Nov. 2021
UPDATE

NYC HEALTH+ HOSPITALS | Elmhurst

Department of Surgery Trauma Policy Manual

AMERICAN COLLEGE OF SURGEONS
Verified Trauma Center

NYC HEALTH+ HOSPITALS | Elmhurst

TABLE OF CONTENTS

1. TRAUMA JOB DESRIPTIONS

A. TRAUMA MEDICAL DIRECTOR (TMD)

1. Overview

The Trauma Service will be directed by the Trauma Medical Director (Director of Trauma). The Trauma Medical Director reports to the Director of Surgery and the Chief Medical Officer. The Trauma Medical Director leads the multidisciplinary activities of the trauma program and is responsible for the planning, organizing, and supervising the systematic care of trauma patients throughout NYC H+H/Elmhurst. The TMD directly supervises and is responsible for the care of the patients and personnel of the trauma service.

2. Qualifications

i. Must comply with all the rules and regulations as established by the Medical Board Bylaws.
ii. Must be a currently board-certified general surgeon by the American Board of Surgery.
ii. Must have full and unrestricted privileges in general surgery.
iv. Must take trauma call.
v. Must be current in Advance Trauma Life Support (ATLS).
vi. Must maintain a minimum of 12 hours annually, or 36 hours in 3 years, of verified external trauma-related continuing medical education.
vii. Membership and active participation in regional or national trauma organizations is essential.
viii. May not direct more than one trauma center.

3. Oversight

i. The TMD has the authority to manage all aspects of trauma care.
ii. Oversees the clinical care of patients on the trauma service.
iii. Chairs and attends 50% of the multidisciplinary peer review committee meetings.
iv. Actively participates in clinical case review of trauma cases that have been identified through the Trauma Performance Improvement Process.
v. Authorizes trauma service privileges of the on-call panel.
vi. Identifies and authorizes representatives/liaisons to the trauma program from other disciplines.
vii. Works with nursing administration to support the nursing needs of trauma patients.
viii. Leads development and implementation of treatment protocols/guidelines to ensure appropriate medical management of all trauma patients utilizing the principles of evidence-based medicine.
ix. Coordinates the performance improvement and peer review processes.
x. Has the authority, in collaboration with the trauma program manager (TPM), to correct deficiencies in trauma care.
xi. Performs annual assessment of trauma panel providers in the form of Ongoing Profession Practice Evaluation (OPPE) and Focused Professional Practice Evaluation (FPPE).
xii. Oversees the trauma clinical activities of the medical staff, providing both consultation on the care of patients as well as education for the medical staff. Has the authority to take corrective action when the need arises.

4. Administrative

i. Participates in budgetary, operational, and strategic planning for the provision of trauma care throughout the hospital.
ii. Provides collaborative supervision and support of the trauma program manager.
iii. Provides ongoing oversight of the trauma registry.
iv. Provides overall supervision of the trauma program staff, including the trauma program manager, trauma performance improvement coordinator, trauma registrars, injury prevention coordinator, support staff, and trauma research staff.
v. Directs the trauma performance improvement program (specifically the multidisciplinary trauma peer review committee and the trauma operations committee (TOC)) or appoints a chair to act on the behalf of the TMD.
vi. Monitors appropriateness of quality indicators and monitoring tools to screen and identify potential adverse trends in trauma patient care.
vii. Represents the trauma program by attending appropriate medical staff/hospital-wide committees.

3. Educational

i. Develops educational objectives based on the results and outcomes of performance improvement activities.
ii. Responsible for education of attending staff, house staff, and medical students in trauma related care.
iii. Responsible for Trauma Grand Rounds.
iv. Must actively participate in the ATLS course.
v. The TMD will appoint, and be assisted by, the associate TMD.

B. TRAUMA PRORAM MANAGER (TPM)

1. Overview

The TPM is fundamental to the development, implementation, and evaluation of the trauma program. The TPM must be full-time and deliciated to the trauma program. The TPM should hold membership and actively participate in regional or national or national trauma organizations (ex. STN, AACN, ENA, EAST, SSCM, or ABA). In addition, the TPM must complete 12 hours annually, or 36 hours every 3 years, of trauma related continuing education (internal or external).

2. Trauma program manager responsibilities include, but are not limited to:

i. Day to day responsibility for process and performance improvement activities as they relate to nursing and ancillary personnel.
ii. Working, in collaboration with the TMD, towards trauma program goals.
iii. Coordination of resources and activities necessary to ensure that the trauma program complies with American College of Surgeons (ACS) Level I trauma center verification requirements and NYSDOH Bureau of EMS and Trauma Systems state trauma center designation requirements
iv. Participating in clinical activities and coordinating management across the continuum of trauma care which include planning and implementation of clinical protocols and practice management guidelines, monitoring care of in-hospital patients, and serving as a resource for clinical practice.
v. Oversight of the trauma performance improvement program and trauma performance improvement personnel.

vi. Leading the development, implementation, and ongoing evaluation of the overall trauma performance improvement patient safety program. In addition, monitors clinical processes and outcomes and systems issues related to the quality of care provided, develop quality filters, audits, and case reviews, identifies trends and sentinel events, and outlines remedial actions while protecting confidentiality.
vii. Actively participating as a member on the multidisciplinary peer review committee and Trauma Operations Committee (TOC).
viii. Correlating trauma PIPS outcomes and PI findings with trauma registry data for adherence to ACS and NYSDOH criteria.
viii. Oversight of all activities of the trauma registry. Responsible for assurance of timely data submissions to the National Trauma Data Bank (NTDB), ACS Trauma Quality Improvement Program (TQIP), NYSDOH state trauma registry, and NYS TQIP collaborative.
ix. Analyzing benchmark reports from the ACS Trauma Quality Improvement Program (TQIP) in collaboration with the TMD and trauma performance improvement coordinator.
x. Ensuring a trauma registry data is secured in accordance with protected health information (PHI/ePHI) security requirements and HIPAA.
xi. Supervising and guiding the trauma PI coordinator, trauma registrars, injury prevention coordinator as well as non-clinical personnel supporting the trauma program.
xii. Leading the verification/re-verification process with all surgical and ancillary disciplines on a concurrent basis.
xiii. Assisting in the development of and assuring compliance with regional and state trauma standards, policies and protocols.
xiv. Functioning in a leadership role to supervise and participate in public education and injury prevention activities for the trauma center.
xv. Serving as a liaison for the trauma center with pre-hospital care providers as well as community and local hospitals that utilize the trauma center for patient referral and care.
xvi. Participation and representation of the trauma service at regional, state and national trauma oversite/advisory meetings.

C. TRAUMA PERFORMANCE IMPROVEMENT COORDINATOR (TPIC)

1. Overview

Coordinates the trauma performance improvement patient safety (PIPS) program for the hospital in collaboration with TMD and TPM. Completion of a trauma performance improvement course, such as TOPIC, is desired.

2. Trauma performance improvement coordinator is responsible for:

i. Coordinating and scheduling monthly trauma multidisciplinary peer review committee and trauma operations committee (TOC) meetings.
ii. Preparing meeting agendas and presentations for the trauma PIPS committee meetings in conjunction with the TMD and TPM.

iii. Compiling the minutes for the multidisciplinary peer review committee and TOC meetings, with final approval by the TMD and TPM.
iv. Correlating trauma PIPS outcomes and PI findings with trauma registry data for adherence to ACS and NYSDOH criteria.
v. Reporting significant trends, issues and outstanding items to the TMD and TPM.
vi. Helping in data collection, tracking and benchmarking of trauma PI issues related to patient care and system development.
vii. Maintaining a trauma PI database to ensure adequate documentation as required by ACS and NYSDOH standards.
viii. Producing and analyzing trended data and provider specific profiles in collaboration with TMD and TPM
ix. Assisting in the preparation of any documents and reports as requested by the NYSDOH, TMD, TPM, or hospital administration
x. Identifying areas for improvement and education using trauma registry performance improvement reports and data.
xi. Defining, developing and utilizing accepted measures to evaluate quality of care and service utilizing appropriate benchmark comparison and statistical analysis in conjunction with the TMD and TPM.
xii. Analyzing benchmark reports from the ACS Trauma Quality Improvement Program (TQIP) in collaboration with the TMD and TPM.
xiii. Participating in committees and department meetings, as required:

- Multidisciplinary trauma peer review
- Trauma Operations Committee (TOC)
- EMS PI committee

D. TRAUMA PERFORMANCE IMPROVEMENT COORDINATOR (TPIC)

1. Overview

The trauma registrar is a vital member of the trauma team. The trauma registrar works directly with the trauma leadership and reports to the TPM. Trauma registrars should receive initial training upon hire.

2. Qualifications

They must attend, or have previously attended, two courses (of the following listed below) within 12 months of being hired:
i. The American Trauma Society's Trauma Registrar Course (or equivalent) and
ii. The Association of Advancement of Automotive Medicine's Injury Scaling Course.
iii. Certified Specialist in Trauma Registry (CSTR) is recommended. In addition, registrars should complete 8 hours of registry specific continuing education per year.

3. The trauma registrar is responsible for:

i. Timely collection and entry of patient data (such as age, sex, mechanism of injury, prehospital care, ED care, procedures, diagnosis, trauma score, length of stay, mortality, etc.) into the trauma registry within 60 days of patient discharge.
ii. Generating trauma registry data reports in support of trauma service performance improvement program activities such as, but not limited to, trauma multidisciplinary peer review committee, Trauma Operations Committee (TOC), and EMS performance improvement committee meeting.
iii. Generating ad hoc trauma registry reports as requested by the TMD or TPM for additional trauma performance improvement initiatives and research activities.
iv. Performing quarterly inter-rater validation reports to ensure accuracy and quality of data entry.
v. Submitting trauma registry data to the National Trauma Data Bank (NTDB), American College of Surgeons Trauma Quality Improvement Program (TQIP), NYSDOH state trauma registry, and NYS TQIP as required.

E. INJURY PREVENTION COORDINATOR (IPC)

1. Overview

Trauma centers must have an organized and effective approach to injury prevention and prioritize their efforts based on local registry and epidemiological data. The IPC develops injury prevention and educational programs based on frequency and seriousness of events/injuries seen at the trauma center based on trauma registry data and community needs. This is a full -time position which cannot be fulfilled by the TPM.

| The injury prevention/outreach coordinator is responsible for:

i. Identifying trauma patients with a positive BAC, and/or positive CAGE Screening, requiring Brief Intervention.
ii. Monitoring compliance and coordinate the SBIRT process.C. Reporting SBIRT compliance at Trauma Operations Committee (TOC).
iii. Developing public awareness by presenting and coordinating injury prevention programs for the community.
iv. Implementing, at minimum, two injury prevention initiatives that address one of the major causes of injury in the community.
v. Coordinating injury prevention outreach educational events targeting the public and professional community.
vi. Disseminating information about the trauma program and trauma systems through public awareness/educational program, newsletters, websites.
vii. Participating in local, regional and state trauma events consistent with the requirement of a Level 1 American College of Surgeons (ACS) Trauma Center
viii. Contributing to the establishment of policies and procedures consistent with the requirements of recognized standards and accreditation/regulatory agencies, the NSYDOH and the ACS.
ix. Maintaining educational record keeping systems that support data retrieval.
x. Reporting all educational/outreach and injury prevention activities at TOC.

F. General Surgery (Trauma Surgeons)

The Trauma Service will be staffed by a group of attending trauma surgeons, designated as the Trauma Surgery Attending Panel. All members of this Trauma Surgery Attending Panel will be approved by the Trauma Medical Director.

| Requirements include:

i. Current board certification, or board eligibility, in general surgery by the American Board of Surgery, American

ii. Osteopathic Association's American Osteopathic Board of Surgery, or the Royal College of Physicians and Surgeons of Canada.

iii. Active participation in the care of injured patients on the Trauma Service.

iv. Dedicated to one trauma center while on call.

v. Attending at least 50% of the multidisciplinary trauma peer review committee meetings.

vii. Successful completion of ATLS (current ATLS or instructor desired).

viii. Demonstrate evidence of ongoing trauma-related education by: 1) staying current with board certification requirements, or 2) obtain at minimum of 36 hours of trauma-related continuing medical education credits every three years (12 hours average on an annual basis). This may be either externally acquired CME or through the trauma service's internal education program.

2. Scope of Service – Trauma Program

The Trauma Service at Elmhurst Hospital exists to care for the subset of patients that are at a high risk of dying or being disabled from multiple or severe injuries. These injuries include but are not necessarily limited to the following:

1) Combined system injury of two or more of the following: Head, chest, abdomen, and extremities; or any single system injury severe enough to cause shock, to require transfusion, or to necessitate observation or treatment in an intensive care unit.
2) Penetrating Injuries:
   - To the head and neck
   - To the trunk
   - To the extremities with vascular compromise
3) Central Nervous System Injuries:
   - Spinal cord injury/paralysis
   - Penetrating head injury
   - Depressed skull fracture
   - Open head injury
   - Cerebral spinal fluid leak
   - History of loss of consciousness
   - Posturing or lateralizing signs
   - Glasgow Coma Score (GCS) less than or equal to 13 or deterioration of GCS of 2 or more
4) Chest Injuries:
   - Major chest wall injury/flail chest/open pneumothorax
   - Cardiac injury
   - Severe pulmonary contusion
   - Wide superior mediastinum on chest x-ray
5) Blunt Abdominal/Pelvic Injuries:
   - Any blunt trauma patient with hypotension
   - Pelvic fracture with shock or evidence of major hemorrhage or open pelvic fracture
   - Falls from two or more stories
   - Pelvic fracture associated with at least one long bone fracture or with thoracic or abdominal injury
   - Injured, surviving passengers of motor vehicle accidents in which there was a fatality
   - Long bone fractures with neurovascular compromise
6) Burned patients

In addition to caring for these types of patients, the Trauma Service will be engaged in an active program of trauma research. The Trauma Service will sponsor programs of continuing medical education in trauma for physicians, nurses, and allied health personnel. Multidisciplinary conferences and lectures will be a key component of this goal. Community outreach will also be an important responsibility of the trauma service and this will include education regarding injury prevention as well as health problems that may affect the community.

The Trauma Service will be actively involved in disaster planning (for both the hospital and the community) and engage in disaster drills on a regular basis. For this purpose, both the Director of Trauma and the Trauma Program Manager will be active members of the Elmhurst Hospital Emergency Preparedness Committee.

The Elmhurst Hospital Trauma Service will participate with the other trauma centers in New York City as well as FDNY in regularly scheduled meetings for purposes of review and quality assurance of the New York City Trauma System.

The Trauma Service will maintain a regularly scheduled Performance Improvement/Patient Safety (PI/PS) program. The Director of the Trauma Service will function as chairperson of the PI/PS Program. The committee will be comprised of the Trauma Program Manager, the Trauma Registrar(s), Trauma Surgeons, and representatives from the departments of Emergency Medicine, Orthopedics, Neurosurgery, Pediatrics, Radiology, Anesthesiology, Surgical Trauma Intensive Care Unit, Geriatrics, Nursing, and hospital administration. The committee will review all trauma cases. There will be frequent quality assurance projects to evaluate various aspects of trauma care so as to improve performance. There will be use of trauma registry data to evaluate care, identify trends, and support quality assurance projects. The Trauma PI/PS Program will report to the Department of Surgery's Performance Improvement Committee and the minutes will be forwarded to the Department of Surgery. Minutes from the Trauma PI/PS will subsequently be reviewed by the hospital-wide PI/PS Committee and ultimately by the hospital's Medical Board.

3. Trauma Admissions

A. Purpose

The goal of trauma team activation is to rapidly bring the necessary resources and skills to an injured patient based on established trauma activation criteria. Trauma team activation ideally is done prior to patient arrival based on EMS pre-notification report or immediately upon patient arrival if no EMS pre-notification has been received. Activating the trauma team is an efficient way to rapidly mobilize a highly focused, interdisciplinary team.

B. Responsible Parties:

i. Attending trauma surgeon

ii. Trauma surgery resident

iii. Attending emergency medicine physician

iv. Emergency medicine resident

v. Emergency department nurse

vi. Trauma medical director

vii. Trauma program director

C. Activation of the Trauma Team

The trauma team may be activated by an attending trauma surgeon, chief surgery resident, attending emergency medicine physician, trauma medical director, trauma program director or emergency department nurse. The decision to activate the trauma team will be based on established trauma activation criteria. The trauma team is activated by dialing the hospital's STAT page number (4-1911) and requesting a trauma team activation (Red or Yellow trauma activation must be specified). Upon activation of the trauma team, designated personnel will immediately respond to the trauma resuscitation area.

1. Trauma Team Response

Three levels of trauma team response: **Red** (full team), **Yellow** (partial team), and **Green** (trauma consult):

Red Activation:

Upon activation of a Red trauma, assigned members of the trauma team (surgery trauma team, emergency medicine trauma team, anesthesia, STICU attending or fellow, and x-ray technologist) must proceed immediately to the trauma resuscitation area. The attending trauma surgeon must arrive to the trauma resuscitation area within 15 minutes of patient arrival. Additional surgical services can be summoned to the trauma resuscitation area on a STAT basis (e.g. Neurosurgery, Orthopedics, etc.) at the discretion of the attending trauma surgeon, attending emergency medicine physician, or trauma team leader.

Yellow Activation:

Upon activation of a Yellow trauma, assigned members of the trauma team (surgery trauma team, emergency medicine trauma team, and x-ray technologist) must proceed immediately to the trauma resuscitation area. The expected response time is not to exceed 15 minutes. The chief surgical resident must discuss the case with the attending trauma surgeon within 30 minutes of activation or sooner if the clinical condition warrants. If the clinical condition of the patient is such that it requires immediate evaluation by the attending trauma surgeon, the chief surgery resident must contact the attending trauma surgeon and request their presence at the patient's bedside. The expected response time of attending trauma surgeon presence in this situation is 15 minutes from chief surgery resident call.

Green Consult:

Trauma surgery consult for an injured patient that does not meet criteria for a Red or Yellow activation but because of diagnosed injuries, injury pattern, and other patient factors delineated by the Green criteria warrant trauma surgery consultation. The Green Trauma response is the senior surgery resident and the expected response is not to exceed 30 minutes. Green trauma patients must be discussed with the attending trauma surgeon prior to patient disposition.

2. Trauma Activation Criteria (refer to Appendix A for diagram):

Red Trauma Activation Criteria

A. Physiologic Criteria

ADULT (15 + years)

Airway: Unable to adequately ventilate, intubated, assisted ventilation or in need of emergent airway
Breathing: RR < 10 or > 29
Circulation: age 15-64: SBP < 90 | age ≥ 65: SBP ≤ 110
Deficit: GCS motor score ≤ 5 *or* total GCS < 9 attributed to trauma

CHILD (0-14 years)

Airway: Unable to adequately ventilate, intubated, or assisted ventilation or in need of emergent airway
Breathing: Respiratory insufficiency (e.g. hypoxia, accessory muscle use, grunting), Respiratory rate < 20 in infants aged < 1 year
Circulation: Abnormal perfusion (e.g. cap refill > 2s, low SBP for age)
< 1 year: SBP < 60
1yr-10 year: SBP < [70 + 2x age]
> 10 year: SBP < 90
Deficit: AVPU: responsive to pain (P) or unresponsive (U)
Total GCS < 9 or deteriorating by 2, with a mechanism attributed to trauma

**** Key Points:**

- All traumatic arrests are to be activated as **RED**
- Consider non-accidental trauma in all patients under 1 year of age without an underlying medical condition to explain an arrest

B. Secondary Survey: Anatomic and Mechanism of Injury

1. Gunshot wound to head, neck, torso, or extremities proximal to the elbow/knee
2. Penetrating/ stab wound to abdomen with evisceration or to anterior chest medial to the nipples (cardiac box)
3. Open or depressed skull fracture
4. Suspected spinal cord injury (e.g. paralysis)
5. Flail chest
6. Unstable pelvic fracture
7. Two or more proximal long bone fractures (humerus or femur)
8. Amputation proximal to the wrist or ankle
9. Crushed, degloved, pulseless, or mangled extremity
10. Patient presenting with tourniquet in place
11. Deterioration of previously stable patient
12. Transfers receiving blood transfusion to maintain vital signs
13. Struck by train/subway

14. Geriatrics (> 65 years of age)
    i. GCS ≤ 12 attributed to trauma
    ii. Motor vehicle vs pedestrian/cyclist - significant impact or >20 mph
    iii. Motorcycle/motorized scooter crash > 20 mph
    iv. Fall > 10 feet or fall down 10 or more stairs
    v. Blast or explosion
15. Emergency Provider Discretion

Yellow Trauma Activation Criteria

Mechanism of Injury

1. Penetrating trauma (except gunshot wounds) to head, neck, torso, or extremities proximal to elbow or knee
2. Fall:
i. Adult (15-64 years) > 20 feet
ii. Child (0-14 years) > 10 feet or 3x height (whichever is less)
iii. Fall from any height if anticoagulated

3. Motor vehicle crash with:
i. Intrusion of vehicle into occupant compartment
ii. Ejection from motor vehicle
iii. Rollover
iv. Death of passenger in same vehicle
v. Striking fixed object with momentum

4. GCS 9 – 13 with mechanism attributed to trauma (age less than 65):
i. Motor vehicle vs pedestrian/cyclist - significant impact or >20 mph
ii. Motorcycle/motorized scooter crash > 20 mph
iii. Blast or explosion (< 65 years of age)
iv. Burn > 10% TBSA (partial or full thickness)
v. Inhalational injury
vi. Suspicion of drowning or hanging or high-energy electrical injury
vii. Blunt abdominal injury with firm or distended abdomen or with seatbelt sign
viii. Femur shaft fracture in geriatric patient (age >= 65 years)
ix. ED provider discretion

Green (Trauma Consult) Criteria

A. Stable patient with significant injury diagnosed after imaging:

1. Head injury with abnormal CT scan needing admission
2. Complex facial fractures (orbital, mandible, LeFort II/III)
3. Hemothorax/pneumothorax seen on x-ray or CT
4. Multiple rib fractures ≥ 2 requiring admission
5. Intra-abdominal injury or persistent abdominal pain requiring admission for serial examinations

6. Acetabular and/or pelvic ring fracture
7. Long bone fracture proximal to knee or elbow
8. Suspected vascular injury (blunt carotid, vertebral, thorax, or extremity)

B. Pregnant patient (≥ 20 weeks gestation) with one or more of the following:

1. Pedestrian struck at low speed (<20 mph)
2. Multiple rib fractures ≥ 2
3. Intra-abdominal injury or persistent abdominal pain requiring admission for serial examinations
4. Long bone fracture (open or closed) proximal to wrist or ankle
5. Acetabular and/or pelvic ring fracture
6. More than one body region injured

C. Pediatric patient (age <15 years) with one or more of the following:

1. Pedestrian struck at low speed (<20 mph)
2. Traumatic brain injury seen on CT scan
3. Femur shaft fracture
4. Open fracture proximal to wrist or ankle
5. More than one body region injured

D. Geriatric patient (age ≥ 65 years) with one or more of the following:

1. Fall from a standing height with loss of consciousness or any traumatic brain injury seen on CT scan.
2. GCS 13-14 with mechanism attributed to trauma
3. Rib fractures ≥ 2 or Hemothorax/pneumothorax or pulmonary contusion seen on x-ray or CT
4. Humeral shaft fracture
5. Acetabular and/or pelvic ring fracture
6. Hip fracture
7. Open fracture proximal to wrist or ankle
8. More than one body region injured.
9. Pedestrian struck at low speed (<20 mph)

E. Transfers from outside hospital with significant injury or injuries

F. ED physician discretion

G. Trauma Activation Upgrade:

In the event of patient deterioration at any point during the initial resuscitation period the patient must be upgraded to the most appropriate level.

