


Objectives

At the conclusion of this presentation the participant will be able to:

- Describe the prehospital through Emergency Department (ED) assessment priorities
- Discuss emergent interventions for life threatening injuries
- Explore several evidence based practice changes/controversies in prehospital and ED trauma care



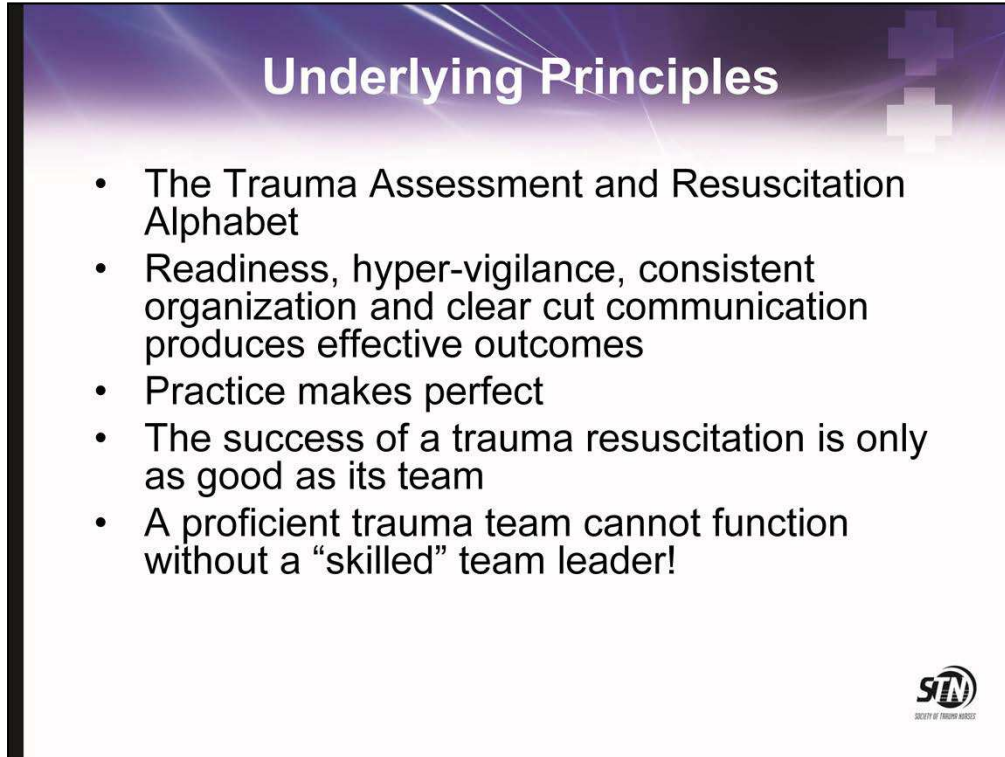
Globally, more than nine people die every minute from injuries or violence—that's 5.8 million people of all ages and economic groups who die each year from both unintentional and violence related injuries! WHO.int , 2010

The three leading causes of injury and violence-related deaths are road traffic incidents (1.3 million), suicides (844,000), and homicides (600,000). WHO.int , 2008

Motor Vehicle Crashes are expected to be the 3rd leading cause of death worldwide by 2020


In addition, millions of people seek medical treatment due to injuries and violence. WHO.int , 2010

Violence can result in serious injuries and even death, but may also lead to other significant mental and physical health consequences such as depression and anxiety, pregnancy complications, and even chronic diseases such as diabetes and heart disease. WHO.int, 2002



Underlying Principles

- The Trauma Assessment and Resuscitation Alphabet
- Readiness, hyper-vigilance, consistent organization and clear cut communication produces effective outcomes
- Practice makes perfect
- The success of a trauma resuscitation is only as good as its team
- A proficient trauma team cannot function without a “skilled” team leader!




Prehospital Emergency Medical Services (EMS) providers are taught Initial Patient Assessment (IPS) and based on findings institute defined protocols.


ED trauma team resuscitation are taught ATLS, ATCN, TNCC, Rural Trauma Team principles and based upon findings institute defined protocols.

However trauma is messy, unplanned, anxiety producing and the effectiveness of the resuscitation depends on the experience of the team members and the leadership/communication skills/ and experience of the team leader.

EMS Assessment



- Primary Assessment
- Vitals/History
- Secondary Survey



The Primary Assessment are the ABC's. Scene Size Up, Airway (while maintaining C-Spine), Breathing and Circulation, then vitals and history, when depending on what their assessment is, they do a focused secondary survey and follow their treatment protocols.

The General Protocol for all EMS providers begins with Scene Size Up. As they are walking toward the patient, they observe for any dangers (man with gun, live wires, angry crowd, weapons, blood, emesis, medications, traffic etc) and they observe the patient. Are they talking, looking around, moving, or do they look "sick" (pale, bleeding, sweaty, clutching chest, laying on ground or slumped in chair or at bottom of stairs). Do they look like they might criteria for C-spine maintenance?

Each state has rules and protocols for Trauma Prehospital Care.

What are the protocols in your state....just google or bing your state EMS rules and protocols.

The following is a sample of a protocol from Montana.

Montana EMS protocols for the A,B,C,Ds

Scene Size Up and Initial Assessment. Done initially on every patient and repeated every 5-10 minutes.

A. Check responsiveness.

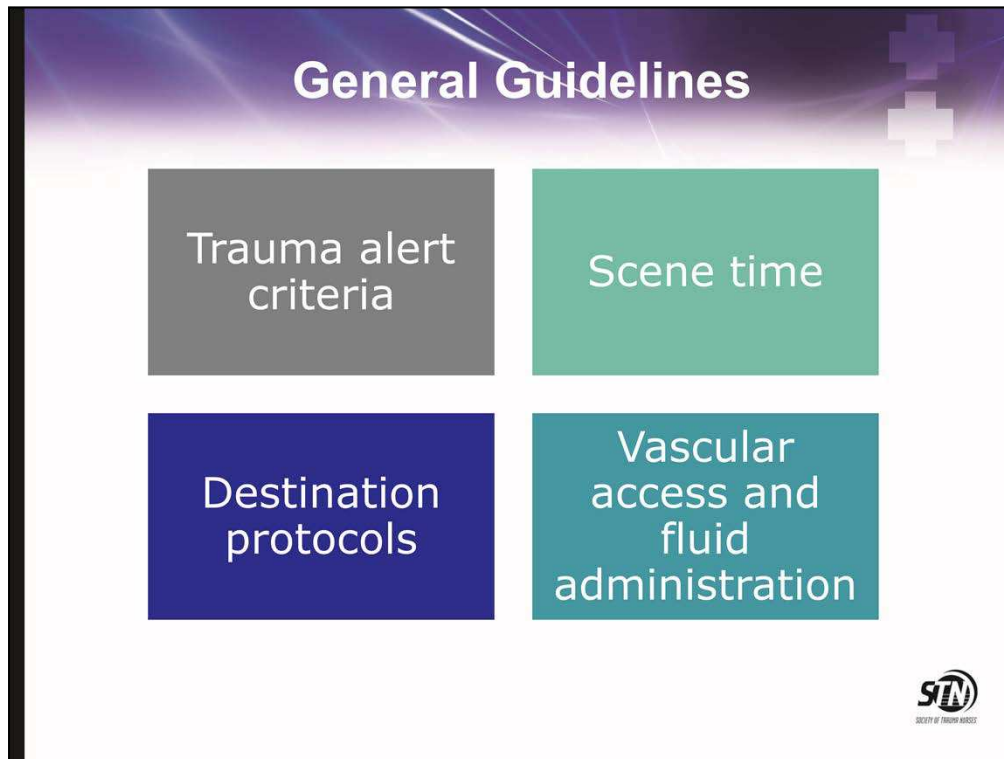
B. AIRWAY - Is it patent? Identify and correct existing or potential obstruction.

C. BREATHING - Present? Estimate rate, quality, and bilateral breath sounds. Consider oxygen administration; establish device/LPM by individual protocol. Identify and correct existing or potential compromising factors.

D. CIRCULATION - Pulse present? Estimate rate, quality, and location of pulse and capillary refill. Control external bleeding, identify and treat for shock.

E. DISABILITY - LOC, AVPU, Glasgow Coma Scale

F. If patient's condition dictates early transport, secondary assessment and additional treatment may be completed en-route to the hospital.



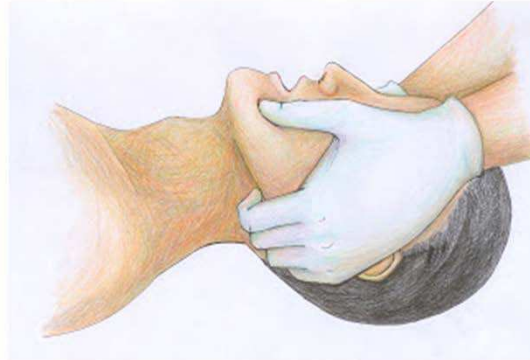
Prehospital protocols frequently also have general guidelines specifically for trauma patients.

Greater Broward County EMS in Florida has some general guidelines along with specific protocols

- The initial assessment of the trauma patient should include determination of trauma alert criteria
- When Trauma Alert criteria are met, scene time should be limited as much as possible (e.g., 10 minutes) and the patient should be expeditiously transported to a trauma center.
- Do not delay transport to establish vascular access or bandage and splint every injury. Priority should be given to airway management and rapid preparation for transport (e.g., full immobilization on a backboard) and control of gross hemorrhage.
- If a vascular access is obtained and hypovolemia is suspected (e.g., the patient shows signs and symptoms of shock, such as systolic BP less than 90 mm Hg), a fluid challenge of 1-2 L (20 mL/kg) may be administered until a systolic BP of 90 mm Hg is maintained. If the patient is still in shock after receiving 2 L of fluid, an additional 1 L of fluid may be administered (maximum total fluid administration = 3 L).
- However, administration of large volumes of IV fluids has been found to be deleterious to the survival of patients with uncontrolled hemorrhage, internally or externally. Studies (NEJM, 1994) have shown that maximal fluid resuscitation may increase the bleeding, thereby preventing the formation of a protective thrombus or dislodging it once the intraluminal pressure exceeds the tamponading pressure of the thrombus. For this reason, consult with the physician should be made prior to the administration of large volumes of IV fluids when the transport time is relatively short (e.g., less than 20 minutes).

