



WELCOME TO THE ER

You'd better hope you brought a book.

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Rural Pediatric Trauma

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MARSHFIELD MEDICAL CENTER

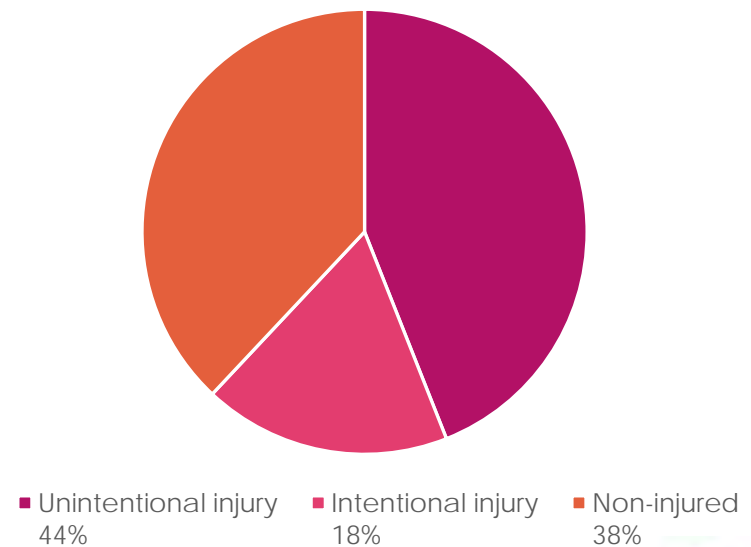
Objectives

- ▶ Scope of rural pediatric trauma
- ▶ The initial assessment of kids
 - ▶ Anatomical considerations and pitfalls
- ▶ FAST exam and imaging
- ▶ What do we need to do for transfer?
- ▶ Summary and Questions

Scope of the problem

- ▶ Injuries remain leading cause of death in 1-19 year olds
- ▶ Each year, over 1 million ER visits for non fatal injuries
 - ▶ 12,000 children die from unintentional injury
- ▶ Costs are an extreme burden for acute care hospitals AND families
 - ▶ Estimate cost of all injured patients in the US \$671 Billion (2013)
 - ▶ \$22.4 Billion represents non-fatally injured kids between 0-14 years old

Cause of death 1-19 years



Access to pediatric trauma centers

RURAL TRAUMA CARE IS VITAL FOR OUR KIDS!

- ▶ 17.4 million children do not have access to pediatric trauma centers within 1 hour
- ▶ 90% of injured children do not have their first point of contact at a designated pediatric trauma center
 - ▶ As of 2018, only 109 ACS Designated Level I/II centers
- ▶ Most care lead by adult specialists with interest and variable training in pediatric specific trauma topics



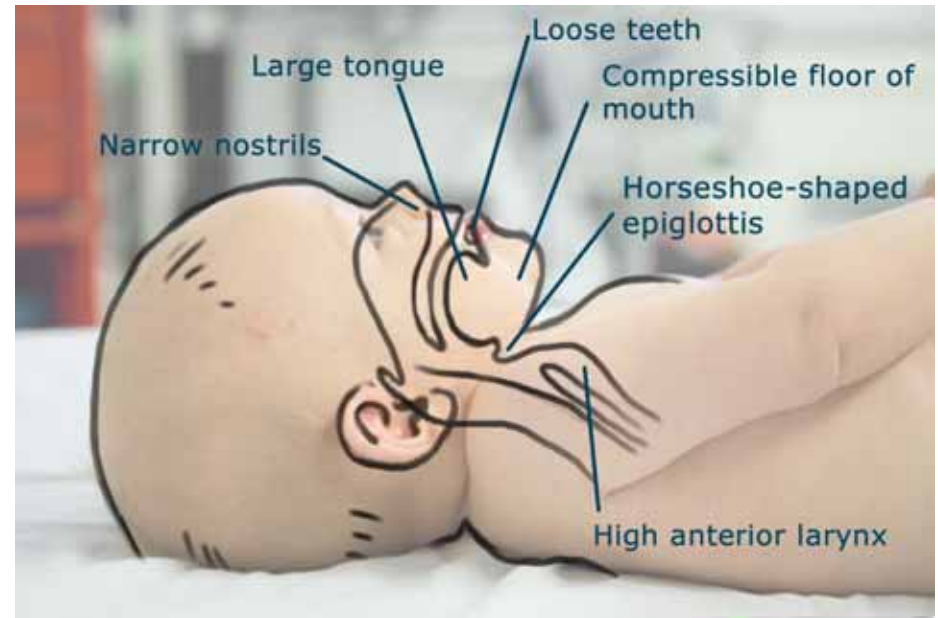
When an injured trauma patient arrives...

