



Providing Evidence-Based Care for Children on Ambulances

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Conflicts and Funding

I have no relevant financial conflicts of interest to disclose

Funding for Projects Discussed in This Presentation

- ***Integrating Evidence-Based Pediatric Prehospital Protocols into Practice***
 - Health Resources and Services Administration (HRSA) EMS for Children (EMSC) Targeted Issues Grant (09/10-08/14) – PI
- ***Pediatric Evidence-Based Guidelines: Assessment of EMS System Utilization in States (PEGASUS)***
 - HRSA EMSC Targeted Issues Grant (09/13-08/17) – PI
- ***Charlotte, Houston, and Milwaukee Prehospital (CHaMP) Research Node***
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Objectives

- To provide a framework for identifying sick pediatric patients
- To increase knowledge about pediatric prehospital management of:
 - Allergic reactions
 - Respiratory distress/failure
 - Seizures
 - Shock
 - Spinal care
 - Pain

Normal Vital Signs

Patient Age Distributions

Neonate :	"Newly Born" < 1 hour old
Infant	≥ 1 hour old and < 1 year old
Child	≥ 1 year old and < 8 years old
Adolescent	≥ 8 years old and < 16 years old
Adult	≥ 16 years old

Normal Vital Signs by Age Group

Age Group	Respiratory Rate / Min.	Pulse/Min.	Systolic BP
Neonate	30-60	120-160	≥ 70
Infant	25-40	120-160	≥ 70
Child	20-30	80-120	70 + (age in yrs. x 2)
Adolescent	15-20	60-110	90-120
Adult	8-12	60-100	90-140

Pediatric Assessment Triangle

Tool to visually differentiate “sick vs. not sick”



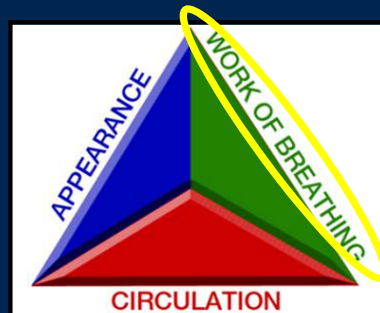
Appearance

- What types of things are you LOOKING for?
 - Awake and alert
 - How are they interacting (eye contact)
 - Motor strength
 - Speech or cry (strong vs weak)



Work of Breathing (WOB)

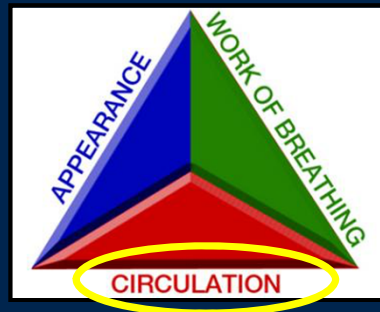
- How can you assess WOB by LOOKING/LISTENING?
 - How fast?
 - Retractions/nasal flaring
 - Auscultation:
 - Wheezing
 - Rales
 - Rhonchi
 - Stridor
 - Grunting
 - Congestion (stertor)



Circulation



cool/clammy vs warm/dry)



EBGs do **NOT dictate** protocol content, but provide **freedom** to integrate best practices while considering:

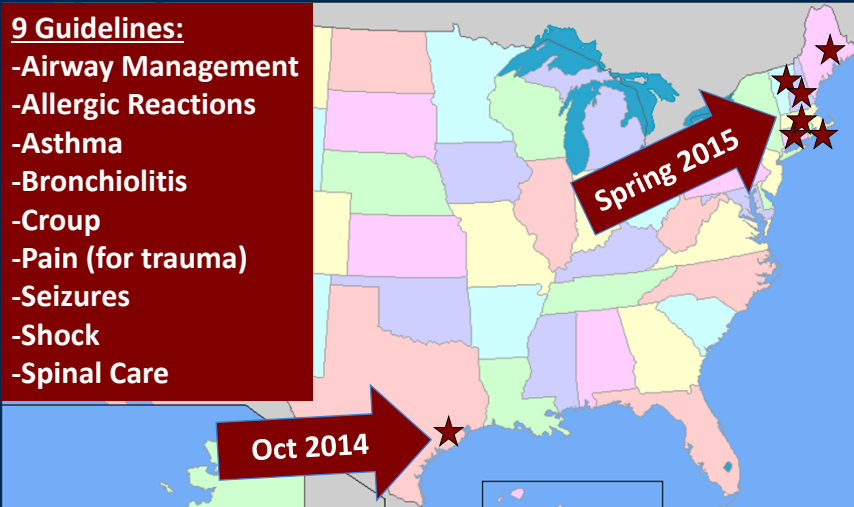
- Provider skills and training
- Cost and local resources

