Pediatric Trauma Care

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Children's Hospital Colorado
Here, it's different.™

What will you do?

You work in a situation without significant pediatric surgical resources or back up. You must care for 4-year-old child who was involved in a high-speed MVC and inappropriately restrained in the back seat. The patient is unconscious and bleeding profusely from a large scalp laceration. You note shallow breathing, heart rate is 150 BPM, and ashen color of the skin. The abdomen is rock hard and there is a large seatbelt sign.

Disclosures:
None

OK…

Don’t

freak

out.

Student Course Manual

New to this edition ▶ mATLS™

MOBILE ADVANCED TRAUMA LIFE SUPPORT

THE
COMMITTEE
ON TRAUMA

AMERICAN COLLEGE OF SURGEONS

Inspiring Quality:
Highest Standards, Better Outcomes

100+years

Childhood Injuries

- Injury mortality accounts for more deaths annually than all other childhood illness COMBINED.
- Neurologic and respiratory derangements far exceed hemodynamic derangements.

Things with Wheels

Falls

Multisystem injuries are the rule – not the exception.

RED
PURPLE

ABCDE priorities are the same.

Bealer's Philosophy on ATLS

ATLS boils down to three plastic tubes:

- A tube in the throat (Airway)
- A tube in the chest (Breathing)
- A tube in the vein (Circulation)

ALL PETER'S
INTUBATION
NIGHTMARES
BEGAN THE
SAME WAY

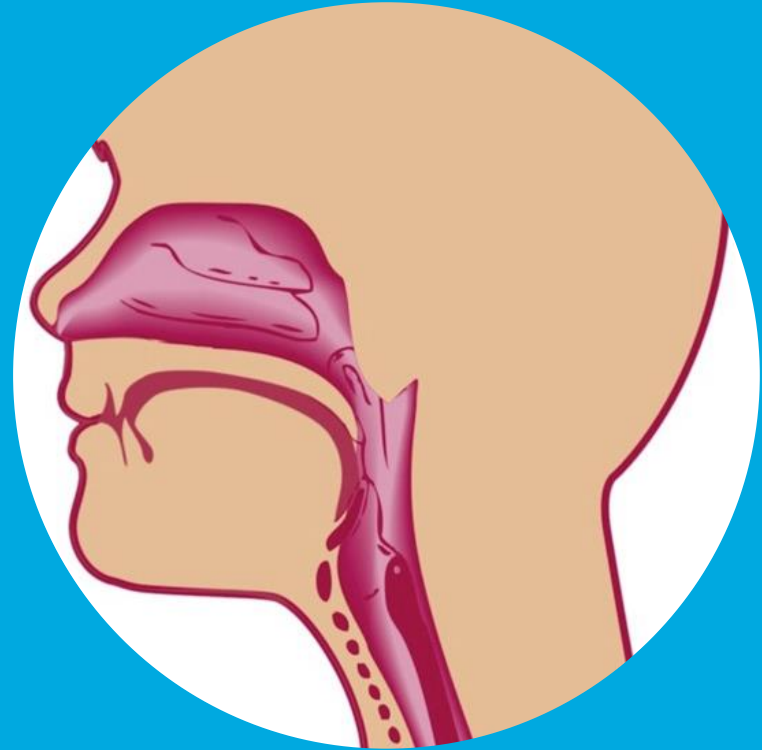
Airway Pitfalls

DANGER!

- Short trachea: main stem bronchial intubation
- ETT depth is 3 x ETT size
- Endotracheal tube easily obstructed
- Deceptive presentation of hypovolemic shock

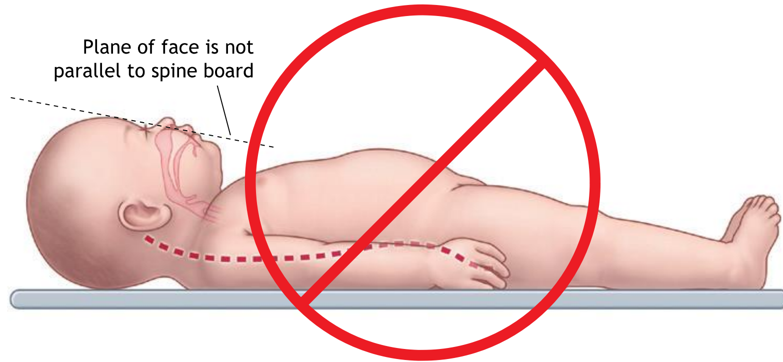
Unique Childhood Anatomy: Airway

- Larger tongue
- Smaller jaw
- Shorter, narrower, funnel-shaped airway
- Anterior larynx