Mandatory RED upgrade criteria:

1. Patient is intubated at any point during the initial resuscitation period
2. Patient becomes hypotensive, based on age specific criteria, at any point during the initial resuscitation period
3. Patient GCS decreases by 2 points, or decreases to < 9, during the initial resuscitation period
4. Patient receives any blood/blood products during the initial resuscitation period or within 4 hours of arrival.

**** Key Point:**

Initial resuscitation period is defined as from patient arrival until diagnostic studies completion.

H. Trauma Transfers:

Trauma transfers will be activated according to established Red, Yellow, or Green trauma activation criteria. Activation will be based on defined physiologic criteria, mechanism of injury, identified injuries, or attending trauma surgeon/attending ED physician discretion as reported by the referring hospital.

References:
Resources for Optimal Care of the Injured Patient. American College of Surgeons Committee on Trauma. 2014. 37-38. Guidelines for Field Triage of Injured Patients: Recommendations of the National Expert Panel on Field Triage, 2011. MMWR. January 13, 2012. 61(RR01); 1-20

4. Surgical Specialty Consult Criteria

A. Emergent Neurosurgery Consultation:

Neurosurgery consult will respond to the trauma patient's bedside within 30 minutes of being called for the following conditions:

1.Significant penetrating injury to the head (gunshot wound or stab wound that penetrates the skull)
2. Acute intracranial hematoma (e.g. epidural, subdural, intra-parenchymal, or subarachnoid) with □5 mm midline shift.
3. Severe open skull fracture (e.g. comminuted, depressed, evidence of the dural penetration/cerebrospinal fluid leak).
4. Comatose patient with intracranial injury (e.g. severe TBI) or suspected elevated intracranial pressure (e.g. unilateral dilated and/or fixed pupil)
5. Spinal cord compression or acute spinal cord injury

The Neurosurgery consult must document the time called, the time arrived at the patient's bedside, and the Neurosurgery attending that is supervising the particular case. The standardized Neurosurgery Consult template form in EPIC should be used for this purpose.

Neurosurgery consultation is required for all traumatic brain injuries, skull fractures, neurologic deficits and any spinal fractures. Time expectation for urgent (but non-emergent) consultation is one hour from request to consult at the patient's bedside.

B. Emergent Orthopedic Surgery Consultation:

Orthopedic surgery consult will respond to the trauma patient's bedside within 30 minutes of being called for the following conditions:

1. Pelvic fracture with hemodynamic instability
2. Extremity fracture or dislocation with vascular compromise in that extremity (loss of pulse/no pulse)
3. Mangled extremity with associated fracture.

The Orthopedic Surgery consult must document the time called, the time arrived at the patient's bedside, and the Orthopedic attending that is supervising the particular case. The standardized Orthopedic Surgery Consult template form in EPIC should be used for this purpose.

C. Urgent (Non-Emergent) Orthopedic Surgery Consultation:

Patients with other orthopedic injuries will require orthopedic surgery consultation. The maximal acceptable response time is one hour from the request to the patient's bedside. Patients with obvious bony deformities must have an orthopedic consultation. X-ray confirmation of a fracture is not required for orthopedic consultation.

D. Facial Trauma Consultation:
Patients with facial trauma will require a consultation from the service covering facial trauma for that day. Facial trauma is covered by four services on a rotating basis; Plastic Surgery, ENT, Oral Maxillofacial Surgery (OMFS), and Ophthalmology. The coverage schedule is listed in AMION. Please note, than when ophthalmology is on call for facial trauma, one of the other services is on second call in the event the injury pattern warrants an additional consultation from that other service. Facial trauma is expected to see the patient within one hour of consultation.

E. Urologic Consultation:
Urologic consultation is required for all patient with renal injuries, bladder injuries, or injury to any part of the GU tract.

5. Trauma Admissions

Trauma patients are to be evaluated and treated in the Trauma Resuscitation Area (Trauma Room) of the Adult Emergency Department (AED).

A. Red Trauma: All patients for whom a **Red** Trauma Team has been activated become the primary responsibility of the Trauma Service. These patients are to be admitted to the Trauma Service. If work up reveals no significant injury that requires admission, then the patient can be discharged from the ED (with the authorization of the Trauma Surgery Attending). It is the responsibility of the Trauma Service to coordinate the care of the patient and arrange for subspecialty consultation. Final management decisions are to be made by the Trauma Service. The Trauma Service is responsible for the assessment and resuscitation of the trauma patient as well as the timing and sequence of diagnostic and therapeutic interventions. The disposition (i.e., operating room, surgical ward, intensive care unit) of the trauma patient is to be decided by the Trauma Service. It is the Trauma Service's responsibility to make transfer arrangements for the patient from the Emergency Room to other hospital areas (e. g., surgical ward or intensive care unit).

B. Yellow & Green Trauma
Patients with injury to multiple systems must be admitted to the Trauma Service. **Yellow** trauma patients must be seen and evaluated by the trauma attending within 12 hours of admission. **Green** trauma patients must be seen and evaluated by the trauma attending within 24 hours of admission. Isolated orthopedic injury with stable hemodynamics can go to the Orthopedic Service. Unstable pelvic fractures require admission to the Trauma Service. If the patient requires STICU admission, then they must be admitted to the Trauma Service. Isolated traumatic intracranial bleed can be admitted to either the Trauma Service or Neurosurgery.

Traumatic intracranial bleed cannot go to medicine, even if caused by syncope (see below).
1. Patients requiring admission with injuries to multiple systems must be admitted to the Trauma Service. Isolated orthopedic injury with stable hemodynamics can go to the Orthopedic Service.
2. Unstable pelvic fractures require admission to the Trauma Service.

3. If the patient requires SICU admission, then they must be admitted to the Trauma Service.

4. Isolated traumatic intracranial bleed can be admitted to either the Trauma Service or Neurosurgery.

5. Traumatic intracranial bleed cannot go to Medicine, even if caused by syncope.

6. Syncope with isolated intracranial bleed goes to Neurosurgery or Trauma Service. These patients cannot be admitted to Medicine.

7. Syncope with any significant trauma (i.e.: facial fractures, rib fractures): Trauma Service.

** This excludes minor soft tissue abrasions, contusions, or lacerations resulting from the fall.**

8. Facial/ocular trauma requiring admission: Trauma Service.

9. Isolated genitourinary trauma requiring admission: Trauma Service

10. Upper extremity Fracture and not able to discharge:

Orthopedic Surgery or Trauma Service (cannot be Medicine)

11. Lower extremity /Pelvic fracture and not able to discharge:

Orthopedic Surgery or Trauma Service. If pelvic fracture is unstable or accompanied by significant blood loss, then Trauma Service. No admissions to Medicine for these diagnoses.

12. Altered mental status after mechanism of trauma except for syncope (i.e. pedestrian struck, assault, motor vehicle crash):

Trauma Service, even if there are no injuries.

13. Rib fractures: Trauma Service Isolated vertebral fractures after trauma: Neurosurgery.14. Isolated vertebral fractures after Trauma go to Neurosurgery

C. Patients who require a critical care environment will be admitted to the Surgical Trauma Intensive Care Unit (STICU) under the Trauma Service.

This means that even patients with isolated head or orthopedic injury must be admitted to the Trauma Service (and not Neurosurgery or Orthopedics). There are 12 beds equipped to care for the surgical/trauma patient, and at least one bed is designated at all times for the potential placement of a new trauma patient. The adjacent Post-Anesthesia Care Unit (PACU) is the designated overflow care area for the STICU. In the event a STICU bed is required for a trauma patient and the STICU is full, the patient deemed most stable for transfer out of the STICU is moved to the PACU. Please refer to STICU overflow policy for further details.

D. Geriatric (>= 65 years old) patients with hip fractures:
Patient should be admitted to a monitored setting (either STICU of B3 SDU). The actual unit (STICU or B3 SDU) will be based on the patient's hemodynamics, physiology, and severity of co-morbidities. If admitted to STICU, then they must be admitted to the Trauma Service.

E. Transfer of a patient from a surgical service (i.e. Trauma, Neurosurgery, Orthopedics, etc.,) to the Medical Service:
1. Injured patients must be admitted to a surgical service (with the exception of minor superficial external injuries such as abrasions, superficial lacerations, bruises, and nasal bone fractures).
2. Subsequent transfer to the medical service for ongoing medical issues may be appropriate under certain circumstances:
i. The injury (or injuries) does not require any intervention and a period of observation appropriate to the injury has been completed and the patient would otherwise be ready for discharge if not for the ongoing medical issues.
ii. The injury (or injuries) has been treated and a period of recovery from the surgical or therapeutic procedure appropriate to the intervention has been achieved and the patient would otherwise be ready for discharge if not for the ongoing medical issues.
iii. A patient has completed treatment for their injury and is awaiting disposition to a rehab/sub-acute rehab or skilled nursing facility and a new medical issue arises that requires inpatient medical care.
iv. The medical issue is not a consequence or complication of their injury or treatment (for example respiratory compromise in a patient with rib fractures or sepsis from a surgical site infection). In other words, the medical issue is not a result or directly related to their injury.
v. A complete transfer note with plans for follow up for each of the injuries has been written prior to transfer.
vi. If a new medical condition / issue arises in a trauma patient that is still under active treatment or observation for an injury, a medical consultation can be obtained but transfer to the medical service is not permitted while the injury is still under active treatment/observation. If the medical condition requires an upgrade in the level of care, then the patient can be moved to the B3 SDU or STICU. The patient should not be transferred to the MICU.
vii. An injured patient that decompensates or develops a complication related to their injury or treatment must not be transferred to the medical service. Those patients should be upgraded to either the B3 SDU or the STICU.

F. Transfer of a patient from the Trauma Service to another surgical service (e. g., orthopedics, neurosurgery, etc.), must adhere to the following protocol:
1. The patient has an isolated injury that will be managed by the new service.
2. The patient has no other injuries that will require attention by the Trauma Service or another service. If multiple services still need to be involved with the patient, then that patient still belongs on the Trauma Service.
3. The patient must undergo a full Trauma Tertiary Survey with documentation in the EMR of such, prior to transfer off the Trauma Service.
4. The patient has been fully assessed by the Trauma Service and deemed to be stable and to have no other trauma-related issues. The Trauma Service must enter a transfer note to that effect in the medical record. The transfer note must be attested by a Trauma Surgery Attending.
5. Transfer to another service cannot occur prior to 24 hours from admission
6. The Trauma Service must communicate with the accepting service the intention to transfer the patient and the accepting service must agree to the transfer (i.e. there are no “automatic” transfers).
7. Transfers of trauma patients off the Trauma Service require the approval by the Trauma Surgery Attending.

6. Pediatric Trauma Resuscitations

All seriously injured children are to be managed in the Adult ED Trauma Resuscitation Room. All injured children are to be brought either directly into the Trauma Room by EMS if critical or seriously injured. If less seriously injured, they are to be triaged in the adult area by the ED Attending assigned to Trauma. If the patient meets criteria for Red or Yellow Trauma or at the discretion of the ED attending, they are to be managed in the Adult Trauma Resuscitation Room. If the triage reveals the patient is not seriously injured and the patient does not meet criteria for a Red or Yellow Trauma activation, then the patient can send to the Pediatric Emergency Department (PED) for management there.

For patients that are managed in the Adult Trauma Room:
If a patient is less than 14 years of age, then the pediatric emergency department will be contacted so a pediatrician and a pediatric nurse can respond to the activation in the Adult Emergency Department (AED). If the patient is 14 years and older, the pediatric staff presence is not required but pediatric consultation can be obtained as warranted.
Pediatric patients that initially present in the PED and meet criteria for a RED trauma activation must be expeditiously transferred by the PED staff to the AED trauma room.

7. Inter-Hospital Transfers

In the event a trauma patient requires treatment not available at Elmhurst Hospital and needs to be transferred to another facility, then the transfer can occur provided the following conditions are met:

The Attending Trauma Surgeon involved in the case has determined that the patient requires transfer for optimal care and is suitable and stable for transfer.

Authorization for the transfer must be obtained from the Director of Trauma or the Director of Surgery.

The transfer of a seriously injured patient must be to another Trauma Center. Transfer to a non-trauma center for a seriously injured patient is prohibited unless the specialized service that is required is not available in any trauma center within the city.

Time frame for transfer: For a ***critical trauma patient,*** the transfer timeline is one hour from patient arrival to decision to transfer and then two hours from decision to patient leaving Elmhurst (three hours total).

Pediatric Trauma Transfers:

NY State requires that pediatric trauma patients that meet the CDC's Field Triage Criteria be brought to a designated pediatric trauma center.

A. The CDC Field Triage Criteria:
1. Glasgow Coma Scale ≤ 13
2. Systolic Blood Pressure (mmHg) < 90mmHg
3. Respiratory rate < 10 or > 29 breaths per minute < 20 in infant aged < 1 year or in need of ventilator support

B. All penetrating injuries to head, neck, torso, and extremities proximal to elbow or knee
1. Chest wall instability or deformity (e.g. flail chest)
2. Two or more proximal long-bone fractures
3. Crushed, degloved, mangled, or pulseless extremity
4. Amputation proximal to wrist or ankle
5. Pelvic fractures
6. Open or depressed skull fracture
7. Paralysis

C. Falls
1. Adults: > 20 feet (one story is equal to 10 feet)
2. Children: > 10 feet or two or three times the height of the child

D. High-risk auto crash
1. Intrusion, including roof: > 12 “occupant site; > 18 “any site
2.Ejection (partial or complete) from automobile
3.Death in same passenger compartment
4. Vehicle telemetry data consistent with a high risk of injury
5. Auto vs. pedestrian/bicyclist thrown, run over, or with significant (> 20 mph) impact
6.Motorcycle crash > 20 mph
i. Older adults (Risk of injury/death increases after age 55 years) SBP < 110 might represent shock after age 65 years
ii. Low impact mechanisms (e.g. ground level falls) might result in severe injury
** Children should be triaged preferentially to pediatric capable trauma centers. **
7. Anticoagulants and bleeding disorders.
8. Patients with head injury are at high risk for rapid deterioration.

E. Burns
Without other trauma mechanism: triage to burn facility
With trauma mechanism: triage to trauma center
Pregnancy > 20 weeks
EMS provider judgment

If such a patient arrives at Elmhurst and upon assessment, the patient meets the CDC Triage Criteria, then that patient must be transferred to a pediatric trauma center.

Transfer should occur only if in the judgment of the Trauma Surgery attending the patient is stable enough for a safe transfer. Otherwise, intervention to stabilize the patient should be undertaken at Elmhurst. For example, it may be necessary to perform a craniotomy for an expanding epidural hematoma or a splenectomy for a ruptured spleen in a patient in shock prior to transfer and then to transfer after the surgery.

The defined age for a pediatric trauma patient is **under age 15 years**. That means if they have reached their 15th birthday, then they can remain at Elmhurst and be treated here.

The decision to transfer a pediatric trauma patient should be made once the primary survey and resuscitation phases are initiated (usually within 30 minutes of arrival).

Initiation of transfer should be made immediately upon recognition of meeting criteria for transfer (usually within 15 minutes following initiation of the primary survey and resuscitation phases).

Transfer of that patient should occur as soon as possible thereafter. The standard for a critical trauma patient is one hour from arrival of patient to decision to transfer and then two hours from decision to transfer to patient leaving Elmhurst (three hours total).

In addition to the CDC Triage criteria, any trauma patient under age 15 years with any of the following conditions should also be transferred, but only if in the judgment of the trauma attending it is safe to transfer the patient prior to intervention:

Injuries requiring any blood transfusion.

Children requiring any one of the following:

Invasive monitoring (arterial and/or central venous pressure)

Intracranial pressure monitoring

Vasoactive medications

Spinal cord or vertebral column injuries

Significant blunt injury to the chest, abdomen or neck.

The pediatric trauma center that we transfer to is Northwell Health's Cohen's Children's Medical Center.

8. Trauma Resuscitation: Primary and Secondary Survey

The protocols to be used for the initial evaluation and management of the trauma patient are to follow those of the American College of Surgeons' Advanced Trauma Life Support (ATLS) Course. This begins with simultaneous treatment and evaluation using the ABC's of trauma: airway control with cervical spine precautions, breathing evaluation with possible assisted ventilation, and support of circulation (tamponade of external bleeding and fluid administration via large-bore I.V. catheters)

A. Airway/Breathing:

In blunt trauma patients, an unstable cervical spine fracture should always be assumed until proven otherwise; therefore, hyperextension of the neck must be avoided.

In the awake patient initial evaluation of the airway can be made by asking the patient a question, such as, his name. If the patient responds in a normal voice, then the airway is probably not in immediate jeopardy. A breathless, stridorous, or hoarse response, or no response at all, indicates that the airway may be compromised. The airway must be assessed carefully for potential management difficulty prior to initiating efforts to secure the airway.