- ▶ Be prepared!
 - ▶ Apply activation criteria that MAKES SENSE FOR YOU INSTITUTION
 - ▶ ACS COT has suggestions, MMC-Marshfield enthusiastic to be a local resource
 - ▶ COVID preparation (yuck!)
 - ▶ Pediatric specific "carts"
 - ▶ Airway equipment, Access equipment, Broselow/PAWPER tape
 - ▶ Pediatric signage
 - ▶ Pediatric specific protocols
 - ▶ Rapid Sequence Intubation, Fluid/Blood administration, I/O access



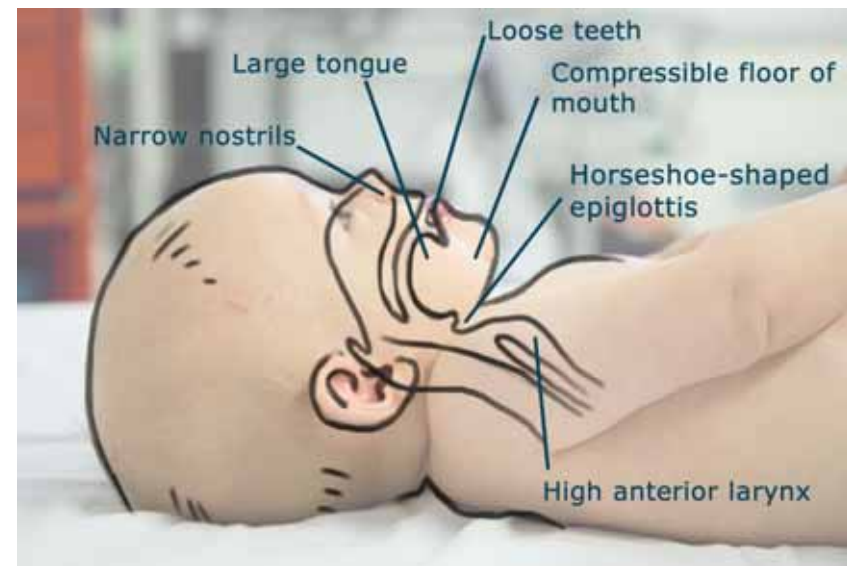
Initial assessment

- ▶ Primary Survey (ABCDE's) – **AIRWAY**
 - ▶ Most preventable deaths in children <14 due to airway complications
 - ▶ Prominent occiput that tilts the head forward
 - ▶ Short neck/Increased lymphoid tissue
 - ▶ Floppy epiglottis
- ▶ Simple upper airway maneuvers key
 - ▶ Jaw thrust/Chin lift
- ▶ Desaturations are rapid
 - ▶ O₂ consumption from high metabolic rate
 - ▶ Limited functional reserve capacity of lung



AIRWAY TIPS

- ▶ Oral intubation most common
 - ▶ Some evidence that VL has better visualization of glottis, but longer time to intubation and increased failure rates
 - ▶ **DO WHAT YOU ARE BEST AT**
 - ▶ Most narrow portion of airway a cricoid membrane (not vocal cords)
 - ▶ Size of ETT: $AGE/4 + 3.5$ (cuffed preferred)
 - ▶ 3 X diameter of tube = length to secure at lip



