<td>Hip (single view)</td>
<td>0.213</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CT scans (slice thickness: 10mm)</th>
<th>Fetal dose (rads)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head (10 slices)</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>Chest (10 slices)</td>
<td>&lt;0.100</td>
</tr>
<tr>
<td>Abdomen (10 slices)</td>
<td>2.600</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

The 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 the fellow is responsible for organizing the weekly Surgical Critical Care conference.

The PGY-3 is the Chief Resident on the service. **This resident is responsible for the Surgical Critical Care Service.** This includes running daily work rounds, review of the previous night’s work-ups including radiology studies and coordinating care with the primary surgical and consulting services.

In addition to providing medical student supervision, 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.**

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.
General Policies

1. All residents will follow the 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. 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
7. Available members from the SICU are expected to respond to all Trauma 99 activations
8. All trauma patients should have the tertiary survey form completed within the first 24 hours of patient admission
9. Unanticipated changes in patient condition must be communicated to the ICU attending and primary surgical services
10. 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:
   • Surgical Critical Care Conference, 12 pm Fridays
   • ICU Multidisciplinary Conference for 10:30 am, last Monday of the month, Rm H3565
   • 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:

1. New admission or transfer to the ICU
2. Unplanned intubation or respiratory failure requiring ventilator support
3. Inability to oxygenate ($pO_2 < 60$) or ventilate (acute increase in $pCO_2 > 10$ mmHg)
4. Unanticipated changes to a patient’s hemodynamic condition including persistent hypotension, new arrhythmia with hemodynamic instability, cardiac arrest, or CODE BLUE
5. Development of a significant neurologic change (CVA, seizure, new onset paralysis)
6. Medication or treatment errors requiring clinical intervention (invasive procedures, increased monitoring, new medications excepting Narcan)
7. Unexpected blood product transfusions not previously discussed with attending, or activation of the Massive Transfusion Guidelines (MTG)
8. Ongoing fluid resuscitation of greater than 4L crystalloid to maintain hemodynamic stability
9. Initiation of new pressors, or continued escalation of pressor requirements (addition of an additional pressor, maximization of a single agent with ongoing hypotension)
10. 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 w/ bedside nurses**
10pm

---

**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

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
Patient known or suspected to be on Warfarin with Life Threatening Hemorrhage\(^1\)

- **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
  - Option 1
  - Vit K 10 mg IV + Kcentra 15-25 units/kg (max 1500U.)
  - Option 2

- **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

Re-check INR in 15-30 mins

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

- **INR >1.4**
  - FFP if clinically indicated

INR>1.4 @ 24 hrs, repeat Vit K 5 mg IV

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:
     - $\text{PaO}_2 > 100 \text{ mm Hg}^\oplus$
     - $\text{PaCO}_2 35-45 \text{ mm Hg}^*$
     - 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 SpO2>=90%

*There is no role for prophylactic or prolonged hyperventilation to decrease ICP. Temporary hyperventilation to a $\text{PaCO}_2$ 30-35 may be considered in acute neurologic deterioration.

#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.” An ICP number (or any number) should not be the sole factor in determining clinical management. Instead, physiological parameters obtained should be evaluated and clinical management adjusted to optimize all physiological parameters.

The following guidelines are traditionally initiated in a stepwise fashion for ICP control, although newer recommendations support the initiation of interventions in any order based on the clinical situation.
ICP MANAGEMENT

ICP Monitor

Target ICP ≤ 20, CPP ≥ 60

ICP ≥ 20 CPP < 60

Hypertonic Saline ± Mannitol\(^a\)
Norepinephrine or Phenylephrine

Yes

ICP/CPP Controlled

No

Further Sedation / Consider Paralysis\(^b\)

Yes

ICP/CPP Controlled

No

Hypothermia and/or Barbiturate Coma with Continuous EEG\(^c\)

Yes

ICP/CPP Controlled

No

Consider Decompressive Craniectomy\(^d\)

References

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\(^a\) 3% Saline per hospital protocol.
Mannitol 0.5-1.0 gm/kg over 10-20 mins. Check serum Osm and Na q 6°

\(^b\) Sedation: propofol (maximum dose = 80 mcg/kg/min). Alternatives include midazolam and dexmedetomidine
Paralytics: cisatracurium or vecuronium

\(^c\) Hypothermia: mild = 35-37° C; moderate 33-35° C.
Barbiturate Coma should be considered a temporizing measure, or in those who are poor surgical candidates. EEG for burst suppression monitoring

\(^d\) Decompressive Craniectomy All decisions regarding surgical intervention should be discussed with the attending neurosurgeon. In general, early surgical interventions may improve clinical outcome
<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

Consider APRV

Failing? (3)

Consider Flolan*

Failing?