1. An airway assessment tool should be used prior to attempting airway management in order to stratify the risk of intubation difficulty. ATLS recommends the use of the LEMON tool.
   i. Look externally (facial trauma, large incisors, facial hair, large tongue)
   ii. Evaluate with the 3-3-2 rule (incisor distance < 3 fingers, hyoid-mental distance <3 fingers, thyroid to mouth < 2 fingers)
   iii. Mallampati score
   iv. Obstruction
   v. Neck mobility (all blunt trauma patients require cervical in-line stabilization therefore the neck is considered immobile/)

2. When airway assessment indicates a potentially difficult airway, neuromuscular blockade should be used with caution and preparations for airway rescue maneuvers should be performed (such as airway adjuncts and surgical airway equipment)
Supplemental oxygen should always be given to trauma patients either via nasal cannula (6L/min) or a non-rebreathing oxygen mask (12L/min).
Airway patency does not ensure adequate ventilation and this must be assessed. Signs of inadequate ventilation include:
1. Poor air exchange at the nose and mouth
2. Diminished breath sounds
3. Decreased chest wall excursion

The procedure of choice for definitive airway control in the trauma patient is oral rapid sequence endotracheal intubation (guided by direct laryngoscopy or video-assisted (GlideScope) with inline immobilization of the cervical spine. The indications for endotracheal intubation are as follows:

i. Airway obstruction
ii. Hypoventilation
iii. Persistent hypoxemia (SaO2<=90%) despite supplemental oxygen
iv. Severe hemorrhagic shock
v. Cardiac arrest
vi. Major burns with smoke inhalation
vii. Relative indications for endotracheal intubation are:
viii. Facial or neck injury with potential for airway obstruction
ix. Moderate cognitive impairment (GCS 9-12)

4. Persistent combativeness refractory to pharmacologic agents and impairing management/diagnostic workup

5. Respiratory distress (without hypoxia or hypoventilation)

6. Cervical spinal cord injury with evidence of respiratory insufficiency (complete cervical spinal cord injury or incomplete injuries C5 and above)

7. General guidelines for the performance of oral endotracheal intubation are as follows:

i. Pre-oxygenation
ii. Continuous pulse oximetry monitoring
iii. Rapid Sequence Intubation (RSI) with a sedative followed by a short acting neuromuscular blocking agent. RSI should be used with caution if the airway is considered difficult. Succinylcholine is the usual agent for neuromuscular blockade if there are no contraindications to its use (such as prolonged immobilization, chronic kidney disease or skeletal muscle myopathies in which case rocuronium may be used)
iv. Intubation is performed via direct laryngoscopy with in-line stabilization of the cervical spine
v. For adults use a large (8mm internal diameter) cuffed endotracheal tube inserted to a distance of 23cm from the incisors.
vi. For children, tube size can be ascertained from the Breslow Tape, or can be estimated as equal to the diameter of the patient's little finger. The proper depth of penetration (in centimeters) can be estimated by multiplying the tube's internal diameter (in millimeters) by 3
v. Confirmation of proper tube position by auscultation of bilateral breath sounds and end-tidal CO2 detection
vi. Securing of the airway
vii. Chest x-ray to confirm proper tube position

8. In-line cervical spine stabilization should be maintained.
Non-surgical attempts at securing the airway should be supervised by either the Emergency Medicine Attending or the Anesthesia Department Attending. In the event endotracheal intubation cannot be achieved with direct laryngoscopy, then the airway may be secured using one of several airway rescue techniques/devices:

i. Insertion of a supra-glottic device (i.e., LMA, Combitube)
ii. Gum-elastic Bougie
iii. Video laryngoscopy
iv. Surgical Airway (cricothyroidotomy)

The surgical airway must be performed by the most senior surgical personnel present (Surgery Attending or Chief Resident). The surgical approach should be a cricothyroidotomy. Tracheostomy is rarely indicated with the rare exceptions of direct laryngeal trauma or complete tracheal disruption.

B. Cricothyroidotomy Procedure

Because the procedure must be done rapidly, only the most senior surgical personnel present should perform it (Surgery Attending and/or Chief Surgical Resident). The neck is quickly prepped by pouring povidone-iodine on it. The larynx is stabilized with one hand while a 2-3cm vertical incision is made over the cricothyroid space. Care is taken to avoid laceration to the anterior jugular veins. Retraction of skin and soft tissue can be provided with a self-retaining retractor. An assistant is also useful for providing retraction. The cricothyroid membrane is palpated and incised horizontally

A trousseau dilator is inserted and spread vertically for visualization of subglottic space. A tracheal hook may be used to retract the inferior border of the thyroid cartilage while a tracheostomy tube (6 mm internal diameter) is inserted and first directed posteriorly then inferiorly.

The cuff of the tracheostomy tube is inflated and the tracheostomy tube is attached to the Ambu-bag or the ventilator (100% oxygen should be given initially). The tracheostomy tube is then sutured to the skin and secured with umbilical tape around the neck. A chest x-ray should be obtained to confirm proper position of the tube.

C. Circulation/Hemorrhage control:

Hypovolemia from hemorrhage is the most likely cause of shock in the trauma patient. Therefore, immediate measures to arrest ongoing hemorrhage must be instituted.

1. All patients must be placed on a monitor and ECG, blood pressure, respiratory rate and oxygen saturation should be monitored.
2. Direct pressure should be applied to points of external bleeding. For extremity bleeding not readily controllable by direct pressure, then a tourniquet should be applied to the affected limb. CAT (Combat Application Tourniquet) tourniquets are available in the Trauma Room (Supply cabinet by bed #3). The tourniquet should be applied about 2 inches above the bleeding point and tightened until the bleeding has stopped. Do not apply the tourniquet directly over a joint since this will interfere with tourniquet effectiveness.
3. Bleeding from junctional wounds (axilla, groin, or neck) or large torso wounds should be controlled with direct pressure. Hemostatic gauze can also be applied to supplement the direct pressure. The hemostatic gauze is available next to the tourniquets in the supply cabinet.
4. Profuse bleeding from large scalp lacerations is difficult to control with pressure dressings or head wraps and is best managed with a wide, running, locking suture. The suture line can be revised for cosmesis at a later time once the bleeding has been controlled and other injuries have been addressed.

5. Intravenous access should be established with short large-bore IVs preferably 14 or 16 gauge. The antecubital area of each arm is the preferred site, however injury to the ipsilateral arm, chest or neck may render that site unreliable and an alternative site should be found. Alternative sites of I.V. access include the femoral vein (which can be accessed percutaneously) or the saphenous vein at the ankle (which can be accessed via cut-down). In the event of a penetrating injury to the abdomen, I.V. access below the diaphragm is contraindicated. Subclavian and internal jugular central access is also acceptable, but the catheter inserted should be a short, large-bore one such as an introducer and NOT a triple-lumen catheter.
6. Intraosseous access can be obtained in both adults and children when intravenous access is not readily achievable. The proximal tibia is the most frequently used site.
7. Crystalloid infusion in the form of two liters (20ml/kg in children) of Lactated Ringer's solution should be given as a bolus to any patient with signs of shock. If there is a restoration of normal vital signs then, the infusion should be slowed to a maintenance rate. If there is no response or only a transient response, then a second bolus must be given while preparations for blood transfusion are made. Cross-matched blood is ideally transfused, but if time does not permit, then type specific blood should be given. If type specific blood is not available, then O-negative blood must be used.
8. All Red Trauma patients will usually require the placement of a Foley catheter in their bladder unless there is a contraindication. A digital rectal examination must be performed prior to catheterization to assess for a mobile or high-riding prostate which may be indicative urethral injury. Similarly, urethral injury should be suspected if there is a scrotal, penile, or perineal hematoma, or if there is blood at the urethral meatus. If any of these conditions are present, the catheterization is contraindicated until a urethral injury is ruled out. This should be done by performing a retrograde urethrogram. If urethral injury is determined, then the Foley cannot be placed via the urethra. Immediate consultation with the urology service is indicated. (Of note, if a pelvic fracture is present as demonstrated by pelvic X-ray, consideration should be given to delaying the urethrogram until after the abdominal/pelvis CT scan to avoid having artifact from the urethrogram obscuring the pelvic anatomy on the CT)

D. Neurologic Exam:

The initial neurologic exam during the primary survey should consist of examination of the pupils and determination of level of consciousness. The Glasgow Coma Score should be calculated. The motor exam and sensory exam should be assessed to check for signs of spinal cord injury.

E. Secondary Survey

1. Exposure: All trauma patients should be completely disrobed. The entire body surface must be examined to assess for injury. It is important that once the examination and any interventions are completed, the patient is covered with blankets to prevent hypothermia.
2. A systematic approach to the secondary survey will increase efficiency and minimize the occurrence of missed injuries:
1. Head: Assess for scalp lacerations, hematomas or skull fractures. The presence of a depressed skull fracture mandates immediate neurosurgical consultation.
2. Face: Assess for lacerations, point tenderness, deformity, orbital instability, malocclusion of the teeth, raccoon's eyes or Battle's sign.
3. Eyes: Visual acuity, pupillary size and reactivity, corneal injuries, foreign bodies (including contact lenses) and extraocular movements should be evaluated.
4. Ears: The tympanic membranes should be examined for blood and the ear canal should be assessed for disruption or the presence of cerebral spinal fluid. These may signify a basilar skull fracture.

5. Neck: Any patient suffering from blunt trauma may have an unstable cervical spine injury and cervical spine precautions are mandatory until an injury has been excluded. The neck should be examined for penetrating wounds/lacerations, tracheal deviation, subcutaneous emphysema, spinal tenderness and hematoma. Until a cervical spine injury has been excluded, cervical spine precautions need to be maintained. This involves maintenance of the rigid cervical collar and immobility of the neck.
6. Neurologic Exam: A more detailed neurologic examination must be done during the secondary survey than that which was done during the primary survey. The Glasgow Coma Score should be recalculated. The pupils should be reassessed. Then the exam should be progress to cranial nerves, motor of all extremities and sensory of trunk and extremities. Reflexes then should be examined. Rectal tone on digital rectal exam should be assessed. Any focal or asymmetrical neurologic findings should prompt immediate neurosurgical consultation. History of loss of consciousness or an altered sensorium will require a head CT scan. GCS of <8 will require definitive airway management.
7. Chest: Thorough evaluation of the chest begins with the physical exam. The chest should be inspected for paradoxical movement. Auscultation for breath sound is mandatory. Palpation for point tenderness, subcutaneous emphysema or crepitus is vital. All blunt trauma patients and those with penetrating wounds to the chest will require a chest x-ray. Additional diagnostic studies will depend on the specific injury pattern and overall condition of the patient and are to be obtained at the discretion of the trauma team.
8. Abdomen: The abdomen should be examined for distention, tenderness, peritonitis, penetrating wounds, ecchymoses (e.g., seat belt marks) and abrasions. Examination of the external genitalia, perineum, vagina, and rectum are mandatory.
9. Extremities: All four extremities, including the hands and feet should be assessed. Peripheral pulses should be assessed and documented. The extremities should be palpated for tenderness or deformity. The joints should be examined for range of motion. Any fractures should be splinted. Orthopedic consultation should be made immediately upon suspicion of a fracture or dislocation.

9. Cervical Spine Clearance

Blunt trauma patients may have injured their cervical spine. Cervical spine injury therefore must be ruled out prior to removing their cervical collar. If possible, the cervical spine should be cleared and the cervical collar removed within 24 hours of collar placement to avoid collar-related complications such as pressure ulcers. If the collar cannot be removed after 24 hours, then a more padded, long-term collar should be placed. In an awake patient, cervical spine clearance is relatively straight-forward because the patient can verbalize symptoms and cooperate with an examination. Patients that cannot cooperate with the examination are those with mental status changes related to drugs or alcohol intoxication, respiratory or metabolic disturbances, traumatic brain injury, or other injuries that may distract from pain in the cervical region.

Any patient with a suspected cervical spine injury and a neurologic deficit should continue to have the cervical collar left in place and a neurosurgical consultation and imaging must be obtained.

A. Cervical Spine Clearance Procedure for in-patients:

If the patient has a reliable exam (awake and alert, no distracting injuries and is not intoxicated), has no focal neurologic deficit (a neurological examination must be performed), is younger than age 65, and a confrontational exam is normal, then the cervical spine can be cleared. Documentation of such should be made in the chart and the cervical collar can then be removed.
Distracting injuries are defined as any injury which is so painful that it may obscure the patient's ability to notice pain in their neck. If the patient is felt to have a distracting injury, then the patient is considered to have an unreliable exam.

1. A confrontational exam consists of:
    i. Loosening the cervical collar and palpating the posterior midline of the neck to assess for midline cervical tenderness. The presence of tenderness means they have failed the confrontational exam and the collar cannot be removed.
    ii. If there is no tenderness, then the patient is asked to actively rotate their neck 45 degrees left and right. If they are unable to rotate their neck, then they have failed the confrontational exam and the collar cannot be removed
    iii. If they can rotate their neck, they are then asked to flex and extend the neck as much as they are able. If they cannot flex/extend their neck, they have failed the confrontational exam and the cervical collar cannot be removed.

2. If the patient has a reliable exam but does not meet the criteria in A above then a thin-slice cervical spine CT scan with axial, coronal, and sagittal reconstructions should be obtained if:
    i. An injury is seen on the CT scan, then the cervical collar is kept on, cervical spine precautions are maintained and a neurosurgical consult must be obtained.
    ii. There is a focal neurological deficit, even if no injury is seen on CT imaging, then the cervical collar is kept on, cervical spine precautions are maintained, and a neurosurgical consult must be obtained.
    iii. There is no injury seen on CT in a patient 65 years old or older who has a reliable exam and a normal neurologic examination and the confrontational exam is negative, then the cervical spine is cleared, appropriate documentation to that effect is entered in the chart and the collar is removed.
    iv. There is no injury seen on CT but the patient failed the confrontational exam, then the patient will require a cervical spine MRI. Neurosurgical consultation can be obtained at this point. If the MRI shows an injury, the collar must be left on, cervical spine precautions must be maintained, and neurosurgical consultation must be obtained.

3. If the patient has an unreliable exam, the cervical collar and cervical spine precautions must be maintained until the patient regains a reliable exam. A thin-slice cervical spine CT scan with axial, coronal, and sagittal reconstructions is required. If a reliable exam does not occur by 48 hours (or is not expected to occur within 48 hours), a careful review the cervical spine CT scan with axial, coronal, and sagittal reconstructions in both soft tissue and bone windows should be undertaken, preferably in consultation with the neuro-radiologist. A cervical spine MRI can also be obtained if the patient's condition permits.

10. Thoracic and Lumbar and Sacral Spine Evaluation

Patients with blunt trauma require evaluation of their entire spine. Palpation of the entire spine is necessary to evaluate for tenderness. A neurologic examination is also required.

The principles for radiological imaging of the thoracolumbar and sacral spine are similar to that of the cervical spine. Imaging is warranted in patients with a neurological deficit referable to the thoracolumbar or sacral spine, have significant back pain, have palpable deformity, or have altered mental status in the setting of a traumatic injury.

A. High-resolution CT imaging is preferred, though patients who are neurologically intact with minimal pain may be first evaluated with XR imaging. This is particularly true of awake, alert, and neurologically intact children to minimize unnecessary radiation exposure.

B. CT chest/abdomen/pelvis studies (including reformatted coronal and sagittal views) can be used in lieu of dedicated spine imaging if there is a low clinical suspicion for an unstable spinal column injury or SCI. This is particularly true in Pediatric patients to minimize radiation exposure. If a spinal column injury is detected, then a dedicated spine CT scan should be considered for increased delineation of the injury at the discretion of the treating physician.

C. Emergent non-contrast MRI of the thoracolumbar spine is warranted in any patient with a referable acute neurological deficit, high suspicion of SCI, significant spinal canal compromise, or concern for significant instability at the discretion of the treating Neurosurgeon.

D. Non-contrast MRI of the thoracolumbar spine with fat suppressed (STIR) sequences should be obtained within 48 hours of injury to rule out associated ligamentous injury in patients with CT findings suggestive of posterior ligamentous complex (PLC) involvement. Disruption of the PLC is considered when determining if a thoracolumbar spine injury is stable or unstable and is often necessary for surgical decision making.

E. Patients who are awake and alert with otherwise stable-appearing minor lumbar spine fractures (e.g. simple anterior-wedge compression fracture, isolated TP fracture) may have dynamic (upright flexion-extension) XR in lieu of MRI at the discretion of the treating Neurosurgeon.

11. Neurotrauma (TBI and SCI) *** Please refer to the appendix on Neurotrauma ***

12. Chest Trauma

The following are some of the more common chest injuries and the policy of the Trauma Service regarding their management:

A. Penetrating chest trauma and no clinical or radiological evidence of hemo or pneumothorax:

If there is no evidence of hemothorax or pneumothorax on chest x-ray, the x-ray must be repeated, preferably as an upright PA and lateral, 6 hours later. If still negative and the patient has no other injuries, discharge may be considered.

B. Simple Pneumothorax

A simple pneumothorax is readily diagnosed on chest x-ray, but can often be diagnosed on physical exam by decreased or lack of breath sound on the ipsilateral side and hyper-resonance to percussion. Ultrasound in the form of an eFAST can also reliably diagnose a pneumothorax but not its magnitude. A pneumothorax as a result of trauma that is seen on a chest X-ray should be treated by placement of a pleural drainage catheter. This catheter can be either a chest tube or a pigtail catheter. Simple observation of any traumatic pneumothorax that is evident on chest X-ray (see occult pneumothorax below) and not placing a pleural drainage catheter should be undertaken with caution and at the discretion of the Trauma Surgery Attending, recognizing that a simple pneumothorax may progress to a tension pneumothorax.

C. Occult Pneumothorax

The increasing use of CT scanning has resulted in the identification of small pneumothoraces that, in past, would not have been discovered when only a chest X-ray was performed. Such a pneumothorax, one that is seen on only chest CT and not on plain chest X-ray is termed an occult pneumothorax. An occult pneumothorax does not require treatment (such as chest tube drainage). This is true even if the patient will be on positive pressure ventilation. Simple observation with a repeat chest X-ray is sufficient.

D. Tension Pneumothorax

A tension pneumothorax develops when a pneumothorax progressively accumulates air without any egress. This causes complete collapse of the affected lung and shift of the mediastinum to the opposite side. The mediastinal shift results in a precipitous decrease in venous return to the heart. The patient with a tension pneumothorax presents with the signs of a pneumothorax (absent breath sounds on the ipsilateral side, hyper-resonance to percussion) but in addition will be in respiratory distress and exhibit tachycardia and may progress to hypotension (often profound). A tension pneumothorax must be diagnosed during the primary survey and immediately treated. This diagnosis must be made on clinical grounds. Waiting to obtain chest x-ray confirmation prior to instituting treatment is potentially dangerous. Effective treatment consists of simply placing a large-bore Angiocath through the 2nd intercostal space in the mid-clavicular line on the affected side. A chest tube must be subsequently placed.

E. Open Pneumothorax:

An open pneumothorax is also often called a “sucking chest wound”. Such a chest injury results from loss of a segment of chest wall. When the chest wall defect is larger than 2/3 the diameter of the trachea, then air is preferentially drawn through the defect and not into the lungs. This can result in serious respiratory compromise. Therefore, it is imperative that the defect be occluded. This is done with an occlusive dressing, preferably with Vaseline gauze. It is important that the dressing be taped on only three sides so as to permit air to leave the thoracic cavity but not to enter. Taping the dressing on all four sides may result in a tension pneumothorax. After covering the defect in such a manner, a chest tube should be placed via a separate incision. The defect will often require closure/repair in the operating room.

F. Hemothorax:

A hemothorax must be drained by placement of a properly placed chest tube. The amount of blood initially drained as well as the hourly output must be recorded. If there is greater than 1,500 cc of blood initially drained then consideration of operative intervention must be made. Similarly, if the hourly output is greater than 200 cc/hour for more than two hours, operative intervention should be considered. Hemodynamic parameters are the most important determinant for need for operative intervention and not any specific amount of drainage however.

If after placement of a chest tube, the hemothorax is not adequately drained, then consideration to Video Assisted Thoracoscopy (VATS) should d be considered. Ideally this should be performed early in the hospital course (days 3-7). Placement of a second chest tube is no longer recommended but instead VATS should be considered. This is to avoid a retained hemothorax, which can lead to a fibrothorax or empyema with their associated morbidity.

G. Rib Fractures:

Rib fractures have been associated with adverse outcomes in trauma patients as they are often accompanied by other findings, such as lung contusion and laceration, hemothorax, pneumothorax, thoracic spine fracture, and intraabdominal injuries. In addition, pain plays a significant role in the pathogenesis of adverse outcomes from rib fractures. Chest wall pain can cause splinting, avoidance of cough, resistance to ambulation, altered chest wall mechanics, and impaired secretion clearance, all of which can contribute to respiratory failure and pneumonia.

In major trauma patients, CT scanning of the chest after an abnormal CXR reveals unsuspected injuries 2/3 of the time, with significant management changes as a result in 20% of those with new findings. In patients with high-energy mechanisms of injury but a normal CXR, CT identifies unsuspected pathology 40-50% of the time. Significant patient co-morbidities increase the risk of pulmonary complications and mortality. These risks can be overlooked and undermanaged, particularly in patients that initially present with minimal respiratory symptoms. Therefore, a rib fracture protocol is necessary to optimize the management of this patient population and minimize avoidable complications.

H. IMAGING

All adult trauma patients with abnormal CXR should undergo CT evaluation of the chest with thoracic spine reconstruction to assess for concomitant injuries. There is no role for rib series radiographs in thoracic trauma patients.

Fractures of the lower ribs have been associated with intraabdominal solid organ injury in multiple studies. Thus, a CT abdomen and pelvis with IV contrast should be performed in any patient with fractures in any of ribs 8-12 on either side. Recent studies have found similar findings with middle and upper rib fractures. Thus, most patients with rib fractures should undergo abdominal and pelvic CT imaging.

Select patients < 65 years old may forego CT of the abdomen and pelvis if they meet the following criteria:
1. Low energy mechanism
2. SBP > 90
3. GCS 14-15
4. No abdominal or costal margin tenderness
5. No femur, pelvis, or spine fracture
6. No pulmonary contusion or pneumothorax
7. Hematocrit > 30%
8. UA < 25 RBCs/HPF
9. No other indication for abdominal CT

** Admitted patient should receive a repeat CXR 24 hours after admission**

I. OTHER TESTS

Patients with evidence of hypoxia or other respiratory compromise should have an arterial blood gas with electrolytes sent. All geriatric trauma patients and trauma patients with central or left chest pain should have an ECG performed.

J. INCENTIVE SPIROMETRY (IS)

Volumetric incentive spirometry has been used to predict morbidity after rib fractures and to minimize respiratory complications in multiple patient populations. Incentive spirometry volume (ISV) has become an important component in stratifying the management of rib fracture patients. Serial measurements also allow early identification of respiratory decline, and determine readiness for downgrade or discharge.