Maintain C-spine/Open Airway

- While sizing up the scene the prehospital provider determines if there is a reason to maintain C-spine on their patient.



<http://statraumaassessment.blogspot.com/2007/06/airway-with-c-spine-control.html>



Did they fall?
High speed collision?
Unconscious?
Paresthesias or paralysis?

Suspected Spinal Injuries

(Not Meeting Major Trauma Criteria)

This protocol is for awake and stable adult and pediatric patients NOT meeting the Major Trauma Criteria (Protocol T – 6).

Spine injury should be suspected if blunt mechanism of injury is present and should be treated if one or more of the following criteria is present:

IMMOBILIZATION CRITERIA

1. Altered Mental Status for any reason, including possible intoxication from alcohol or drugs (GCS <15 or AVPU other than A).
2. Complaint of neck and/or spine pain or tenderness.
3. Weakness, tingling, or numbness of the trunk or extremities at any time since the injury.
4. Deformity of the spine not present prior to this incident.
5. Distracting injury or circumstances (i.e. anything producing an unreliable physical exam or history).

High risk mechanisms of injury associated with unstable spinal injuries include, but are not limited to:

- Axial load (i.e. diving injury, spearing tackle)
- High speed motorized vehicle crashes or rollover
- Falls greater than standing height

IF THERE IS ANY DOUBT, SUSPECT THAT A SPINE INJURY IS PRESENT!

Who gets a c-collar?

This is the New York State protocol. Note that if patient meets the major trauma criteria, they automatically get a c-collar.

For the purpose of this protocol, major trauma is present if the patient's physical findings or the mechanism of injury meets any one of the following criteria:

PHYSICAL FINDINGS

1. Glasgow Coma Scale is less than or equal to 13
2. Respiratory rate is less than 10 or more than 29 breaths per minute
3. Pulse rate is less than 50 or more than 120 beats per minute
4. Systolic blood pressure is less than 90 mmHg
5. Penetrating injuries to head, neck, torso or proximal extremities
6. Two or more suspected proximal long bone fractures
7. Suspected flail chest
8. Suspected spinal cord injury or limb paralysis
9. Amputation (except digits)
10. Suspected pelvic fracture
11. Open or depressed skull fracture

MECHANISM OF INJURY

1. Ejection or partial ejection from an automobile
2. Death in the same passenger compartment
3. Extrication time in excess of 20 minutes
4. Vehicle collision resulting in 12 inches of intrusion in to the passenger compartment
5. Motorcycle crash >20 MPH or with separation of rider from motorcycle
6. Falls from greater than 20 feet
7. Vehicle rollover (90 degree vehicle rotation or more) with unrestrained passenger
8. Vehicle vs. pedestrian or bicycle collision above 5 MPH

New York Major Trauma Criteria

- Glasgow Coma Scale is less than or equal to 13
- Respiratory rate is <10 or more than 29
- Pulse rate is < 50 or more than 120
- Systolic blood pressure is < 90 mmHg
- Penetrating injuries to head, neck, torso or proximal extremities
- Two or more suspected proximal long bone fractures
- Suspected flail chest
- Suspected spinal cord injury or limb paralysis
- Amputation (except digits)
- Suspected pelvic fracture
- Open or depressed skull fracture



The above physical findings automatically warrant maintenance of C-Spine and ultimate placement of collar.

Mechanism of Injury

- Ejection or partial ejection from an automobile
- Death in the same passenger compartment
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These also mandate c-spine immobilization.

What are your local protocols?

What if the patient walks in to the Emergency Department triage and states he fell 40 feet off his barn roof? Or was in a rollover crash yesterday? What are your nursing protocols in this situation?

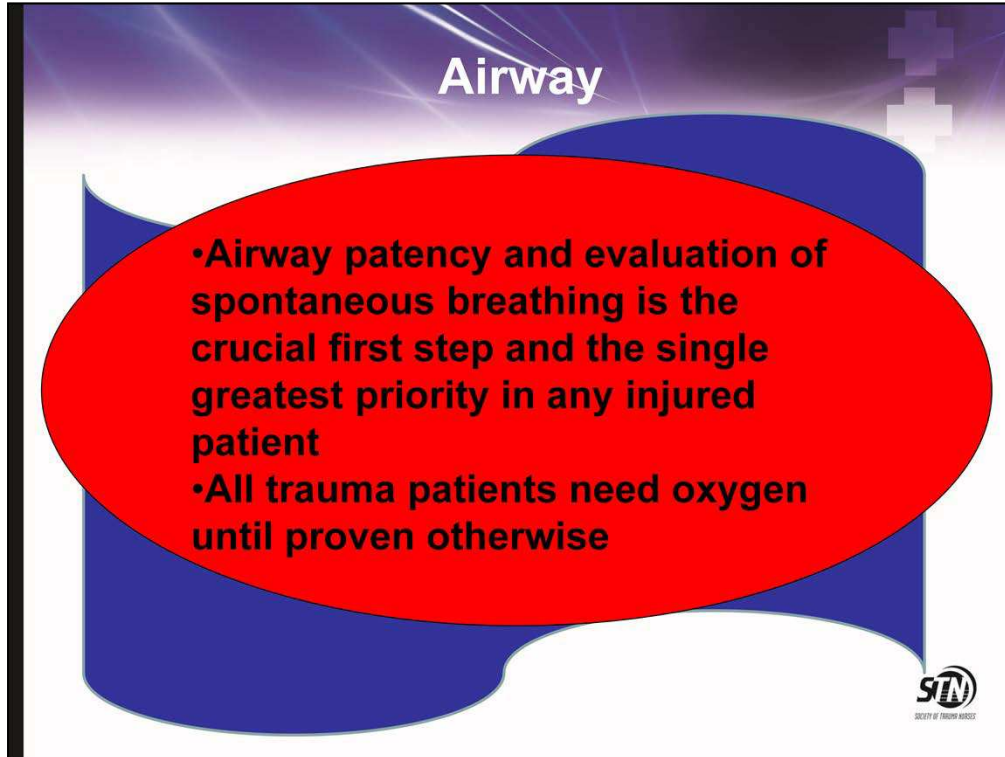


Large neck

No neck

Elderly with curved spine

Drunk and disorderly

A presentation slide titled "Airway" with a blue and purple background. A large red oval contains two bullet points. The STN logo is in the bottom right corner.

Airway

- Airway patency and evaluation of spontaneous breathing is the crucial first step and the single greatest priority in any injured patient
- All trauma patients need oxygen until proven otherwise

STN
SOCIETY OF TRAUMA NURSES



Based upon their treatment protocols, each ambulance carries a proscribed inventory of equipment

If patient needs airway support, all ambulances have the equipment and all level of providers can clear an airway, suction, apply oxygen and use a Bag-Valve-Mask (BVM)

Some more advanced providers are licensed to insert advanced airways; LMA, King and Combitube. And Paramedics are licensed to insert endotracheal tubes (ETT).

The American College of Surgery Committee on Trauma, The American College of Emergency Physicians and the National Association of EMS Physicians collaborated on a document titled Ambulance Equipment in 2005, and revised in April 2009 Endotracheal tubes, and End Tidal CO2 detectors. There are no LMAs, King Airways or Combitubes on this list. However there are a number of state Medical Control Boards or Regional Medical Control that have these airway adjuncts on their lists.

Prehospital Intubation

- Improves outcome

Field intubation has been associated with significant decreases in mortality from 57% to 36% in patients with severe head injury and from 50% to 23% in patients with isolated severe head injury.



mikeledray / Shutterstock.com



Endotracheal intubation was introduced to EMS in the mid 1980s. *Ferbrache, 2011*




There have been a multitude of studies on prehospital intubation with and without Rapid Sequence Intubation (RSI) since then, with variable outcomes.

A common theme throughout the articles is that successful endotracheal intubation and/or RSI is dependent upon

- **a small number of closely monitored paramedics**
- **who are frequently exposed to the procedure.**

Prehospital Intubation

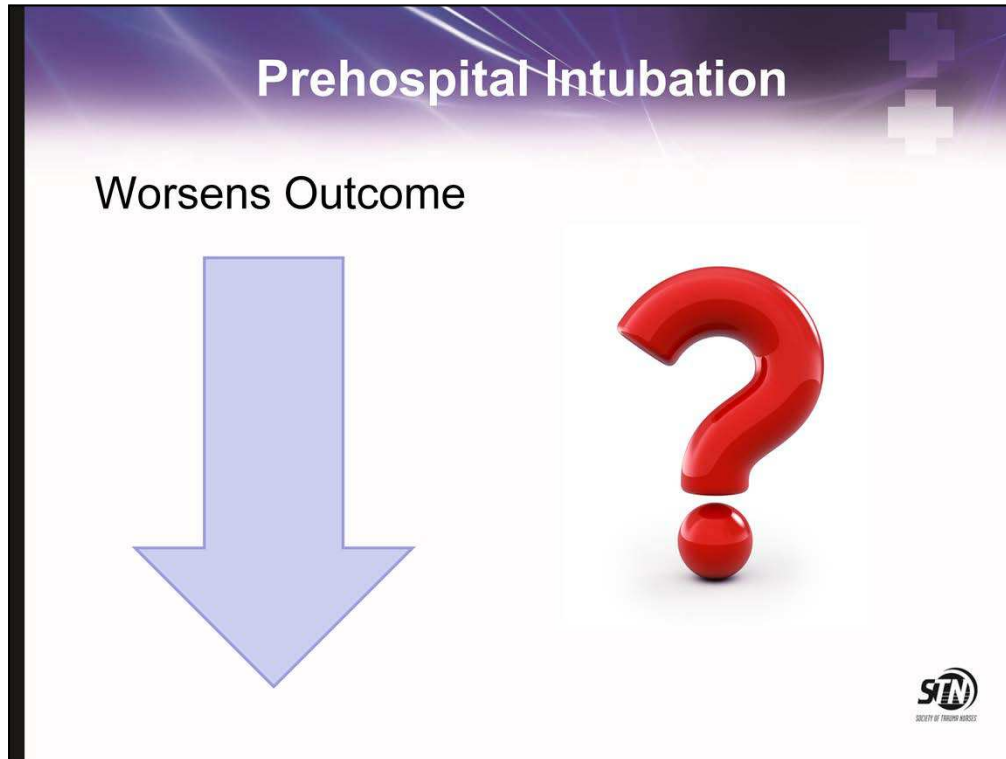
No change in Outcome



Murray, 2000

For patients with severe head injury, prehospital intubation did not demonstrate an improvement in survival.