Rescue Strategies:

APRV

Refer to RT Care policy

Fionlan

See Epic Flolan Order Set

*Inhaled Nitric Oxide

iNO is no longer used routinely for severe hypoxia, but may be considered if due to intracardiac 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

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

3. General Failure Criteria

- PaO2 < 55 torr
- SpO2 < 88%

Recruitment Maneuvers

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

APRV

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

- For aspiration pneumonia, include anaerobic coverage (e.g. Zosyn, Unasyn (ampicillin/sulbactam), 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

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

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

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ATS/IDSA Guidelines, Am J Respir Crit Care Med 2005
Chastre, J et al, JAMA 2003 290:19
Esposito S et al, JAC 2012; 67: 2570 – 2575
Wunderink RG et al, CID 2012 Mar 1;54(5)

Rev. 5/13
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></td>
<td>Antifungal: Continued evidence of systemic infection while on anti-</td>
</tr>
<tr>
<td>Cefoxitin (*no enterococcus activity)</td>
<td>Meropenem (*if ESBL likely)</td>
<td>bacterial therapy, especially if colonized with candida (e.g. fluconazole)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VRE: Patients whom VRE has previously been recovered, previous receipt of antibiotics that select for Enterococcus 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

- Remove line and treat with ≥ 14 days of abx
- If line is retained treat with systemic abx + antibiotic lock for 10-14 days

S. aureus
- Remove line and treat with 7-14 days of abx

Enterococcus
- Remove line and treat with 7-14 days of abx

GNR
- Remove line and treat with antifungal therapy for 14 days after first negative blood cx

Candida spp.
- Remove line and treat with antifungal therapy for 14 days after first negative blood cx

MISSA:
- nafcillin (2nd line: cefazolin or vanco)

MRSA:
- vancomycin

Methicillin susceptible CoNS:
- nafcillin (2nd line: cefazolin or vanco)

Methicillin resistant CoNS:
- vancomycin

Ampicillin susceptible:
- ampicillin + gentamicin*

Vancomycin susceptible:
- vancomycin + gentamicin*

VRE:
- linezolid or daptomycin

E. coli and Klebsiella:
- ceftriaxone

Pseudomonas:
- Zosyn, cefepime, or meropenem (± tobramycin or ciprofloxacin)**

ESBL Serratia or enterobacter:
- ertapenem or meropenem

*Candida spp.
- caspofungin or fluconazole (if susceptibility known)

*Mermel LA et al, CID 2009; 49:1–45

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

Hooten et al, CID 2010; 50:625–663
* 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

---

**MRSA coverage**
- Vancomycin
- Linezolid

**Anti-pseudomonal agent**
- Piperacillin-tazobactam (Zosyn)
- Cefepime
- Meropenem (if high suspicion of ESBL)
- Aztreonam (penicillin allergies)

**Secondary agent for gram negative coverage**
- ± Tobramycin
- ± Levofloxacin (has atypical coverage)
- ± Ciprofloxacin

**Other**
- ± Depending on source, consider:
  - **Candida:** Caspofungin
  - **Meningitis:**
    - Ampicillin+ceftriaxone
    - Acyclovir
  - **Use meningitis dosing**
  - **Influenza, H1N1**
    - Oseltamivir
  - **Atypicals**
    - Azithromycin, doxycycline

---

**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><strong>Pseudomonas aeruginosa</strong></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 and a risk assessment profile (RAP) score has been developed and validated to characterize such risk. Patients with a RAP score ≥ 5 are at the highest risk and chemoprophylaxis is cost-effective in this patient population. 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 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.
Risk Assessment Profile Score (RAP)

Underlying condition
Morbid obesity  2
Malignancy  2
Abnormal coagulation factors at admission  2
History of Thromboembolism  4

Iatrogenic factors
Femoral line >24 hours  2
4 or more transfusions in first 24 hours  2
Surgical procedure >2 hours  2
Repair or ligation of major vascular injury  3