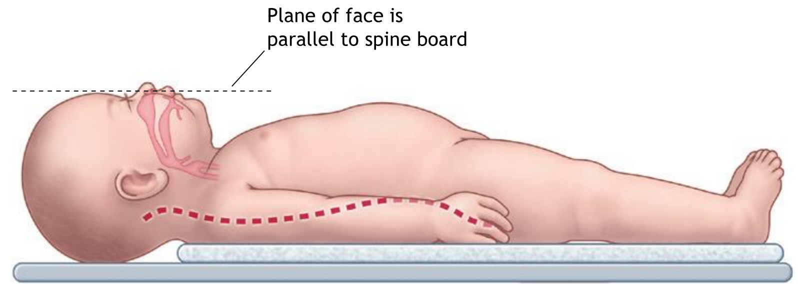


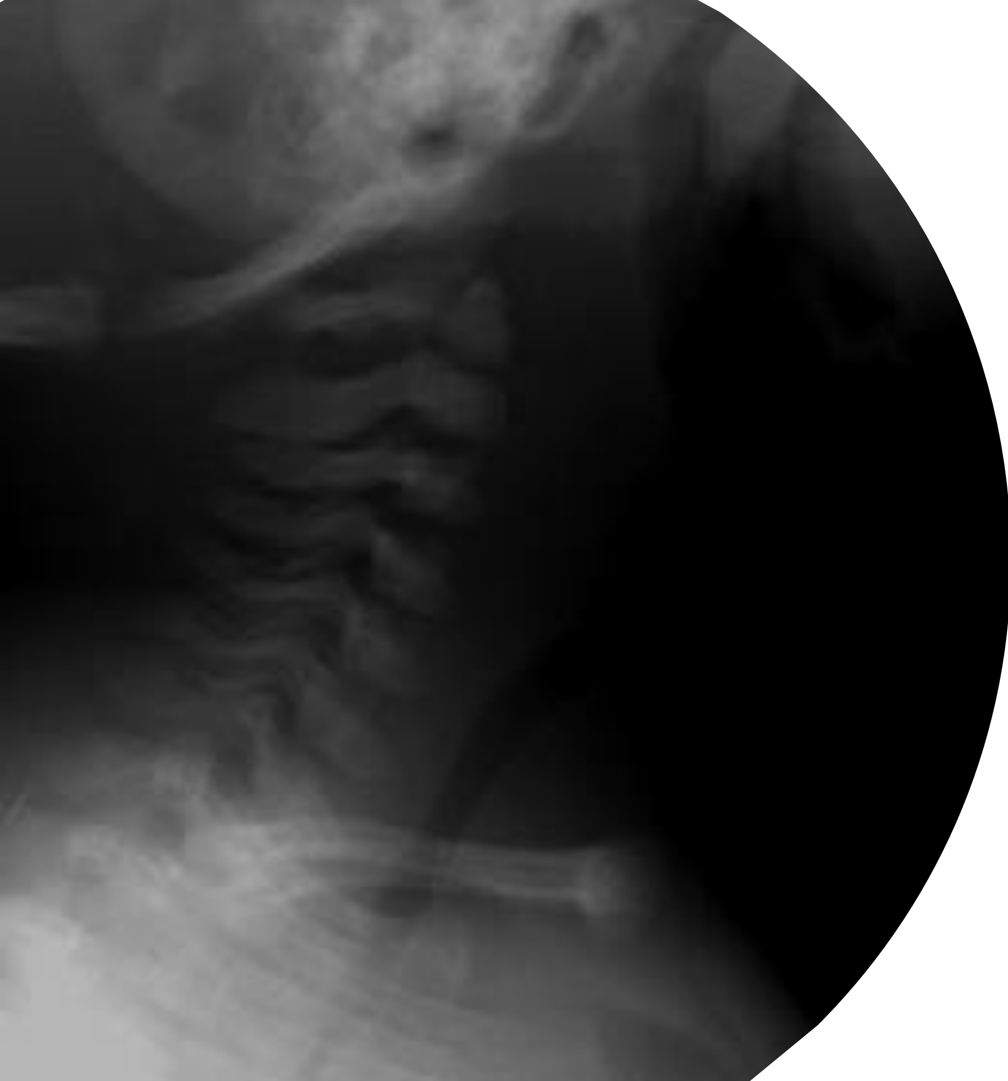
Sniff Position

Prominent occiput in younger child



1” pad under torso for neutral position



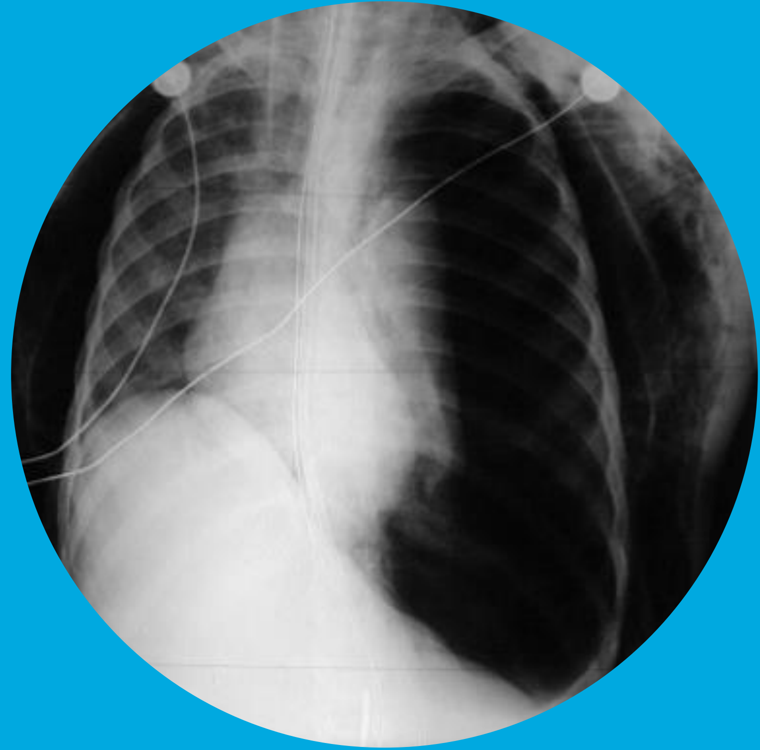


C-Spine

- Flexible spinal ligaments
- Anteriorly wedged vertebrae
- Flat facet joints
- Angular momentum
- Pseudosubluxation
- SCIWORA

“B”-Breathing

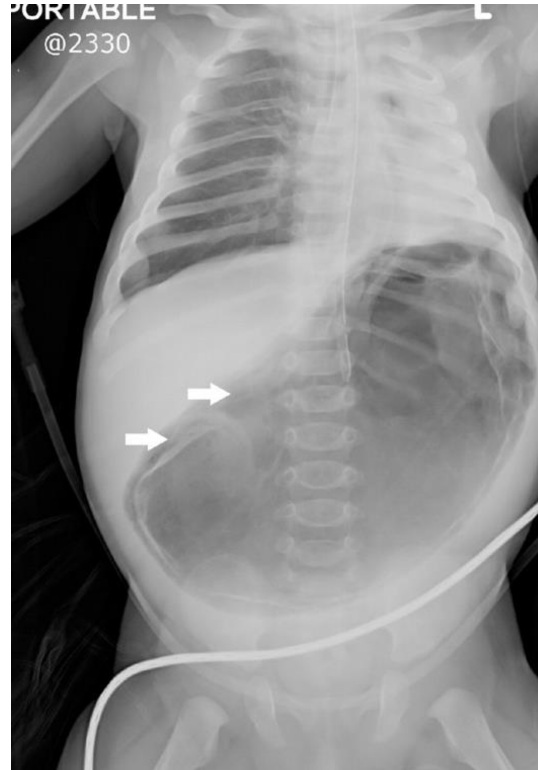
- Soft, pliable chest wall – pulmonary contusion
- Horizontally aligned ribs, weak intercostal muscles
- Rib fractures indicate significant force
- Tension pneumothorax more likely due to mobile mediastinum

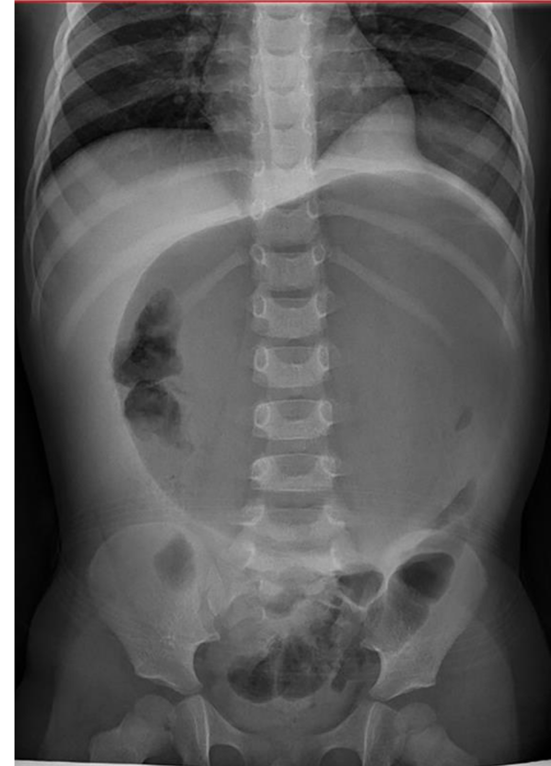


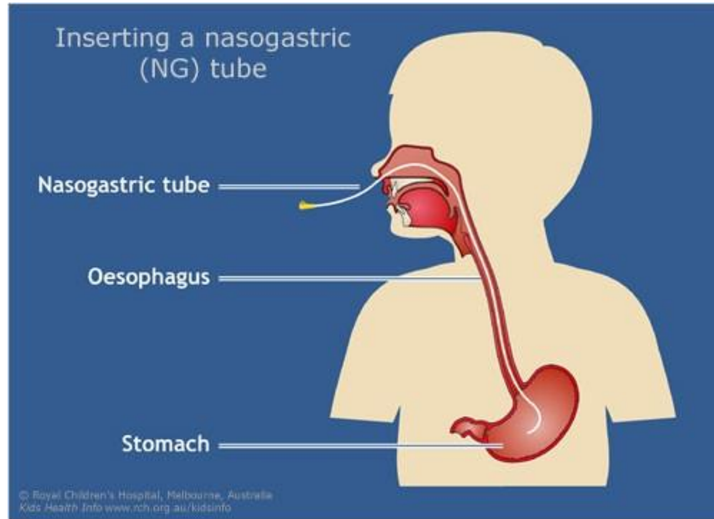
Chest tubes

- Sized based on rib spacing
- Landmarks identical to adult
- Measure length on child prior to insertion.
- Manage to closed suction/water seal drainage