Arbabi, 2004 Does not change outcome in head injured patients,



Davis, 2005 Prehospital intubation is associated with a decrease in survival among patients with moderate-to-severe TBI.

Davis, 2003 Greater mortality than controls 33% vs.. 24% with RSI in head injury

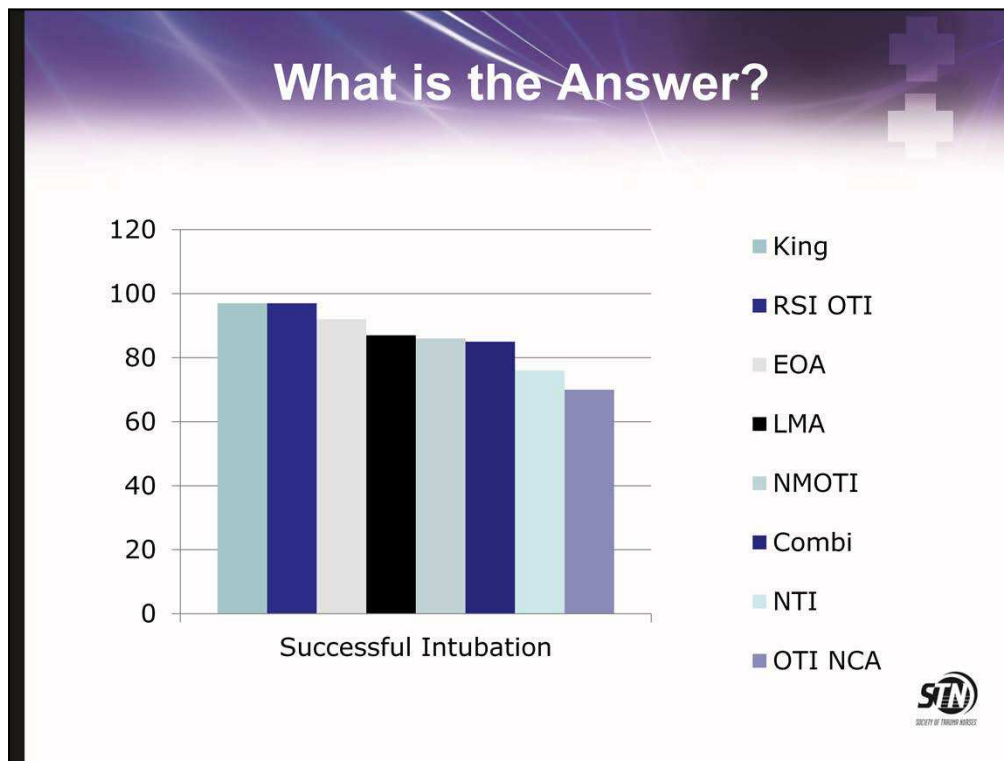
Bochicchio, 2003

Prehospital intubation is associated with a significant increase in morbidity and mortality in trauma patients with traumatic brain injury who are admitted to the hospital without an acutely lethal injury.

Stockinger and McSwain, 2004 Similar or greater mortality than BVM

Bakur, 2011 Pre-hospital endotracheal intubation in isolated, moderate to severe TBI patients is associated with a nearly 5-fold increase in mortality.

Ferbrache, 2011 Once we are able to look past ETI as the “gold standard,” we can see it for what it is: a procedure that has drawbacks when performed by paramedics in the prehospital setting.



There were 57,132 patients in 117 studies with nasal and oral endotracheal intubation.

Overall success rate of

(NTI) Naso-tracheal intubation. 75.9% (65.9%-83.7%).

(NMOTI) Non medicated oral endotracheal intubation was 86.3% (82.6%-89.4%)

(OTI NCA) Oral endotracheal intubation on non-cardiac arrest patients 69.8% (50.9%-83.8%)

(RSI OTI) RSI oral endotracheal intubation was 96.7% (94.7%-98.0%)

For adjunct airways (LMA, Combitube, King, EOA) and Percutaneous airways there were 35 studies, ,patients.

Overall success rate of

(EOA-EGTA) 92.6% (90.1%-94.5%);

Combitube (ETC) 85.4% (77.3%-91.0%);

(LMA) 87.4% (79.0%-92.8%);

(King LT) 96.5% (71.2%-99.7%);

For Percutaneous Airways

Needle cricothyrotomy 65.8%

Surgical cricothyrotomy 90.5%

What do you think?

What is practice in our area?

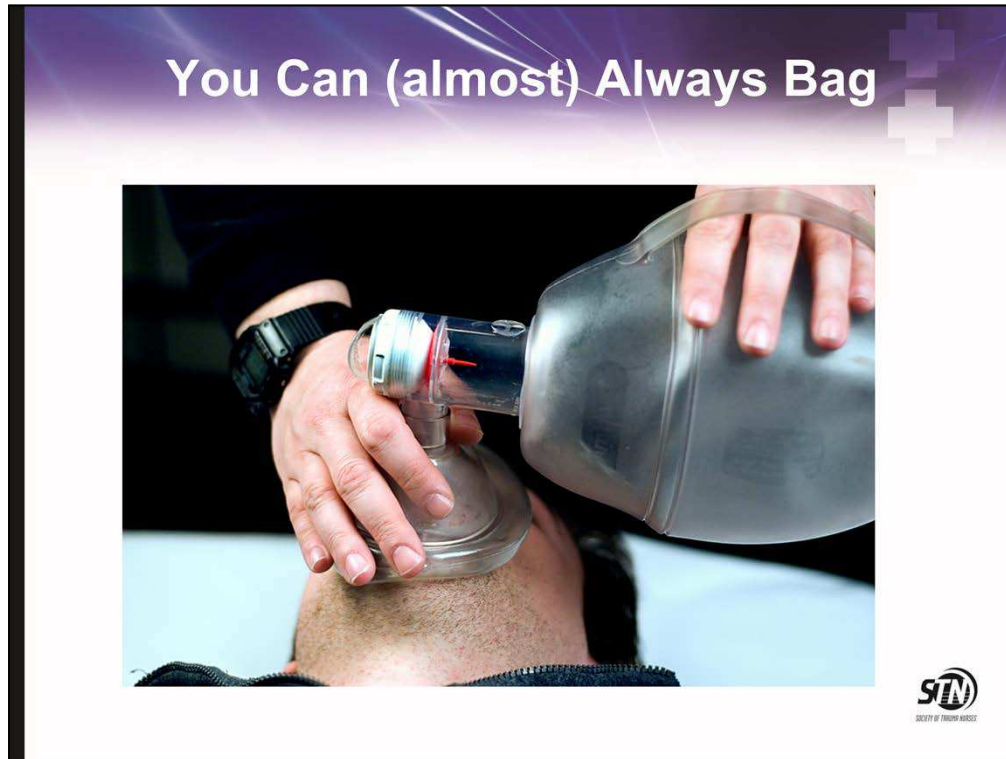
Example of EMS Intubation Protocol



- Consider intubation if GCS is less than 8 or airway cannot be maintained
- If patient is intubated or has an airway such as Combitube, King, LMA $P_{ET}CO_2$ levels should be continually monitored and maintained at 33 – 43 mmHg if available



Overventilation can be detrimental to a patient with an intracranial bleed/swelling.



When can you not ventilate a nonintubated patient with a BVM?

Seizure?

Trauma to face?

Can you OVERventilate? Absolutely, and it can be detrimental to the patient. Always use an ETCO₂ device to monitor exhaled CO₂.

Overventilation of a head injured patient can cause secondary hypoperfusion.

Overventilation of a shocky patient shifts the oxyhemoglobin dissociation curve to the left and hemoglobin holds on tighter to oxygen, making less available to the tissues.



STOP THE BLEEDING!!


Stop the Bleeding

Proven effective techniques of hemorrhage control:


- Direct pressure
- Tourniquets

Unproven techniques:

- Elevation of limb
- Pressure points
- Cold application



Wikihow.com



Idaho EMS protocol for bleeding: <http://www.idph.state.id.us/ems/protocols.asp>

Hemorrhage Control Protocol

Control bleeding with direct pressure.

Large gaping wounds may need application of a bulky sterile gauze dressing and direct pressure by hand

Consider application of tourniquet if unable to control hemorrhage with direct pressure




Part of the routine gear of all combat soldiers.

It can be applied with one hand, making it possible to apply to yourself if necessary.

Indications for Tourniquet

- Hemorrhage from an extremity that cannot be controlled with direct pressure or a pressure bandage.
- Traumatic amputation
- There may be times (tactical, rescue, entrapped patient, multiple patient scene, backwoods environment) when tourniquet application is the best first option.00

There are no contraindications for applying a tourniquet



Ask if anyone has ever applied a tourniquet.

Ask if anyone has ever SEEN a tourniquet.



- The affected extremity should be exposed - a view of the tourniquet should not be obscured
- Mark it with brightly colored cloth, etc.
- The time of tourniquet application should be specifically noted
- Inform each successive provider that a tourniquet is in place
- Time of tourniquet application can also be written directly on the patient




Should all trauma patients have 2 large bore IV sites?

Should all hypotensive trauma patients have IV fluid boluses?

Is there evidence based practice?