ISV 12-15 cc/kg IBW is considered necessary to produce an adequate cough. Thus, minimum adequate ISV is considered to >15 cc/kg IBW.

Ideal Body Weight (IBW) calculation:
- Male = 50 kg + 0.91 kg/cm (height – 152.4 cm)
- Female = 45.5 kg + 2.3 kg/cm (height – 152.4 cm)

https://www.cdc.gov/dengue/training/cme/ccm/page57681.html

All adults with rib fractures must undergo bedside incentive spirometry assessment and therapy, unless contraindicated.
Maximum ISV is measured x3 and the largest volume recorded, along with cough (strong, weak, or absent), and reported pain level (1-10) during IS and cough. This should first be done prior to admission, when possible, to help determine appropriate unit assignment. If admitted, all trauma patients should be ordered for incentive spirometry 10x/HR while awake unless contraindicated.

K. DISPOSITION

Appropriate disposition is necessary to optimize pulmonary recovery and prevent complications. Central to this is the need for aggressive nursing care commensurate with pain and respiratory compromise. Some therapies ICU-level monitoring per protocol.

L. HOME

Patients < 45 years old with 1-2 rib isolated fractures may be discharged to home if they have:
1. ISV > 15 cc/kg IBW
2. Adequately controlled pain during cough & IS
3. No hypoxia or hypercapnia
4. No significant cardiorespiratory comorbidity
5. No pleural effusion or significant pulmonary contusion
6. No evidence of malnutrition
7. No use of ambulatory assist devices
8. Safe accommodations

Patients should be able to demonstrate proper usage of their incentive spirometer, with which they will be discharged. Patients should be sent with verbal and written instructions on how to use their spirometer, as well as signs and symptoms that require return to the ED for re-evaluation.

M. TRAUMA SERVICE

All adult patients with traumatic rib fractures who do not meet the criteria for discharge require admission to the trauma service. The exception is patients presenting with active myocardial infarction who require admission to the CCU.

N. SURGICAL TELEMETRY

Admission to a surgical telemetry unit (SDU or STICU) is appropriate for the following traumatic rib fracture patients:
1. > 45 years old with > 4 ribs fractured or flail segment
2. > 65 years old with > 3 rib fractures
3. Weak or no cough
4. Pain > 6 during IS or cough
5. Incentive spirometer volumes (ISV) <15 cc/kg IBW
6. Other injury or illness requiring a monitored unit
7. ISV < 12 cc/kg IBW Admit to STICU
8. ISV < 10 cc/kg IBW Positive pressure therapies indicated; consider intubation

** Comorbid conditions have been associated with an increased risk of rib fracture-associated pneumonia and intubation. The presence of the following should prompt consideration for admission to a higher level of care (i.e. SDU instead of ward, STICU instead of SDU):
1. COPD
2. CHF
3. Albumin < 3.5 g/dL (as evidence of protein calorie malnutrition)
4. Use of an ambulatory assist device
5. Tube thoracostomy

** Presence of two or more of these factors mandate upgraded admission unit **

O. UNIT DOWNGRADE

If there is no other need for ICU-level care, the patient may transfer out of STICU to SDU when ISV > 12 cc/kg IBW x24 hours, cough is strong, and pain and respiration are adequately managed with therapies that can be administered in the SDU.

Patient may transfer to floor when ISV > 15 cc/kg IBW x24 hours, cough is strong, respiratory therapy interventions are not required, and pain is adequately managed exclusive of spinal, regional, or drip therapies.

P. DISCHARGE

Patients who have normal mobility, ISV > 15 cc/kg IBW, strong cough, and well-controlled pain (<5) for >24 hours on oral medications may be considered for discharge home if they have no active comorbidities or other therapeutic or monitoring needs requiring inpatient management. Patients may need to be assessed for ongoing therapeutic requirements or assistance which necessitates transfer to a rehabilitative or skilled nursing facility. Patients may not fulfill ISV requirements for downgrade from STICU or SDU. If otherwise stable for discharge, they may be sent from telemetry directly to an outside rehabilitative or skilled nursing facility.

Q. OPTIMIZING PULMONARY STATUS / PREVENTION OF PULMONARY COMPLICATIONS

1.SERIAL ASSESSMENTS

ISV, cough, and pain should be assessed together several times each day. STICU and SDU patients should have each measured every 4 hours while awake by nursing. Floor patients should be assessed three time each day by the trauma team: During morning rounds, in the early afternoon, and in the evening (by the overnight team).

2. MOBILIZATION

Early out of bed whenever possible is essential for reducing pulmonary morbidity. Out of bed to chair followed by ambulation is ideal if the injuries permit. This is facilitated by the aggressive nursing care possible primarily in stepdown and critical care units. PT and rehabilitation medicine consultation should be made as needed for early mobilization.

3. PAIN MANAGEMENT

All patients with rib fracture pain, unless contraindicated, should receive:

i. Standing NSAID and/or acetaminophen
ii. PRN or PCA opioids
iii. Consider the addition of gabapentin or Lyrica if the above are inadequate.
iv. Consider Lidoderm patches for localized pain associated with chest tubes.

In the ICU setting, Precedex or Ketamine GTT can be considered to improve pain, IS, and mobilization. These are particularly useful in patients with substance abuse histories, including alcohol abuse. If pain is inadequately managed despite the above measures, consult Pain Management. Epidural or regional pain interventions are often useful in these cases. Continue psychoactive home medications unless contraindicated.

4. CONSULTATIONS

Respiratory therapy: Patients with ISV < 15 cc/kg IBW, to assess for adjunct respiratory therapies
PM&R, PT/OT: Patients > 65 years old within 48 hours of admission to assist with progressive mobilization and assess for ongoing rehabilitation needs. Younger patients not ambulating independently by 48 hours from admission should be seen by PT.
Pain management: Patients with inadequately controlled pain despite optimization of standard medical therapeutics (see Pain section)
Trauma geriatrics: Patients > 65 years old who meet criteria (See Geriatric Trauma PMG)
Social work: Geriatric patients, patients with alcohol or substance abuse, patients likely to require discharge to a facility

R. Blunt Cardiac Injury

An admission electrocardiogram (ECG) should be performed on all patients in whom blunt cardiac injury is suspected. A serum troponin I level should be obtained on all patients in whom a blunt cardiac injury is suspected.

If the admission ECG is abnormal (arrhythmia, ST changes, ischemia, heart block, and unexplained ST changes), the patient should be admitted for continuous ECG monitoring. This should be either to the B3 step down unit (SDU) or the STICU. For patients with preexisting abnormalities, comparison should be made to a previous ECG (if available) to determine need for monitoring.

Patients with an elevated troponin I level but with a normal ECG should be admitted to a monitored setting (SDU or STICU). In patients with a normal ECG result and normal troponin I level, blunt cardiac injury is ruled out.

For patients with hemodynamic instability or persistent new arrhythmia, an echocardiogram should be obtained. If an optimal transthoracic echocardiogram cannot be performed, the patient should have a transesophageal echocardiogram. Patients with hemodynamic instability or persistent new arrhythmia should also get a cardiology consult. The presence of a sternal fracture alone does not predict the presence of blunt cardiac injury and thus should not prompt monitoring if the ECG is normal and the troponin I level is normal.

S. Chest Tube Placement

1. Indications for chest tube placement:

i. Traumatic Pneumothorax (tension, simple or open, but not for occult)
ii. Hemothorax seen on chest X-ray.
iii. Occult Pneumothorax can be treated at the discretion of the Trauma Surgery Attending, a pig-tail catheter can suffice in these circumstances.
iv. Hemothorax seen on CT scan can be drained if it is considered significant at the discretion of the Trauma Surgery Attending
v. Subcutaneous emphysema of the chest wall. (Extreme caution must be exercised when placing a chest tube for this indication, because the lung may be adherent to the chest wall and be injured during chest tube placement.)

2. Procedure for chest tube insertion:

i. Chest tube insertion must be supervised by a surgical senior resident, surgical chief resident, or surgical attending.
ii. Whenever possible, informed consent from the patient should be obtained.
iii. The chest tube insertion site is prepped with povidone-iodine or Chloraprep and sterile drapes applied.
iv. he area is anesthetized with 1% lidocaine including the skin, subcutaneous tissue and as much as possible of the pleura.
v. With a scalpel, an approximately 2 cm incision is made at the fourth or fifth intercostal space in the mid-axillary line.
vi. A short, subcutaneous tunnel is fashioned over the superior edge of the rib and the overlying fascia and intercostal muscles are divided sharply.
vii. The pleural space is entered by bluntly perforating the pleura with a Kelly clamp.
viii. A gloved finger is then inserted to confirm penetration into the thoracic cavity and to gently free up any intra-pleural adhesions. Care must be taken to avoid provider injury from fractured ribs.
ix. A chest tube is directed posteriorly toward the pleural apex. Care must be taken to ensure that the most proximal hole of the chest tube is well within the chest.
x. The tube is then secured to the skin with a heavy silk suture.
xi. Vaseline gauze and an occlusive dressing are then applied to the exit site.
xii. The tube is connected to the Pleur-Evac suction device.
xiii. The tube is further secured to the patient with adhesive tape.
x. A chest x-ray must be obtained to confirm proper tube placement.
xi. Administration of presumptive antibiotics just for the chest tube are not indicated.

3. Chest Tube Management

a. Chest tubes should be placed to suction at -20cm H2O for 24 hours after placement.
b. A daily AP radiograph should be routinely obtained for all patients with a chest tube in situ.
c. Suction should be discontinued after 24 hours or when an air leak has sealed whichever is longer.
d. Following removal of suction, a repeat chest radiograph should be obtained in 3 hours.
e. Chest tubes should be removed when no significant residual effusion is present on CXR and when 24hr drainage is < 30mL.
f. If the CXR continues to demonstrate the presence of a continued effusion 24 hours after placement of tube thoracostomy, a CT scan of the chest should be obtained to evaluate adequacy of tube placement and need for surgical procedure.

4. Chest Tube Removal

a. Chest tubes may be removed at end-inspiration or end-expiration. Both methods are equally safe.
b. Following chest tube removal, an occlusive dressing should be placed over the skin exit site and affixed with an adhesive dressing.
c. A chest radiograph should be obtained ≥ 4 hours after chest tube removal and evaluated for clinically significant pneumothorax or pleural effusion/hemothorax.

T. Flail Chest

The major morbidity of flail chest is due to the associated underlying pulmonary contusion. The patient with flail chest must be closely monitored for adequacy of oxygenation and ventilation. Effective pain control must be provided and pulmonary toilet in the form of incentive spirometry, chest physiotherapy and even suctioning if necessary is of vital importance. Patients with flail chest are best kept in a monitored setting such as the Surgical Trauma Intensive Care Unit or Surgical Step-Down Unit.

U. Widened Mediastinum on Chest x-ray

An injured thoracic aorta with a contained hemorrhage can often manifest on chest x-ray as a widened superior mediastinum, apical pleural cap, blunting of the aortic window, deviation of the trachea to the right or deviation of the left mainstem bronchus inferiorly. When there is such a suspicion of aortic injury, a CT scan of the chest should be obtained to verify if there is indeed any evidence of aortic injury. An equivocal CT scan may require angiography. Confirmation of aortic injury will require immediate transfer of the patient to Bellevue Hospital for surgical repair. Blunt aortic injury implies contained bleeding, therefore uncontained bleeding takes precedence. If the patient has more immediately life-threatening injuries (such as those requiring craniotomy or laparotomy), then the aortic repair can be delayed and those injuries should be addressed first.

V. Fracture of scapula or first or second ribs

The scapula and the first two ribs are well protected from blunt trauma by the musculature of the shoulder girdle. Therefore, if they are fractured, then the patient probably sustained a severe force and an associated thoracic great vessel injury is a distinct possibility. Therefore, such patients will require a CT scan of their chest if there hemodynamic status permits.

W. Penetrating wounds to the chest

1. Whenever there is a penetrating wound to the anterior chest medial to the nipples, the potential for cardiac injury exists. These patients will require sonography/echocardiography to evaluate for the presence of pericardial fluid. This assessment can be achieved with the bedside Focused Abdominal Sonography for Trauma (FAST) examination. If pericardial fluid is found then the patient will need operative evaluation/intervention which may consist of thoracotomy, sternotomy or at the very least a subxiphoid pericardial window, at the discretion of the on-call surgery/thoracic surgery attending.

Penetrating wounds to the posterior chest, medial to the medial borders of the scapulae also require sonography/echocardiography of the heart, but in addition will require a chest CT scan to evaluate for great vessel injury.

2. Gunshot wounds whose trajectories traverse the mediastinum pose a unique diagnostic challenge. If the patient is hemodynamically unstable or shows signs of severe hemorrhage, then prompt surgical exploration must be undertaken. The possibility of having to explore both thoracic cavities must be kept in mind and appropriate provisions for this should be made when positioning the patient in the operating room. If the patient is hemodynamically stable, then evaluation should consist of chest x-ray and chest CT scan. The trajectory seen on the CT scan will dictate the need for further testing. If the trajectory approaches the esophagus, then esophagography or esophagoscopy may be indicated. Bronchoscopy may be indicated in the trajectory of injury approaches the Tracheobronchial tree.

3. Thoracoabdominal Wounds. Any penetrating would to the chest that is below the levels of the nipples anteriorly or below the inferior tips of the scapulae posteriorly, is classified as a thoracoabdominal wound and requires evaluation for potential abdominal injury as well. A thoracoabdominal wound that does not otherwise have an indication for a laparotomy or thoracotomy may require diagnostic laparoscopy (especially on the left side) to rule out a diaphragmatic injury.

13. Emergency Department Resuscitative Thoracotomy

A. Thoracotomy

In the emergency department is to be used as a life-saving measure for those trauma patients suffering a cardiac arrest either during transport to the hospital or soon after arrival. Emergency department resuscitative thoracotomy permits:
1. Release of pericardial tamponade
2. Control of intra-thoracic blood loss
3. Internal cardiac massage
4. Cross clamping of the descending thoracic aorta to enhance coronary and cerebral perfusion and to reduce subdiaphragmatic hemorrhage. In general, resuscitative thoracotomy has the highest chance of success for patients with a penetrating injury to the heart and the lowest chance of survival for blunt trauma patients.

B. Indications for Emergency Department Resuscitative Thoracotomy:

1. Patients undergoing CPR with no signs of life (signs of life are defined as respiratory effort, motor effort, pupillary activity, and electrical cardiac activity) and there is less than 10 minutes of CPR time for blunt trauma patients, < 15 minutes of CPR time for patients with penetrating trauma to the torso, and < 5 minutes of CPR time for patients with penetrating trauma to the neck or extremities.
2. Patients with signs of life and undergoing CPR or profound refractory shock (SBP< 60).

3.The decision to proceed with the Emergency Department Resuscitative Thoracotomy, especially for blunt mechanism, it must be considered of the patient's overall trauma severity and should not use length of time of CPR alone.

C. Emergency Room Resuscitative Thoracotomy Procedure:

1. The entire procedure must be supervised by the most senior surgical personnel present (Surgery Chief Resident and/or Trauma Surgery Attending). A qualified surgeon must be present prior to proceeding with a thoracotomy.
2. The left chest must be quickly prepped by rapidly pouring povidone-iodine on it.
3. With a scalpel, a left anterolateral thoracotomy is performed through the fourth or fifth intercostal space. This is usually just below the nipple. In women, an assistant must retract the breast superiorly and out of the way. The chest wall layers are incised in one maneuver down to the intercostal muscles.
4. The intercostal muscles and pleura are then incised with either a scalpel or preferably with scissors.
5. The rib spreader is then inserted between the ribs with the handle directed posteriorly and the ribs are spread apart.
6. The lung is reflected superomedially (this may require the division of the inferior pulmonary ligament).
7. The pericardium is inspected for evidence of tamponade.
8. If tamponade is present, the pericardium is opened with scissors in a longitudinal direction anterior to the phrenic nerve and the tamponade is released.
9. Any injury to heart should be controlled at this time.
10. The descending thoracic aorta in the posterior mediastinum is identified and the mediastinal pleura is incised. Blunt dissection anterior and posterior to the aorta is rapidly performed to permit space for application of the aortic clamp.
11. The aortic clamp is then applied.
12. If cardiac massage is still necessary at this point, it should be done through the opened pericardium. Internal cardiac massage is performed with two hands in a hinged, clapping motion from palms to fingers, sequentially compressing the heart from the cardiac apex to the base of the heart.
13. If indicated, the thoracotomy can be extended across the sternum in a clam-shell fashion to provide access to the right thoracic cavity to address hemorrhage on that side. The internal mammary arteries will need to be ligated in such a scenario.
14. If vital signs are successfully restored with these maneuvers, then the patient must be emergently transported to the operating room for definitive management.

14. Abdominal Trauma

A. Penetrating Abdominal Trauma:

For the purposes of penetrating trauma, the external surface landmarks of the abdomen are as follows:
1. Anterior abdomen from the levels of the nipples to the inguinal creases between the two anterior axillary lines.
2. Posteriorly from the tips of the scapulae inferiorly to the gluteal folds between the two posterior axillary lines.
3. The flank is the area between the anterior and posterior axillary lines.

B. Gunshots Wounds to the Abdomen.

With a few highly selected exceptions, all gunshot wounds to the abdomen (anterior abdomen, flank, and back) should be expeditiously transferred to the operating room for surgical management (exploratory laparotomy). Exception to this policy may be made at the discretion of the Trauma Surgery Attending when there is a high suspicion that the wound is tangential and the peritoneum/retroperitoneum has not been violated. Confirmatory tests (i.e. CT scan) will be required in this situation to confirm such a suspicion.

C. Stab Wounds:

1. Stab wounds to the anterior abdomen medial to the anterior axillary lines should be managed as follows:

i. Hemodynamically unstable patients should be brought to the operating room for an exploratory laparotomy.
ii. Patients with evisceration of abdominal contents (i.e.: bowel, omentum) should be brought to the operating room for an exploratory laparotomy.
iii. Patients with obvious diffuse peritonitis (tenderness away from the wounding site) on physical exam should be brought to the operating room for an exploratory laparotomy.
iv. Hemodynamically stable patients without any of the above should have a local wound exploration done in the trauma room under local anesthesia.

- A local wound exploration is performed under local anesthesia and entails enlarging the wound with a scalpel and carefully cutting down through the fat to see where the wound tract stops or if it continues through the fascia.
- A local wound exploration does NOT entail probing the wound with a finger or a cotton swab.
- A positive local wound exploration consists of violation of the anterior fascia. Peritoneal penetration is often difficult to ascertain with certainty therefore fascial violation is considered a positive exploration.
- If the wound is found to be superficial and does not penetrate the fascia, then it should be irrigated with saline and sutured or stapled closed. That patient may be discharged from the ED.
- If the wound is found to penetrate the fascia or facial penetration cannot be reliably excluded, then the patient should undergo an abdominal CT scan.
- In stable patients with a stab wound over the left costal margin, a left thoracoabdominal wound, a local wound exploration is contraindicated. The patient will require a diagnostic laparoscopy to evaluate for diaphragmatic injury.
- If the wound is over the right costal margin, a right thoracoabdominal wound, these patients can be managed as other anterior abdominal stab wound patients above and do not require a laparoscopy specifically to evaluate for diaphragmatic injury. If the CT scan shows an isolated injury to the liver and in the opinion of the Attending Trauma Surgeon, the potential for a hollow viscous injury is low, that patient can be managed non-operatively with observation.

** If the abdominal CT scan is negative for injury, then the patient should be admitted for a period of observation with serial abdominal examinations. During this period of observations, the patient should not receive antibiotics or pain medications. Patients admitted for observation must have a reliable clinical examination. Brain or spinal cord injured patients or intoxicated patients or those that need anesthesia for another indication will require additional testing, (e.g. diagnostic peritoneal lavage, diagnostic laparoscopy at the discretion of the Trauma Surgery Attending). The period of observation is 24 hours. Complete blood counts should also be obtained on admission and 12 hours later to note the trend of the hematocrit and the white blood cell count.*

** The development of fever, tachycardia, hypotension, peritonitis or worsening abdominal pain/tenderness, falling hematocrit or rising white blood cell count during the observation period indicates the need for exploratory laparotomy. If after 24 hours the patient is afebrile, has stable vital signs, and a benign abdominal examination, the patient may be discharged home.*

** If the abdominal CT scan shows signs suggestive of injury, then the patient will require an exploratory laparotomy*

D. Stab wounds to the flank (defined as the area between the anterior and posterior axillary lines) should be managed as follows:

1. Patients that are hemodynamically unstable, have diffuse peritonitis, or evisceration of abdominal contents require exploratory laparotomy.
2. Hemodynamically stable patients are evaluated by abdominal CT scan. The CT scan should include oral, intravenous and rectal contrast. A radiopaque marker such as an ECG lead or skin staples should be placed on the wound so it can be visualized on the CT scan. This way the tract of the wound can be followed on CT scan and proximity or injury to any retroperitoneal structure can be more readily assessed. If the CT scan does not show an injury requiring laparotomy, the patient should be observed for 24 hours without pain medication or antibiotics. During the observation period, the development of fever, tachycardia, hypotension, peritonitis, falling hematocrit or rising leukocytosis are indications for exploratory laparotomy

3.Stab wounds to the posterior abdomen (defined as the area between the posterior axillary lines laterally and the tips of the scapulae superiorly and the gluteal folds inferiorly) should be managed as follows:

Hemodynamically stable patients are worked up with an abdominal CT scan. A radiopaque marker such as an ECG lead or skin staple should be placed on the wound. Then a CT scan with oral, rectal and intravenous contrast should be obtained with special attention given to the wound tract and its proximity or injury of any retroperitoneal structure. If the CT does not show any injury, and the wound tract is away from any major anatomic structure, the patient may be discharged home.

i. All patients with penetrating abdominal trauma will require a Foley catheter. Gross blood in the urine will require an evaluation of the upper and lower genitourinary tracts.

ii. All patients with penetrating abdominal trauma will require a rectal examination. Blood in the stool will require further evaluation depending on the nature and location of the injury. This evaluation may entail laparotomy if indicated but at least a rigid/flexible sigmoidoscopy. Any penetrating wound to the buttocks, perineum or with a trajectory in proximity to the rectum will require a rigid/flexible sigmoidoscopy, regardless of the presence or absence of blood on rectal examination.

