Innovation and Improvement Center

Emergency Medical Services for Children

Prehospital Care of Children: Review of Evidence-Based Guidelines

May 22, 2019

Acknowledgement

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Maternal & Child Health

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EIC

Emergency Medical Services for Children

Evidence-Based Pediatric Asthma and Seizure Management for EMS

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Department of Pediatrics, Section of Emergency Medicine

Acknowledgement

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- Three HHS, HRSA/MCHB, EMSC Targeted Issues grants:
  - H34MC19347 and H34MC26199 awarded to Baylor College of Medicine for the "Integrating Evidence-Based Pediatric Prehospital Protocols Into Practice" and "Pediatric Evidence-Based Guidelines: Assessment of System-wide Utilization in States (PEGASUS)" projects
  - H34MC26201 awarded to the Medical College of Wisconsin for the Charlotte, Houston, and Milwaukee Prehospital (CHaMP) research node

I have no financial conflicts of interest to disclose

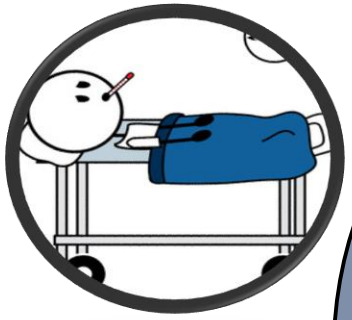
HRSA Maternal & Child Health

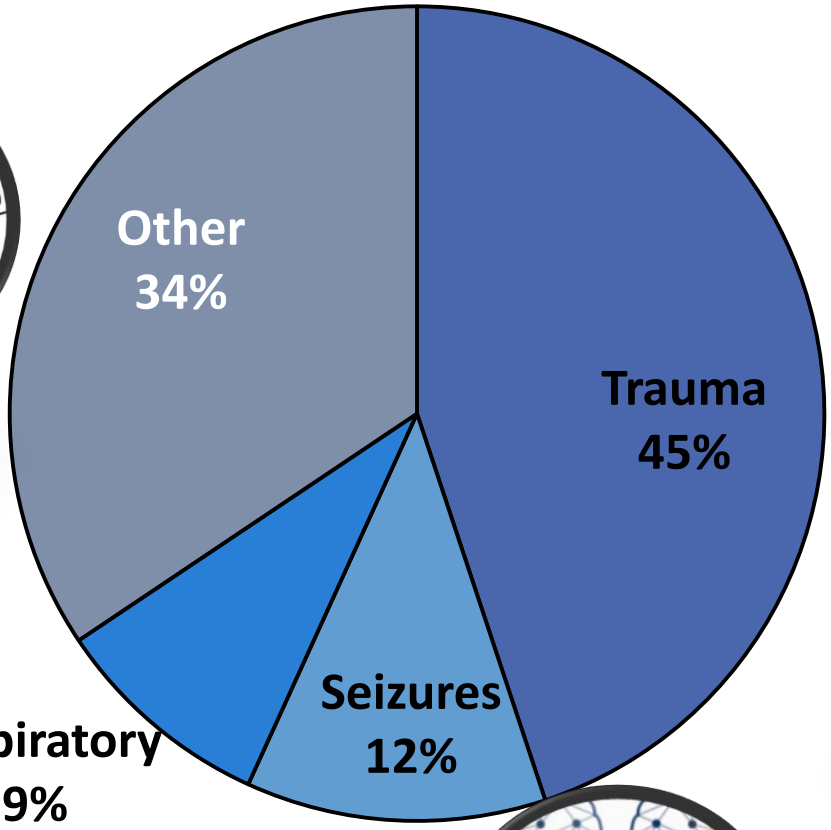
An ambulance is called for this child...

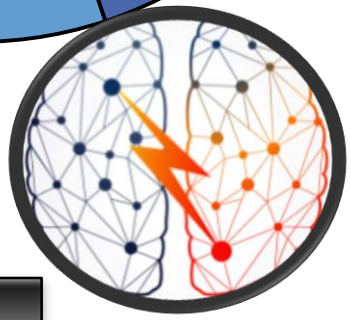
Objectives

- To determine how to modify EMS asthma and seizure **protocols** to be more evidence-based
- To identify several **metrics** to assess the quality of pediatric asthma and seizure care in EMS systems

Pediatric EMS Transports







Reasons EMS Transports Children

Richard J. *CJEM.* 2006; 8(1)