Common Protocols

<ul style="list-style-type: none">• Initiate IV/IO (18ga or larger) and hang NS, if approved.• Consider 2nd IV/IO where hypovolemia is suspected (Adult only)• (Adult) If SBP < 100 mmHg or heart rate > 120, initiate a fluid bolus of Normal Saline: 500 ml	<p>“The harm associated with prehospital IV fluid administration is significant for victims of trauma. The routine use of prehospital IV fluid administration for all trauma patients should be discouraged.”</p> <p>Haut ER, 2011</p>
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Many of the prehospital protocols that can be found on the intranet have similar protocols as seen in slide.

In 2008, EAST published a guideline “Prehospital Fluid Resuscitation”. This guideline indicates that there is no Level 1 evidence to indicate *“there is insufficient data to support a level 1 recommendation for placing vascular access in the pre-hospital setting”* and also *“there is insufficient data to support specifically where and through which approach vascular access should be obtained in the pre-hospital setting of trauma.”*

The study by ER Haut et al, published in Annals of Surgery, March 2011 states:

Several mechanisms for these worse outcomes associated with IV fluid administration have been suggested:

- dislodgement of clot formation
- dilution of clotting factors
- and acceleration of hemorrhage caused by elevated blood pressure

The concept of “hypotensive resuscitation” is based upon the idea that patients with uncontrollable sources of bleeding such as solid organ injury (i.e., liver, spleen) or other internal bleeding vessels (i.e., pelvic vessels) may “pop the clot” that has been formed if the blood pressure is raised before sites of hemorrhage have been controlled (i.e., using surgery or angiography). The first prospective study of this strategy showed that “delay of aggressive fluid resuscitation until operative intervention improves the outcome” in hypotensive patients with penetrating torso injuries.^[15] Our current study agrees with these findings with over 3000 hypotensive penetrating trauma patients.



IO devices are on the list of equipment for most if not all advanced life support rigs. All medications, fluids and blood can be administered through an IO.

The above is just an example of a device available for insertion and the most common insertion location.



Splinting has 4 purposes:

- Decrease blood loss
- Relieve pain
- Provide immobility
- Prevent further damage



Traction splints are to immobilize a painful, swollen, deformed mid-thigh injury with no lower leg injury ONLY.

Pelvic Fractures

- Physical exam is unreliable
- DO NOT ROCK or palpate the pelvis in the prehospital arena
- Avoid log rolling as much as possible
- Apply splint if in your area protocols



www.expeditionmedicine.co.uk/

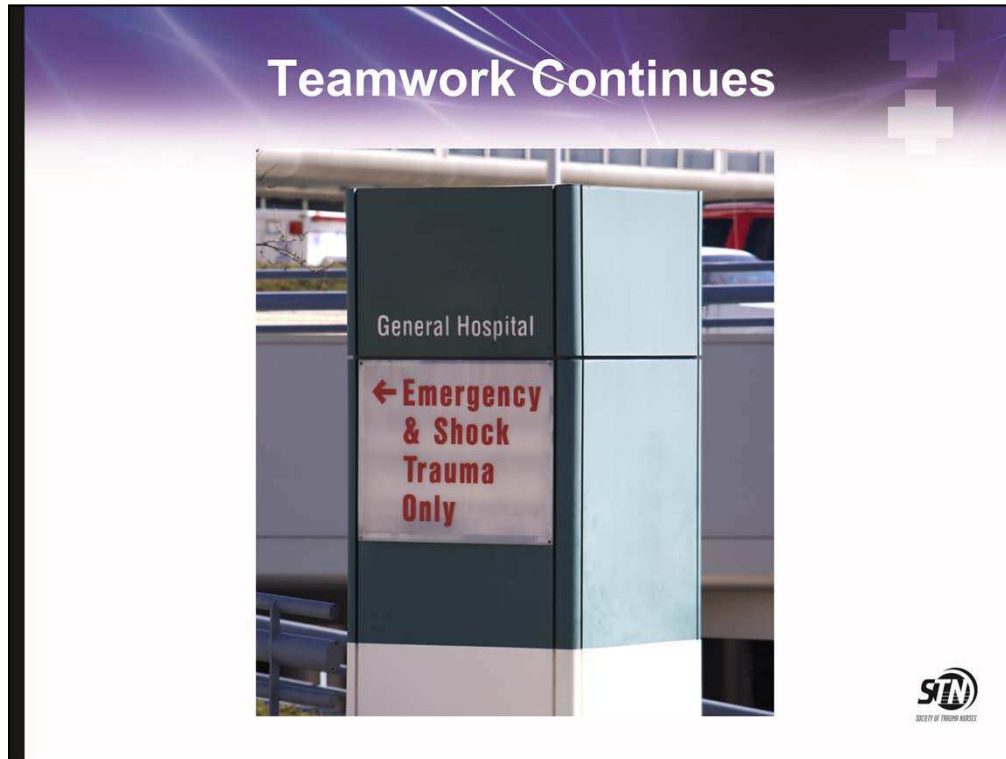


- Asymmetry of the pelvis – **do not** spring (rock) the pelvis. Visual alignment and gentle palpation of the Anterior Superior Iliac Spine may help demonstrate pelvic injury, but often the pelvis visually appears normal, thus mechanism of injury is vital in determining injury
- Shortening/rotation of the leg/s
- Inguinal pain
- Localized swelling/contusion
- Hematuria/urinary incontinence
- MECHANISM, MECHANISM, MECHANISM! (albeit not a clinical feature!) – there may be no obvious clinical abnormality despite significant injury. Thus clinical suspicion is essential.
- Do your prehospital providers have pelvic splints on board and a protocol to use them?

Optimizing Prehospital Resuscitation

- Low volume or no fluid administration in major trauma
- Splint all fractures
- Dress all wounds
- Wrap pelvic fractures with binder (if in protocol)
- Tourniquets
- Limit scene time to 10 minutes

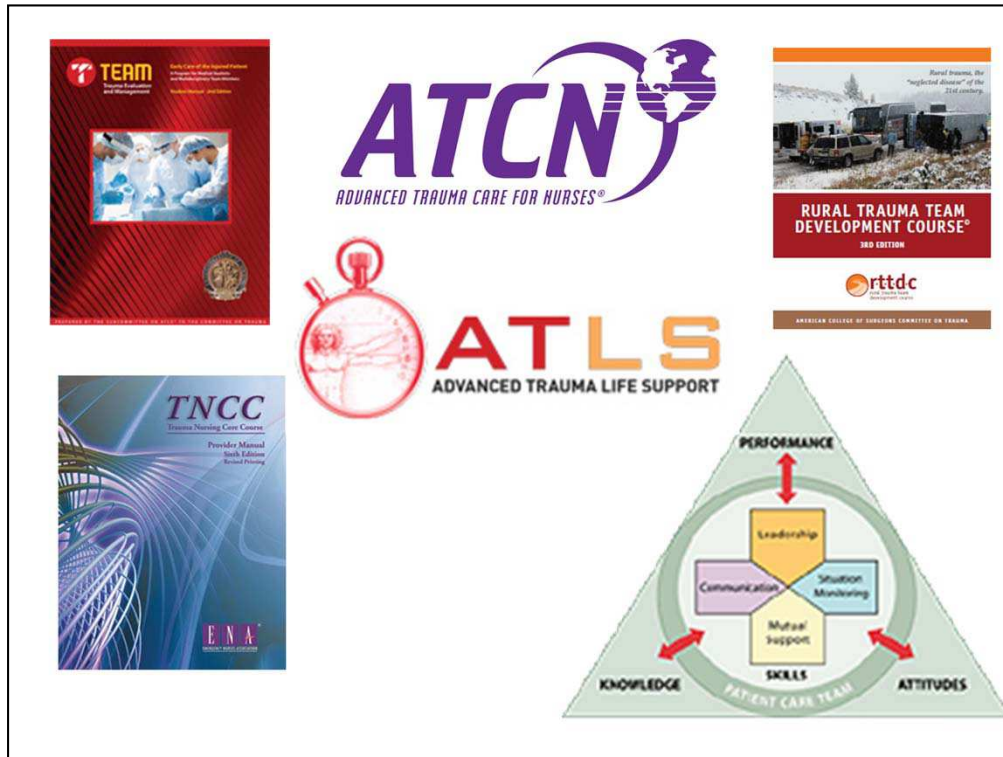




Nursing leadership, skill and communication were identified as a part of resuscitation team success.

Yun S. J of Applied Psychology 2005 published research that investigated leadership and effectiveness of teams operating in a high-velocity environment, specifically trauma resuscitation teams. On the basis of the literature and their own ethnographic work, the authors proposed and tested a contingency model in which the influence of leadership on team effectiveness during trauma resuscitation differs according to the situation. Results indicated that empowering leadership was more effective when trauma severity was low and when team experience was high. Directive leadership was more effective when trauma severity was high or when the team was inexperienced. Findings also suggested that an empowering leader provided more learning opportunities than did a directive leader. The major contribution of this article is the linkage of leadership to team effectiveness, as moderated by relatively specific situational contingencies.

Smith LA. J of Trauma 2009 wrote that the addition of TNS to a Level I Trauma Center's resuscitation team has statistically increased the efficiency of the trauma team and expedited patient care as reflected by decreased time spent in resuscitation and evaluation of major trauma patients. Increased efficiency is further supported by the decreased rate of return to the trauma resuscitation room following CT scans for completion of patient care issues prior to final destination.



There are a number of excellent programs that emphasize the Team concept of trauma care. The above logos were acquired from the organizations websites.

One that you might not be familiar with is TeamSTEPPS.

[Http://teamstepps.ahrq.gov/](http://teamstepps.ahrq.gov/)

The Department of Defense (DoD) and the Agency for Healthcare Research and Quality (AHRQ) have developed TeamSTEPPS, a teamwork system which offers a powerful solution to improving collaboration and communication within your institution. Teamwork has been found to be one of the key initiatives within patient safety that can transform the culture within healthcare. Patient safety experts agree that communication and other teamwork skills are essential for the provision of quality healthcare and for the prevention and mitigation of medical errors and of patient injury and harm.