Injury-related factors
AIS score >2 for chest*  2
AIS score >2 for abdomen  2
AIS score >2 for head, or Coma (GCS <8 for >4 hours)  3
Spinal Fractures  3
Complex lower extremity fracture**  4
Pelvic fracture  4
Spinal cord injury +/- paraplegia or quadriplegia  4

Age
40-59 years  2
60-74 years  3
>=75 years  4

*Abbreviated Injury Score
**Grade IIIb, comminuted fractures (>3 fragments), unilateral femur and tibia, or bilateral femur OR tibia

References:
**Contraindication to Chemical Prophylaxis?**

1. Intracranial bleed (<24hrs post injury)
2. Spinal Cord Injury (<24 hrs post injury)
3. Ongoing Hemorrhage
4. Uncontrolled coagulopathy
5. Grade IV Spleen/Liver Injury (<24 hrs post injury)

**Contraindication to Chemical Prophylaxis?**

<table>
<thead>
<tr>
<th>Low Risk</th>
<th>Mod/High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAP &lt; 3</td>
<td>RAP &gt;=3</td>
</tr>
</tbody>
</table>

**YES**

- Anticipated Contraindication > 7 days

**NO**

- Low Risk
- RAP < 3
- SCDs + Early ambulation
- LMWH**
  - Lovenox 40mg SQ daily

**NO**

- Low/Mod Risk
- RAP <5
- SCDs + Early ambulation
- **If Renal Insufficiency (Cr>=2.5 or CrCl<30ml/min)**
  - Unfractionated Heparin
  - 5000 units SQ Q 12 hrs

**YES**

- High Risk
- RAP >=5
- SCDs + q week Duplex#
  - And Consider IVC filter

**#Order study through Vascular lab**
  - (Found in Epic under Vaslab)
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 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.

Relative contraindications to enteral feeds include:
• Peritonitis
• Intestinal obstruction
• Mesenteric ischemia
• Major GI bleed
• Complicated enteroenteric fisula
• Severe malabsorptive state
• Patients requiring neuromuscular blockade
• Patient requiring ongoing resuscitation with fluids and vasoactive support to maintain MAP > 60 mmHg

Enteral Access: All feeding tubes will be confirmed by radiography, not auscultation alone. Gastric access (NGT/OGT) is adequate for most patients. Post-pyloric placement will be determined to be necessary by one of the following:
• Gastric outlet obstruction
• Gastroparesis with persistent high gastric residuals despite prokinetic 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 critically ill patients. Glutamine (Impact Glutamine) should be considered in burn and trauma patients (avoid in patients with severe sepsis). Patients with ARDS ALI should be placed on an enteral formulation characterized by an anitinflammatory lipid profile and antioxidants (Pivot 1.5).

Metabolic Requirements: May be calculated using predictive equations (ie, Harris-Benedict, Ireton Jones, or Penn State equations) or indirect calorimetry.
- 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. JPEN, 2009;33;277
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

- Contraindication to EN(a)

  - 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
        - GRV ≥ 400 ml or SOI?(d)
          - Yes
            - Replace residual
            - Hold TF
            - Recheck GRV after 2 hr
          - No
            - 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
    - Contraindication to EN(a)

    - Protein calorie malnutrition?(c)
      - Yes
        - TEN(b)
      - No
        - No
          - TEN(b)

  - No
    - NPO ≥ 7 days?
      - Yes
        - TPN(b)
      - No
        - TPN(b)

- Standard (No TPN)

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

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

(a) Note relative contraindications
(b) Consult Nutrition when initiating TEN or TPN support
(c) Defined as acute weight loss ≥ 10-15% or body weight < 90% ideal body weight
(d) Signs of intolerance (SOI) = gastric tympany, abdominal distension, or emesis
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.
(3) 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 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 malignancy
  6. BMI>40
  7. Advanced liver disease
- **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

- **Candidate for emergent ECMO**
  - CPR
  - No
  - Yes

- **< 30 min of witnessed CPR**
  - No
  - Yes

- **Unwitnessed CPR or > 30 min of CPR**
  - Yes

- **Awake after CPR with negative neurologic exam**
  - No

- **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.
Stanford Health Care
Lucile Packard Children’s Hospital Stanford
Level I Pediatric Trauma Center.
Pediatric Surgery & Trauma Contacts