Airway pitfalls

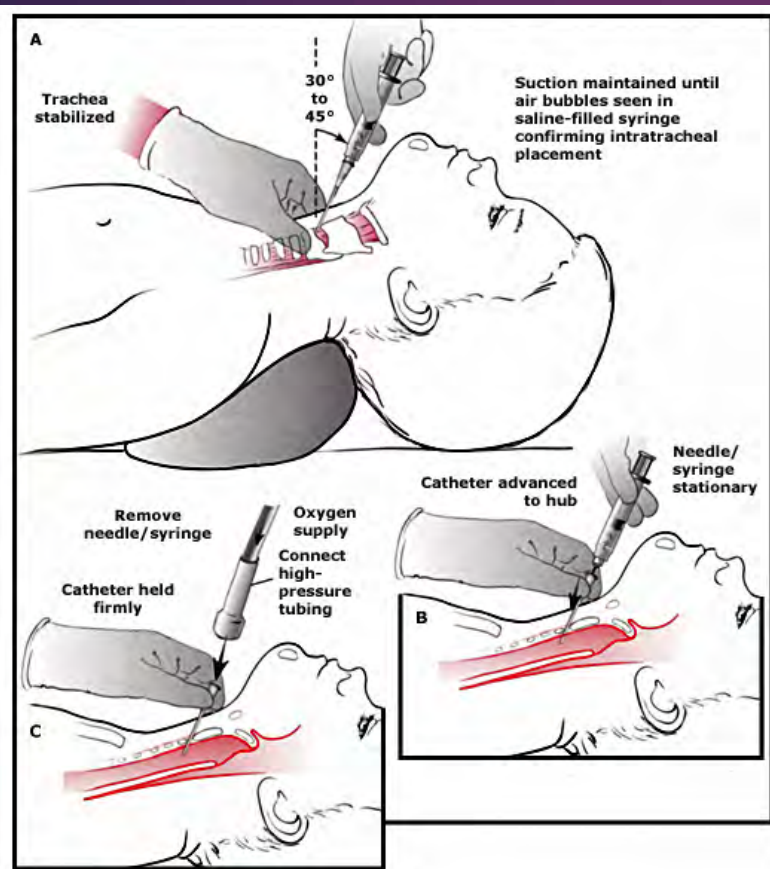
LMA Supreme



Figure 1: Fully deflated. Attach a syringe. Compress mask with thumb and maintain tension to the inflatable cuff until a vacuum is felt.



Figure 4: Press the hard palate. Maintain pressure on the hard and soft palate, continue to rotate the mask in a circular motion until the mask is seated.



neutral or Supreme™ pointing distal



Secure to cheek across or to inflation. needed to inflated intracuff

▶ Rescue strategies

- ▶ Use a colorimetric device (EtCO₂ > 4%)
- ▶ Insert a LMA if unsuccessful

Child weight	LMA size
<5 kg	#1
5-10 kg	#1.5
10-20 kg	#2
20-30 kg	#2.5
30-50 kg	#3

Initial assessment

Age	Respiratory Rate
<1 year	30-40
1-2 years	25-35
2-5 years	25-30
5-12 years	20-25
>12 years	12-20

- ▶ Primary Survey (ABCDE's) – **B**reathing
 - ▶ Children use diaphragm more due to underdeveloped chest wall musculature
 - ▶ Chest wall highly compliant with less ossified ribs
 - ▶ **Rib fractures suggest significant injury**
 - ▶ More likely to have TBI, HTX/PTX, and liver and spleen injuries
 - ▶ Very sensitive marker for trauma center need
 - ▶ Mediastinum very mobile
 - ▶ Concern for tension pneumothorax

Initial Assessment

- ▶ Primary Survey (ABCDE's) – Circulation
- ▶ NOT JUST THE BLOOD PRESSURE
 - ▶ Level of consciousness, skin color, HR, peripheral pulses
 - ▶ BP can be falsely misleading
- ▶ Signs of decompensated shock
 - ▶ Altered mental status
 - ▶ Mottled skin with capillary refill >2 sec
 - ▶ Weak pulses

Age	Heart Rate beats/min	Systolic BP (mm Hg)	Diastolic BP (mm Hg)
0-3 mo	100-150	65-85	45-55
3-6 mo	90-120	70-90	50-65
6-12 mo	80-120	80-100	55-65
1-3 yr	70-110	90-105	55-70
3-6 yr	65-110	95-110	60-75
6-12 yr	60-95	100-120	60-75
> 12 yr	55-85	110-135	65-85