EVIDENCE QUALITY	STRONG (desirable effects ≠ undesirable effects)	WEAK (desirable effects ≈ undesirable effects)
High (Well-performed RCT/unbiased observational study)	Prehospital studies → limited	
Moderate (Limited RCT/unbiased observational study)	<ul style="list-style-type: none"> • Applies to most patients • Further research likely to affect confidence of recommendation 	<ul style="list-style-type: none"> • Alternative approaches may be better for some patients • Further research likely to affect confidence of recommendation
Low (Critical outcome from observational/flawed RCT)	<ul style="list-style-type: none"> • Recommendation may change with higher quality evidence • Further research likely to affect confidence of recommendation 	<ul style="list-style-type: none"> • Alternatives may be equally reasonable • Further research likely to affect confidence of recommendation
Very Low (Unsystematic clinical observation)	<ul style="list-style-type: none"> • Recommendation may change with higher quality evidence • Estimate of effect is uncertain 	<ul style="list-style-type: none"> • Alternatives may be equally reasonable • Estimate of effect is uncertain

Pediatric Evidence-Based Guidelines: Assessment of EMS System Utilization in States (PEGASUS)

9 Guidelines:

- Airway Management
- Allergic Reactions
- Asthma
- Bronchiolitis
- Croup
- Pain (for trauma)
- Seizures
- Shock
- Spinal Care



Case



Signs of Anaphylaxis

Known/likely allergen exposure
+
Hypotension
OR
Respiratory compromise

Signs of Anaphylaxis

Acute onset of **at least 2** of the following categories:

- **Angioedema:** Facial/lip/tongue swelling, throat tightening, voice change
- **Breathing:** Shortness of breath, wheeze, stridor, cyanosis
- **Poor perfusion:** Altered mental status, syncope, delayed capillary refill, hypotension
- **Rash:** Hives, itching, extremity swelling
- **Gastrointestinal:** Vomiting, abdominal pain

Severity should be differentiated as
ANAPHYLAXIS vs. NON-ANAPHYLAXIS

Allergic Reactions	
DO	DON'T
<ul style="list-style-type: none"> • Give an H1-blocker PO/IM/IV (e.g. diphenhydramine 1 mg/kg) for pruritus 	<ul style="list-style-type: none"> • Use a cardiac monitor for 1 dose of epinephrine
<ul style="list-style-type: none"> • Give an H2-blocker PO/IV with an H1-blocker for urticaria 	<ul style="list-style-type: none"> • Give steroids
<ul style="list-style-type: none"> • Give epinephrine (0.3 mg for ≥ 25 kg; 0.15 mg for < 25 kg) IM in the thigh via an auto-injector for anaphylaxis 	<ul style="list-style-type: none"> • Give SQ epinephrine
<ul style="list-style-type: none"> • Repeat epinephrine IM Q5-15 min for ongoing anaphylaxis 	<ul style="list-style-type: none"> • Give prophylactic epinephrine in the asymptomatic patient exposed to a known allergen
<ul style="list-style-type: none"> • Use albuterol nebs for wheezing 	
<ul style="list-style-type: none"> • Use epinephrine nebs for stridor or wheezing 	
<ul style="list-style-type: none"> • Treat anaphylactic shock with 60 ml/kg isotonic fluids → epinephrine drip 	