4. Diagnostic Peritoneal Lavage (DPL):

Diagnostic Peritoneal Lavage (DPL) is a highly sensitive (but not specific) test for intraperitoneal injury. It is useful to evaluate the peritoneal cavity for blood or intestinal contents in patients suffering from penetrating or blunt abdominal trauma. In the blunt trauma patient, its use has mostly been supplanted by Focused Abdominal Sonography for Trauma (FAST). Its indication in penetrating trauma is limited as well. It is ideally suited for the hemodynamically stable patient with a stab wound to the anterior abdomen (not the flank or back as it does not evaluate the retroperitoneum) who is without evisceration or peritonitis but cannot be reliably evaluated by serial physical exams because of brain/spinal cord injury, intoxication, or is undergoing general anesthesia for another indication. Another major indication is for the evaluation of free abdominal fluid on a CT scan of a blunt trauma patient that does not have a solid organ injury.

This is especially true for the blunt trauma patient with an abdominal ecchymosis from a seat belt (“seat belt sign”) and free fluid on CT scan which is a marker for potential small bowel injury.
Its major drawbacks include its invasive nature and its lack of specificity regarding exactly what is injured. It is not sensitive for diaphragmatic injuries. Injuries to the retroperitoneum are not assessable by DPL.

5. Indications:

i. Unstable patients with blunt trauma (relative, DPL is now mostly supplanted by FAST for this indication except unstable patients with a pelvic fracture) or a hemodynamically unstable patient with a pelvic fracture requires that an intra-abdominal source of bleeding be ruled out. A positive FAST is reliable to indicate intra-abdominal bleeding but a negative FAST is not. A DPL is indicated in these cases.
ii. Stable patients with penetrating wounds to the anterior abdomen (not gunshot wounds) that do not otherwise meet criteria for laparotomy, but do not have a reliable clinical exam secondary to brain/spinal cord injury, intoxication, or undergoing general anesthesia for another indication.
iii. Stable patients with blunt trauma who have free fluid seen on CT scan but no solid organ injury to explain its presence. There should be no other indications for laparotomy such as thickened bowel loops or mesenteric streaking on CT scan or peritonitis on physical exam.

6. Contraindications:

i. Any clear indication for laparotomy.
ii. Previous abdominal surgery (relative).

7. Technique of DPL:

i. Diagnostic Peritoneal Lavage must be performed under the supervision of the surgery chief resident or Trauma Surgery Attending only.
ii. Only the “open” technique is permitted. The “closed” percutaneous technique is prohibited.
iii. Unless contraindicated, both a nasogastric tube and a Foley catheter must be in place prior to proceeding to DPL.
iv. In the case of a suspected or confirmed pelvic fracture, the DPL incision must be made in a supraumbilical location. This is necessary to avoid entering a pelvic hematoma that may potentially be tracking up the lower end of the abdominal wall. A supraumbilical incision is also mandatory in the pregnant patient. If there is definitely no pelvic fracture then an infra-umbilical approach is acceptable.
v. The abdomen should be prepped with povidone-iodine of Chloraprep and draped with sterile towels.
vi. Intravenous sedation should be provided if it is not contraindicated and the area to be incised should be anesthetized with 1% lidocaine.
vii. A midline vertical incision approximately 3 cm long should be made in the skin and carried down to the fascia. In obese patients, this incision will have to be proportionately longer.
viii. The fascia is grasped with forceps or clamps and incised at the linea alba. The incision needs to be only 1 cm long.
ix. The peritoneum is identified, grasped with either forceps or clamps and carefully incised.
x. The lavage catheter is gently inserted at a 45-degree angle directed toward the pelvis.
xi. A 10cc syringe is connected to the catheter and aspirated. If 10cc of gross blood is aspirated, the lavage is considered positive and the procedure is terminated. The patient is then taken for an exploratory laparotomy.
xii. If gross blood is not aspirated, the catheter is secured to the skin with sutures and connected to an IV bag of normal saline.
xiii. One liter of saline is infused (10mL/kg for children).
xiv. The empty saline bag is now placed on the floor and the lavage fluid is retrieved by gravity siphonage.
xv. 50mL of collected fluid is sent for analysis: WBC count, RBC count, amylase, and bilirubin.

8. Criteria Indicating a Positive DPL:

a. WBC count > 500/mm3
b. RBC count > 100,000/mm3 in blunt trauma and > 25,000/mm3 in penetrating trauma.
c. Amylase or bilirubin level significantly greater than serum value.

Blunt Abdominal Trauma:

a. The evaluation of patients with blunt abdominal trauma will depend upon their hemodynamic status, their level of consciousness and their associated injuries.
b. A bedside abdominal ultrasound (Focused Abdominal Sonography for Trauma or FAST) should be performed for all patients with blunt trauma.
c. In a stable patient with normal sensorium (i.e.: no head injury, no alcohol or drugs) and no distracting injuries (i.e.: an open lower extremity fracture), a physical exam of the abdomen and a Focused Abdominal Sonography for Trauma (FAST) exam may suffice. If the exam is normal with no tenderness, masses or other evidence of injury, at the discretion of the Trauma Service, no further evaluation of the abdomen needs to be undertaken. Any abnormal findings will require further evaluation and again at the discretion of the Trauma Service. Such an evaluation will usually but not necessarily be an abdominal CT scan. It must be emphasized that a CT scan is for hemodynamically stable patients only. If a patient is unstable then a CT scan is contraindicated and other means of evaluation must be performed.
c. In patients with an altered mental status (due to drugs, alcohol or head injury) or with significant pain from another injury (such as an open fracture), the physical examination may not be reliable. These patients will require an abdominal CT scan.
d. If a patient is hemodynamically unstable and has multiple potential sources of hemorrhage (i.e.: pelvis and abdominal cavity), then a Focused Abdominal Sonography for Trauma (FAST) examination should be performed. If the FAST is positive for abdominal fluid, then the patient will likely require exploratory laparotomy. In the event the FAST is equivocal or negative, then a diagnostic peritoneal lavage (DPL) should be performed. If the lavage results are positive (see criteria above) then the patient will need an exploratory laparotomy. If the results of FAST or DPL are negative, then the patient should be managed according to what other potential sources of bleeding are likely (i.e. pelvic fracture).

Blunt Injuries to the Spleen:

a. Hemodynamically unstable patients or those with diffuse peritonitis and a blunt injury to the spleen require urgent laparotomy.
b. Patients that are hemodynamically stable and do not have diffuse peritonitis but have a blunt splenic injury do not require laparotomy and can be considered for nonoperative management. The severity of the splenic injury as seen on CT scan, age of the patient, neurologic status or the presence of associated injuries are not contraindications to a trial of nonoperative management.
c. Patients with blunt splenic injury that are hemodynamically stable must have an abdominal CT scan with intravenous contrast and the splenic injury must be graded according to the American Association for the Surgery of Trauma (AAST) grading scale. The grade must be documented in the medical record. CT scan without intravenous contrast is not appropriate for evaluation.
d. Angiography of the spleen should be considered for those patients who have evidence of a contrast blush on CT scan, high injury grade (grades IV or V), large hemoperitoneum, or evidence of ongoing bleeding.
e. Patients selected for non-operative management should be in a monitored setting (STICU or surgical step–down unit). Serial hematocrit measurement should be at least every 6 hours for the first 48 hours for splenic injury grades III and higher. Patients with splenic injury grades I to III should be at bed rest for at least 24 hours and for those with grades IV and higher, bed rest should be at least 48 hours. The actual activity regimen will be at the discretion of the Attending Trauma Surgeon.

7.Blunt Injuries to the Liver:

a. Hemodynamically unstable patients or those with diffuse peritonitis and a blunt liver injury require urgent laparotomy.
b. If the patient with a blunt liver injury is hemodynamically stable and without peritonitis, then a laparotomy is not required and the patient can be considered for nonoperative management.
c. The liver injury must be assessed by an abdominal CT scan using intravenous contrast. CT scans without intravenous contrast are not appropriate. The liver injury must be graded according to the American Association for the Surgery of Trauma (AAST) grading scale. The grade must be documented in the medical record.
d. Patient selection for nonoperative management is based on hemodynamic stability and not by degree of liver injury, age, neurologic status, or associated injuries.
e. If the CT scan demonstrates evidence of active extravasation (contrast blush), then angiography of the liver with embolization should be considered.
f. Patients selected for non-operative management should be observed in a monitored setting (STICU or surgical step-down unit). Serial hematocrit measurements should be at least every 6 hours for the first 48 hours for injury grades III or higher. Patients should be at bed rest for 24 hours for grades I to II and bed rest for at least 48 hours for grades III and higher but the actual activity regimen is at the discretion of the Attending Trauma Surgeon.
g. Patients with liver injury Grades IV or V will require a repeat CT scan prior to discharge.

15. Trauma Imaging – Adult and Pediatric:

The appropriate use of radiologic imaging is indispensable for the proper evaluation and management of the trauma patient. The following protocols have been developed in collaboration between the Trauma Service and the Department of Radiology and reviewed regularly.

A. Primary Survey:

Imaging during the primary survey is limited to the following:

1. AP chest X-ray
2. AP pelvis X-ray
3. FAST (Focused Assessment with Sonography for Trauma) and e-FAST
4. Other imaging can be obtained only once the primary survey is completed and the secondary survey has begun.

B. Secondary Survey

Adults:

Whole Body CT scanning (WBCT or Pan-Scan): This entails non-contrast CT of the head and cervical spine and then IV contrast enhanced scanning of the chest, abdomen and pelvis with reconstruction of the thoracic and lumbar spine. The WBCT is usually indicated for patients with blunt trauma and a significant mechanism of injury or altered sensorium. This has supplanted selective CT scanning in most centers, including our own.

All **RED** trauma patients must be accompanied to the CT scan by the Trauma Team. The patient must be on a monitor (Pro-Pac) with the monitoring of continuous heart rate, continuous pulse oximetry and blood pressure cuff cycled continuously. The hotline phone in the Trauma Bay should be utilized to inform CT scan that the patient is on the way. If the patient is intubated, the respiratory therapist must also accompany the patient so as to set up the ventilator in the CT scanner.

All **YELLOW** trauma patients must be accompanied by either the Trauma Team or ED team. They also must be on a Pro-Pac monitor with continuous heart rate and pulse oximetry and continuous cycling of the blood pressure cuff.

For RED trauma patients:
The WBCT entails non-contrast CT of the head and cervical spine. This is then followed by IV contrast-enhanced CT of the chest, abdomen and pelvis. Finally, a delayed excretory phase is obtained to opacify the ureters and the bladder. Intravenous contrast is required for **RED** trauma patients unless there is a known severe contrast allergy. No oral contrast is used for **RED** trauma patients. **RED** trauma patients have immediate priority for CT scanning. For **Yellow** Trauma Patients: CT scan priority is less than **RED** patients but the expectation is CT within 1 hour. WBCT is obtained with intravenous and oral contrast. If the patient has an altered sensorium, is vomiting or is otherwise considered an aspiration risk or cannot take oral contrast, then the oral contrast can be omitted. This requires documentation to that effect by either the ED or Trauma physician. The documentation can be in a progress note or in the comments on the CT order. In addition, a creatinine level is required for **Yellow** Trauma patients. Even though the intravenous contrast is also required, the dose can be reduced or changed in the event of a low GFR. If the condition of the patient is such that waiting for a creatinine level is not possible, then a note by the ED attending or Trauma physician attesting of the need to forgo the creatinine level is required.

For YELLOW trauma patients:
Do not routinely get a delayed excretory phase CT. In the event there is a pelvic fracture or hematuria, then a delayed excretory phase to evaluate the ureters and bladder is required.

C. Penetrating trauma to the back or flank:
Abdominal and pelvic CT scan with intravenous, oral AND rectal contrast to opacify the entire colon. A radio-opaque marker should be placed on the penetrating wound so as to assist the radiologist in identifying the wound tract.

D. Penetrating Neck Trauma:
Patients with penetrating neck trauma that do not have hard signs or other criteria for immediate operative exploration, are worked up initially with a CT angiogram of the neck. Close evaluation of the wound tract seen on the CT scan can guide further imaging. A contrast esophagogram is only required if the track of the wound is seen approaching the esophagus.

E. Penetrating extremity trauma:
A vascular exam is required to determine what imaging, if any, is indicated. A diminished pulse or ABI less than 0.9 is usually an indication for a CT angiogram of that extremity. Bilateral runoff is usually advised to provide comparison with the uninjured extremity.

F. Blunt cerebrovascular injury (CVI):
A CT angiogram of the neck is required for patients with the following:
1. Arterial hemorrhage from the neck, mouth, nose, or ear
2. Cervical hematoma
3. Cervical bruit in a patient younger than 50 years of age
4. Focal or lateralizing neurologic deficit (e.g., hemiparesis, transient ischemic attack, Horner's syndrome, vertebrobasilar insufficiency)
5. Stroke seen on head CT or MRI.
6. The presence of major thoracic trauma, especially of the great vessels.
7. Injury mechanism compatible with severe cervical hyperextension/rotation or hyperflexion
8. Severe facial trauma including bilateral facial fractures in any facial third, complex midface (Lefort II and Lefort III fractures) and subcondylar fractures.

9. Neurologic deficit inconsistent with head CT.
10. Basilar skull fracture involving the carotid canal
11. Closed head injury consistent with diffuse axonal injury with Glasgow Coma Score <6
12. Cervical vertebral body or transverse foramen fracture, subluxation, or ligamentous injury at any level, or any fracture at the level of C1-C3
13. Near-hanging resulting in cerebral anoxia
15. Clothesline-type injury or seat belt abrasion associated with significant cervical pain, swelling or altered mental status.
16. Scalp degloving injury

G. Pediatric Trauma Imaging:

Imaging for pediatric patients (age< 15) should be selective. WBCT is usually not done unless the mechanism is severe and the patient is not evaluable or has significant injury already apparent. A chest X-ray can usually suffice if normal and a Chest CT may be omitted.

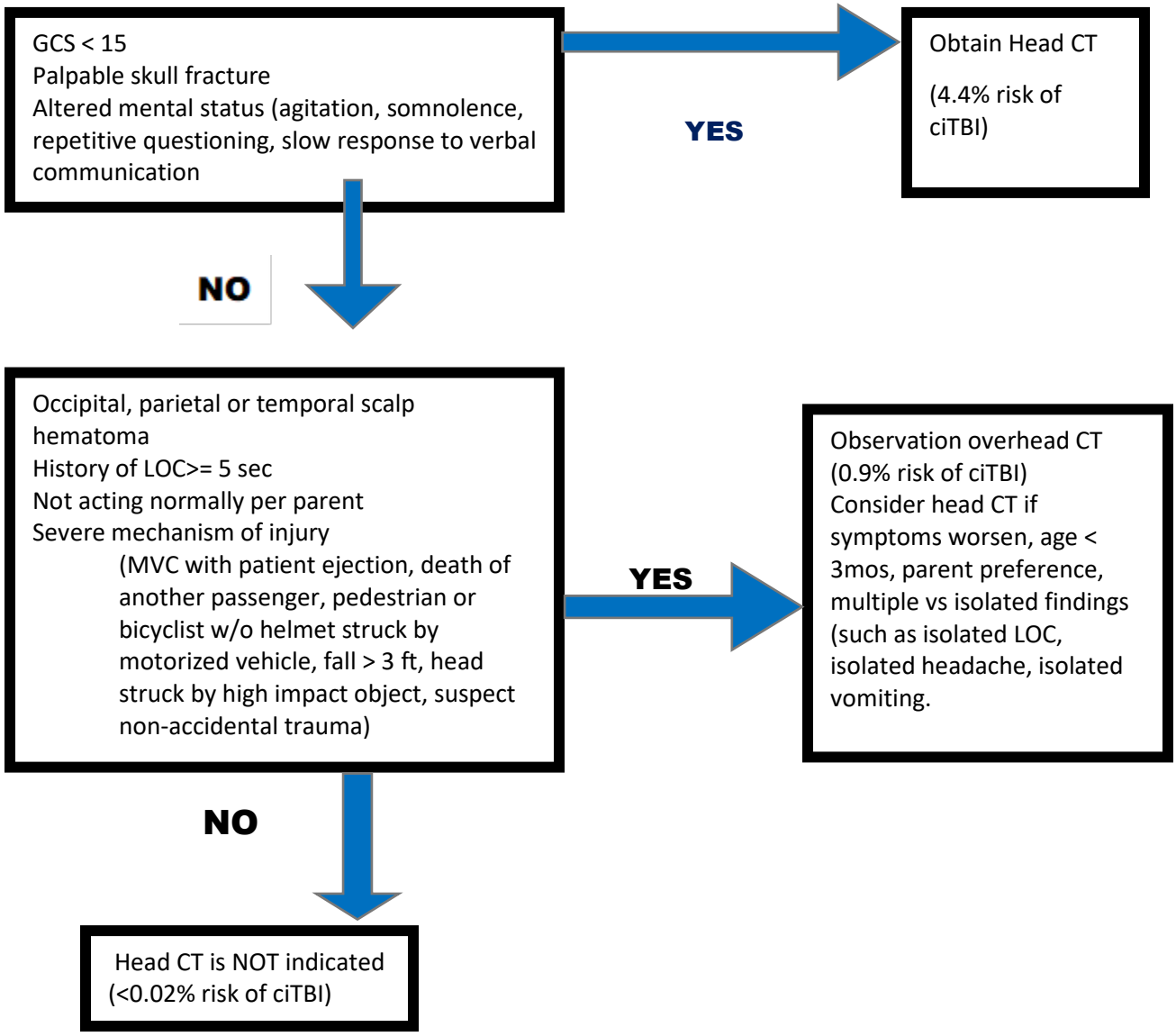
H. Cervical spine imaging in children:

1. Pediatric patients are at increased risk of occult ligamentous and spinal cord injury compared to adults due to biomechanical difference in the immature cervical spine.
2. While NEXUS and the CCR are not specifically validated for use in pediatric patients, use of NEXUS is acceptable to reduce need for imaging as its successful use in screening patients less than 18 years of age has been demonstrated.
3. Additionally, the 2012 AANS/CNS Guidelines may be used to assess the need for cervical spine imaging in pediatric trauma patients:
4. Cervical spine imaging is not recommended in children who are 3 years of age or older following trauma and who:
i. Are alert
ii. Have no neurological deficit;
iii. Have no midline cervical tenderness;
iv. Have no painful distracting injury;
v. Do not have unexplained hypotension;
vi. Are not intoxicated.