TeamSTEPPS is an evidence-based program aimed at optimizing performance among teams of healthcare professionals — enabling them to respond quickly and effectively to whatever situations arise. This curriculum was developed by a panel of experts, incorporating over 25 years of scientific research that has been conducted on teams and team performance

Trauma Team Training Course



Prepares teams of 5 to care for trauma victims with the limited resources found at African rural hospital and health centers

CNIS Safer Surgery, Obstetrics + Communities in Africa
Canadian Network for International Surgery



This philanthropic group provides team training in Africa.

This slide reflects that a Trauma Team does not need a verified or designated trauma center environment, but can be developed to work efficiently and effectively with the resources available.

Communication



Pay attention to episodic events of hypotension!

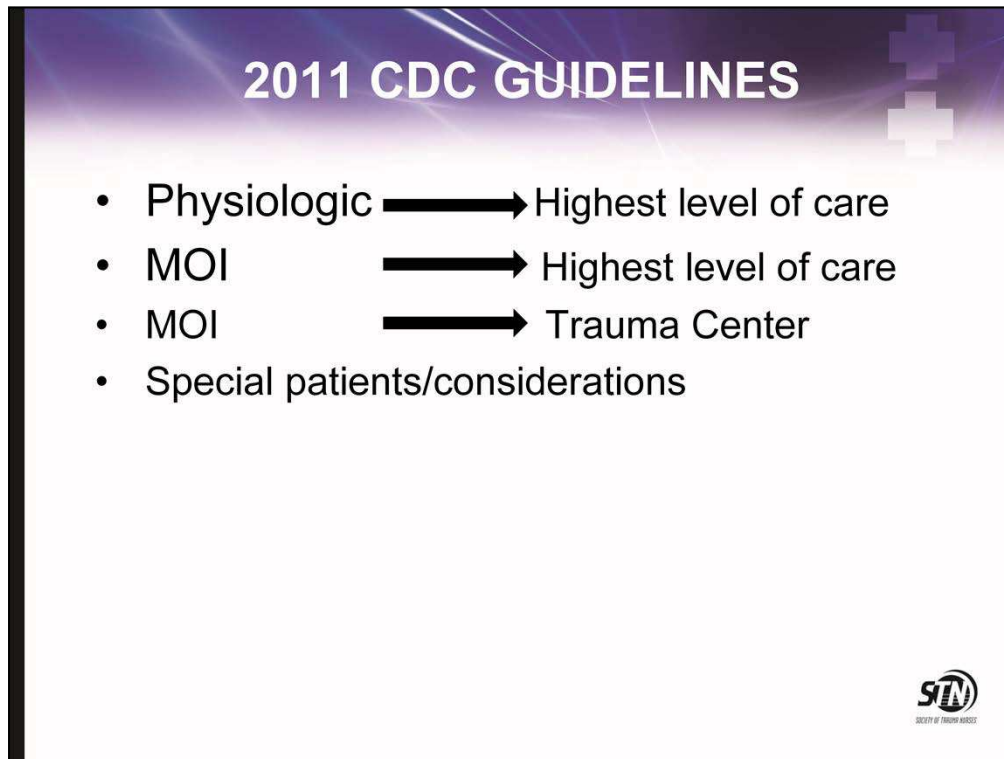


The field communication to the ED sets up the expectations and thus the deployment of appropriate personnel, departments and equipment to the ED.

A standardized format ensures that all appropriate information is transmitted.

Each hospital should have its own Trauma Team Activation Criteria. **This is a good place to review yours.**

The CDC has published the 2011 Guidelines for Field Triage of Injured Patients



Physiologic Criteria that send the patient to the highest level of care within the defined trauma system

- Glasgow Coma Scale –less than or equal to 13
- Systolic Blood Pressure (mmHg) – less than 90 **Note that information of episodic hypotension is critical and may be a marker of considerable injury.**
- Respiratory Rate –less than 10 or greater than 29, or need for ventilatory support (Respiratory rate less than 20 in infant aged less than 1 year)

Mechanism of Injury that send the patient to the highest level of care within the defined trauma system

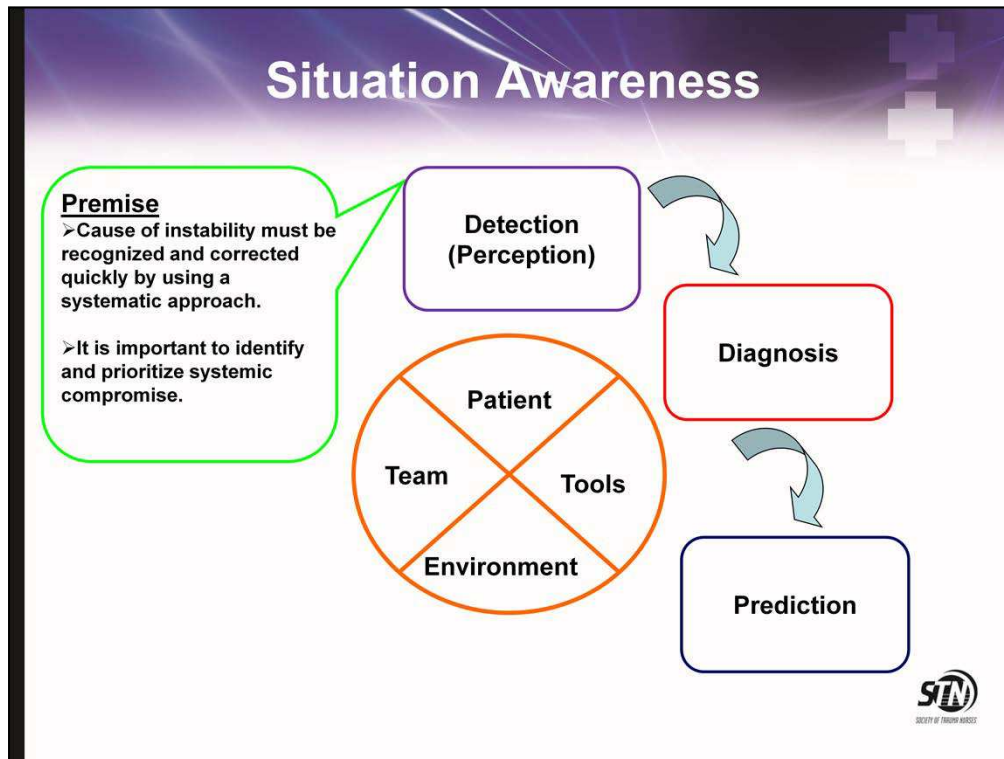
- All penetrating injuries to head, neck, torso, and extremities proximal to elbow or knee
- Chest wall instability or deformity (e.g. flail chest)
- Two or more proximal long-bone fractures
- Crushed, degloved, mangled, or pulseless extremity
- Amputation proximal to wrist or ankle
- Pelvic fractures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

Mechanism of Injury criteria that send the patient to a trauma center (need not be the highest level of care)

- Falls -Adults: >20 feet (one story is equal to 10 feet) -Children: >10 feet or two or three times the height of the child
- High-risk auto crash -Intrusion, including roof: >12 inches occupant site; >18 inches any site -Ejection (partial or complete) from automobile -Death in same passenger compartment -Vehicle telemetry data consistent with a high risk of injury
- Auto vs. pedestrian/bicyclist thrown, run over, or with significant (>20 mph) impact
- Motorcycle crash >20 mph

Special Patient or System considerations

- Older Adults -Risk of injury/death increases after age 55 years -SBP <110 may represent shock after age 65 - Low impact mechanisms (e.g. ground level falls) may result in severe injury
- Children -Should be triaged preferentially to pediatric capable trauma centers
- Anticoagulants and bleeding disorders -Patients with head injury are at high risk for rapid deterioration
- Burns -Without other trauma mechanism: triage to burn facility -With trauma mechanism: triage to trauma center
- Pregnancy >20 weeks
- EMS provider judgment



The causes of instability must be recognized and corrected quickly by using a systematic approach.

Purpose of Primary Survey:




To allow key supportive interventions to be undertaken swiftly, it is more important to identify and prioritize systemic compromise than to confirm specific diagnoses.

Detection: *Airway assessment* Diagnosis: *blood in mouth, patient unresponsive*
Prediction: *"gonna die if I don't intubate!"*

Do we have the tools needed to intubate? Are they nearby? Is there a member of the team who knows where they are? Is the suction turned on? Is the Bag-valve-mask connected to Oxygen? Do we have a person who is able to intubate? Does somebody have to ask these questions or do the elements in the circle work as a unit to accomplish a rapid, successful intubation.

Most Potentially Preventable Trauma Deaths are related to:

- Airway obstruction
- Hemorrhage
 - Hemopneumothorax
 - Intracavitary bleeding
 - Intracranial hemorrhage




Airway obstruction may be missed:

- if we are distracted by an open femur fracture
- if we don't assess the neck under the C-Collar and miss an expanding hematoma
- if we don't have a working suction when an obtunded patient has emesis of his last meal in CT scan


Hemorrhage may be missed:

- if we don't perform serial exams
- if we wait for the vital signs to change
- if we don't rapidly reverse warfarin (Coumadin) in a patient with a tiny intracranial bleed.

We all need to know our A, B, C, Ds





1. All trauma patients need oxygen until proven otherwise
2. All trauma patients are bleeding until proven otherwise
3. All trauma patients have a cervical spine injury until proven otherwise
4. All unconscious trauma patients have a brain injury until proven otherwise



These are the Golden Rules of Trauma.

Hemodynamically unstable trauma patients need an early definitive airway:

- Prevents aspiration
- Reduces the oxygen debt of breathing
- Maximizes systemic oxygen delivery
- Corrects acid base disturbances
- Allow clinician to focus on other life-threatening issues



The most definitive airway is.....

The ETT

Discuss the intubation process in your “shop”

- Who can intubate?
- How many attempts before another person is to try?
- Do you have a glidescope?
- How about the LMA, combitube?
- Does the staff know where they are?
- Do you ever do surgical airways in the ED, in the ICU?
- If your patient arrives to the ED with an ETT/combitube or other type of tube, do you replace with an ETT? If you do, when is it usually performed?