Asthma Management	
DO	DON'T
<ul style="list-style-type: none"> • Assess distress 	<ul style="list-style-type: none"> • Routinely obtain an ECG
<ul style="list-style-type: none"> • Use pulse oximetry 	<ul style="list-style-type: none"> • Give nebulized saline or steam
<ul style="list-style-type: none"> • Apply oxygen if $SaO_2 < 90\%$ 	<ul style="list-style-type: none"> • Routinely place an IV
<ul style="list-style-type: none"> • Give albuterol (4-6 puffs or 2.5-5 mg neb) → multiple 	<ul style="list-style-type: none"> • Routinely give IV fluids
<ul style="list-style-type: none"> • Give PO/IM/IV steroids 	<ul style="list-style-type: none"> • Give inhaled magnesium
<ul style="list-style-type: none"> • Give ipratropium 0.5 mg x 3 	<ul style="list-style-type: none"> • Use heliox
<ul style="list-style-type: none"> • Give IV/IO magnesium (40 mg/kg, max 2 g) 	<p>DO GIVE STEROIDS</p> <ul style="list-style-type: none"> -Dexamethasone: 0.6 mg/kg, PO/IV/IM/IO (max 16 mg) -Methylprednisolone: 2 mg/kg, IV/IM (max 125 mg)
<ul style="list-style-type: none"> • Give IM epinephrine 0.01 mg/kg (1:1000) (or 0.15-0.3 mg autoinj.) 	
<ul style="list-style-type: none"> • Use CPAP 	
<p>2012 version available at: www.bcm.edu/pediatrics/emsc</p>	
<p>Texas Children's Hospital College of Medicine </p>	

Case



Bronchiolitis Management

DO

- Assess distress
- Use pulse oximetry
- Apply oxygen if $\text{SaO}_2 < 90\%$
- **Suction** secretions
- Give **inhaled epinephrine** (0.5 ml racemic or 3 ml 1:1000)
- Use CPAP

DON'T

- Routinely obtain an ECG
- Give albuterol
- Give nebulized saline or steam
- Routinely place an IV
- Routinely give IV fluids
- Give inhaled magnesium
- Use heliox
- Give steroids

Case



Croup Management

DO

- Assess distress
- Use pulse oximetry
- Apply oxygen if $\text{SaO}_2 < 90\%$
- Give **steroids**
- Give **inhaled epinephrine** (0.5 ml racemic or 3 ml, 1:1000) for stridor at rest
- Use CPAP



DO GIVE STEROIDS

-Dexamethasone: 0.6 mg/kg,
PO/IV/IM (max 16 mg)



DON'T

- Routinely obtain an ECG
- Give albuterol
- Give nebulized saline or steam
- Routinely place an IV
- Routinely give IV fluids
- Give inhaled magnesium
- Use heliox