Pediatric Trauma Medical Director
Karl Sylvester, MD 650-804-0597

Pediatric General Surgery
24/7 answering service 650-723-6439
Matias Bruzoni, MD 650-213-6105
Stephanie Chao, MD 650-504-1852
Julie Fuchs, MD 650-384-9463
Gary Hartman, MD 650-353-0720
Claudia Mueller, MD 650-319-5037
David Powell, MD 410-858-0410
Karl Sylvester, MD 650-804-0597
James Wall, MD 650-556-5042
Chad Thorson, MD, Fellow 305-978-8868
Raji Koppolu, CPNP 18426 pager
Samantha Lee, CPNP 28100 pager

Pediatric Trauma Program Manager
Karla Earnest, RN, MS, MSN, CNS 650-353-6845
Email: trauma@stanfordchildrens.org 15698 pager,

Pediatric Trauma Nurse Coordinator
Michelle Padreddii, RN, BSN 650-319-5669
Email: mpadreddii@stanfordchildrens.org 15470 pager
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
Pager  3-8222
Patient Placement (Beds)  5-7788
Pediatric Surgery/Trauma 24/7  3-6439
Pediatric Anesthesia Fellow 24/7  1-9706
Pediatric Anesthesia back-up 24/7  1-9705
Pediatric ED Child Life  6-0896
Pediatric ED - desk  3-4422
Pediatric ED RSN  4-0057
PICU - desk  7-8850
PICU Fellow  1-9748
Radiology Manager On-Call 24/7  18703 pager
SCAN Consult 24/7  27226 pager
SHC ED - desk  3-7337
SHC ED RSN  4-2243
SHC Nursing Supervisor  6-1767
SHC-OR  3-7251
Social Work 24/7  18083 pager
Transfer Center  3-7342
Vascular Access  4-7422
Wound Ostomy Care Nurse (LPCHS)  650-815-5891
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

YES  
PT GOES TO ED FOR TRAUMA EVALUATION

NO  
TRANSFER CANCELLED

DECISION TO ADMIT TO LPCHS

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

Approved: Pediatric Trauma Task Force 12/10; Revised: 3/11, 3/13, 3/14, 3/16
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
  - Pediatric downtime documentation pack
  - Pediatric cardiac pack
  - Pediatric neuro trauma pack
  - Pediatric general trauma pack
- Pediatric Anesthesia Cart

LPCHS-OR Response Team Members

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

Stanford-OR needs to provide:

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

- Requires > 20 ml/Kg of PRBCs in the 1st hour of resuscitation
- High likelihood of > 0.1 units/kg of PBRCs within 12 hours of resuscitation

Pediatric MTG Pack (20-50 Kg)

- 4 Units of PRBCs
- 2 Units of thawed plasma
- 1 Unit of apheresis platelets

Process

- Call Blood Bank (3-6445)
- Activate pediatric MTG
- Provide the following information:
  - Patient name
  - MRN
  - DOB
  - Name of ordering MD
  - Contact name and phone number

- Send a runner to Transfusion Service, Room H1404, with the “Emergency Release of Blood Products Transfusion Service Order and Call Slip” form containing:
  - Minimum 2 patient identifiers
  - Physician signature (or RN’s for verbal order)
Pediatric Modified Rapid Sequence Intubation

Assemble equipment
Utilize Broselow Tape and Cart
Utilize Difficult Airway Cart for alternative airway supplies
Call Pediatric Anesthesia Code 55 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 • Minimum dose: 0.1 mg**
- Consider in patients <8 years old to block laryngoscopy induced bradycardia

Intracranial Antihypertensive
- **Lidocaine 1 mg/kg IV push**
- Give when increased ICP is known or suspected

Sedative
- **Etomidate 0.3 mg/kg IV**
  - Decreases ICP, minimal CV effects
- **Ketamine 1.5-2 mg/kg IV**
  - Bronchodilator, increases BP and HR

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 Code 55 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 with Propofol drip (head injury) or benzodiazepines and opioids