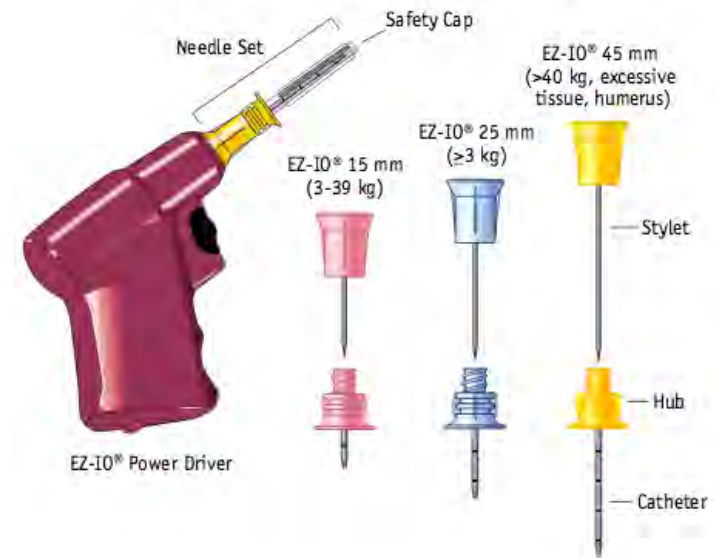
Adapted from: Mathers LH, Frankel LR. Stabilization of the Critically Ill Child. *Nelson textbook of pediatrics*, 17th Edition, 2004.¹⁹

OK to call for transfer IMMEDIATELY!!!



Circulation Pitfalls

- ▶ IV Access can be challenging
 - ▶ Smaller veins and more subcutaneous fat
 - ▶ Vein collapse from hypovolemia, hypothermia, hematomas and fractures
 - ▶ First attempt in AC, then saphenous vein at ankle, Interosseous catheter placement (after 3 tries) in proximal tibia, proximal humerus, or distal femur
- ▶ 20mL/kg bolus of LR or 0.9%NS
 - ▶ Repeat once then proceed with blood



Disability

- ▶ Assessment of level of consciousness, pupillary exam, and neurological exam
- ▶ Pediatric Glasgow Coma Scale
 - ▶ Have it on the wall!
- ▶ Serious brain injury
 - ▶ Unilateral pupil dilatation suggests impending herniation
 - ▶ Intubation followed by brief hyperventilation (EtCO₂ of 30)
 - ▶ Administer 3% hypertonic saline at (1-5mL/kg)
 - ▶ Avoid mannitol unless certain isolated head injury

PEDIATRIC GLASGOW COMA SCALE (PGCS)				
	> 1 Year	< 1 Year	Score	
EYE OPENING	Spontaneously	Spontaneously	4	
	To verbal command	To shout	3	
	To pain	To pain	2	
	No response	No response	1	
MOTOR RESPONSE	Obeys	Spontaneous	6	
	Localizes pain	Localizes pain	5	
	Flexion-withdrawal	Flexion-withdrawal	4	
	Flexion-abnormal (decorticate rigidity)	Flexion-abnormal (decorticate rigidity)	3	
	Extension (decerebrate rigidity)	Extension (decerebrate rigidity)	2	
	No response	No response	1	
	> 5 Years	2-5 Years	0-23 months	
VERBAL RESPONSE	Oriented	Appropriate words/phrases	Smiles/coos appropriately	5
	Disoriented/confused	Inappropriate words	Cries and is consolable	4
	Inappropriate words	Persistent cries and screams	Persistent inappropriate crying and/or screaming	3
	Incomprehensible sounds	Grunts	Grunts, agitated, and restless	2
	No response	No response	No response	1
TOTAL PEDIATRIC GLASGOW COMA SCORE (3-15):				

Exposure

SIGNS THAT YOU
MAY HAVE FROZEN
PLUMBING ...



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- ▶ Children are more susceptible to hypothermia
 - ▶ Can lead to arrhythmias, coagulopathy, and persistent acidosis
 - ▶ 9.2 X more likely to die if arrive cold on transport
- ▶ Set trauma room temperature to 80 degrees
- ▶ Remove all wet cloths (including partially cut off)
- ▶ Use warmed IVF, Bair hugger when temperature is below 36 degrees C