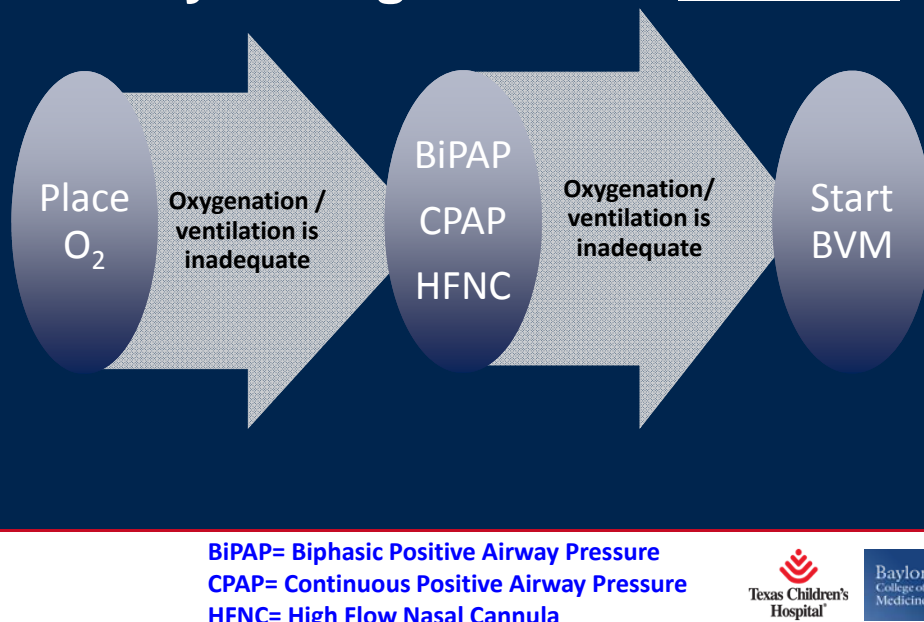
SUMMARY: Respiratory Distress			
Intervention	Asthma	Bronchiolitis	Croup
Oxygen	✓	✓	✓
Suction		✓	
Albuterol	2.5-5 mg neb or 4-6 puffs MDI		
Epinephrine	0.1 mg/kg (1:1000) IM/SQ	3 ml (1:1000) neb	3 ml (1:1000) neb
Ipratropium	0.5 mg neb x3		
Steroids	0.6 mg/kg Dexamethasone PO/IV/IM <u>OR</u> 2 mg/kg Methylprednisolone IV/IM		0.6 mg/kg Dexamethasone PO/IV/IM
Magnesium	40 mg/kg IV		
CPAP	✓	✓	✓

Assessment: Distress vs. Failure		
Parameter	Distress	Failure
Respiratory rate	• Fast	• Slow → apnea
Effort	• Mild retractions/flaring	• Severe → absent
Breath sounds	• Stridor, wheeze, crackles, rhonchi	• Abnormal → diminished
Heart rate	• Tachycardia	• Tachycardia → bradycardia
Skin color	• Pink	• Pale → cyanotic
Oxygen saturation	• >90% on room air	• <90% despite supplemental oxygen
Mental Status	• Normal	• Agitated → decreased