References

Rapid Sequence Intubation for Pediatric Patients

- Pre-oxygenate BVM if no spontaneous respirations
- Consider: Atropine Sulfate 0.02 mg/kg (minimum dose 0.1 mg if <1 year old)
  - Lidocaine 1 mg/kg IV push
  - Give when increased ICP is known or suspected
- Sedation
- Etomidate 0.3 mg/kg
- Utilize laryngeal manipulation (BURP maneuver) to visualize cords as needed
- Paralysis
- Succinylcholine Chloride 2 mg/kg IV OR Rocuronium 1 mg/kg IV
- Intubate, inflate cuff, check tube position
Pediatric Surgery response to the ED for Trauma 99

- Attending will respond to the ED within 30 minutes
- Fellow or Senior Surgical Resident will respond to the ED within 30 minutes

Documentation Options

- Trauma Flow Sheet – MD Name and time stamp (S-EPIC) – *Tell the Recording RN your name and role when you arrive in the ED*
- Pediatric Surgery Consult Note in the ED (S-EPIC)
- Pediatric Surgery – Trauma Acceptance Note (LPCHS-EPIC)
- Pediatric Trauma H&P (LPCHS-EPIC)

Trauma Tertiary Survey

- All trauma patients admitted to PICU
- All Trauma 99 & 97 Activations admitted to Acute Care
- Upon request of Admitting Sub-specialty Service for isolated injury

Approved: Pediatric Surgery Division and Pediatric Trauma Medical Director, 2/2016
**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, 3/2016

**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, 3/2016
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
• Provides notification call with basic ring-down info for Pediatric Trauma 99 to LPCHS-OR RSN (1-2820)
  o Age, mechanism, and known injuries

Adult Trauma Surgeon
• Responds to ED
• Leads trauma survey and resuscitation

Pediatric Trauma Surgeon
• Responds to the ED for Pediatric Trauma 99
• Provides consultation
• Provides notification call to LPCHS-OR ARC (1-9706 or 1-2820)
• Provides face-to-face IPASS hand-off to OR Team

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
  o PICU Attending responds within 30 minutes to cover PICU
  o If assistance with active patient management is not needed, PICU Fellow returns to PICU
• Transports unstable patient to LPCH OR
• Provides concurrent status updates to PICU and OR
• Provides face-to-face IPASS hand-off to OR Team
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

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 Attending

- Pediatric Anesthesia Attending responds to the ED
  - 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

Approved: 11/2014 Pediatric Trauma Task Force, Stanford Trauma Service, Pediatric ED Medical Director, Pediatric Anesthesia Medical Director, PICU Trauma Liaison, and PICU Surgical Director
LPCHS Roles & Response to Pediatric Trauma 99

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

Approved: 11/2014 Pediatric Trauma Task Force, Stanford Trauma Service, Pediatric ED Medical Director, Pediatric Anesthesia Medical Director, PICU Trauma Liaison, and PICU Surgical Director
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/MTP)

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 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 patient transfers emergently to LPCHS-OR:
  - O-neg blood & FFP transfers with patient from ED to LPCHS-OR
  - 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
- For least impact to downstream processes, change the name after the patient transfers to the PICU and is stabilized post-op
- Current EPIC processes do not allow charts to merge until after discharge.

Approved: Pediatric Trauma Task Force, 11/2015
<table>
<thead>
<tr>
<th>Emergency Department</th>
<th>Admitting Surgeon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pediatric Trauma 97/99 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, 4/2016
**Pediatric 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>• Trauma Service responsible for pt</td>
<td>• Trauma Service responsible for pt</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>
<tr>
<td>PICU or OR Admission</td>
<td>Trauma Attending to Peds Sx Attending AND PICU Attending</td>
<td>Trauma Attending to Peds Sx Attending AND PICU Attending</td>
</tr>
<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>
</tbody>
</table>

- Early alert and consult to Pediatric Neurosurgery for head/spine trauma
- Trauma Service remains responsible for pediatric trauma patient throughout their ED phase of care
- Pediatric Surgery assumes care of pediatric trauma patient at time of admission to LPCHS or at handoff in ED
- 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
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, 1/2015
Revised: 3/2016
**HIGH RISK**
- GCS $\leq 13$
- 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 if 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

---

**Relative 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>$\text{O}$</td>
<td>0 mSv</td>
<td>0 mSv</td>
</tr>
<tr>
<td>$\text{☢}$</td>
<td>&lt;0.1 mSv</td>
<td>&lt;0.03 mSv</td>
</tr>
<tr>
<td>$\text{☢☢}$</td>
<td>0.1-1 mSv</td>
<td>0.03-0.3 mSv</td>
</tr>
<tr>
<td>$\text{☢☢☢}$</td>
<td>1-10 mSv</td>
<td>0.3-3 mSv</td>
</tr>
<tr>
<td>$\text{☢☢☢☢}$</td>
<td>10-30 mSv</td>
<td>3-10 mSv</td>
</tr>
<tr>
<td>$\text{☢☢☢☢☢}$</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 (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as “Varies”.