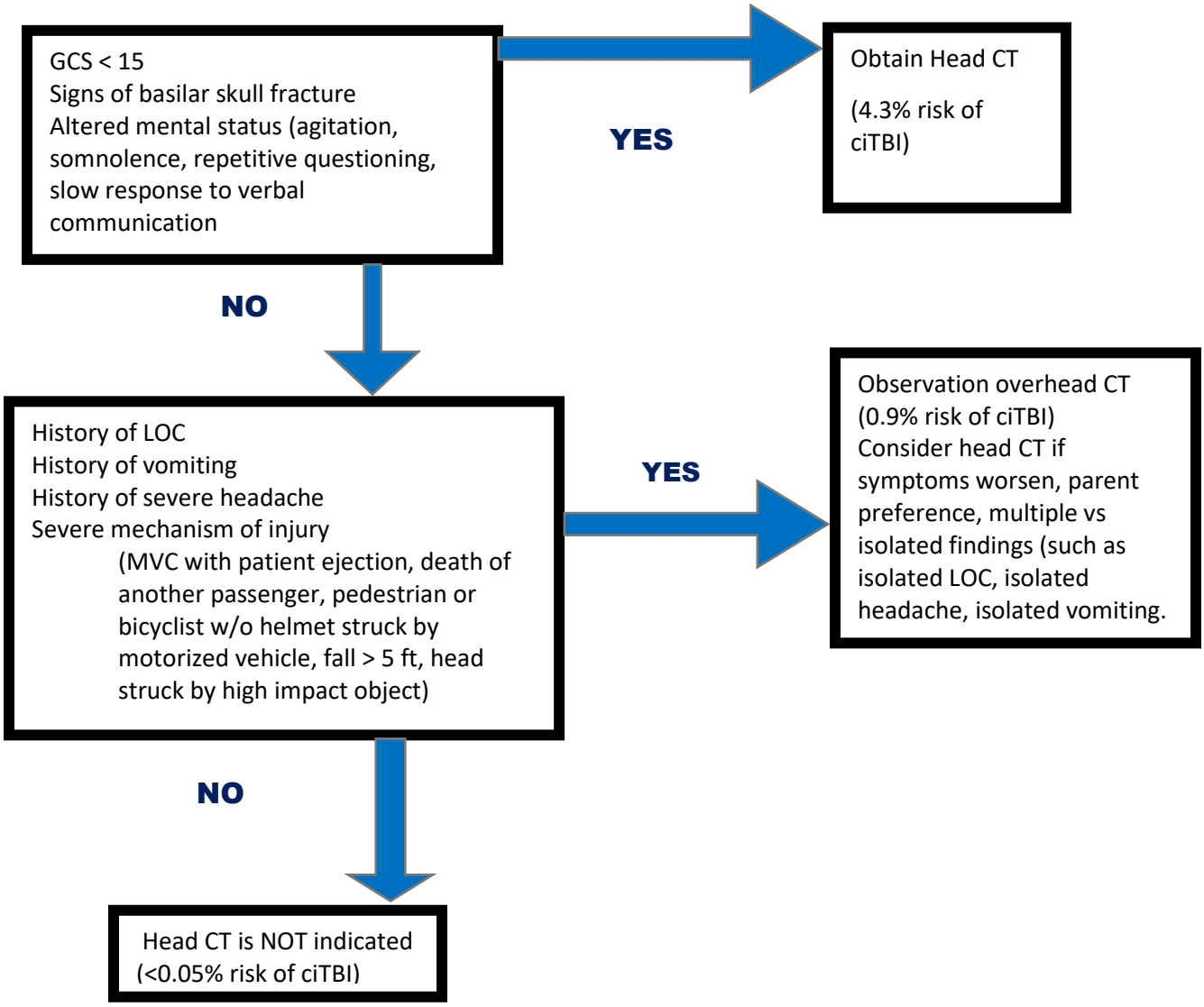
5. Cervical spine imaging is not recommended in children who are less than 3 year of age following trauma and who:
i. Have a GCS >13;
ii. Have no neurological deficit;
iii. Have no midline cervical tenderness;
iv. Have no painful distracting injury;
v. Are not intoxicated;
vi. Were not involved in a motor vehicle collision;
vii. Do not have unexplained hypotension;
viii. Did not have a fall from a height >10 feet;
ix. Did not have non-accidental trauma as a known or suspected mechanism of injury

Cervical spine radiographs or high-resolution CT is recommended for children who have experienced trauma and who do not meet either set of the above criteria.
The indications for Head CT scanning in children should follow the PECARN algorithm:

FOR PATIENTS YOUNGER THAN 2 YEARS OLD



FOR PATIENTS AGE 2 YEARS AND OLDER



16. Pelvic Fractures

Patients with pelvic fractures have usually sustained a significant blunt force and are at risk for major hemorrhage and death. In addition, there is a risk of GU, rectal, and in female vaginal injury not to mention potential nerve injury in patients with pelvic fracture. The expeditious evaluation and management of these patients, using a multidisciplinary approach, is mandatory in order to provide optimal outcomes for these patients.

A. INITIAL EVALUATION

The initial evaluation of patients with suspected pelvic fracture is the same for all trauma patient and involves the principles of ATLS. Physical examination may be notable for pain on palpation of the pelvis, rotated or foreshortened lower extremities or obvious deformity of the pelvis.
Rectal examination and for females, vaginal examination is required for all patients with pelvic fractures.

B. RADIOLOGIC IMAGING

Plain film X-ray of the pelvis should be obtained in all blunt trauma patients that are triaged to the trauma bay (**RED** and **YELLOW**) activations and other patients as history and physical exam dictates.

Patients that are hemodynamically stable and do not show signs of shock can be worked up with CT scanning of the pelvis in addition to the other body CT scans. Patients with pelvic fractures should undergo delayed imaging CT whereby the CT scan is repeated in the excretory phase to allow opacification of the GU tract, including ureters and bladder.

Any evidence of IV contrast extravasation on the arterial phase of the CT scan requires serious consideration of angiography for potential embolization at the discretion of the Trauma Surgery Attending in consultation with the interventional radiologist.

C.CONSULTATIONS

All patients with pelvic fracture require orthopedic surgery consultation. In the event the patient is hemodynamically unstable, STAT orthopedic consultation should be obtained with a response time not exceed 30 minutes.
Suspicion of urethral injury such as blood at the urethral meatus, scrotal or perineal hematoma, or high-riding prostate on rectal examination, preclude placement of a Foley catheter until urethral injury is ruled out by retrograde urethrogram. Urology consultation is required for urethral or bladder injury.

D. HEMODYNAMICALLY UNSTABLE PATIENTS

Patients with pelvic fracture that are hemodynamically unstable (hypotension, evidence of shock, significant tachycardia) require rapid evaluation and institution of therapeutic interventions.
Bleeding sources outside the pelvis must be excluded if possible. Chest X-ray may exclude thoracic hemorrhage. FAST examination may be helpful for excluding abdominal sources of bleeding but this must be done with caution as there is a not-insignificant rate of false negative FAST examination in pelvic fracture. Diagnostic peritoneal aspiration (DPA) should be considered at the discretion of the Attending Trauma Surgeon.

Pelvic X-ray is required for all patients suspected of pelvic fracture and signs of hemodynamic instability. Orthopedic consultation must be obtained for patients with pelvic fractures and hemodynamic instability. The orthopedic consultant must arrive to the patient's bedside within 30 minutes of request in these cases.

E. Pelvic Binder (T-POD)

A pelvic binder (T-POD) should be applied to patients with pelvic fracture and hemodynamic instability if the fracture pattern on X-ray permits. Care should be used in applying a pelvic binder in cases of lateral compression fractures since excessive pressure by the binder may make the injury worse. In cases of lateral compression pelvic fracture, a pelvic binder can be used more like a splint to stabilize the fractures and not for compression / reduction of volume. The binder should be applied with only minimal pressure in these cases.

The pelvic binders (T-POD) are stored in the trauma bay along with the surgical trays. In the event a pelvic binder (T-POD) is not available, then a sheet wrapped around the greater tuberosities and iliac crests and held in place with a large clamp may be used as a substitute. The ankles can also be taped together to provide additional stabilization of the pelvis.

F. MTP

Hemodynamically unstable patients with pelvic fractures should have activation of the massive transfusion protocol (MTP).
Tranexamic acid (TXA) 1g IV should also be administered at the discretion of the Trauma Surgery Attending.
Large bore IV access should be above the diaphragm for patients with pelvic fractures.
Angiography in IR suite
If the patient has been stabilized with the MTP, then angiographic embolization should be provided in the interventional radiology suite. The angiography team must be available within 30 minutes from request.

G. PATIENTS IN EXTREMIS

If the patient is in extremis despite MTP administration, then the patient should be rapidly transported to the trauma operating room (OR #1) for intervention.

H. Pre-peritoneal pelvic packing

Pre-peritoneal pelvic packing should be performed by the Trauma Surgeon via a lower vertical midline pre-fascial incision and packing the retroperitoneal space with 3 laparotomy pads on each side.

I. External-fixator placement

Orthopedic surgery should join the trauma team in the operating room and consideration for a rapid application of a pelvic external - fixator device should be considered. This may aide in the tamponade effect of the pre-peritoneal pelvic packs by stabilizing the pelvis and allowing the packs to compress the bleeding more effectively.

J. Angiography in the OR

For the patients with pelvic fractures that are in extremis and taken immediately to the operating room, the interventional radiologist should join the trauma team and orthopedic surgery team in the operating room for angiographic embolization there. The Trauma Room OR table is radiolucent and designed for fluoroscopy. The digital C-arm is to be brought in the room to assist both orthopedics with the external-fixator placement and the interventional radiologist for the angiogram. A cart with appropriate catheters, guide-wires, and embolization material is stored in the Trauma operating room (OR #1) for this scenario.

K. REBOA

Another alternative for the pelvic fracture patient in extremis is the use of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA). The REBOA device is restricted to use by the Trauma Attending Surgeon only and is to be placed via a percutaneous femoral approach. Deployment in Zone III only is to be used for control of pelvic bleeding. REBOA can be inserted and deployed in the Trauma bay of the ED or in the operating room, by the Trauma Surgery Attending. An arterial pressure monitoring line should also be inserted above the diaphragm (usually radial but can be brachial). Deployment of REBOA is limited to 30 minutes because of the profound ischemic insult that the zone below deployment experiences. Therefore, rapid definitive bleeding control must be accomplished.

Patients with REBOA deployment are also candidates for immediate transport to the OR for bleeding control measures there such as external fixation and angiographic embolization. Once the definitive control of pelvic bleeding has been achieved, further work up of the patient will be performed depending on the patient's condition and at the discretion of the Trauma Surgery Attending.

** Admission to the STICU is required for these patients. **

L. Performance Improvement

All cases of angiographic embolization of pelvic fractures, pre-peritoneal packing placement, or REBOA deployment will be monitored by the Trauma PIPS process.

17. Penetrating Neck Trauma

The patient with penetrating neck trauma should be assessed according to the ABC's of ATLS. In addition, the location and specific nature of the injury will affect its subsequent management. The patient should be assessed for active bleeding and expanding hematoma. If these are present then immediate operative intervention may be warranted without delays in obtaining radiologic or endoscopic studies. Other signs of injury include: subcutaneous emphysema, hemoptysis, palpable thrill or audible bruit, stridor, hoarseness or neurological deficit.
If no absolute indication for immediate operative intervention exists, then the location of the injury will determine the nature of the evaluation. The neck can be divided into four regions for the purposes of the diagnosis. These are the posterior neck and the three zones of the anterior neck.

A. Posterior Neck Injuries

The posterior neck is defined as the area lateral to the lateral borders of the sternocleidomastoid muscles encompassing the entire posterior aspect of the neck. The musculature is relatively thick here, compared to the anterior neck. Stab wounds to the posterior neck should be evaluated by CT angiography. The wound tract should be studied on the CT scan. If there is no evidence of injury or proximity to any structure, then the wound can simply be closed and the patient observed. If there is evidence of injury or the wound seems to closely approach a vital structure, then the patient can be explored or can undergo further diagnostic testing at the discretion of the trauma surgeon.

B. Anterior Neck Injuries

The anterior neck is that region located medial to the lateral borders of the sternocleidomastoid muscles. It is further subdivided into three anatomic zones. Any wound that is in this location and is found to penetrate the platysma muscle will require further evaluation. Wounds that do not penetrate the platysma muscle can simply be irrigated and closed.

1. Zone I:

Zone I is that portion of the anterior neck between the clavicles and the cricoid cartilage. Operative exposure of injuries to this location may require various different incisions depending on the structure injured, therefore precise delineation of the injury is important prior to surgery. Therefore, patients with injury to Zone I of the neck will require the following diagnostic tests:

i. CT angiography of the neck
ii. Contrast esophagogram (esophagoscopy can be substituted)
iii. Chest X-ray to evaluate for hemo/pneumothorax

2. Zone II:
The anterior neck between the cricoid cartilage and the angle of the mandible is defined as Zone II. Injuries to this area are relatively easily exposed with an incision along the medial border of the sternocleidomastoid muscle. Alternatively, Zone II neck injuries may be evaluated CT angiography of the neck and esophagography (or esophagoscopy). As these two approaches are equivalent in diagnostic accuracy, CT and esophagography are the preferred method because of their non-invasive nature.

3. Zone III:
Zone III is that small area located between the angle of the mandible and the base of the skull. This area is notoriously difficult to expose and may often require disarticulation or osteotomy of the mandible. Unless there is an absolute indication for immediate operative intervention (e.g., expanding hematoma or active arterial bleeding), the following diagnostic work-up should be performed:

i. CT angiography of the neck
ii. Endoscopy of the hypopharynx

18. Extremity Trauma

A. Hand Injuries:
Except for the most minor, superficial lacerations, all injuries to the hand require a hand surgery consultation.

B. Upper or lower extremity fractures (except hand):
1. All fractures to the extremities require orthopedic consultation. If there is a gross deformity on physical exam, orthopedic consultation should be made immediately without waiting for x-ray confirmation of the fracture.
2. All fractured extremities should be splinted prior to any patient transport from the trauma room.
3. All fractured extremities should have a neurovascular exam performed and documented
4. A diminished or absent pulse, especially if not restored after adequate fracture reduction will require an angiogram (CT angiogram or conventional catheter angiography).

C. Open fractures:
Open fractures are present when a fractured bone is exposed to contamination from the external environment through a disruption of the overlying skin and subcutaneous tissue. These fractures are highly susceptible to infection. Appropriate management consists of early antimicrobial administration, early washout and debridement and skeletal fixation.

**** All open fractures must be graded by the Gustilo classification system as follows: ****
1. Gustilo Type I - Open fracture with skin wound < 1cm.
2. Gustilo Type II - Open fracture with skin wound > 1cm and <10cm without extensive soft tissue damage.
3. Gustilo Type III - Open fracture > 10cm with extensive soft tissue injury / contamination or significantly comminuted fracture.
4. Gustilo IIIa - Soft tissue coverage is adequate.
5. Gustilo IIIb - Significant soft tissue loss requiring tissue transfer / flap.
6. Gustilo IIIc - Associated vascular injury.

The Gustilo type of injury must be documented in the patient's chart. Antibiotics must be administered for all open fractures within 1 hour of patient arrival.

Patients with Gustilo Type I or Type II open fractures should receive a first-generation cephalosporin such as cefazolin (2g IV Q 8hrs). If MRSA is a consideration or the patient is penicillin allergic, then vancomycin (15mg/kg IV Q 12hrs) should be used instead.

Patients with Gustilo Type III fractures should also receive gram-negative coverage in addition such as gentamicin (5mg/kg IV Q 24hrs). If there is severe contamination or if there is vascular compromise, then anaerobic coverage should be added as well such as penicillin.

Fluoroquinolone antibiotics should NOT be used for open fractures.

Antibiotics must be continued until 24 hours after surgery. For highly contaminated wounds (Gustilo Type III), the antibiotics should be continued for 72 hours.

Tetanus toxoid (0.5ml IM) AND tetanus immunoglobulin (250 U IM) should be administered if the immunization history is unknown or if it has been > 10 years since the patient's last dose.

The open fracture wound should be irrigated with a solution of saline mixed with povidone-iodine as soon as possible at the bedside and a splint and sterile dressing applied until the patient can be taken to the operating room.

The patient should be taken to the operating room for irrigation and debridement and skeletal stabilization within 24 hours of arrival.

In the operating room, the skin defect over the bone should be closed if possible.

If the wound cannot be closed initially (Gustilo Type IIIb), then definitive soft tissue coverage should be completed within 7 days of the injury. Plastic surgery consultation should be obtained for any wound that cannot be closed primarily during the initial surgery.

D. Penetrating Trauma to the Extremities:

1. The extremity that has sustained a penetrating insult (gunshot wound or stab wound) must be assessed for signs of vascular injury. If there is overt evidence of vascular injury ("hard signs"), then the patient should undergo immediate arterial exploration and no further vascular work-up (such as angiography) should be performed. Restoration of perfusion to the extremity should be achieved in less than 6 hours in order to maximize the potential for limb salvage. If, on the other hand the exam is normal or there are only signs suggestive of, but not conclusive of vascular injury ("soft signs"), then the evaluation must be more selective:

2. Active arterial or pulsatile bleeding should be controlled with direct manual pressure while the patient is transported and prepped for surgery. A tourniquet may be used as a temporary adjunct if manual pressure is unsuccessful

3. Indications for immediate arterial exploration (no pre-op angiogram).
   i. Pulsatile bleeding.
   ii. Expanding hematoma.
   iii. Palpable thrill / audible bruit
   iv. Loss of a palpable distal pulse in the affected extremity (Note: A pulse that is only evident on Doppler exam is NOT a palpable pulse and such a patient is considered to have loss of pulse).

v. If the trajectory of the wound is close to or overlies the anatomic course of an artery (proximity injury) but the physical exam is normal, then an ankle / brachial index (ABI) of the affected extremity must be calculated. This is determined by dividing the systolic arterial pressure of the affected limb (obtained by Doppler) by the systolic pressure in an uninjured arm. If the calculated ABI is less than 0.9, then an angiogram (CT angiogram) is indicated. If the ABI is greater than 0.9, then the patient should be observed for 12 hours with serial vascular exams and after that the patient may be discharged.

4. Patients that meet the following criteria (but have none of the above, mentioned indications for immediate surgical exploration) should undergo CT angiography and NOT immediate surgical exploration:
i. ABI less than 0.9.
ii. Palpable but diminished distal pulse.
iii. Pain, paresthesia, paralysis NOT associated with other signs of ischemia (this may be secondary to nerve injury).

19. Amputations

The patient must be stabilized according to the ATLS protocol. Bleeding should be controlled by direct pressure or by tourniquet. The patient should then be assessed for other trauma. Subsequent surgical management of the amputation will be at the discretion of the Trauma Team. If the upper extremity, distal to the level of the elbow is involved, then an immediate hand surgery consultation is required.

Consideration for replantation should be made in suitable candidates. Plastic surgery consultation is required. Factors for consideration include the mechanism and zone of injury, the amputated body part and its functional importance, age, medical comorbidities, smoking, occupation, and potential for rehabilitation should also factor in the decision.

A. Indications for replantation:

1. All thumb amputations.
3. Multiple-digit amputations.
4. Amputation level between the palm and distal forearm.
5. Amputations in healthy children.

B. Relative contraindications:

1. Severely crushed or mangled parts.
2. Prolonged warm ischemia time.
3. Severe contamination.
4. Avulsion injuries.
5. Advanced age, poor health, or atherosclerotic disease.

If replantation is considered, immediate consultation with a replantation center is mandatory. Elmhurst Hospital Center maintains a transfer agreement for replantation with Bellevue Hospital Center.
Then amputated part should be cooled to increase the ischemia threshold. This is accomplished by wrapping the amputated part with a sterile gauze moistened with Ringer's lactate solution. This is then placed in a plastic bag or small container which is then placed on ice. The amputated part should never be placed directly in ice. The patient must be stable prior to transfer. There must be a complete evaluation for other injuries, and if found, appropriately managed prior to transfer.

20. Pregnant Trauma Patient

The priorities for treatment of the injured pregnant patient remain the same as those for the non-pregnant patient with important adaptations because of the physiologic and anatomic changes associated with pregnancy. The best way to assure fetal survival is to assure material stabilization. Therefore, the mother should receive treatment priority:

Airway / breathing:
The fetus is extremely sensitive to hypoxia, therefore assuring an adequate airway for the mother is essential. All pregnant patients should receive supplemental oxygen.

Circulation:
Pregnancy is associated with a physiologic hypervolemia, so signs of shock may be delayed. Vigorous crystalloid resuscitation is therefore important until the extent of injuries can be assessed. It is also important to note that the enlarged uterus can compress the inferior vena cava causing hypotension (supine hypotension syndrome). Position the patient with the left side tilted down 15 degrees if possible.

Spinal Injury:
If spinal injury is a possibility, then the patient can be tilted to the left while still strapped to the background. Immediate consultation with the OB/GYN service is required for all pregnant trauma patients.

Secondary Survey:
The secondary survey should proceed as in any trauma patient with certain additional assessments:
Obtain a prenatal and obstetrical history as well as an estimation of gestational age.
Assess for the presence of vaginal bleeding, ruptured membranes, bulging perineum, presence of contractions, and abnormal fetal heart rate / rhythm.

A. Radiographic examination:
All indicated x-rays should be obtained but with adherence to the following guidelines to prevent unnecessary radiation exposure to the fetus:
1. Obtain the minimum number of x-ray to obtain the most information and to avoid duplication of studies.
2. Shield the patient's abdomen with a lead apron whenever possible.
3. If many x-rays will be required over a prolonged period (such as a patient with a long ICU stay), then a radiographic dosimeter badge should be attached to the patient to serve as a guide to the total radiation dose.

** Pregnant patients whose blood is Rh-negative may be sensitized to Rh-positive fetal blood if there is significant fetomaternal transfusion secondary to the trauma. Therefore, the Kleihauer-Betke (KB) test should be done on all pregnant trauma patients who are in their second or third trimester. A positive KB test must be repeated in 24 hours to identify ongoing fetomaternal hemorrhage. If positive, Rh-immune globulin (Rhogam) should be administered to the mother. The dose is 300ug with an additional 300ug for every 30ml of fetomaternal transfusion estimated by the KB test. The Rhogam must be administered within 72 hours of the trauma.

C. Fetal assessment:
Obstetrical ultrasound should be used to evaluate the uterus, placenta and fetus. The fetal heart rate and the presence of uterine contractions should be assessed.