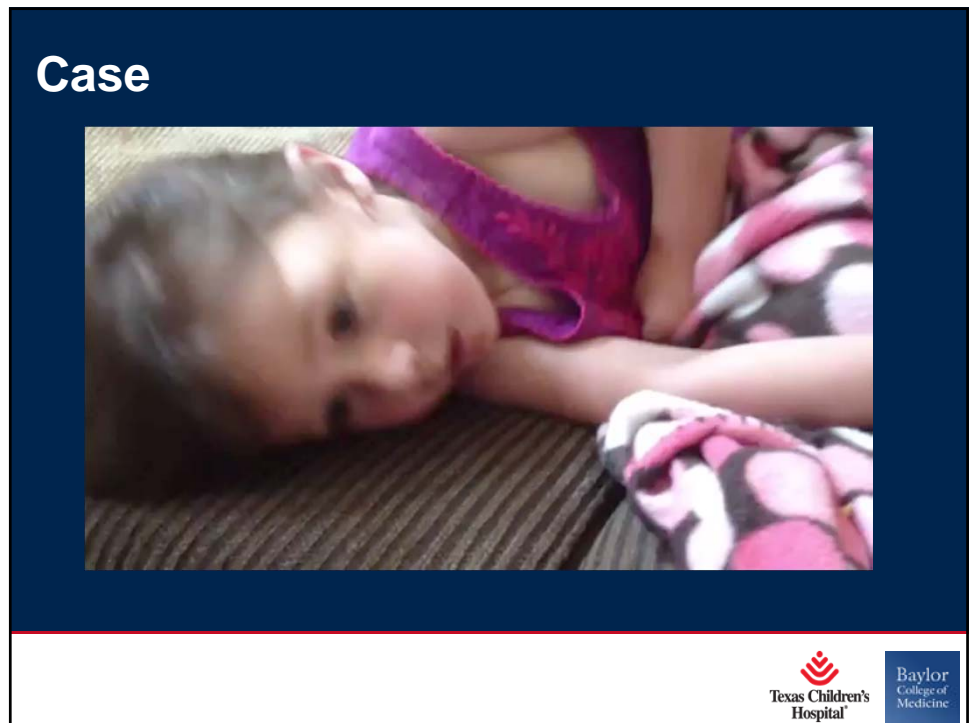
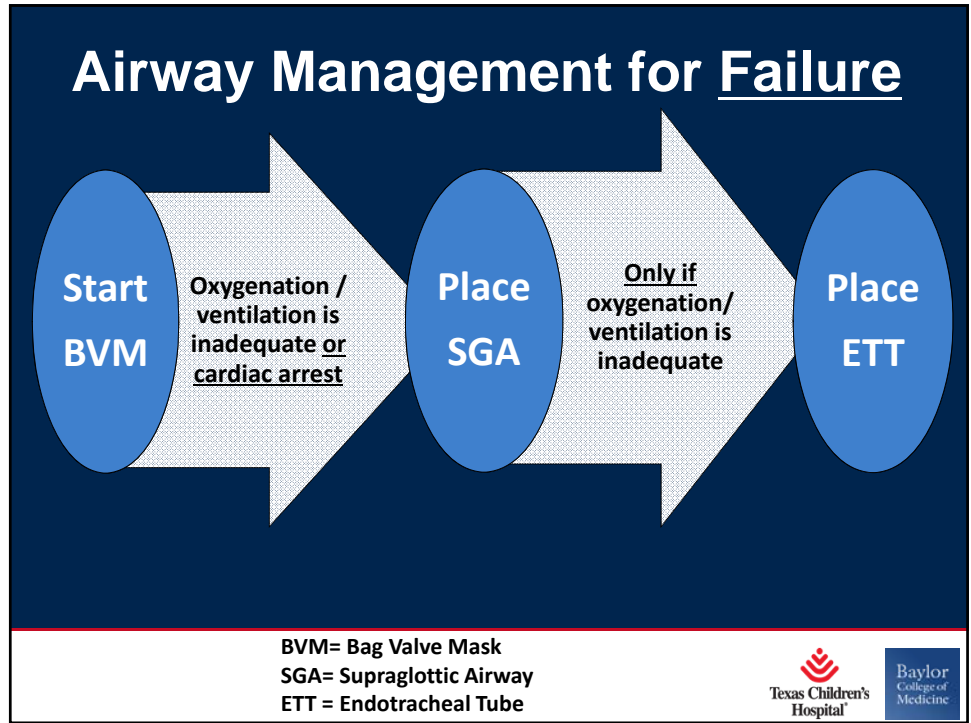



Airway Management for Distress



Bag Valve Mask Troubleshooting

- Reposition the airway
- Suction the mouth
- Check the mask size and seal
- Check O₂ source
- Intervene for gastric distension
- Place oropharyngeal airway