---

References:

Adapted from PECARN TBI, age-based clinical prediction rules of outcome
Approved: Pediatric Neurosurgery Division, Pediatric Trauma Task Force and Pediatric Radiology Division, 8/2015
Cervical Spine Clearance in Children after Trauma

If the child is stable, conscious and communicative and has no high-risk mechanism or distracting injuries per NEXUS/CCR criteria, the **ED or Trauma or Neurosurgery Attending** 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/Neurosurgery Attending** 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**
Cervical Spine Clearance in Children after Trauma

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

Yes

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.

No

C-SPINE cleared by ED or Trauma or NS Attending

C-SPINE cleared by ED or Trauma or NS Attending

Neurologic Exam

NORMAL

ABNORMAL

NEUROSURGERY CONSULT

NORMAL

Abnormal but with persistent neck pain

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.
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 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

Approved: Pediatric Neurosurgery Division, Pediatric Trauma Task Force and Pediatric Radiology Division, 8/2015
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-IV
Admit to PICU
Advance Care per protocol

Manage based upon Clinical Assessment & Potential for OR

Discharge Criteria Met?

D/C Home

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

Rev. 6/14
Pediatric Trauma Task Force
# 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-DISCHARGE IMAGING</td>
<td>NONE</td>
<td>NONE</td>
<td>NONE</td>
<td>NONE</td>
</tr>
<tr>
<td>POST-DISCHARGE IMAGING</td>
<td>NONE</td>
<td>NONE</td>
<td>NONE</td>
<td>NONE</td>
</tr>
<tr>
<td>POST INJURY ACTIVITY RESTRICTION/ F/U VISIT</td>
<td>3 WEEKS</td>
<td>4 WEEKS</td>
<td>5 WEEKS</td>
<td>6 WEEKS</td>
</tr>
<tr>
<td>VITAL SIGNS</td>
<td>Q2hX 8h, THEN Q4h</td>
<td>Q2hX 8h, THEN Q4h</td>
<td>Q2hX 8h, THEN Q4h</td>
<td>Q1h x 12h; q2h x 12h, THEN q4h</td>
</tr>
<tr>
<td>BEDREST</td>
<td>8h</td>
<td>24h</td>
<td>24h</td>
<td>48h</td>
</tr>
<tr>
<td>HCT</td>
<td>12 h POST INJURY</td>
<td>12 h POST INJURY</td>
<td>12 h AND 36 h POST INJURY</td>
<td>6h, 18h, 40-48h, POST INJURY</td>
</tr>
</tbody>
</table>

Delayed clinical findings may present \( \geq 48h \) post trauma

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
- 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

Approved Pediatric Trauma Task Force,
4/2015; Revised, 2/2016
# Pediatric Blunt Renal Trauma Management

<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>24hrs</td>
<td>24 hrs</td>
</tr>
<tr>
<td>Hospital LOS</td>
<td>Based on discharge criteria: HCT stable, Tolerate diet, 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>4 weeks</td>
<td>5 weeks</td>
<td>6 weeks</td>
</tr>
<tr>
<td>Bedrest</td>
<td>Ambulate when able</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCT</td>
<td>12 h post injury</td>
<td>12 h post injury</td>
<td>12 h and 36 h post injury</td>
<td>6h, 18h, 40-48h post injury</td>
</tr>
</tbody>
</table>

Approved Pediatric Trauma Task Force, 4/2015

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

Treatment proceeds as indicated

Neurovascular compromise? Compartment Syndrome? Open or Closed Fracture?

Operative Management?

LPCHS-OR or Stanford-OR

ED Management?