Gastric Distention



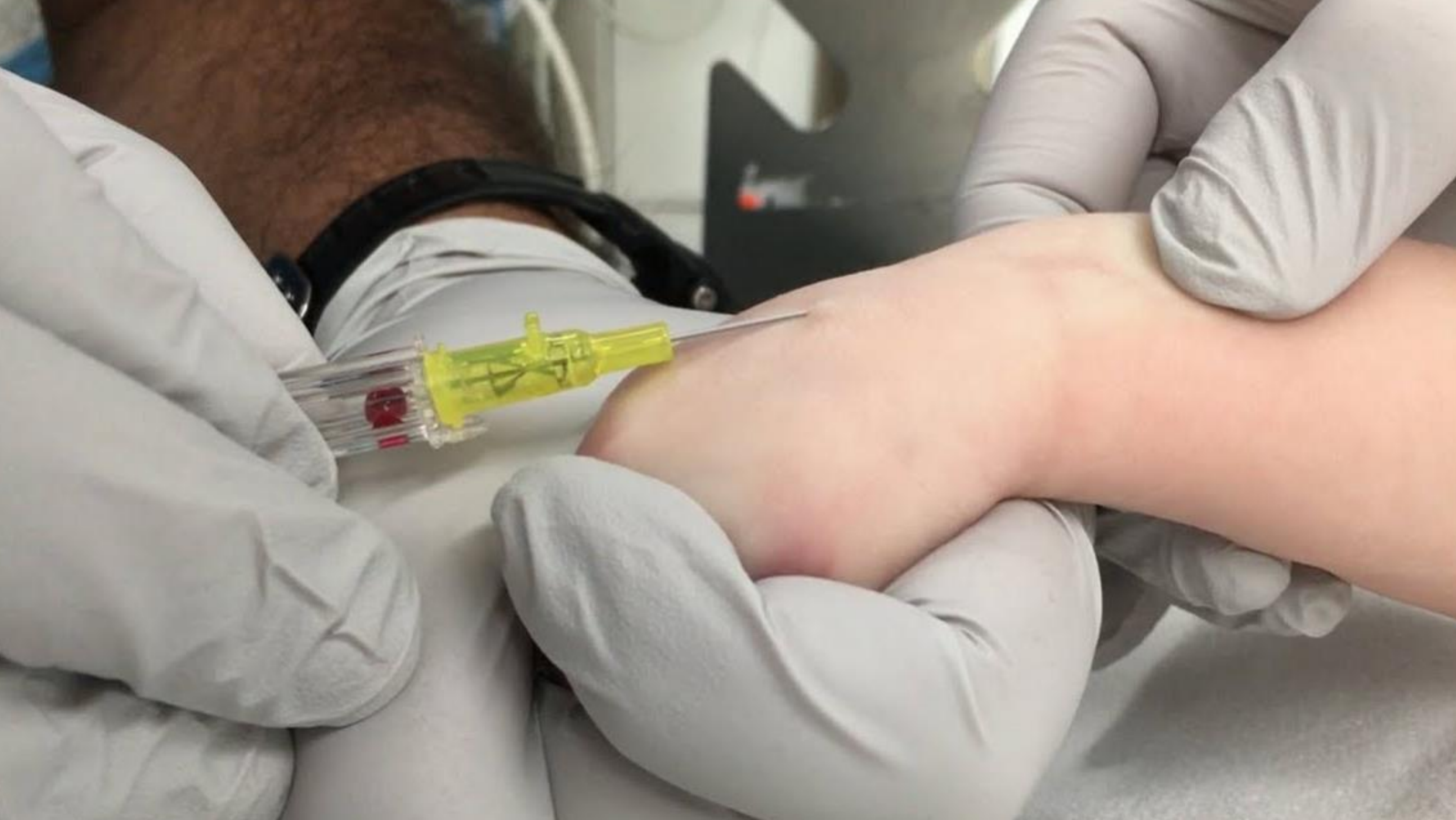


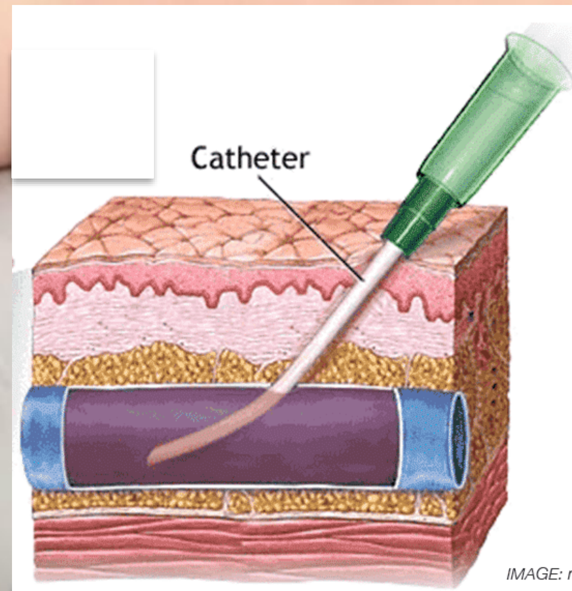

Inserting a nasogastric
(NG) tube
Nasogastric tube
Oesophagus
Stomach
© Royal Children's Hospital, Melbourne, Australia
Kids Health Info www.rch.org.au/kidsinfo

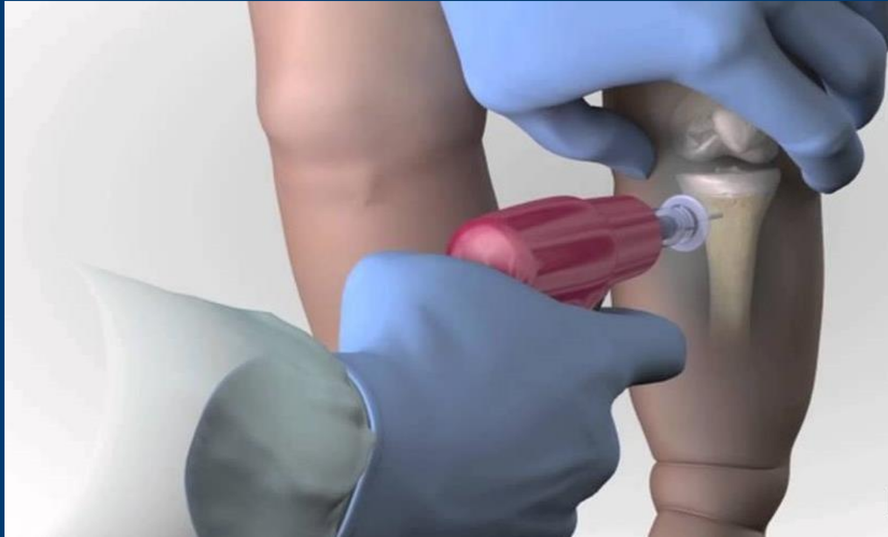
"C": Circulation

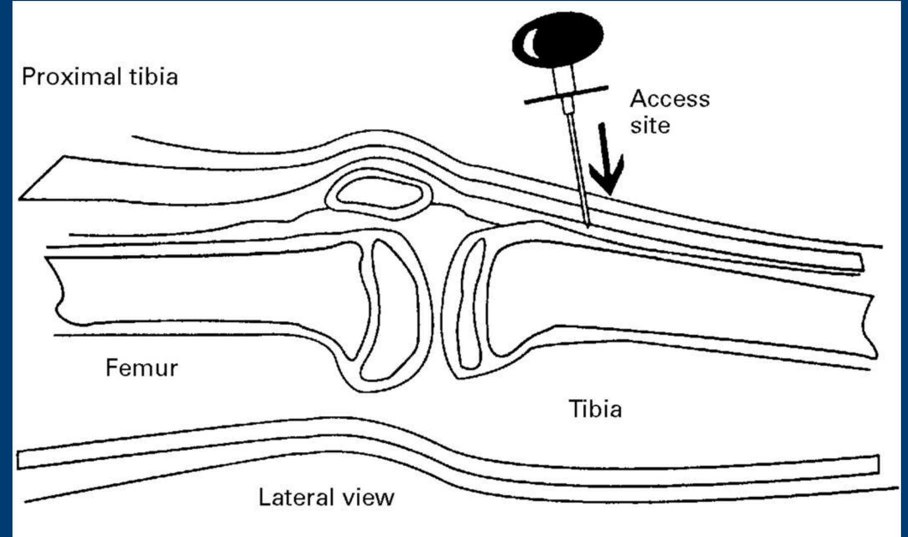
Signs of Shock

- Tachycardia
- Altered mental status
- Poor capillary refill
- Cool extremities
- External blood loss
- Late Signs
  - Hypotension
  - Low Urine output