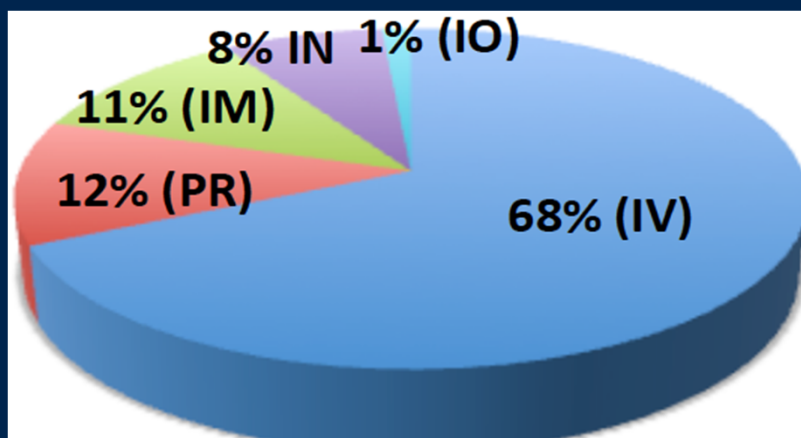
Seizure Management

DO <input checked="" type="checkbox"/>	DON'T <input checked="" type="checkbox"/>
<ul style="list-style-type: none"> Give IM/IN benzodiazepines as 1st line treatment (midazolam 0.2 mg/kg) 	<ul style="list-style-type: none"> Give rectal medication (except EMT/AEMT)
<ul style="list-style-type: none"> IV/IO benzodiazepines (0.1 mg/kg) can be given subsequently after 5 minutes—including diazepam 	<ul style="list-style-type: none"> Place an IV/IO initially
<ul style="list-style-type: none"> Check blood glucose Give dextrose IV/IO (D10, 5ml/kg) or glucagon IM for hypoglycemia (<60 mg/dL) 	<ul style="list-style-type: none"> Require medical control for the 1st 2 doses of medication (apnea risk ↑ after 2 doses)

Shah MI et al. *Prehospital Emerg Care.* 2014; 18(1): 15-24



Simulation Training: No Change




Routes of EMS Administered Midazolam to Seizing Children

Shah MI. *Prehospital Emerg Care.* 2016; 20(4)

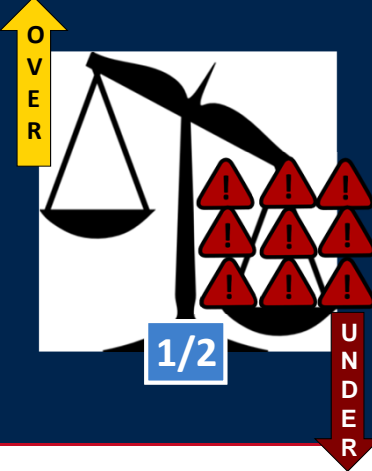


Simulation Training: No Change


Impact of Simulation on Paramedic Seizure Management



1/3





1/2






14 min

Shah MI. *Prehospital Emerg Care.* 2016; 20(4)






Multi-Modal Training: Partial Change

29% → 74%	59% ~ 67%	57% = 57%
		
Preferred Routes	Received midazolam	Correct dose given

Paramedic Adherence After a Pediatric Seizure Protocol Change

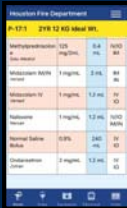
Marino MC. *Prehospital Emerg Care.* 2018

Systems Changes are Required

Paramedic Identified Barriers and Enablers to Seizure Management

Systems Enablers



Systems Barriers



Carey JM. NAEMSP. 2018 (abstract)

Paramedic Solutions



Baylor College of Medicine

Case



Texas Children's Hospital

Baylor College of Medicine

Signs of Shock

SHOCK = Inadequate Perfusion to Organs:

- **Lungs**: Hypoxia, respiratory distress
- **Heart**: Tachycardia, hypotension
- **Kidneys**: Decreased urine output
- **Brain**: Altered mental status
- **Extremities**: Cold/warm, delayed capillary refill, pale/mottled/cyanotic

Causes of Shock

- **Medical**:
 - **Septic** (fever, immunocompromise)
 - **Hypovolemic** (vomiting, diarrhea, poor intake)
 - **Anaphylactic**
 - **Cardiogenic** (myocarditis, congenital, cardiomyopathy)
- **Trauma**:
 - **Hemorrhagic** (internal or external; blunt or penetrating)
 - **Obstructive** (pneumothorax, cardiac tamponade)
 - **Neurogenic** (spinal trauma)