Initial Labs/Imaging

- ▶ **IMAGING IS NOT REQUIRED FOR TRANSFER, DO NOT DELAY FOR IMAGES!!!**
- ▶ Order labs and images only if it will directly influence your management
 - ▶ CXR in all cases
 - ▶ Pelvic fracture uncommon in children, obtain only with concerning signs or physical exam (unexplained hypotension, pelvic instability, blood at penile meatus or urethra)
 - ▶ NO routine lab tests have good sensitivity, specificity, PPV or NPV alone!
 - ▶ MMC-M T&S only, +/- CBC for level 2 activations,
 - ▶ Highest level activations test for metabolic state (ABG), blood loss (CBC) and coagulopathy (TEG)

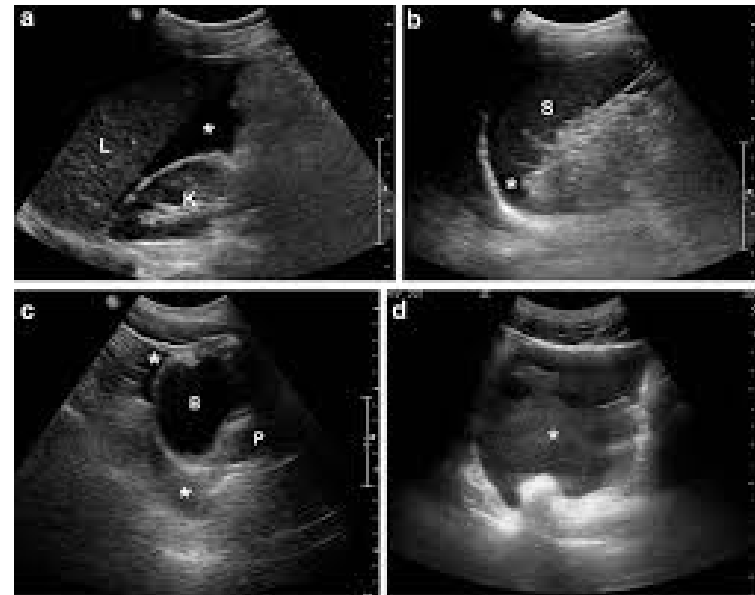
Image Gently Campaign

- ▶ Half of all radiation attributable to medical imaging
- ▶ Pediatric patients account for only 4% of all CT imaging, but 20% of all CT related cancer deaths
 - ▶ Linear relationship between development of leukemia and chest/brain cancer
 - ▶ Estimated that between 1 in 570 to 1 in 6130 CT scans will lead to childhood cancer depending on age, sex, and type of study
- ▶ ONLY order the test if it will influence your centers care of the patient
- ▶ Regional Trauma Advisory Council (RTAC) has a position statement out supporting this for northern Wisconsin
- ▶ “The 5 things that physicians should question” is the routine use of whole body diagnostic CT scanning



Focused Assessment with Sonography for Trauma (FAST)

- ▶ Is an adjunct to the primary survey in many centers, depending on availability and user training
- ▶ Due to poor sensitivity FAST should not be used to Rule Out injury
 - ▶ 30- 50% of negative FAST exams have solid organ injury in children with concerning exam findings
- ▶ Abdominal tenderness has a 6X increase risk of significant abdominal trauma
 - ▶ Other important findings are bruising/seatbelt sign, cyanosis



Summary

- ▶ Trauma remains the #1 cause of death for children ages 1-19
 - ▶ Most children do not have access to dedicated trauma centers and are initially treated by adults practitioners with an interest in pediatrics – **THANK YOU!**
- ▶ Be prepared – Have signage of important protocols, drug dosages, and data
- ▶ Airway issues are the #1 cause of preventable deaths
 - ▶ Due to anatomic features of a child's head and neck
 - ▶ Chose the correct size: $\text{age}/4 + 3.5$ or size of pinky finger
 - ▶ Tape at the correct distance: Tube size X3 = distance to insert tube at lip
 - ▶ Use a LMA for rescue



Summary Cont...

- ▶ Access can be challenging
 - ▶ Start with antecubital fossa, hand, and then saphenous
 - ▶ Failed attempts X 3, move to I/O access
- ▶ Resuscitation
 - ▶ Start with LR bolus 20mL/kg X2
 - ▶ Move to blood early and during transport if able
 - ▶ FAST exam cannot exclude intra-abdominal source of blood loss
- ▶ Imaging
 - ▶ CXR in nearly all cases
 - ▶ Order only tests that will impact YOUR management
 - ▶ Never delay transport for imaging

QUESTIONS?