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

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

Admit to LPCHS* vs DC home with follow-up

Approved: Pediatric Trauma Task Force, Pediatric Trauma Orthopedic Liaison, 11/2015
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:
  
<table>
<thead>
<tr>
<th>Nerve</th>
<th>Motor</th>
<th>Sensory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median (AIN)</td>
<td>“OK” sign and</td>
<td>Index finger</td>
</tr>
<tr>
<td></td>
<td>thumb abduction</td>
<td></td>
</tr>
<tr>
<td>Radial (PIN)</td>
<td>“Thumb’s up” sign</td>
<td>Dorsal web space</td>
</tr>
<tr>
<td>Ulnar</td>
<td>Scissors”</td>
<td>Small finger</td>
</tr>
</tbody>
</table>

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?
  - Yes
  - Symptomatic treatment
  - No
  - Physical Exam:
    - High index of suspicion for open fracture
    - AP Pelvis
    - CT vs MRI (controversial)
    - CONSULT PEDIATRIC ORTHOPEDIC SURGERY
    - Hemodynamically stable?
    - Yes
    - Resuscitate per APLS guidelines
    - Place pelvic binder
    - R/O alternative source of bleeding
    - No
    - Admit to LPCHS Pediatric Surgery/Trauma
    - HAND-OFF: Trauma Attending to Pediatric Surgery & PICU Attending

- **Skeletally Mature**
  - Follow adult pelvic fracture guidelines
  - No
Pediatric Pelvic Fracture

May consider Stanford-OR if
- ≥14y and ≥80 lbs (36.4 kg)
  **AND**
- Adult-type fracture with skeletal maturity
- Consider consult to OTA* colleague
  **OR**
- Too hemodynamically unstable for safe transfer from ED to LPCHS-OR

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

*OTA – Orthopedic Trauma Association, Fellow

References:
High-energy pediatric pelvic and acetabular fractures.

Approved: Pediatric Trauma Task Force and Pediatric Orthopedic Surgery Trauma Liaison, 2/2016
**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 aPTT above 50 seconds
Pediatric VTE

Does not meet criteria for routine prophylaxis. If ≥ 18 years eligible for adult guidelines

Hospitalized patient age ≥10 years

Altered mobility >48hrs?

No

Yes

Other VTE risk factors*?

No

Yes

Other VTE risk factors*?

No

Yes

Contrindications to anticoagulation**?

No

Yes

Early ambulation

Early ambulation AND Mechanical Prophylaxis

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

Early ambulation AND Mechanical Prophylaxis

LOW Risk

MODERATE Risk

HIGH Risk

References:

Approved: Pediatric Trauma Task Force, PICU Trauma Liaison and PICU Surgical Director, 3/2016
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)
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 and/or the Suspected Child Abuse and Neglect (SCAN) Team, as needed.
- Neurosurgery may admit injured children with confirmed isolated head or spine trauma and consults the Suspected Child Abuse and Neglect (SCAN) Team, as needed.
- 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 must have a Trauma Tertiary Survey by Pediatric Surgery.

Outside hospital trauma transfers to PICU:

- Patients injured <24 hours prior requesting transfer from an outside hospital ED must transfer to the Stanford-ED for Primary and Secondary Trauma Surveys before admitting to the PICU
- Patients injured >24 hours prior may transfer to the ED or PICU based on admitting surgeon preference
- Outside hospital in-patients must admit directly to PICU
  - Direct admits <24 hours post-injury require a full trauma evaluation by an ATLS certified provider within 15 minutes of arrival; the ATLS provider may be a PICU or Pediatric Surgery Fellow or Attending.
- The Transfer Center should automatically direct requests for transfer of injured children to the Trauma Service in the ED; however, occasionally requests for direct transfer of injured patients 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.

Approved: 5/11/2015 by Pediatric Trauma Medical Director, PICU Surgical Director, and PICU Trauma Liaison
Revised: 4/19/2016
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


Consider Transfer to Burn Center for deep partial (2nd degree) or full thickness (3rd degree) burns ≥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></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>
<tr>
<td>AGE</td>
<td>BOYS</td>
<td>GIRLS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>-------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 MONTHS</td>
<td>5.9</td>
<td>5.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 MONTHS</td>
<td>7.8</td>
<td>7.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 YEAR</td>
<td>10.1</td>
<td>9.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 YEARS</td>
<td>12.3</td>
<td>11.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 YEARS</td>
<td>14.6</td>
<td>14.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 YEARS</td>
<td>16.6</td>
<td>15.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 YEARS</td>
<td>18.6</td>
<td>17.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 YEARS</td>
<td>25</td>
<td>24.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 YEARS</td>
<td>32</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 YEARS</td>
<td>50</td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Estimated Circulating Blood Volume