Catheter




Proximal tibia
Access
site
Femur
Tibia
Lateral view

Circulation

- ”Estimate” kids total blood volume at 80cc/kg
- Bolus isotonic solution at 20 mL/kg
- Blood should be given if resuscitation is needed following two boluses of crystalloid
- Early use of plasma and platelets
- Bleeding of more than half the child’s blood volume in the first four hours should be resuscitated with PRBCs, and early use of plasma and platelets

- Permissive hypotension is an option in patients without traumatic brain injury
- Maintenance fluid after resuscitation follows the 4:2:1 rule
- 4 mL/kg for the first 10 kg
- 2 mL/kg for the second 10 kg
- 1 mL/kg for every kg beyond 20 kg

“D”: Disability

Modified Glasgow Coma Scale for Infants and Children

	Child	Infant	Score
Eye opening	Spontaneous To speech To pain only No response	Spontaneous To speech To pain only No response	4 3 2 1
Best verbal response	Oriented, appropriate Confused Inappropriate words Incomprehensible sounds No response	Coos and babbles Irritable cries Cries to pain Moans to pain No response	5 4 3 2 1
Best motor response*	Obeys commands Localizes painful stimulus Withdraws in response to pain Flexion in response to pain Extension in response to pain No response	Moves spontaneously and purposefully Withdraws to touch Withdraws to response in pain Abnormal flexion posture to pain Abnormal extension posture to pain No response	6 5 4 3 2 1

*If patient is intubated, unconscious, or preverbal, the most important part of this scale is motor response. Motor response should be carefully evaluated.

“D” – cont’d

- Antibiotics for open fractures
- Spinal precautions
- Aligning fractures
- Assessing for compartment syndrome
- Early removal of backboards

Exposure

- Higher body surface area to mass ratio
- Thinner skin
- Less insulation by subcutaneous tissue

PREVENT HYPOTHERMIA.

How Kids Are Different

- Age-specific vital signs
- Smaller blood volume (70 – 80 mL / kg)
- Decreased functional residual capacity
- Vigorous compensatory response
- Sudden deterioration
- Increased vagal tone

Age-Specific Vital Signs

Sign	Age Group		
	0 – 2 years	3 – 5 years	6 – 12 years
Heart Rate	< 150 - 160	< 140	< 100 - 120
Blood Pressure	> 60 - 70	> 75	> 80 - 90
Respiratory Rate	< 40 - 60	< 35	< 30
Adequate Urine Output	1.5 – 2 cc/kg	1 cc/kg	0.5 – 1 cc/kg

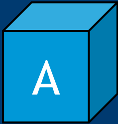
Physiologic Impact: Hemodynamic Changes

Normal

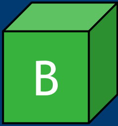
Heart rate
Blood pressure
Cardiac output

15
30
45

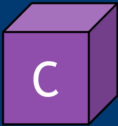
% Blood loss



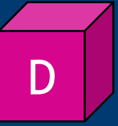
Obstructs easily – Usual reason for DECOMPENSATION



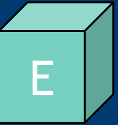
Tension pneumothorax; avoid barotrauma



Vascular access; fluid and blood



Pediatric GCS score; extremities/compartment syndrome



Avoid heat loss

You work in a center without pediatric surgical resources. A 4 year old child who was inappropriately restrained in the back seat presents in shock, with a large ”seatbelt” sign and with a rigid abdomen. You have started fluid resuscitation. What is your priority in further management?

A. CT Scan of the abdomen
B. Obtain FAST-in the ED
C. Administer IV antibiotics
D. Stabilize the patient and arrange immediate transfer to a center with appropriate surgical resources

Stabilization

- Identify and manage life and limb threats within your capabilities
- Focus on the patient
  - ✓ Repeat Primary/Secondary Survey
  - ✓ Shock Therapy
- Appropriate Immobilization
- TRANSPORT IMMEDIATELY

Patient is a 4-year-old appropriately restrained child involved in a high speed MVC. Patient is awake, alert and hemodynamically stable. Physical exam Is normal. Your center has no resources for observing pediatric patients. What is your next step in management?

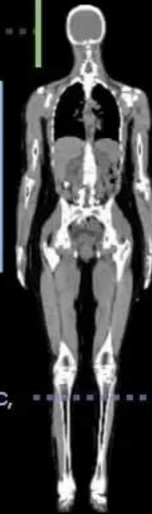
A. CT Scan of the abdomen
B. Obtain FAST-in the ED
C. Discharge patient to home
D. Stabilize the patient and arrange immediate transfer to a center with appropriate surgical resources

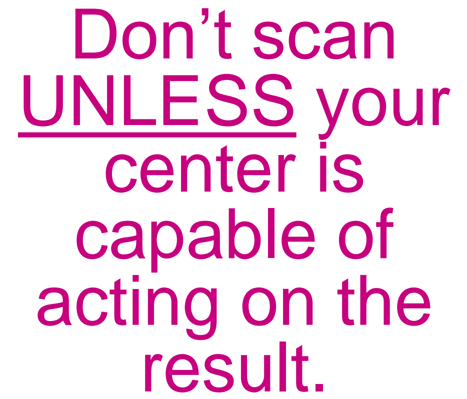
MAVIG
MAVIG
LightSpeed

PAN SCAN

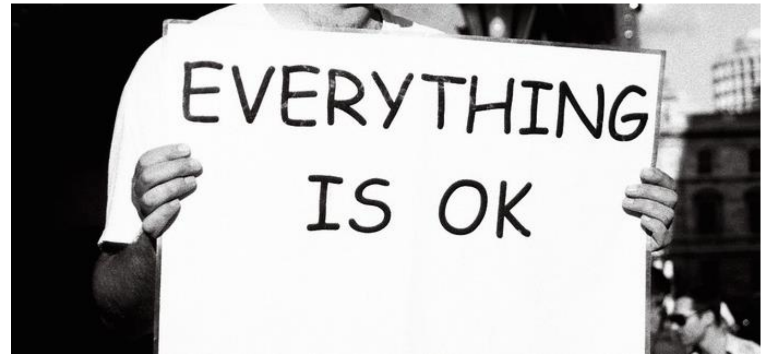
Whole Body CT (WBCT)

1. Non-contrast head, cervical spine
2. IV contrast enhanced imaging of the chest, abdomen and pelvis
3. 3D reconstructions of the cervical, thoracic, and lumbar spine




Don't scan UNLESS your center is capable of acting on the result.
ATLS-10th ED

CT only provides images not <u>reassurance</u>



Safest way to obtain reassurance

OBSERVATION

What is the only imaging “required” prior to transferring an injured child?