Early RECOGNITION and TREATMENT are essential

SHOCK	DO <input checked="" type="checkbox"/>	DON'T <input checked="" type="checkbox"/>
Recognition	<ul style="list-style-type: none"> Use history, exam, and vitals → notify hospitals Have decision support tools Check lactate and glucose 	
Treatment (medical)	<ul style="list-style-type: none"> Obtain rapid IV/IO access Give a 20 ml/kg isotonic fluid bolus in <15 min and repeat PRN (x3) Normalization goal: HR, cap refill, mental status, BP, urine output Give pressors if fluid refractory ((nor)epi/dopa) Consider antibiotics for <u>septic</u> shock, if transport time >1 hour Give an IV/IO/IM glucocorticoid to patients with adrenal insufficiency (hydrocortisone preferred) 	<ul style="list-style-type: none"> Give 20 ml/kg isotonic fluid boluses for <u>cardiogenic shock</u> (give 10 ml/kg; repeat if tolerated) Use vasopressin as a pressor Give steroids to just anyone
Treatment (trauma)	<ul style="list-style-type: none"> Stabilize unstable pelvic fractures Apply direct pressure to open wounds Apply tourniquets to control extremity hemorrhage Use topical hemostatic agents when tourniquets are not feasible Obtain rapid IV/IO access, give 20 ml/kg isotonic fluid boluses (x3 PRN, as noted above) 	<p>GIVE PRESSORS (via infusion pump)</p> <ul style="list-style-type: none"> -Dopamine: 10-20 mcg/kg/min -Norepi: <u>0.05-0.5</u> mcg/kg/min -Epinephrine: <u>0.05-0.3</u> mcg/kg/min

Case



SPINAL CARE	DO <input checked="" type="checkbox"/>	DON'T <input checked="" type="checkbox"/>
Assessment	<ul style="list-style-type: none"> Carefully assess necks with these mechanisms: high risk MVC, ATV, snowmobile, axial loading, fall>10 feet 	<ul style="list-style-type: none"> Assume trauma when unconscious Presume injury based on age
Management (Extrication)	<ul style="list-style-type: none"> Use the lift and slide technique to place on long spine boards for extrication Allow self-extrication, after applying C-collars Keep children in harnessed car seats 	
Management (Immobilization)	<ul style="list-style-type: none"> Apply C-collars for <u>any</u> of these: neck pain, torticollis, neuro deficit, altered level of alertness, intoxication, distracting injury, agitation, or communication barriers Allow EMS providers to selectively restrict spinal motion for children in the field Use padding to maintain spinal neutrality Use manual methods, if removing helmets 	<ul style="list-style-type: none"> Manually stabilize necks (if moving) Manage patients with comorbidities differently Place a C-collar or backboard for <i>any</i> penetrating injuries
Transport	<ul style="list-style-type: none"> Transport children in harnessed car seats, if the seat can be strapped to the stretcher Follow CDC Field Triage Guidelines Transport to pediatric trauma center, if feasible, when spinal injury is suspected 	<ul style="list-style-type: none"> Routinely use long spine boards for transport

PAIN	DO <input checked="" type="checkbox"/>	DON'T <input checked="" type="checkbox"/>
Assessment	<ul style="list-style-type: none"> Assess pain as part of general patient care Consider analgesics for all trauma patients Use an age-appropriate pain scale <ul style="list-style-type: none"> <u>0-3 years</u>: Observational (FLACC, CHEOPS) <u>4-11 years</u>: Self-report (face-based) <u>>12 years</u>: Self-report (numerical) Reassess Q5 min after giving opiates 	<ul style="list-style-type: none"> Ignore pain based on age or transport time
Management	<ul style="list-style-type: none"> Use opiates for moderate to severe pain: <ul style="list-style-type: none"> Morphine 0.1 mg/kg IV/IO (repeat: 0.05 mg/kg) OR Fentanyl 1 mcg/kg IV/IO/IN (repeat: 0.5 mcg/kg) Use caution for altered mental status, hypoventilation, hypotension, allergy Redose for ongoing, significant pain 	<ul style="list-style-type: none"> Assume most patients will have a complication
<p>Gausche-Hill M et al. <i>Prehospital Emerg Care</i>. 2014; 18(1): 25-34</p>		
 		

Guidelines **Metrics** **Data**

NATIONAL MODEL EMS CLINICAL GUIDELINES

EMS COMPASS

NEMESIS
BETTER DATA. BETTER CARE.

Coordinated effort is necessary to improve the quality of EMS care

Texas Children's Hospital Baylor College of Medicine

Guidelines **Metrics** **Data**

EMS 2050 AGENDA
Envision the Future

NEMESIS

NEMESIS
BETTER DATA. BETTER CARE.

Hosp