D. Monitoring:
Continuous cardiotocographic monitoring (fetal heart rate and uterine contraction activity) should be provided for all pregnant trauma patients with a gestational age>20 weeks. This monitoring should be for a minimum of 6 hours. Any evidence of hypotension, vaginal bleeding, uterine or abdominal tenderness, a non-reassuring fetal heart rate pattern, rupture of the amniotic membranes, serious maternal injury, or frequent uterine activity (defined as >6 contractions/hr) will require continuation of the monitoring. In the absence of any of these signs, then after a minimum 6 hours of monitoring, discharge of the patient can be considered. Longer monitoring or other obstetrical interventions are to be performed at the discretion of the obstetrician. Monitoring can be done wherever the patient needs to be (e.g., the O.R, the intensive care unit), however, if the patient needs to be admitted and does not require a critical care setting, then the monitoring should be done on the obstetrical floor.

** In a pregnant trauma patient presenting in cardiac arrest that has a > 24 weeks gestation, a perimortem cesarean section should be considered. A cesarean section in this circumstance must start within 4 minutes of maternal arrest with the goal of delivering the fetus within 20 minutes.

21. Emergent Admission to OR

In the event that a trauma patient requires emergency surgery, the operating room and anesthesia will be immediately notified. This should be done by use of the O.R. hot-line phone located in the trauma resuscitation area of the E.R.

The patient should be placed on a portable monitor for ECG, blood pressure, and oxygen saturation, and brought to the operating without delay. The Trauma Team is to accompany the patient en-route to the operating room.

Emergency trauma surgery should be performed in operating room #1, which is reserved and specifically equipped for trauma. For an exploratory laparotomy, the patient should be positioned supine on the operating table with both arms out on arm boards. The patient should be prepped with povidone-iodine or Chloraprep from the chin to the mid-thighs. It is important to have access to the chest (in the event a thoracotomy becomes necessary) as well as to the groin in the event a saphenous vein harvest is required. If a thoracotomy for intra-thoracic injuries, and not a laparotomy, is planned, then the positioning of the patient is at the discretion of the thoracic surgeon. For a neck exploration, the entire neck, lower jaw, and chest as well as one groin are prepped into the field.

In the event that more than one trauma surgery must be performed simultaneously, the second-call surgery attending will be notified. The chief surgical resident may begin an emergent trauma case while the second surgery attending is en-route. Other attendings that should be called if more surgeons are required are the Director of Trauma, followed by the Director of Surgery. Indeed, all surgery attending's phone and beeper numbers are available to the chief resident as well as the hospital operator, and there should be no hesitation to call in the event that multiple surgeons are required.

22. Burns

Burned patients should be evaluated just like any trauma patient using the ABC's.

A. 100% oxygen should promptly be administered. Inhalational injury may produce airway edema and therefore the airway must be carefully assessed. Any evidence of airway edema should prompt intubation.

B. The patient should be carefully assessed for other trauma in addition to the burn.

C. The total body surface area (TBSA) burned should be estimated. This can be done using a burn chart (different for children and adults).

D. Initial fluid resuscitation should be with lactated Ringer's solution and the initial rate can be estimated by multiplying the TBSA burned by weight in kilograms and then dividing by 8. This will give the initial infusion rate in ml/hr.

E. The burn wounds should be covered with sterile dry gauze. Chemical burns should be copiously irrigated with saline.

F. The following patients with burns should be resuscitated, stabilized, evaluated for associated injuries, and then promptly transferred to a designated burn center:
1. Second-degree burns of >10% total body surface area (TBSA).
2. Full-thickness burns of over 5% TBSA.
3. Any burn involving the face, hands, feet eyes, ears, or perineum that may result in cosmetic or functional disability.
4. High-voltage electrical injury, including lighting injury.
5. Inhalational injury.
6. Chemical burns.
7. Any burn in a patient who is deemed to have a significant comorbid condition (diabetes, COPD, cardiac disease, renal failure)

G. Elmhurst Hospital Center maintains transfer agreements with two designated Burn Centers – Jacobi Hospital Center and The New York Hospital-Cornell Medical Center. Burned patients, once adequately stabilized and resuscitated must be transferred to one of these facilities. Appropriate communication with the accepting physician is required prior to transfer.

23. Venous Thromboembolism (VTE) Prophylaxis

Trauma patients are at significantly increased risk for venous thromboembolism (VTE) which includes deep venous thrombosis (DVT) and pulmonary embolism (PE). Prophylaxis of VTE is necessary but often complicated by the fact that trauma patients are at increased risk for bleeding because of their injuries. The following is a guideline to assist clinical practice of venous thromboembolism (VTE) prophylaxis in trauma patients. These guidelines are for patients age 15 years and older. For patients younger than 15 but post-puberty, pharmacologic VTE prophylaxis should be considered for those with severe injury (ISS greater than 25).

A. Sequential Compression Devices (SCD's).
Sequential compression devices (SCD's) should be used for all trauma patients with the following exceptions.
1. SCD placement is contraindicated on a fractured extremity prior to fixation.
2. SCD placement is contraindicated on extremities with external fixators or large open wounds.
3. SCD's may be used on fractured extremities following open reduction and internal fixation.
4. Early mobilization, if possible and not contraindicated, should be implemented in all patients.

B. Pharmacologic VTE prophylaxis:
All trauma patients who do not have a contraindication should be started on pharmacologic VTE prophylaxis as soon as possible. Enoxaparin is the agent of choice unless there is renal insufficiency. The specific agents and doses are as follows depending on age, weight and renal function:
1. Patient age 18-65 and weight > 50 kg and creatinine clearance > 60 mg/dl and no TBI or spinal injury cord injury: Enoxaparin 40 mg SQ q 12hrs
2. Patient age > 65 or weight < 50 kg or creatinine clearance 30-60 mg/dl or with, TBI, or spinal cord injury or pregnant: Enoxaparin 30 mg SQ q 12hrs
3. Patients with creatinine clearance < 30 mg/dl: Heparin 5000 mg SQ q 8hrs.

C. When to initiate pharmacologic VTE prophylaxis:
Pharmacologic VTE prophylaxis should be initiated as soon as possible and for most trauma patients, within 24 hours of admission with the following considerations/exceptions:

D. Actively bleeding or hemodynamically unstable patients or those with a coagulopathy:
Pharmacologic VTE prophylaxis may begin once the bleeding has been controlled and resuscitation completed and coagulopathy resolved.

E. Patients with Solid Organ Injury:
In the non-operative management of liver, spleen, and renal injuries, pharmacologic VTE prophylaxis may be initiated within 24 hours of Grades I-III injuries and after 24 hours for Grades IV-V injures if there is no evidence of ongoing blood loss.

F. Severe Pelvic Fracture with large pelvic hematoma:
Pharmacologic VTE prophylaxis can begin after 24 hours of injury if there is no evidence of ongoing blood loss.

G. Traumatic Brain Injury:
Pharmacologic VTE prophylaxis should be initiated 24 hours after injury following stable head CT if the head CT injury pattern is low risk, defined as: subdural/epidural hematoma < 8mm, largest single contusion < 20mm, no more than one contusion per lobe, isolated subarachnoid hemorrhage or isolated intraventricular hemorrhage.

If the injury pattern does not meet the above low risk criteria, then it is considered high risk (subdural/epidural >8mm, contusion >20mm, >1 contusion per lobe, post-craniotomy or post-EVD/ICP monitor placement). Pharmacologic VTE prophylaxis can be initiated at 48 hours post-injury (or post-op, whichever is later) if the repeat (or post-op) head CT is stable. If the repeat head CT shows progression, then the pharmacologic agent must be held until the head CT stabilizes. Post-craniotomy/ICP monitor (EVD, parenchymal ICP monitor) patients and those with intracranial drains (subdural, epidural) generally can begin pharmacologic VTE prophylaxis 48 hours after monitor insertion or post-op.

** Please note that initiation of pharmacologic VTE prophylaxis for TBI patients requires consultation and agreement by the Neurosurgery service. **

H. Spinal fractures and spinal cord injuries (SCI):

Patients with spine fractures (other than simple transverse or spinous process fractures) or SCI may be started on pharmacologic VTE prophylaxis once the
Attending Neurosurgeon has deemed that there is no emergent need for surgical decompression or stabilization. If spinal surgery is planned, pharmacologic VTE prophylaxis will be held 12 hours before operation and resumed at 24 hours post-operatively after approval by Neurosurgery team.

** Please note that initiation of pharmacologic VTE prophylaxis for spinal fractures/spinal cord injury patients requires consultation and agreement by the Neurosurgery service. **

I. Interruption (or holding) of pharmacologic VTE prophylaxis:

Continuous, uninterrupted dosing of pharmacologic VTE prophylaxis is the goal for most trauma patients throughout their hospital stay. Missed doses of chemical VTE prophylaxis have been shown to significantly increase the risk of VTE. Pharmacologic VTE prophylaxis should NOT be routinely held for invasive/surgical procedures except for spinal, intracranial and ophthalmologic surgeries.

J. Hip Fracture patients prior to surgery:

Pharmacologic VTE prophylaxis should not be interrupted unless the patient will be undergoing spinal anesthesia. If the patient is to have spinal anesthesia, then the pharmacologic VTE prophylaxis should be held 12 hours prior to the spinal anesthesia.

K. Epidural Catheter for pain management:

Another exception for holding a dose of pharmacologic VTE prophylaxis is for the removal or placement of an epidural catheter placed for pain control purposes. The dose should be held for 12 hours prior to placement or removal of an epidural catheter.

L. Neurosurgical drains:

The dose of pharmacologic VTE prophylaxis should be held for the placement or removal of an epidural/subdural or spinal drain. In those cases, the dose should be held for 6-12 hours prior to the placement or removal of the epidural/subdural or spinal catheter (if possible) to mitigate risk of hemorrhage.

M. EVD/ICP monitor:

Pharmacologic VTE prophylaxis should be held 6-12 hours prior to EVD/ICP monitor placement (if possible) to mitigate risk of hemorrhage, but does not need to be held prior to EVD/ICP monitor removal.

N. Continued contraindication to pharmacologic VTE prophylaxis:

Some patients continue to have a contraindication to VTE prophylaxis such as continued bleeding or multiple neurosurgical procedures. If a patient cannot be started or maintained on regular pharmacologic VTE prophylaxis, then a surveillance venous duplex of the lower extremities should be obtained every 7 days while not on pharmacologic VTE prophylaxis.

O. Dose adjustment of enoxaparin:

Consider monitoring anti-Xa levels to adjust the dose of enoxaparin. Peak level target of 0.2-0.4 IU/ml or trough level target of 0.1-0.2 IU/ml. This should especially be considered for pregnant patients because of the increased renal clearance and weight changes and progressive hypercoagulability associated with pregnancy. Pregnant patients should be started on enoxaparin 30 mg q 12hrs and then the dose titrated by anti-Xa levels.

P. Inferior Vena Cava (IVC) filters:

Prophylactic IVC filter placement is not indicated. IVC filter placement should be considered in the setting of a pulmonary embolus or a proximal DVT and the patient has a strong contraindication to therapeutic anticoagulation.

Q. Post Discharge Pharmacologic VTE prophylaxis:

Patients with major trauma continue to be at high-risk of VTE even after discharge. If the patient is discharged to a rehab or sub-acute rehab facility, then they should continue pharmacologic VTE prophylaxis at the facility. If the patient is being discharged to home, then pharmacologic VTE prophylaxis should be continued for select high risk patients (orthopedic injuries, s/p laparotomy or thoracotomy) for 4 weeks from the date of initial admission. It should also be considered for non-ambulatory, para/quadriplegic TBI/SCI patients if approved by the neurosurgery attending for that patient. For home therapy, the enoxaparin dose should not exceed 30mg q 12 hrs. For patients that are s/p major orthopedic surgery, the duration of therapy should be up to 35 days post- surgery date. Aspirin, 81 mg PO daily can also be considered if enoxaparin post discharge is not practical or feasible.

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24. Rhabdomyolysis Prevention and Treatment

Rhabdomyolysis is a syndrome characterized by muscle necrosis and the release of intracellular muscle constituents into the circulation. Creatine kinase (CK) levels are typically markedly elevated, and muscle pain and myoglobinuria may be present. The severity of illness ranges from asymptomatic elevations in serum muscle enzymes to life-threatening disease associated with extreme enzyme elevations, electrolyte imbalances, and acute kidney injury.

A. DIAGNOSIS

Rhabdomyolysis can be seen in trauma patients, especially those with significant blunt or crush injury or if there is prolonged immobilization at the time of the trauma (found down for many hours, prolonged extrication).

Trauma patients with a blunt mechanism of injury or were down for a prolonged time interval should have admission serum CK levels sent as well as repeat CK with 12 to 16 hours. This is in addition to the regular laboratory panels which include BUN and creatinine levels.

The hallmark of rhabdomyolysis is an elevation in CK levels. Serum CK levels are usually at least five times the upper limit of normal, but range from approximately 1500 to over 100,000 international units/L. The serum CK begins to rise within 2 to 12 hours following the onset of the muscle injury and reaches its maximum within 24 to 72 hours. A decline is usually seen within three to five days of cessation of muscle injury. CK has a serum half-life of about 1.5 days and declines at a relatively constant rate of about 40 to 50 percent of the previous day's value. In patients whose CK does not decline as expected, continued muscle injury or the development of a compartment syndrome may be present. No absolute cut-off value for CK elevation can be defined, and the CK should be considered in the clinical context of the history and examination findings.

Myoglobin, a heme-containing respiratory protein, is released from damaged muscle in parallel with CK. Myoglobin is rapidly excreted in the urine, often resulting in the production of red to brown urine. It appears in the urine when its plasma concentration exceeds 1.5 mg/dL. Visible changes in the urine only occur once urine

levels exceed from about 100 to 300 mg/dL, although it can be detected by the urine dipstick at concentrations of only 0.5 to 1 mg/dL. Myoglobin has a half-life of only two to three hours, much shorter than that of CK. Because of its rapid excretion and metabolism to bilirubin, serum levels may return to normal within six to eight hours. Thus, it is not unusual for CK levels to remain elevated in the absence of myoglobinuria.

In rhabdomyolysis, myoglobin appears in the plasma before CK elevation occurs and disappears while CK is still elevated or rising. Therefore, there is no CK threshold for when myoglobin appears. Routine urine testing for myoglobin by urine dipstick evaluation may be negative in up to half of patients with rhabdomyolysis.

Other manifestations of rhabdomyolysis include fluid and electrolyte abnormalities. Hypovolemia results from "third-spacing" due to the influx of extracellular fluid into injured muscles and increases the risk of acute kidney injury. The influx of fluid into the muscles may also lead to compartment syndrome. In addition, the patient may also have hyperkalemia, hyperphosphatemia, hypocalcemia, hyperuricemia, and metabolic acidosis.

Acute kidney injury (AKI) is a common complication of rhabdomyolysis. The reported frequency of AKI ranges from 15 to over 50 percent. The risk of AKI is lower in patients with CK levels at admission less than 15 to 20,000 units/L; risk factors for AKI in patients with lower values include dehydration, sepsis, and acidosis. Volume depletion resulting in renal ischemia, tubular obstruction due to pigment casts, and tubular injury from free chelated iron all contribute to the development of renal dysfunction.

B. TREATMENT

The general goals for prevention of AKI in all patients at risk for rhabdomyolysis induced AKI are twofold:
1. Correction of volume depletion if present.
2. Prevention of intratubular cast formation.

Volume administration — The prevention of AKI requires early and aggressive fluid resuscitation. The goals of volume repletion are to maintain or enhance renal perfusion, thereby minimizing ischemic injury, and to increase the urine flow rate, which will limit intratubular cast formation by diluting the concentration of heme pigment within the tubular fluid, wash out partially obstructing intratubular casts, and increase urinary potassium excretion.

For patients who are at risk for heme-associated AKI due to rhabdomyolysis from any cause, initial fluid resuscitation with isotonic saline at a rate of 1 to 2 L/hour is suggested.

The plasma CK concentration correlates with the severity of muscle injury, and concentrations >5000 unit/L identify patients who are at risk for the development of AKI. However, it may be difficult to identify patients who are at high risk for AKI based upon the initial plasma CK value since the CK level may still be rising from ongoing muscle injury. Thus, sequential CK measurements are critical in tailoring therapeutic interventions.

All patients should be initially treated with vigorous fluid repletion until it is clear from sequential laboratory values that the plasma CK level is stable and not increasing. Patients who have a stable plasma CK level <5000 unit/L do not require intravenous fluid, since studies have shown that the risk of AKI is low among such patients. Fluid repletion should be continued until plasma CK levels decrease to <5000 unit/L and continue to fall. Studies have shown that there is a low likelihood of AKI when peak CK levels are under 5000 to 10,000 unit/L.

Bicarbonate — Limited data suggest that alkalization of urine may benefit patients with severe rhabdomyolysis. Patients for whom bicarbonate therapy is to be administered should be monitored in the STICU or step-down unit. A nephrology consultation should also be obtained. The administration of bicarbonate may cause severe alkalosis among anuric patients. Bicarbonate infusion should be considered for patients who have severe rhabdomyolysis, such as those with a serum CK above 5000 unit/L or clinical evidence of severe muscle injury (e.g., crush injury) and a rising serum CK, regardless of the initial value. In such patients, bicarbonate may be given, providing the following conditions are met:

1. Hypocalcemia is not present
2. Arterial pH is less than 7.5
3. Serum bicarbonate is less 30 mEq/L

Bicarbonate infusion 130 mEq/L of sodium bicarbonate (150 mL [3 amps] of 8.4 percent sodium bicarbonate mixed with 1 L of 5 percent dextrose or water) via an intravenous line separate from that used for the isotonic saline infusion. The initial rate of infusion is 200 mL/hour; the rate is adjusted to achieve a urine pH of >6.5.

If bicarbonate is given, the arterial pH and serum calcium should be monitored every two hours during the infusion. The bicarbonate infusion should be discontinued if the urine pH does not rise above 6.5 after three to four hours, if the patient develops symptomatic hypocalcemia, if the arterial pH exceeds 7.5, or if the serum bicarbonate exceeds 30 mEq/L. If the bicarbonate solution is discontinued, volume repletion should be continued with isotonic saline.

If a diuresis is established, bicarbonate therapy can be continued until plasma CK decreases to less than 5000 unit/L or symptomatic fluid overload develops.

** Mannitol and loop diuretics are NOT recommended. **

25. Anticoagulation Rapid Reversal

Warfarin (Coumadin) is one of the most prescribed medications in the United States. Reversal of anticoagulation in patients with warfarin-associated intracranial hemorrhage (ICH) is a medical emergency, as anticoagulation is associated with hematoma growth, neurologic deterioration, and increased risk of death and major disability. In addition, an increasing number of patients are now being treated with the antiplatelet agent clopidogrel (Plavix), or one of the direct oral anticoagulants (DOACs), dabigatran (Pradaxa), rivaroxaban (Xarelto) or apixaban (Eliquis). Given the increasing numbers of patients on these medications, it is imperative to identify patients on anticoagulants as quickly after presentation as possible so that diagnostic imaging and prompt reversal of the anticoagulant may be implemented, if indicated.

All trauma patients presenting to the Emergency Department shall be queried about their use of anticoagulants and antiplatelet drugs in their initial triage, immediately after the primary survey, or as soon as reasonably possible. In instances where the patient cannot provide this information efforts should be made to determine this information from other sources (family, pharmacy, primary physician, electronic medical record). In instances where there is no ability to determine the patient's risk for anticoagulation clinical suspicion should guide the expediency of the workup. A STAT PT and INR should be sent.

High clinical suspicion should be present in any patient found to be on an anticoagulant or antiplatelet therapy (warfarin, clopidogrel, dabigatran, rivaroxaban or apixaban) who presents with a blunt trauma mechanism including a single level fall (i.e. fall from standing).

A. Reversal Protocol for Specific Agents:

The urgency of reversal should be guided by the specific bleeding risk and the degree of anticoagulation. The degree of warfarin anticoagulation can be determined by the INR. The degree of anticoagulation of the DOACs and clopidogrel cannot be readily determined and treatment will be guided empirically and the risk of ongoing bleeding. This applies to all types of traumatic bleeding but intracranial hemorrhage (IHC) will usually require more urgent correction of the anticoagulation.

B. Warfarin (Coumadin):
1. Vitamin K administration (intravenous): Administer 10 mg Vitamin K by slow intravenous infusion, no faster than 1 mg/min; to minimize anaphylactic risk. Vitamin K administration can be repeated every 12 hours for persistent INR elevation.
2.High doses (5 to 10 mg) of intravenous vitamin K can fully reverse warfarin-induced anticoagulation. While vitamin K achieves a sustained reversal, the effect takes approximately 12 to 24 hours, during which time the ICH may continue to enlarge. Vitamin K is unique among the available reversal agents in achieving a sustained reversal of warfarin-induced anticoagulation, and therefore is almost always administered as part of a reversal regimen, because of the prolonged half-life of warfarin. However, because its effect is delayed, other more rapidly-acting agents are typically co-administered. While oral and intravenous routes of administration appear equally effective in correcting the INR, intravenous vitamin K administration is preferred because it results in more rapid correction of the INR and because oral administration can be problematic in the setting of acute ICH. To reduce the risk of anaphylaxis, slow infusion of vitamin K, no faster than 1 mg/min, is recommended. High doses of vitamin K also result in a variable period of refractoriness to re-institution of warfarin, a factor that needs to be kept in mind if resumption of warfarin therapy is contemplated.