image
gently®

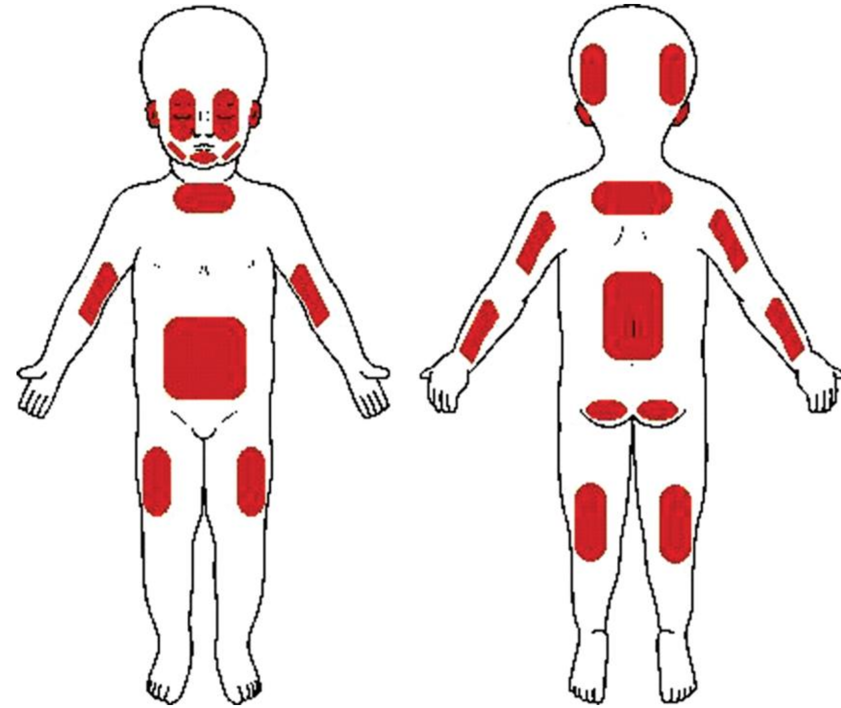
C-SPAN

PRESENTS:

PANTS OF FIRE

The Road to 2000 Lies

- Bruising on the **T**runk, **E**ars, or **N**eck on a child less than 4 years

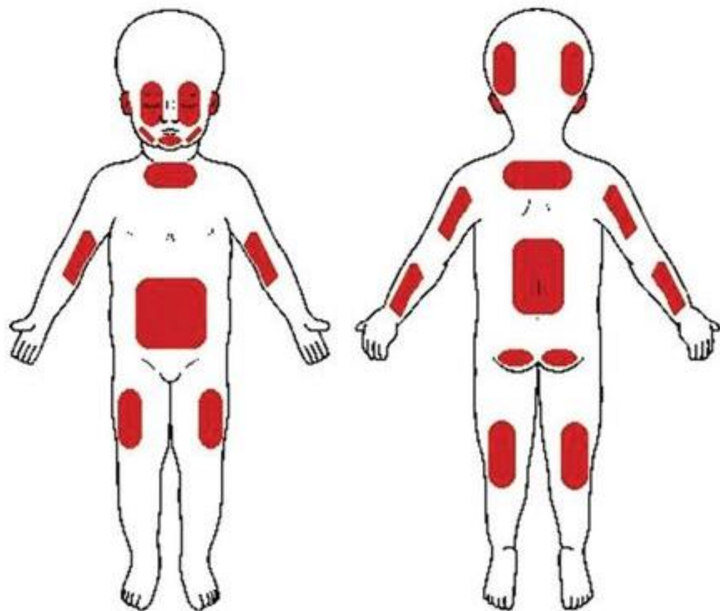


- ANY bruising on a child less than 4 MONTHS

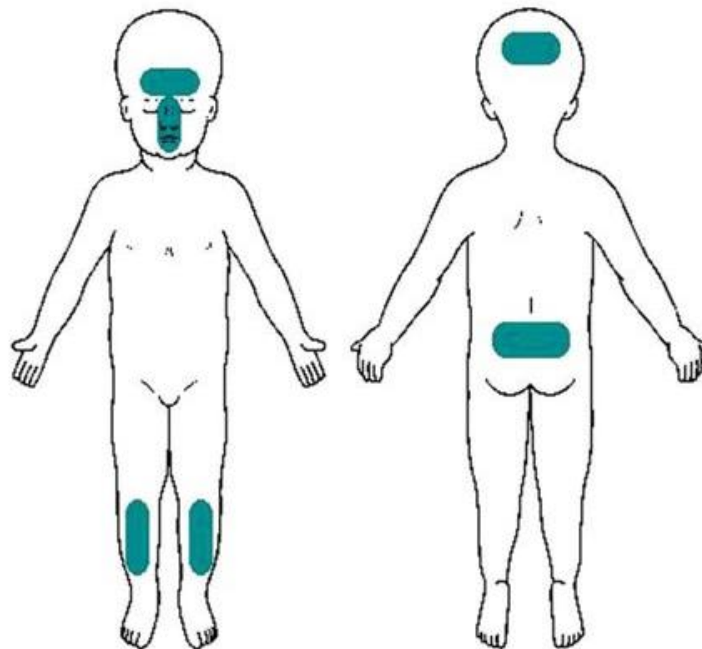
- Injuries to Frenulum

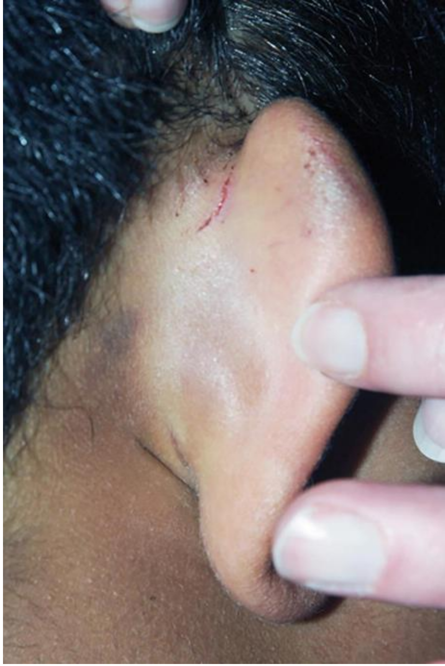
Physical Abuse Bruising

Locations Suggestive of Abuse Patterns

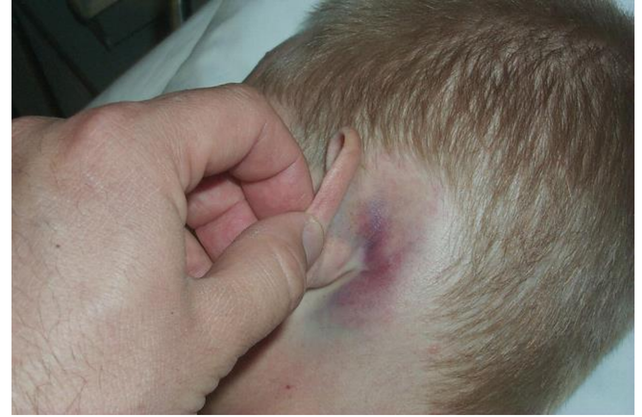


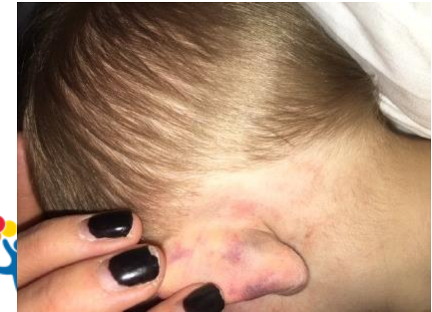
Locations Suggestive Accidental Bruising

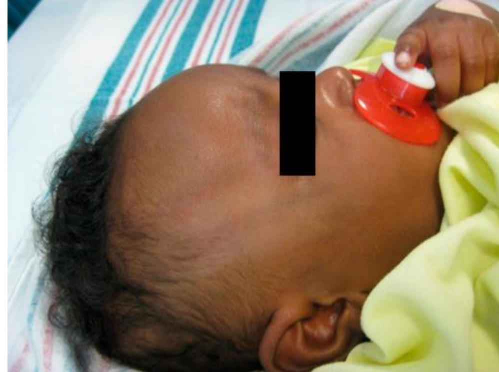


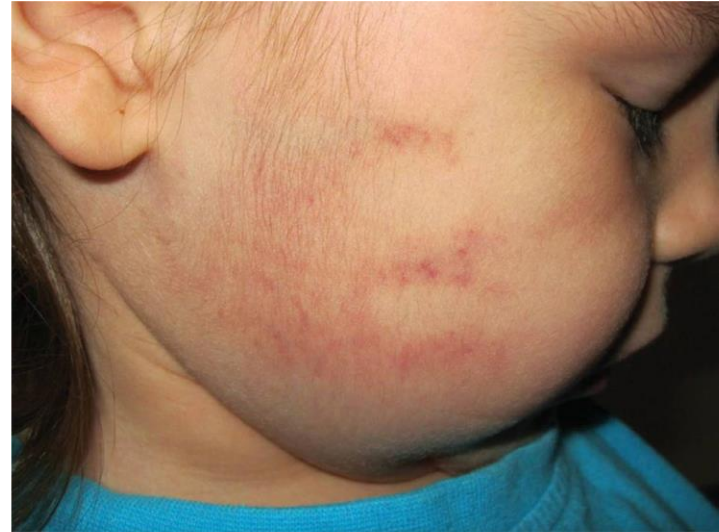


الحدث









What is a provider's responsibility in cases of NAT?