Understand the significance of patterns

- First and second rib fractures indicate a major transfer of energy, and should be a red flag (increase the suspicion of an thoracic aortic injury).
- Retraction indicate increased work of breathing
- Asymmetry may indicate pneumo or hemo-thorax, or flail chest.
- If an adult is breathing more than 24 times a minute WORRY.

What happens if you intubate prior to treating a pneumothorax? (it can cause a tension pneumothorax because of the positive pressure ventilation)

If the patient is intubated in the Trauma Bay, the patient should always have a chest x-ray prior to traveling outside of the Trauma Bay. The image should be reviewed by the trauma surgeon prior to the move, to assure that the tube is in the correct position and to assure that an occult pneumothorax has not increased in size.

Treat the pneumo before ETT

Life-threatening thoracic injuries need to be detected early

Life threatening injuries are:

- Tension pneumo
- Massive hemothoraces
- Cardiac tamponade
- Flail chest

Hemorrhage:



All trauma patients are bleeding until proven otherwise



Give blood to **replace** blood loss....and warm it!!


- Definitive treatment is not blood transfusion it is **STOP THE BLEEDING**
- All unstable trauma patients have a presumed diagnosis of hypovolemia even before a specific diagnosis
- Stop the bleeding-- hemorrhage control is much more important than fluid resuscitation
- Mandates the earliest possible “goal directed therapy”

Shock presentation will provide in depth information on blood resuscitation and massive transfusion.

Recognize Trouble!

Prehospital hypotension and ED instability

- During the first 90 minutes in the ED, patients who were hypotensive with major abdominal injuries requiring lap sustained an additional 1% increase in mortality for every 3 minutes spent in resuscitation before surgery.
Clarke JR, et al. J Trauma 2002
- Trauma patients with prehospital hypotension that are normotensive on arrival should have an arterial blood gas with BD interpreted early upon admission to help identify those patients who are at risk for “crumping.”
Bilello JF et al. J Trauma 2011



Truncal GSW, pelvic fractures, major mechanism of injury to blunt trauma patients are at big risk for internal bleeding and shock.

Be aware of “episodic hypotension (systolic \leq 90 mm Hg)”- increases morbidity and doubles mortality especially in head injured patients.

Monitoring the vital signs continuously, and drawing a lactate level and monitoring base deficit with your ABG's should give you early warning of decompensation or under-resuscitation.

First, prehospital hypotension merits trauma team activation. Blunt trauma patients with prehospital hypotension that are normotensive

on arrival should have an arterial blood gas (ABG) with BD interpreted early upon admission to help identify those patients who are at risk for “crumping.”

Surgeons should strongly consider taking blunt trauma patients with prehospital hypotension, a BD 6, and a positive FAST examination directly to the OR even if they are presently normotensive in the trauma bay. In addition, such patients with a BD 6 should have a repeat FAST if the initial study was negative. Invasive monitoring such as an arterial line and a central venous line should be placed expeditiously in blunt trauma patients with prehospital hypotension and a serum BD 6. Since these patients are at risk for repeat hypotension and its consequences, the ability to detect hypotension as soon as it occurs and intervene with both resuscitation

Hemorrhage: 5 Anatomic Areas of Origin

Box 1. Bedside assessment of the 5 cardinal sites of massive adult hemorrhage

Anatomic site	Modality	Reliability
Intraperitoneal	FAST	Positive test is diagnostic; negative test is suspect
	DPL	Gross positive is diagnostic; technically positive only is suspect
Retroperitoneal	Pelvic radiograph	Unstable fracture pattern is suggestive
Thoracic (pleural)	Chest radiograph	Positive test is usually diagnostic
Multiple long-bone fractures	Physical examination	US and radiograph confirmatory but do not quantify blood loss
External bleeding	Physical examination	Positive findings diagnostic but do not quantify blood loss



FAST = focused assessment with sonography for trauma; DPL = diagnostic peritoneal lavage; US = ultrasonography.

Kirkpatrick AW, et al. Can J Surg 2008;51(1):57-69.



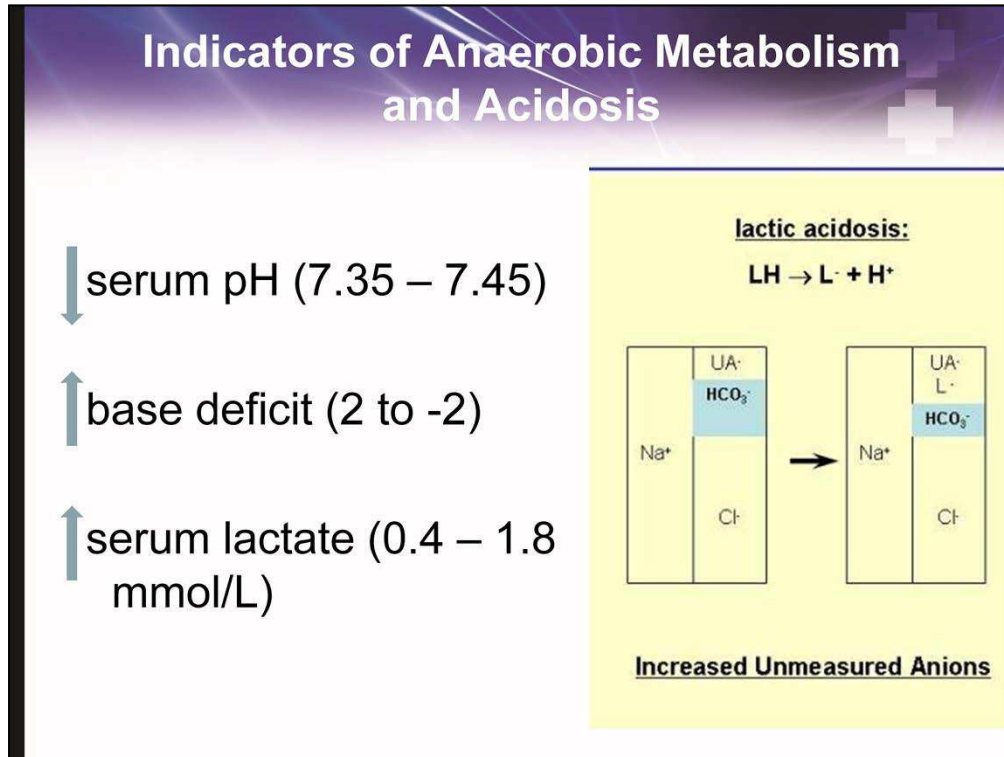
Resuscitation

- For Resuscitation to Occur:
 - Adequate perfusion and tissue oxygenation must be restored
- Resuscitation Measures Directed at:
 - Control the bleeding
 - End points
 - Normothermia
 - Normal INR
 - No base deficit



Perfusion requires an adequate “pressure head” for blood to reach end organs. This is not accomplished by giving a vasoconstrictor, but by stopping the bleeding and replacing blood volume with “red trucks” (RBCs) to carry oxygen to the tissues.

Adequate resuscitation can be evaluated by monitoring the patient’s temperature, INR and base deficit.



The O₂ supply-demand imbalance and accumulation of O₂ debt are reflected by **low serum pH**, a **base deficit** and **elevated serum lactate**.

Reminder of normal lab values

Normal pH: 7.35 to 7.45

Base deficit= 0 (2 to -2)

Lactate acid= 0.4 - 1.8 mmol/L


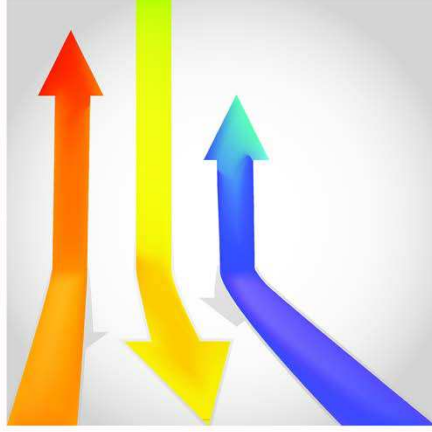
HCO₃= 22-26 mEq/L or 22-26 mmol/l

CO₂= 35 to 45 mmHg

Note on the right side of the graph, the **decrease** in the Bicarb and the increase in Chloride and Lactic Acid

Base Deficit

- Amount of fixed base (bicarbonate) required to correct the pH of an aliquot of blood to 7.40 at 37 C
- Excellent correlation of base deficit to lactate and pH
- Normalizes rapidly with adequate resuscitation and control of hemorrhage




Sometimes there is confusion with the terminology. An improving base deficit is actually less negative. A base deficit of -8 is improving (going up) when it reaches -2.