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Estimated Blood Volume</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>
</tbody>
</table>
# PEDIATRIC G-Tubes, Chest Tubes, Foley

<table>
<thead>
<tr>
<th>AGE</th>
<th>NG TUBE SIZE</th>
<th>CHEST TUBE SIZE</th>
<th>URINARY CATHETER SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant 3 – 9 kg</td>
<td>5 – 8 Fr</td>
<td>10 – 12 Fr</td>
<td>6 – 8 Fr</td>
</tr>
<tr>
<td>Small Child 10 – 11 kg</td>
<td>8 – 10 Fr</td>
<td>16 – 20 Fr</td>
<td>8 – 10 Fr</td>
</tr>
<tr>
<td>Child 12 – 14 kg</td>
<td>10 Fr</td>
<td>20 – 24 Fr</td>
<td>10 Fr</td>
</tr>
<tr>
<td>Child 15 – 18 kg</td>
<td>10 Fr</td>
<td>20 – 24 Fr</td>
<td>10 – 12 Fr</td>
</tr>
<tr>
<td>Child 19 – 22 kg</td>
<td>12 – 14 Fr</td>
<td>24 – 32 Fr</td>
<td>10 – 12 Fr</td>
</tr>
<tr>
<td>Young adult 24 – 28 kg</td>
<td>14 – 18 Fr</td>
<td>28 – 32 Fr</td>
<td>12 Fr</td>
</tr>
<tr>
<td>Young adult 30 – 36 kg</td>
<td>16 – 18 Fr</td>
<td>32 – 38 Fr</td>
<td>12 Fr</td>
</tr>
<tr>
<td>Age Of Patient</td>
<td>Laryngoscope Blade</td>
<td>Endotracheal Tube Size (Internal Diameter in mm)</td>
<td>Distance From Mid Trachea To Lips (cm)</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------</td>
<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 |
<p>| 6 months       |                   | 3.5 cuffed, 3.5 uncuffed | 9 – 10 | 6 – 8 |
| 1 year         | Miller 1 Wis-Hipple 1½ | 4.0 cuffed &amp; uncuffed | 10.5 – 12 | 8 |
| 2 years        | Miller 2 Macintosh 2-3 | 4.5 &amp; 4.0 cuffed | 13.5 | 8 |
| 4 years        |                   | 5.0 &amp; 4.5 cuffed | 15 | 10 |
| 6 years        |                   | 5.5 &amp; 5.0 cuffed | 16.5 | 10 |</p>
<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><strong>Age (yrs) + 16</strong></td>
<td><strong>3 x ETT size</strong></td>
<td><strong>2 x ETT size</strong></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>Adolescents</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 &gt; 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 Hematoma</td>
<td>Subcapsular, &lt;10% surface area</td>
<td>2</td>
</tr>
<tr>
<td>Laceration</td>
<td>Capsular tear, &lt;1 cm parenchymal depth</td>
<td>2</td>
</tr>
<tr>
<td>II Hematoma</td>
<td>Subcapsular, 10% to 50% surface area; intraparenchymal, &lt;10 cm in diameter</td>
<td>2</td>
</tr>
<tr>
<td>Laceration</td>
<td>Capsular tear, 1-3 cm parenchymal depth, &lt;10 cm in length</td>
<td>2</td>
</tr>
<tr>
<td>III Hematoma</td>
<td>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>Laceration</td>
<td>Parenchymal depth &gt;3 cm; major duct involvement; blood loss &gt;20%; moderate</td>
<td>3</td>
</tr>
<tr>
<td>IV Laceration</td>
<td>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 Laceration</td>
<td>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>Vascular</td>
<td>Juxtahepatic venous injuries (i.e., retrohepatic vena cava/central major hepatic veins); massive; complex</td>
<td>5</td>
</tr>
<tr>
<td>VI Vascular</td>
<td>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>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*
### SOLID ORGAN GRADING - PANCREAS

<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>
</tr>
</tbody>
</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