C. Four-factor Prothrombin complex concentrate (PCC) (Kcentra) administration:
Dosage based on INR and body weight. PCC (four factor) is to be ordered in EPIC under the blood products category (blood derivatives). PCC dosage should be calculated using the Kcentra dosage calculator link in EPIC. The dose in units is based on the factor IX content in the product and should be rounded to the nearest available vial size.
1. For INR 2 to < 4: 25 units/kg and not to exceed 2500 units.
2. For INR 4-6: 35 units/kg and not to exceed 3500 units.
3. For INR >6: 50 units/kg and not exceed 5000 units.

D. Treatment goals and monitoring:
The goal of therapy should be to reverse the effects of the anticoagulation in as timely a manner as possible and to maintain such correction for a minimum of 72 hours. Continue administering reversal agents until the INR is in the normal range (<1.4). The INR should be checked 30 minutes after PCC infusion to be certain that it has returned to normal; if not, infusion of additional PCC should be considered. Serial INR determinations should be performed over the next 24 hours (e.g., INR checked every six hours for the first 24 hours), and then checked daily for a few days to ensure that the INR correction is maintained.

E. Dabigatran (Pradaxa):
Administer idarucizumab (Praxbind): Infuse 5g IV (2 consecutive 2.5g vials) intravenously as a bolus injection

F. Apixaban (Eliquis) or Rivuroxaban (Xarelto):
There is no specific reversal agent or pharmocologic antidote for these agents. In addition, apixaban and Rivuroxaban are highly protein-bound and not readily removed by hemodialysis. In the event of imminent risk of death, four factor PCC (Kcentra) may be administered but its utility has not been proven for these agents. The use of PCC carries a risk of prothrombotic events so it should be used cautiously and only in extreme clinical situations. In addition, for non-intracranial hemorrhage, the administration of Tranexamic acid (TXA) 1,000 mg IV over 10 minutes, may also be considered. TXA administration in the setting of intracranial hemorrhage should be avoided. Cerebral infarction may occur in the presence of subarachnoid hemorrhage.

G. Anti-platelet agents: Aspirin and clopidogrel (Plavix):
These agents irreversibly bind platelets. There are no specific reversal agents. In the setting of major or life-threatening bleeding in patients on these agents, platelet transfusion may be considered. In addition, desmopressin (DDAVP), a synthetic analog of vasopressin, may be used. Dosage: 0.3 mcg/kg IV over 15-30 minutes.

26. Post-Traumatic Stress Disorder (PTSD) and Depression Screening

Studies have shown that 10-42% of trauma patients will experience symptoms of Post-Traumatic Stress Disorder (PTSD) within one year of injury. Other studies have shown links between traumatic injury and PTSD associated with depression or depression alone. Untreated, PTSD and depression can have severely detrimental impacts on the patient's well-being, quality of life, and ability to return to work. Early screening and referral for treatment for PTSD and depression has the potential to greatly benefit the patient and prevent the detrimental effects of these conditions by improving symptoms and ultimately the outcomes for these patients.

Elmhurst Hospital's Trauma Service provides for screening for PTSD and depression of its trauma patients. All admitted trauma patients are interviewed by the social worker and this includes an assessment for depression. In addition, select trauma patient will be screened specifically for PTSD and depression using the Injured Trauma Survivor Screen (ITSS). This is a 9 questions tool that screens for both depression and PTSD.

A. The PTSD screen will be applied to the following trauma patients:

1. Trauma patients on the surgical floor (B3 or B3 step down unit) with the following mechanisms of injury:
    i. Violence (assault, stab wounds, gunshot wounds).
    ii. Pedestrian or bicyclist struck by a motor vehicle.
    iii. Patients injured in a motor vehicle collision (MVC).
    iv. Falls from height.
2. Exclusions criteria (the screen is not to be applied to these patients):
    i. Patients in the STICU
    ii. Self-inflicted injuries (those patients will require a formal psychiatry consultation)
    iii. Moderate to severe TBI (those patients will require neuropsychology evaluation for TBI)
    iv. Falls from standing height.

The time frame for initiating the ITSS will be on or after day 4 of hospitalization. For those not screened prior to discharge, the screen can also be performed in the trauma clinic.
The PTSD / depression screening tool to be used is the Injured Trauma Survivor Screen (ITSS) for PTSD and Depression. This screening tool consists of 9 questions that are to be answered by the patient as either yes or no. A yes answer is scored as 1 and a no answer is scored as 0.

The first question is for both PTSD and depression. Questions 2-5 are for PTSD and questions 6-9 are for depression. A score of 2 is considered a positive screen and an indication for referral to psychiatric services. If the scores in the questions 1-5 equal 2 or greater, then the patient is at risk for PTSD. If the scores in questions 1, and 6-9 add up to 2 or greater, then the patient is at risk of depression.

B. The ITSS tool has been uploaded as a template in EPIC and is available to the inpatient and outpatient trauma providers. The 9 questions are:

1. Did you think you were going to die?

2. Do you think this was done to you intentionally?

3. Have you felt more restless, tense, or jumpy than usual?

4. Have you found yourself unable to stop worrying?

5. Do you find yourself thinking that the world is unsafe and that people are not to be trusted?

6. Have you ever taken medication for, or been given a mental health diagnosis?

7. Has there ever been a time in your life you have been bothered by feeling down or hopeless or lost all interest in things you usually enjoyed for more than 2 weeks?

8. Have you felt emotionally detached from your loved ones?

9. Do you find yourself crying and are unsure why?

27. GERIATRIC TRAUMA MANAGEMENT

Geriatric trauma patients are at increased risk for adverse outcomes because they often have decreased physiologic reserve, can have significant pre-existing co-morbidities and are often on medications that have an effect on vital signs as well as response to injury. Therefore, a geriatric specific protocol is necessary in order to optimize the management of this patient population.

A. DEFINED POPULATION

A geriatric trauma patient will be defined as an injured patient who is 65 years of age or older.

B. TRAUMA TRIAGE CRITERIA

The initial assessment and primary survey is the same for geriatric trauma patients as it is for all trauma patients. Geriatric trauma patients that meet **RED** trauma activation criteria will be activated as **RED** trauma patients.

In addition, because of the greater prevalence of hypertension in the elderly, what would be a normal blood pressure in the non-elderly may in fact be hypotension in the elderly. Therefore, for a geriatric patient, the blood pressure value under which a patient is considered hypotensive and therefore in need of a **RED** trauma activation is a systolic blood pressure of < 110 mmHg.

Geriatric trauma patients that meet **YELLOW** activation criteria will be activated one tier higher (**RED** trauma) for the following conditions:
1. Blast or explosion (**RED**)
2. Fall greater than 20 feet (**RED**)
3. Femoral shaft fracture should be activated as a **YELLOW** trauma

In addition, those patients 65 years or older who meet the following criteria will be activated as a **Green** Trauma (unless they meet criteria for **RED** or **YELLOW**):
1. Fall from a standing height with loss of consciousness or any traumatic brain injury seen on CT scan.
2. Pedestrian struck at low speed (<20mph)
3. Two or more rib fractures
4. Humeral shaft fracture
5. Hemothorax Pneumothorax
6. Pulmonary contusion
7. Pelvic fracture
8. Open fracture proximal to wrist or ankle
9. More than one body region injured.
10. Hip fractures

C. INITIAL IMAGING AND LABORATORY TESTS

Imaging should include all CT scans needed to rule out injury in appropriate areas at risk. Occult injuries are common in the elderly and radiation exposure is of minimal risk. Therefore, imaging should include liberal use of CT scanning for blunt injury.
For patients presenting with a cervical collar, a CT scan of the cervical spine is required prior to cervical collar removal (i.e. the cervical spine cannot be “cleared” clinically in the geriatric population).

*** *All geriatric patients must have the following labs:**

1. CBC
2. Electrolytes and renal panel
3. PT/PTT/ and INR Blood alcohol level
4. Hypoperfusion is often underappreciated in the elderly. All geriatric trauma patients should have either an arterial or venous blood gas measurement to evaluate the lactate and base deficit.
5. All geriatric patients should have a baseline electrocardiogram.
6. All geriatric patients after blunt trauma should have at a minimum a chest X-ray.

D. ADMISSION UNIT

Any geriatric patient with physiologic compromise (relative hypotension, tachycardia, tachypnea/dyspnea, elevated base deficit or lactate), significant injury, and high-risk mechanism of injury (rollover, ejection, high speed), uncertain cardiovascular status, or chronic cardiovascular or renal disease should undergo close monitoring in either the STICU or the step-down unit, the actual unit to be determined on a case by case basis. An elevated base deficit (>6) or lactate (> 2.5) should prompt STICU or step-down unit admission.

**** Other criteria for STICU or step-down unit admission:**

1. Three or more rib fractures
2. Traumatic brain injury
3. Pneumothorax or hemothorax or pulmonary contusion

E. GERIATRIC SERVICE CONSULTATION

A comprehensive geriatric assessment by a geriatrician can reduce long term morbidity and mortality. The identification of the geriatric trauma patient that would benefit from a specialized geriatric medicine consultation is crucial. Patients should be screened using the following questions derived from the Identification of Seniors at Risk screening tool (ISAR).

Two or more affirmative answers to the following questions will identify patients that should have an inpatient geriatric medicine consultation:

1. Before you were injured, did you need someone to help you on a regular basis?
2. Since the injury, have you needed help more than usual to help take care of yourself?
3. Have you been hospitalized for one or more nights in the past 6 months?
4. In general, do you have problems seeing well?
5. In general, do you have serious problems with your memory?
6. Do you take more than 3 different medications every day?

E. MEDICATION MANAGEMENT

A complete medication list should be obtained as soon as possible after admission, including prescription medication, over the counter medications, and herbal remedies and nutritional supplements.
Communication with the patient's primary care physician must be done in a timely fashion to obtain as complete a medication and disease history as possible.
Follow the Beers Criteria for decision making regarding medication management. Print outs of the Beers Criteria will be posted in Trauma inpatient care areas including the STICU, Step Down unit, and B3 wards. Pocket cards of the Beers criteria will also be distributed to the Trauma team members.
Continue medications with withdrawal potential, including SSRI's, TCA's, antidepressants, benzodiazepines, anti-psychotics, MAOI's, beta blockers, clonidine, and steroids. Continue beta blockers or start if indicated.
Continue statins when appropriate. Adjust dosages for renal function based upon GFR.

F. OPTIMIZING PULMONARY STATUS / PREVENTION OF PULMONARY COMPLICATIONS

Geriatric trauma patients are at increased risk for pulmonary complications such as aspiration, atelectasis, and pneumonia. It is vital to implement the following strategies to decrease pulmonary-related complications.

1. Aspiration precautions:
Speech and swallow pathology service evaluation in select patients with suspicion for dysphagia or concern for safety or efficiency of swallowing or change in swallow function suspected:
   i. Coughing or choking with swallowing
   ii. Difficulty initiating swallowing
   iii. Sensation of food sticking in throat
   iv. Drooling
   v. Change in dietary habits
   vi. Change in voice or speech
   vii. Nasal regurgitation
   viii. Oral or pharyngeal regurgitation
   ix. History of aspiration pneumonia

2. Head of bed elevation at all times with repositioning if not contraindicated by injury (e.g. unstable spinal fracture).
3. Getting out of bed for all meals when possible
4. Sitting upright while eating and for 1 hour after completing
5. Use of incentive spirometer and chest physical therapy

G. DELIRIUM ASSESSMENT and PREVENTION

Delirium is one of the most common complications affecting the geriatric patient. Delirium is associated with worse outcomes, longer lengths of stay, functional decline, higher rates of institutionalization, higher mortality, and higher costs and resource utilization. Up to 30 to 40 percent of cases of delirium are preventable. Consequently, the best treatment for delirium is prevention.

DELIRIUM PREVENTION STRATEGIES:

   i. Education targeted to health care professionals about delirium
   ii. Multicomponent, multidisciplinary nonpharmacological interventions which may include:
   iii. Daily physical activity
   iv. Cognitive reorientation
   v. Bedside presence of a family member whenever possible
   vi. Sleep enhancement (for example, nonpharmacological sleep protocol and sleep hygiene)
   vii. Early mobility and/or physical rehabilitation
   viii. Adaptations for visual and hearing impairment

ix. Nutrition and fluid repletion

x. Pain management
xi. Appropriate medication usage
xii. Adequate oxygenation
xiii. Prevention of constipation

Minimization of patient tethers whenever possible (for example, Foley catheters, periodic removal of sequential compression devices, EKG cords). Patients at risk for delirium should be screened with the Confusion Assessment Method -short form (CAM-short form) in order to initiate optimal delirium treatment as early as possible.

Ask these questions:
1. Is there evidence of an acute change in mental status from baseline, and if so, does it tend to come and go or increase and decrease in severity?
2. Does the patient have difficulty focusing attention?
3. Is the patient's thinking disorganized or incoherent?
4. What is the patient's level of consciousness? (alert, vigilant, lethargic, stupor, or coma)

If the answer is yes to 1 and 2 or yes to 3 or anything other than alert to 4, then diagnosis of delirium is suggested.

The health care team should evaluate all postoperative patients who develop delirium for possible precipitating conditions. These include:
i. Uncontrolled pain
ii. Hypoxia
iii. Pneumonia
iv. Infection
v. Electrolyte abnormalities
vi. Urinary retention
vii. Fecal impaction
viii. Medications
ix. Hypoglycemia

H. MOBILIZATION

Early out of bed if possible is essential in order to reduce morbidity. Out of bed to chair followed by ambulation is ideal if the injuries permit. Appropriate fall assessment and prevention is required along with an early mobilization strategy. Geriatric trauma patients should have early (within 48 hours of admission) physical therapy consultation if their condition permits. Rehabilitation medicine consultation as needed.

I. DECISION MAKING CAPACITY / GOALS OF CARE

Discuss with family, surrogates and healthcare team and document the following:
1. Patient's priorities and preferences regarding treatment options.
2. Post-injury risks of complications, mortality and temporary/permanent functional decline.
3. Advance directives or living will and how these affect initial care and life-sustaining preferences, including mechanical ventilation, CPR, dialysis, blood transfusion, permanent enteral feeding and transition to comfort care should complications occur.
4. Identify surrogate decision-maker
5. Make liberal use of palliative care consultation service
6. In appropriate setting, present hospice as a positive active treatment
7. Hold family meeting within 72 hours of admission and discuss goals of treatment

J. DISCHARGE

Begin discharge planning immediately post-injury (by 24 hours). This should include assessment of the home environment, social support, and medical equipment needs. Social worker involvement is mandatory for planning a safe discharge. Rehabilitation and physical therapy consultation as needed for optimal discharge disposition.

28. PALLIATIVE CARE IN TRAUMA PATIENTS

The Trauma Service at Elmhurst Hospital recognizes that trauma care has evolved and is not only about preventing mortality. The care of the injured patient must occur in an environment that maintains comfort, dignity, personhood and privacy of the patient.

Communication by the clinician must address the condition, prognosis and treatment of the patient in a fashion that is timely, ongoing, clear, complete and compassionate.

Medical decision making must be patient focused and aligned with the patient's values, care goals, and treatment preferences.

In addition to the patient, care must also be provided to the patient's family. This is accomplished by providing open access and proximity to the patients. maintaining interdisciplinary support for the family, and finally the provision of bereavement support for the families of patients who expire.

Palliative care will be delivered in parallel with life sustaining trauma care, throughout the continuum from injury to recovery. The unit of care is the patient and the family.

** Palliative care begins at patient arrival in the Trauma Resuscitation Bay. **

This is specifically provided by:
1. Pain and symptom management simultaneously with resuscitation and diagnosis
2. Communication of bad news/death to the family with bereavement support.
3. Elderly patient will need assessment for advance directives to ensure that all care is aligned with the patient's wishes. If advance care directives are known, the goals of care conversation can be had early.
4. All trauma patients that are admitted for injuries are by definition seriously ill and are therefore candidates for palliative care assessment and treatment.
5. All patients should have pain and symptom management simultaneously with resuscitation and diagnosis and definitive treatment of traumatic injuries.
6. All patients should be screened for early palliative care.
7. All patients should have any health care proxy or advance directives identified as early as possible.
8. All patients and their families should be provided with emotional and informational support.

	Negative Screen	Category 1 Positive screen	Category 2 Positive screen
Traumatic Injury mortality risk	Non-life threatening injuries	Potentially life threatening injuries	High hospital mortality due to trauma injury
Disability	Non-disabling trauma injuries	Potentially disabling trauma injuries	Permanent disability of functional outcome incompatible with patient's wishes
Previous Functional Status	Healthy, no serious chronic illness	One or more serious illness, frailty, older age	Chronic serious illness, frailty, older age
"Surprise" Question (***Would you be surprised if the patient died within 12 months?)***	Surprise question: YES	Surprise Question: NO	Surprise Question: NO
Examples	Young with: mulitple fractures, mild TBI, GSW abdomen, pneumothorax	**Young with:** Spinal cord injury; moderate TBI; amputation; any trauma plus shock **Old/chronically ill with:** Mild TBI; multiple fractures; chest trauma; low spinal cord injury	**Young with:** severe TBI; high spinal cord injury; major hemorrhage; multiple amputation **Old,Frail or end organ failure with:** mild TBI; rib fractures; any spinal cord injury; any injury requiring surgery

*All trauma patients should be screened for early palliative care.

If patient screens positive as Category 1, this means that they have a potential life expectancy < 1 year or have severe functional decline.

The following must be implemented within 72 hours of admission:

1. Advance Care Plan
2. Goals of care conversation/Family meeting
3. Code status discussion
4. Pain and symptom assessment and treatment
5. Support for family
6. Consider palliative care consultation

If patient screens positive as Category 2, then this means that the patient has a high probability of dying or the expected outcome is unacceptable to the patient. The following must be implemented within 72 hours of admission:

1. Palliative care consultation is mandatory
2. Comfort measures
3. Focused Goals of Care Conversation
4. DNR, Withdrawal of life support protocols
5. Pain and symptom management are a PRIORITY
6. Bereavement and spiritual support of family
7. Consideration of transitions in care, hospice, organ donation.

29. NEUROTRAUMA DIVERSION PROTOCOL

A. Purpose:
To define the process for implementation of a neurotrauma diversion plan when the neurosurgeon on call becomes encumbered.

B. Policy:
If the on-call Neurosurgeon Attending becomes encumbered and additional neurosurgical resources are required, the backup Neurosurgeon will be notified. If the demand for neurosurgical services is extreme, additional Neurosurgeons from the on-call list will be notified. If the Neurosurgery faculty are overwhelmed, the Trauma Surgeons are deemed capable and able to provide the initial evaluation and stabilization of the neurotrauma patient by the Director of Neurosurgery at Elmhurst Hospital Center. In the event that back-up resources have been exhausted, the Trauma Attending will arrange for transfer of patients requiring neurotrauma care to Bellevue Hospital Center for adult (age 15 years and older) patients and Northwell Health's Cohen's Children's Medical Center for pediatric (age less than 15 years) patients.

C. Guideline:
The on-call Neurosurgeon Attending will notify the Trauma Attending if the situation arises where the service lacks the capability to accept additional new, severe neurotrauma patients. This notification will include an estimate of the duration of disrupted/encumbered emergency neurosurgical availability. The Trauma Attending will determine and implement a response strategy appropriate to the circumstances described by the on-call Neurosurgeon Attending. This may include transfer of appropriate adult patients to Bellevue Hospital Center and pediatric patients to Northwell Health's Cohen's Children's Medical Center. When neurosurgical readiness normalizes, the Neurosurgeon Attending will notify the Trauma Attending who will ensure that the Trauma Centers status is updated regarding neurosurgical readiness.

** All instances of this activation and all cases of transfers to another facility will be reviewed by the Trauma PIPS process. **

D. Trauma Surgeon Neurosurgical Evaluation and Stabilization:
In order to provide timely and appropriate care for head or spinal cord injured patients, the Trauma Surgeons may initiate management of these injuries prior to the arrival of the trauma Neurosurgeon. In addition, in the event the trauma Neurosurgeon is encumbered and the patient is to be transferred to Bellevue Hospital Center or Northwell Health's Cohen's Children's Medical Center, the trauma attending will evaluate and manage these patients in lieu of the Neurosurgeon while the patient transfer process is implemented.

The Director of the Department of Neurosurgery at Elmhurst Hospital Center reviews the education and training of the Trauma Surgeon Attendings and deems at his/her discretion the individual provider approved to provide the initial evaluation and stabilization of the neurotrauma patient.

Factors to be considered by the Director of Neurosurgery when considering Trauma Surgeon approval include but are not limited to:
1. Clinical competence in performing neurologic evaluations and initiating treatment for serious neurologic injuries.
2. Current ATLS certification.
3. Utilization of the American College of Surgeons (ACS) TQIP Best Practices in the Management of Traumatic Brain Injury.
4. Utilization of the Brain Trauma Foundation (BTF) Guidelines for the Management of Severe Traumatic Brain Injury (endorsed by the AANS/CNS Joint Section on Neurotrauma and Critical Care).
5. Utilization of the AANS/CNS Joint Guidelines for the Management of Acute Cervical Spine and Spinal Cord Injuries.