Base Deficit Categories


Normal	(2 to -2)
Mild	(-3 to -5)
Moderate	(-6 to -9)*
Severe	(-10 or higher)

***A base deficit of -6 is a marker of severe injury & significant mortality.**

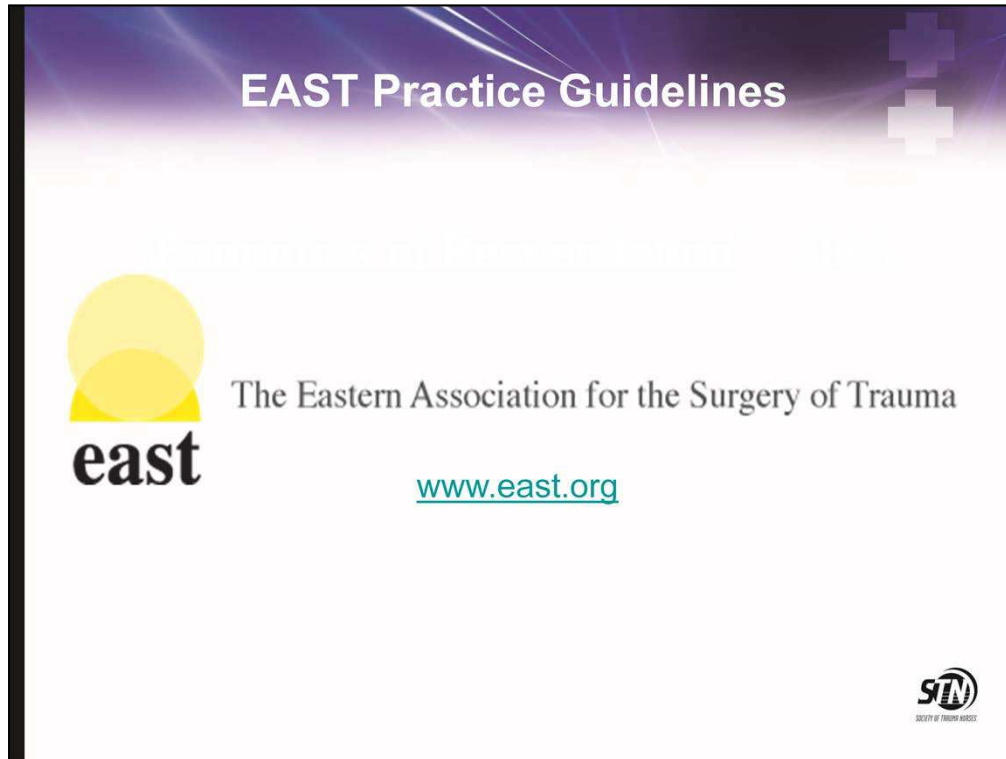
Classic Resuscitation Endpoints



- B/P, HR
- pulse pressure
- Mentation
- Urine output
- base deficit
- serum lactate
- serum pH



•If our patient was alert, warm, not tachycardic and making urine, we were happy. They were “better”.



“During resuscitation from traumatic hemorrhagic shock, normalization of **standard clinical parameters such as blood pressure, heart rate, and urine output are not adequate to guarantee survival without organ system dysfunction.**

Numerous parameters including :

- hemodynamic profiles
- acid-base status
- gastric tonometry
- regional measures of tissue O₂ and CO₂ levels have been studied.

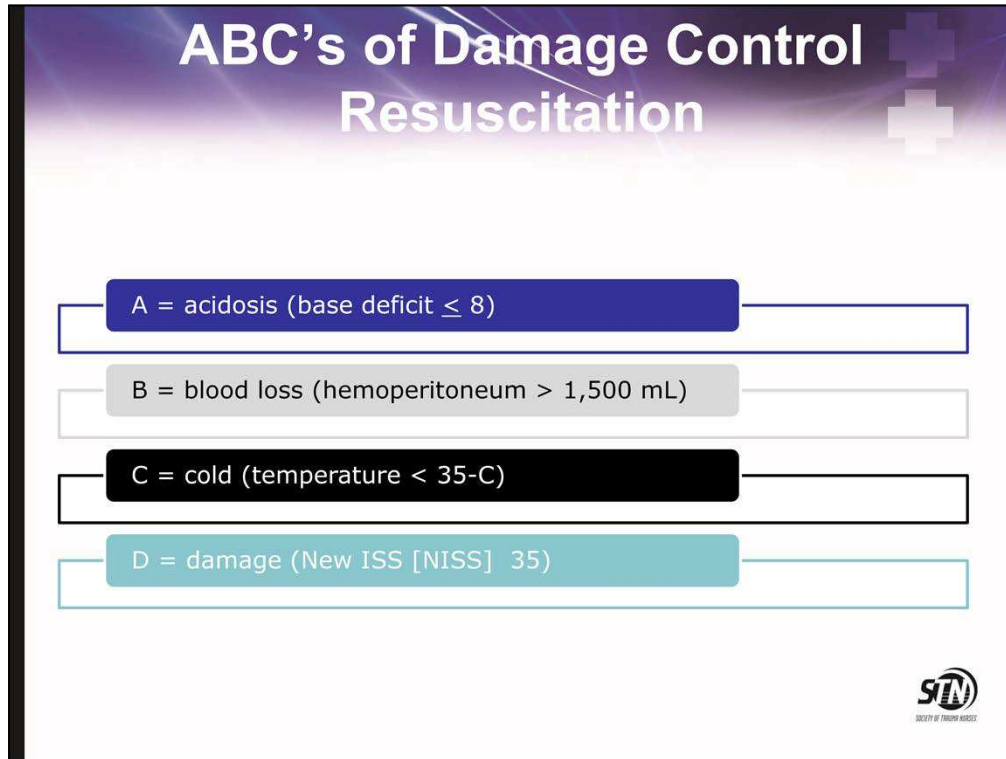
Many can be useful for predicting risk of organ failure and death. Studies comparing use of these parameters as endpoints for resuscitation protocols, however, have failed to show clear benefit in terms of patient outcomes.

At present, it seems prudent to use one of these endpoints rather than relying on standard clinical parameters.” EAST.org



- Damage Control Resuscitation using repeated point of care testing, commercial warming devices and the use of multiple blood products and FDA approved drugs such as TXA (tranexamic acid.)
- All efforts are directed toward normalizing the INR, base deficit and temperature.
- Damage control resuscitation consists of two parts and is initiated within minutes of arrival in the emergency department.
 - First, resuscitation is limited to keep blood pressure at 90 mm Hg, preventing renewed bleeding from recently clotted vessels.
 - Second, intravascular volume restoration is accomplished by using thawed plasma as a primary resuscitation fluid in at least a 1:1 ratio with PRBCs.
 - Recombinant FVIIa is used along with the very first units of red cells and plasma and as required throughout the resuscitation.
 - For patients who will require continued resuscitation, the blood bank is notified to activate the massive transfusion protocol.

Crystalloid use is significantly limited and serves mainly as a carrier to keep lines open between the units of blood products.



This is a recent article that indicates when a patient will NEED Damage Control Resuscitation/Damage Control Surgery. (Once the bleeding is stopped, get them out of the OR and to the ICU to warm and further resuscitate.)

The NISS is defined as the sum of the squares of the Abbreviated Injury Scale (AIS) score of each of the patient's three most severe AIS injuries, regardless of the body region in which they occur. This can be easily derived by the surgeon from CT images or from the open abdomen/Chest

From a nursing perspective, keeping patient warm from the beginning by removing wet clothing, keeping patient covered and environment warm, warming ALL IV fluids and frequent monitoring of temp goes a long way toward preventing hypothermia .

Optimizing ED Trauma Resuscitation-

Stop the bleeding

- Direct pressure to all external bleeding
- Rapid suturing of all scalp and facial wounds
- Rapid application or evaluation of Thomas/Hare Traction splints for femur fracture
- Binder for pelvic fracture
- Rapid reduction and pressure dressings of mangled extremities



Optimizing ED Trauma Resuscitation

- Low volume blood sampling
 - 3 cc for ISTAT: Na/K/Cl/Ca, Hgb, Hct, PO₂, PCO₂, pH, PT, INR, Lactic acid, Creatinine, Troponin
- Use FAST to rapidly detect intra-abdominal fluid
- Auto transfusion of thoracic blood using the pleurevac system
 - Avoid spilling blood on floor during chest tube insertion



Optimizing ED Trauma Resuscitation- Fluid Resuscitation

- Minimize crystalloid
- Early resuscitation with 1:1 RBC to FFP
- Warm all fluids
- Move quickly to definitive intervention (OR/IR)



Must maintain a critical level of perfusion to vital organs while avoiding over-resuscitation.

Optimizing Resuscitation Across the Continuum

- Operating Room
 - Rapid exposure
 - Evacuation of blood
 - Packing
 - Control contamination
 - Anticipate and fight the “trauma triad” of death: Hypothermia, Acidosis, Coagulopathy
- Regroup!



Abbreviated laparotomy and planned reoperation.

Bleeding and intestinal contamination are temporarily controlled by packing, ligating, stapling & temporary vascular shunts & abdominal cavity is closed rapidly.

If patient went emergently to the OR, they will need to get to radiology for further imaging, at least for a quick CT scan of the brain if the patient had a GCS of 13 or less or is on an anticoagulant and the patient had hit their head during the traumatic event.




Time to rewarm, resuscitate with more blood/blood products, monitor labs, do a tertiary survey.


If the patient went emergently to OR, bypassing CT, they may need to take a road trip when deemed stable enough to go to evaluate further injuries.

If there are orthopedic injuries, this may be the time for Ortho to insert a traction pin for femur fractures, and for splints to be reassessed and reapplied as necessary.

Persistent Metabolic Acidosis Indicates



- Continued bleeding
- Inadequate resuscitation
- Myocardial dysfunction



Don't forget to monitor the ABGs (even if patient is not on the ventilator). Persistent acidemia and base deficit require focused assessments and testing to figure out WHY!

Interventions to Decrease the Need for Blood Transfusion

- Intervene early in resuscitation to STOP bleeding
- Conserve blood early
- Aggressive, rapid, and efficient operative interventions
- Use novel surgical methods to STOP bleeding in the operating theater
- Early use of interventional radiology when appropriate
- Correct hypothermia, acidosis, coagulopathy



Neurological

All unconscious trauma patients have brain injury until proven otherwise



- Expanding intracranial hemorrhage requires optimization of oxygenation, ventilation and circulatory support.
- Avoid hypotension in brain injured patients= poor outcome.
- Double jeopardy in unstable patients with severe head injury. Associated brain injuries are present in up to 60% of patients with severe blunt trauma.

Goal Directed Therapy

- **Recognize trouble!**
 - High risk patients
 - Geriatric patients
 - Pediatric patients
 - Pregnant women
 - Anticoagulants
 - Beta blockers



This elderly gentleman slipped on ice and fell in his driveway. He has a large bruise on his left lateral flank and lower chest, outward rotation of left leg.

He takes Plavix and has a permanent pacemaker.....

Discuss his possible injuries, priorities of care, how to reach prevent hypothermia, how to monitor the adequacy of his perfusion.