1. Provide expert testimony in court
2. Provide confirmation to law enforcement that an abusive injury has occurred.
3. Collect evidence and provide prosecutorial opinion confirming abuse
4. Report suspected cases of abuse

4. Report suspected cases of abuse

DIAGNOSIS

- Assessment from a PEM
- Consultation with Trauma Surgery
- CPT specialist consultation
- Skeleton Survey
- Retinal Examination
- Axial imaging where appropriate

Questions?

CONTACT US

<u>ONE CALL</u>: For Patient Transfers / Trauma Consults (719) 305-3999

<u>Trauma Program Manager</u>:
Lana Martin
Lana.Martin@childrenscolorado.org or
(719) 305 – 6100 option 2

<u>COS Pediatric Grand Rounds/General Surgery</u>:
Mike Pirtle
Michael.Pirtle@childrenscolorado.org or
(719) 305-6100 option 4

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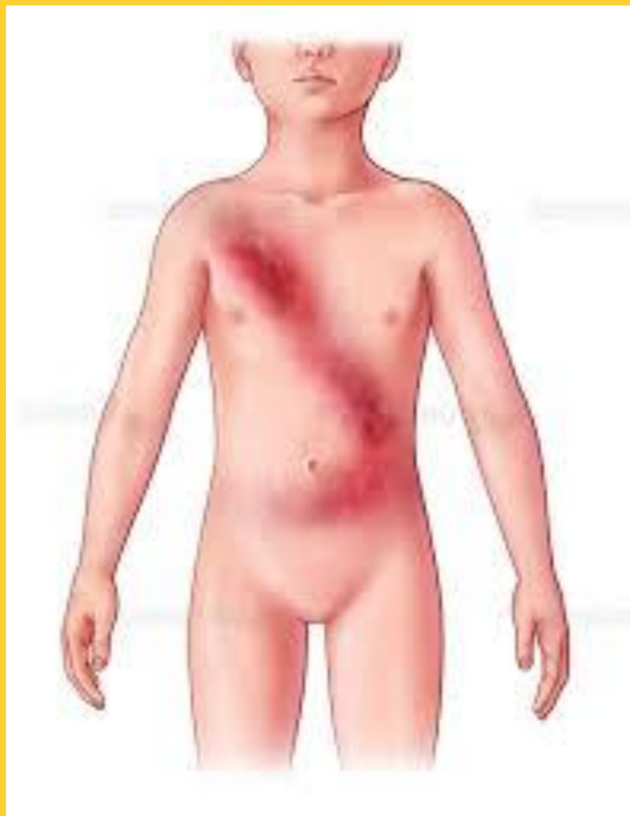
Here, it's different.™

Do you have to identify every injury prior to transfer of the patient?



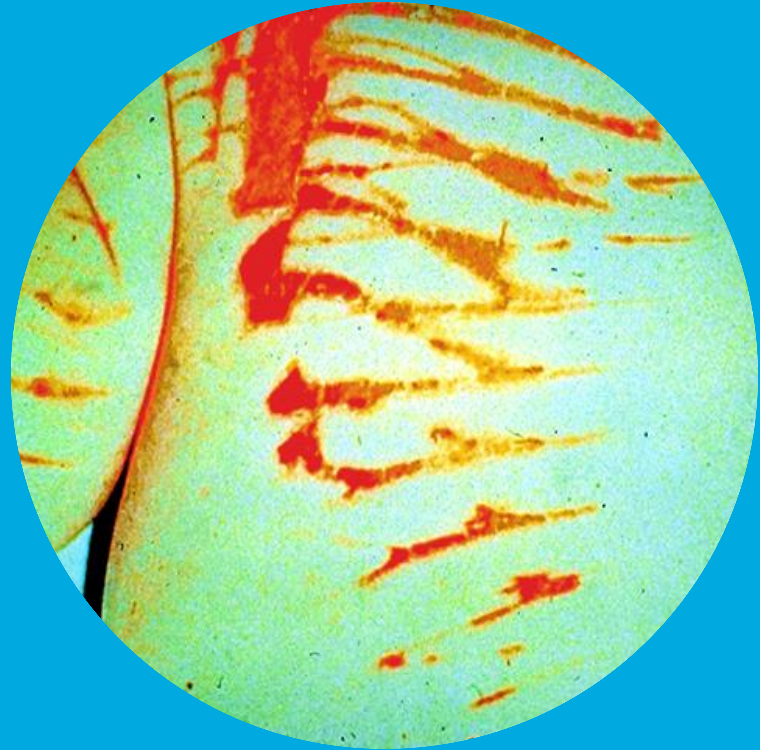
Mechanisms of Injury and Biomechanics

- Motor vehicle crashes
- Falls
- Lap belt complex
- Air bag injuries

Child Maltreatment

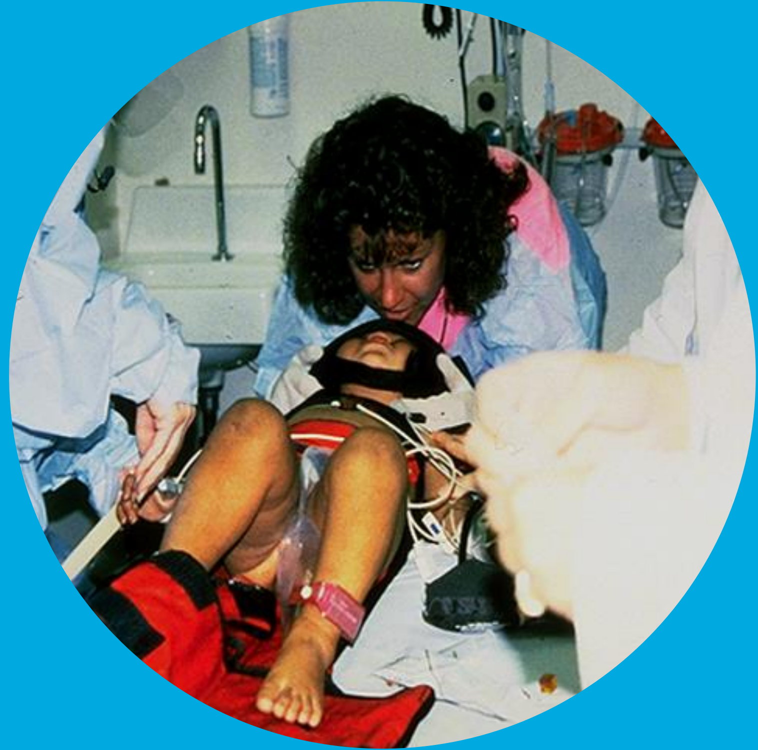
Associated with:

- Head injuries
- Burns
- Abdominal injuries
- Soft tissue injuries
- Fractures



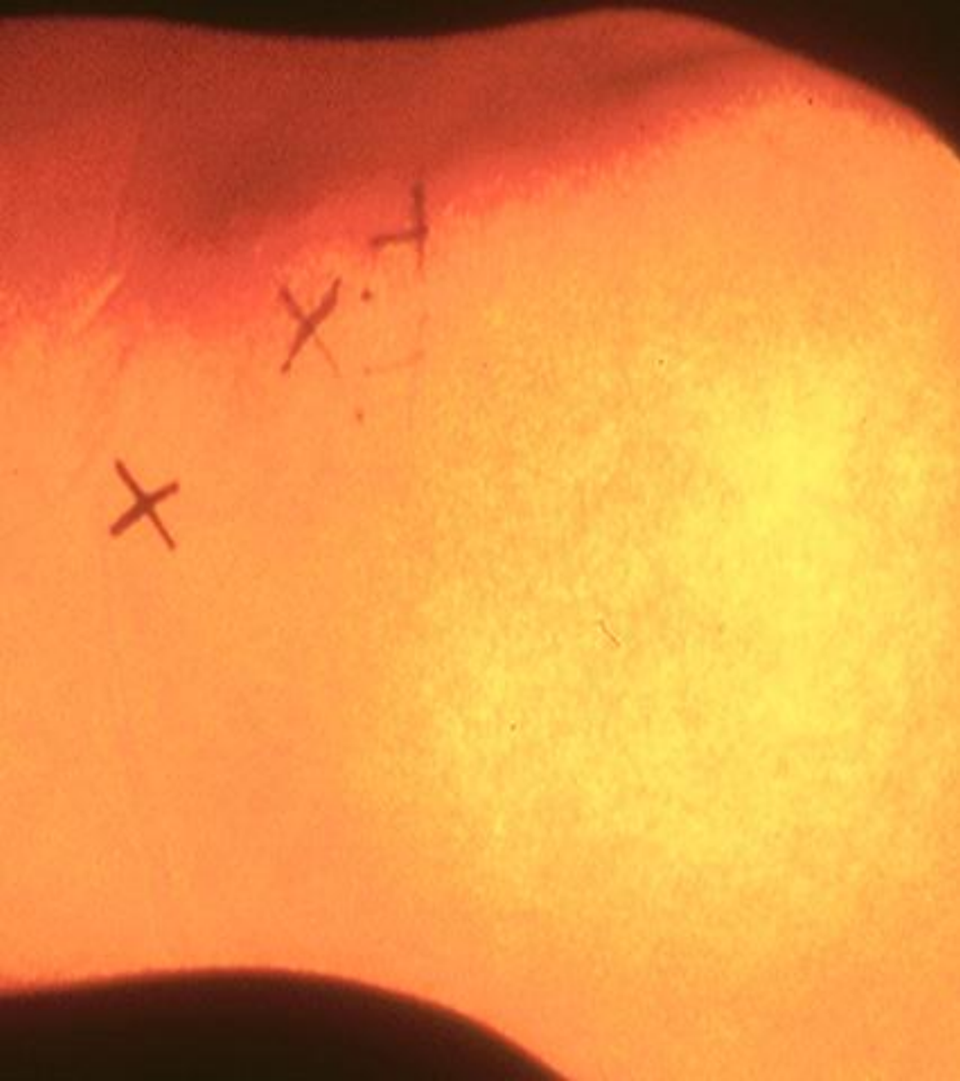
Types of Injuries

- Blunt trauma: 80%
- Order of frequency
  - Head
  - Musculoskeletal
  - Abdomen, liver and spleen most common abdominal injury
  - Thorax



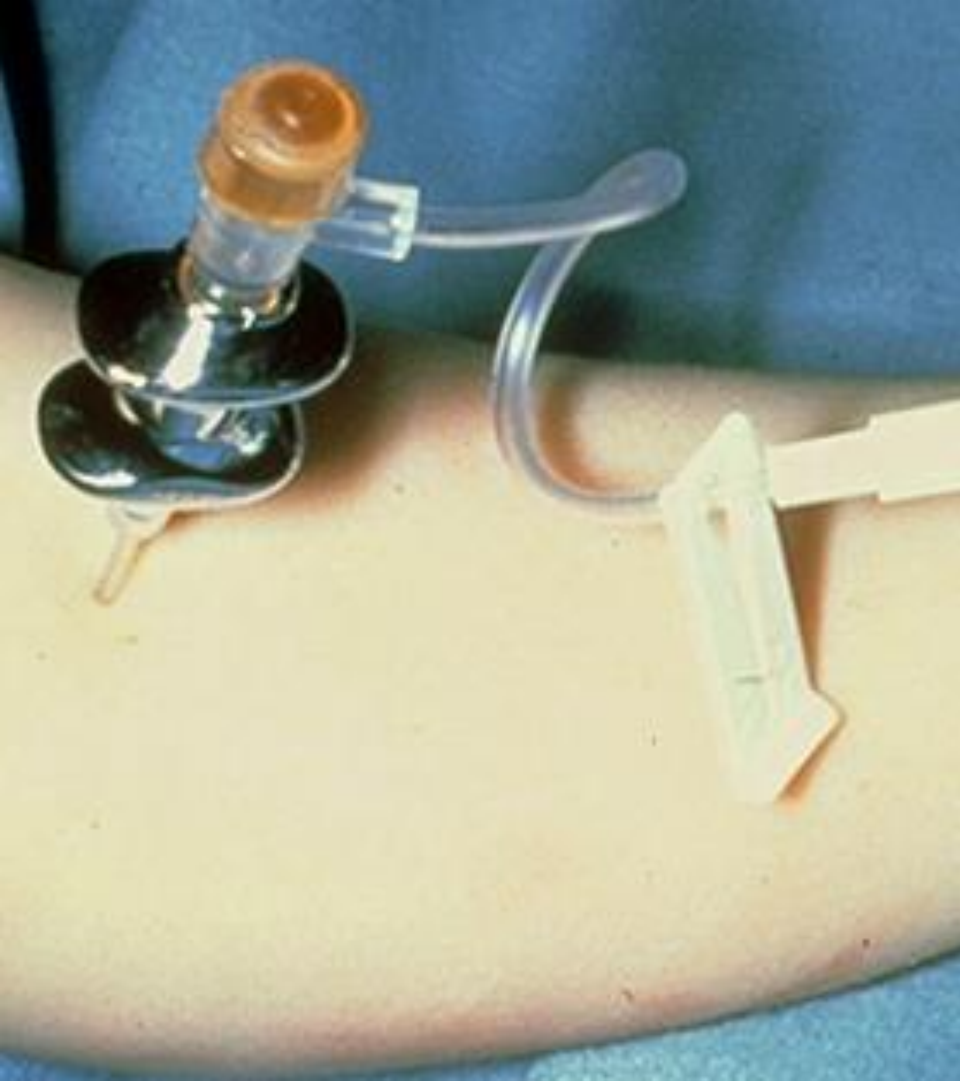
What are the patient care responsibilities in centers without the resources for definitive care ?

Child on a Backboard



Site for Intraosseous Infusion

If peripheral venous access cannot be established within 3 attempts or 90 seconds, initiate intraosseous (IO) access with a 16- or 18-gauge bone marrow needle.