“Routine Trauma Labs”

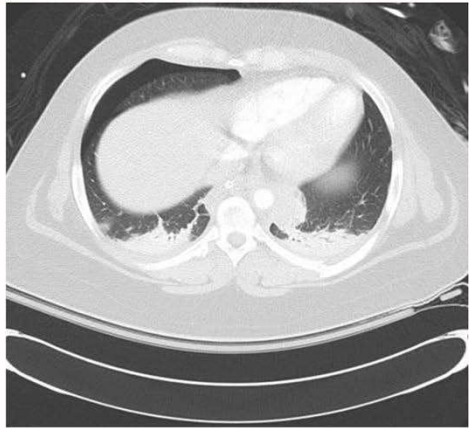


Namais N. J of Trauma 1996
and Tasse JL. J Trauma
2008 concluded that
information provided by
routine admission
chemistry and coagulation
profiles in trauma patients
seldom lead to clinical
interventions. **These
tests should not be
ordered routinely on
admission in trauma
patients**



Do you still have “routine trauma labs” or are specific labs ordered based upon prehospital communication, after the secondary assessment?

CT Scan for thoracic trauma




An occult pneumothorax seen on a CT scan that was not detected on a plain anteroposterior supine chest radiograph.


- Recognize the insensitivity of the AP CXR to detection of pneumothoraces
- Remarkably large occult pneumothoraces may be present without an obvious anterolateral pleural stripe on AP CXR



Routine Pelvic X-ray



- Duane TM. J Trauma 2002: Not necessary in awake and alert
- ATLS advocates as an adjunct to primary survey in **multiply injured trauma patients**



The American College of Surgeons Advanced Trauma Life Support advocates the routine use of the antero-posterior pelvic X-ray as an adjunct to the primary survey in multiply injured trauma patients.

<http://www.trauma.org/archive/ortho/literature/routinexray.html>

Some authors suggest that this is not cost effective and that clinical criteria may be used to screen for the presence of a pelvic injury. There is no Level 1 or Level 2 evidence supporting the use of routine AP pelvic x-ray as an adjunct to the primary survey .

Examination of the pelvis is notoriously unreliable, especially in obtunded, intoxicated or obese patients.



In addition, repeated 'springing' of the pelvis may result in disruption of any clot that has formed and lead to further exsanguination.

The antero-posterior pelvic X-ray should still be routinely used to determine the presence of pelvic injury in multiply injured trauma patients. Clinical examination, especially repeated 'springing' of the pelvis, should be kept to an absolute minimum.

In the awake and alert patient, the need for a pelvic radiograph was readily identified by clinical examination. Because elimination of this film would result in financial savings, its routine use should be removed from standard trauma protocols in the minimally injured patient and limited to severely injured patients as recommended by the Advanced Trauma Life Support protocol.

Routine Cervical Spine X-ray

- The primary screening modality is axial computed tomography (CT) from the occiput to T1 with sagittal and coronal reconstructions
- Plain radiographs contribute no additional information and should not be obtained



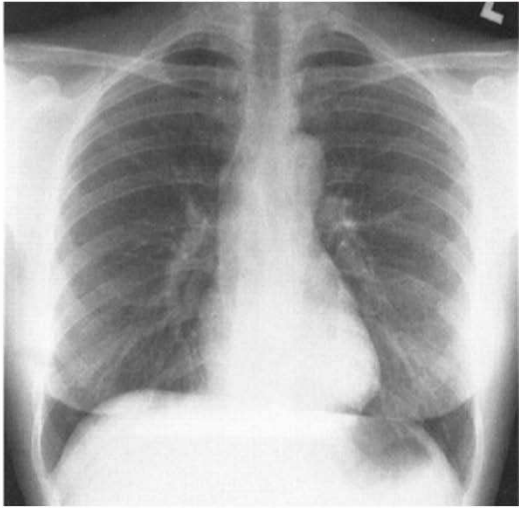
EAST.org 2009 All patients in whom CS injury is suspected must have radiographic evaluation. This applies to patients with pain or tenderness, patients with neurologic deficit, patients with altered mental status, and patients with distracting injury.

The primary screening modality is axial computed tomography (CT) from the occiput to T1 with sagittal and coronal reconstructions (Level 2 evidence).

Plain radiographs contribute no additional information and should not be obtained (Level 2 evidence).


Note the image is of a cross table lateral c-spine image .

Routine Chest X-ray



Chest x-ray

- Early
- Valuable
- Significant injury
- Position of patient
- Never delay procedures for x-ray





- The CXR should be performed early; in ATLS , it is essentially an extension of the primary survey, simultaneously occurring during primary survey, or prior to the secondary survey.
- By doing early, the most life threatening injuries can usually be identified.
- If normal, the clinician can focus on other areas as the etiology of occult bleeding
- AP chest x-ray is perhaps the most valuable diagnostic study in the EARLY management of chest trauma
 - It is inexpensive, noninvasive and easy to obtain as a general rule.
 - It provides a quick assessment of significant bony, vascular, and lung related injuries.
 - Although a high-quality, upright CXR demonstrates better images in determining vascular injuries and estimation of fluid/blood within the chest cavity, this is usually not possible in the blunt trauma victim due to restrictions in position e.g. hypotensive, cervical spine immobilization, etc.
 - In penetrating trauma, an upright film may be possible and provide answers to some of the early management priorities.
 - Placing a radiopaque marker at the sight of the wound is helpful in determining the trajectory of a missile. This marker should be placed at both wounds, suspected entrance and exit, although the wounds should never be labeled as such but rather described in terms of size, tissue destruction, appearance of any residue around the wound, etc.
- In some facilities, the patient may be taken to CT scan prior to CXR, especially if patient is hemodynamically stable, has a significant mechanism, and if in close proximity.
- Keep in mind that life-saving procedures should never be delayed in patients who has strong clinical suspicion based on history and exam.

Image is a normal chest x-ray

Computed Tomography

- Used for hemodynamically stable patients
- Noninvasive procedure
- Newer helical scanners

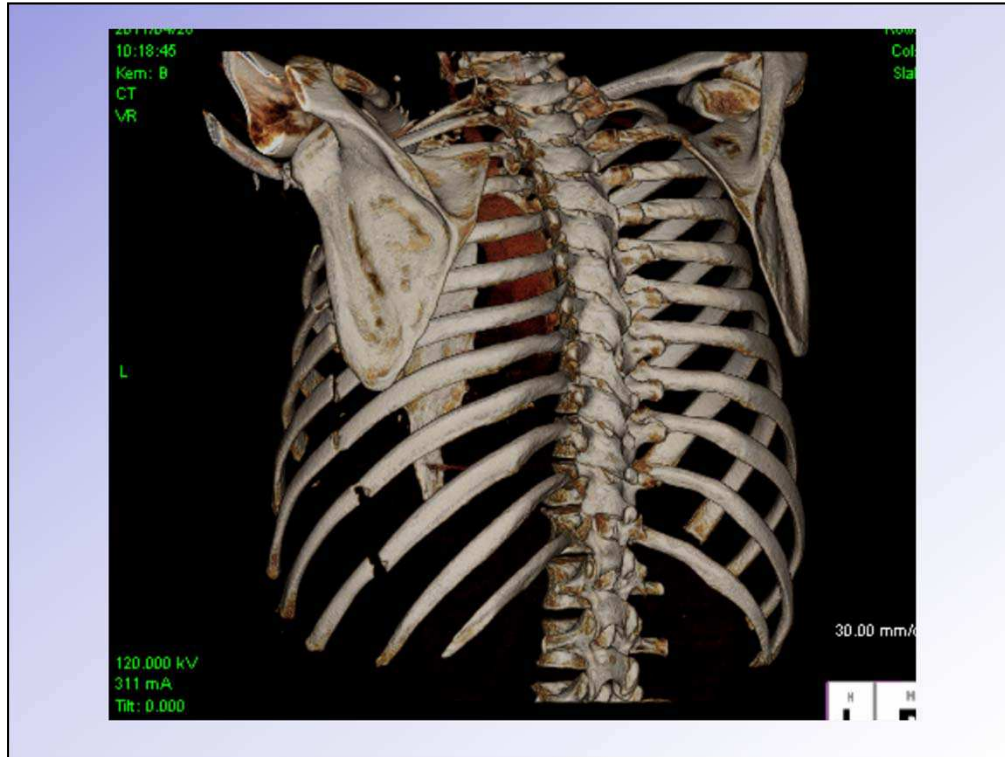


- CT scan is the currently accepted standard of evaluation used in hemodynamically stable patients.
- CT scan more sensitive for pneumothoraces, fluid collections, and infiltrates, & aortic injury
- Any unstable patient should be in the OR, and should not be taken to CT scan.
- New generation multidetector helical scanners have improved dramatically in terms of image quality and speed.
- Many “pan scan” trauma panels (head, cervical spine, chest/abdomen/pelvis) can be completed in minutes.
- The use of a CT in a penetrating trauma should be carefully considered before performing. Trajectory can be determined utilizing CT.
- Three-dimensional (3-D) reconstruction plays a role in clarifying complex injuries
- CTA is also an option to evaluate the aorta and has shown to be equivalent to aortography, however, aortography may be more appropriate depending on injured vessel/branch.

The information obtained with CT scan can provide surgeons the ability to determine operative vs. nonoperative management.

As with any radiologic test that requires transport out of the resuscitation area, many things should be considered such as the ease and safety of transporting a patient with various lines, equipment, appropriate staff, etc. A patent airway is of utmost importance. **The CT scan has been referred to as the “tunnel of death” due to suboptimal anticipatory consideration for what could occur while in CT scan.**

IV contrast is utilized for the most accurate, detailed imaging. In the elderly patient, administration of contrast of any route should be used prudently given their predisposition to renal problems. Newer contrast agents have improved and decrease the amount required.



Demonstrates details of rib fractures after 3-D reconstruction.

Consistent organization and clear cut communication produces effective outcomes

Well established and maintained clear roles and goals

Similar training- street through hospital

Effective function of the team begins with the Team leader



Summary and Conclusions

- It takes a team
- Team communicates
- Team uses research based protocols
- Team has a defined leader
- Trauma centers save lives!