Intraosseous Infusion

- In children under 6 years of age, use the proximal tibia
- Verify placement by aspiration of bone marrow
- Fluid, blood, and medications can be infused

Planning and Implementation

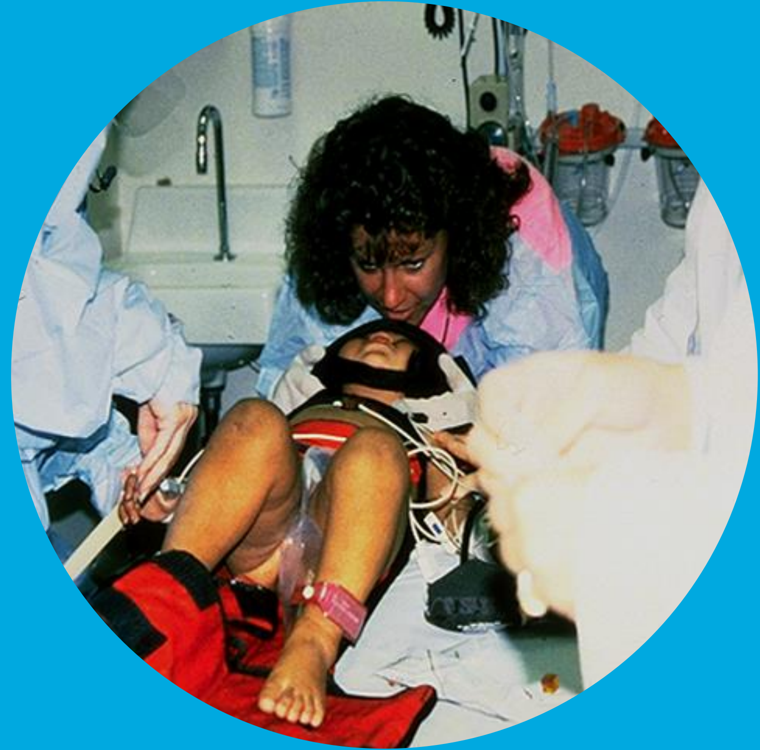
- Insert an indwelling catheter
  - Infants: 2 ml/kg/hr
  - Children: 1 ml/kg/hr
- Keep the child warm
- Get a complete set of vital signs, including temperature
- Obtain a pediatric consult

Psychosocial support

- Utilize anxiety-reducing techniques
- Provide family members with information; include them in care; refer them to support programs
- Report suspected child maltreatment
- Prepare for operative intervention, admission, or transfer
- Provide injury prevention teaching

Monitor

- Vital signs
- Urinary output
- Level of anxiety of patient and family and their ability to cope



Summary

Planning and Implementation

Psychosocial support

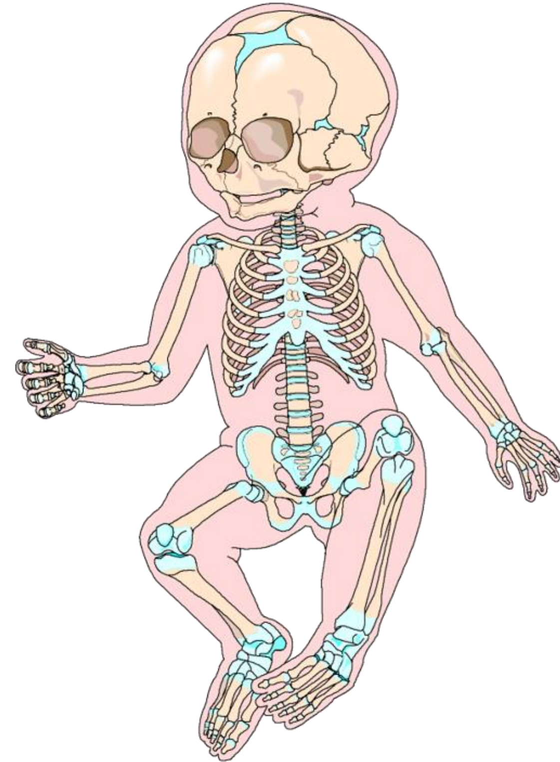
- Utilize anxiety-reducing techniques
- Provide family members with information; include them in care; refer them to support programs
- Report suspected child maltreatment
- Prepare for operative intervention, admission, or transfer
- Provide injury prevention teaching

Childhood Injuries

- Injury mortality accounts for more deaths annually than all other childhood illness COMBINED
- Kids are different-Anatomy, physiology and mechanisms of injury produce patterns of injury that are distinct from adults
- Injuries must be considered in terms of both age and stage of development.
- Neurologic and respiratory derangements far exceed hemodynamic derangements.

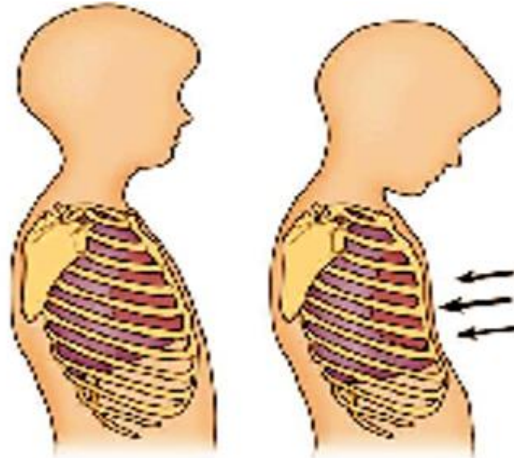
Anatomy

- Larger head, softer cranium, open fontanelles
- Open physeal spaces, flexible cartilagenous skeleton



Anatomic and Physiologic Differences

Anatomic/Physiologic Differences	Clinical Correlation
• Softer, thinner chest wall	• Lung injury more frequent
• Compensatory vasoconstriction	• Normal blood pressure with early shock
• Larger body surface/mass ratio	• Multiple system injury common; heat loss



Mission

As a private, non-profit pediatric hospital, our mission is to improve the health of children through the provision of high-quality, coordinated programs of patient care, research, education and advocacy.

Patient Care

We keep our patients and their families at the center of everything we do, especially when it comes to experience, quality and safety. Equipped with the most advanced technology, our experts deliver some of the best outcomes in the country.

Research

We offer our patients the most innovative treatments today. Collaborating with our colleagues from the University of Colorado on the Anschutz Medical Campus ensures that our discoveries rapidly lead to new medicines, devices and treatment practices.

Education

Lifelong learning advances our mission. Through academic and community partnerships, we shape the future of pediatric health by training tomorrow's health care professionals.

Advocacy

Our influence extends beyond our health system. We bring health programs to the community and advocate in the state and national legislatures.

Vision

Child health. Reimagined. Realized.

Values

For a child's sake…

We are a caring community called to honor the sacred trust of our patients, families and each other through humble expertise, generous service and boundless creativity.

…This is the moment.

Where We Are

1 Pediatric expertise at Memorial Central

2 Urgent and Outpatient Specialty Care

3 Therapy Care, Printers Park

4 Therapy Care, Pueblo

5 Children's Hospital Colorado Foundation

★ Children's Hospital Colorado—Colorado Springs

What We Bring

First
Pediatric only hospital in Southern Colorado

First
Operating rooms built just for kids

First
Emergency room built and staffed for kids only

First
Epilepsy monitoring unit for just kids

Our families complete our care team

We include patients and their families in every care decision — and we do our best to make sure they don't have to worry about anything else while they're here. We know kids need to play, learn and connect, even when they're sick, and we offer dozens of amenities to help them do just that.

For kids:

Child Life specialists help children to cope and feel comfortable in the hospital.

Philips Ambient Experience MRI puts kids in a jungle or deep sea adventure to make testing less stressful.

Creative Arts therapists promote physical and emotional health through yoga, art, dance and music.

Seacrest Studios connects kids in the hospital with an in-house radio and TV broadcast studio.

Playrooms on every floor offer antsy kids an outlet, wherever they are.

Teen Zone offers adolescents a 3,000 square-foot hangout with tons of amenities.

For families:

Private rooms with full-size pullout beds and ample storage

A Family Resource Center, where parents can recharge while kids are in the hospital

A chapel and Spiritual Care for people of any faith

Daycare for siblings at our Creative Play Center

Outside areas and gardens where families can relax and get some fresh air

Flat-screen TVs, internet access and on-demand video in every room

The Difference

Childhood Injuries	Adult Injuries
Fell off my bike.	Slept wrong.
Fell out of a tree.	Sat too long.
Twisted my ankle.	Sneezed too hard.

Pitfalls

DANGER!

- Gastric dilation can increase risk of aspiration and cause hypotension
- Difficult intravenous access in children <6 years
- Missed hollow viscus injury
- Subtle musculoskeletal injury findings