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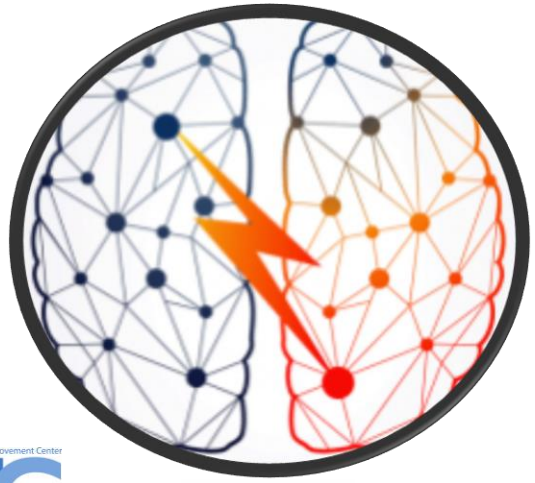
NHTSA
www.nhtsa.gov



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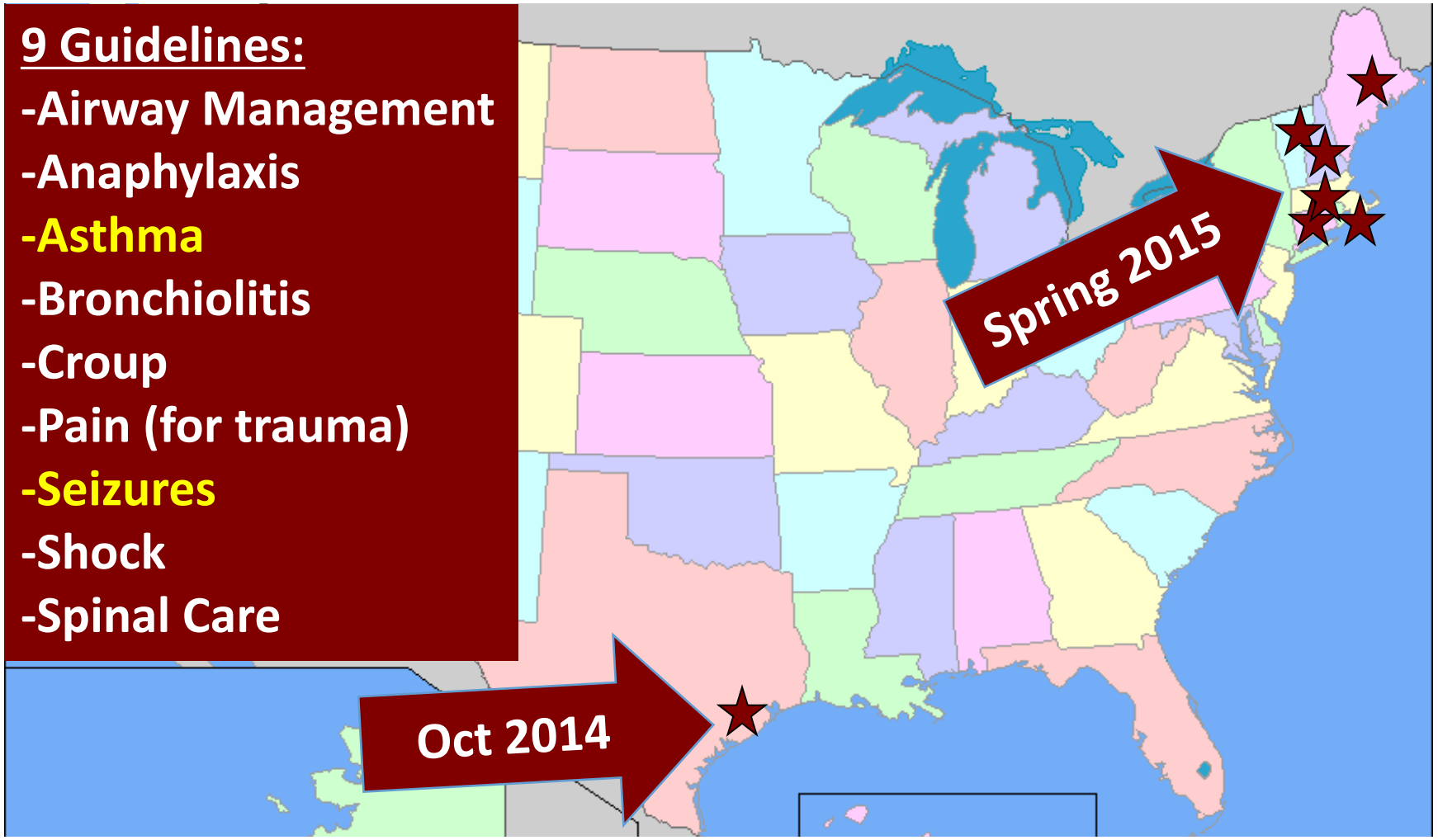
Pediatric Evidence-Based Guidelines: Assessment of EMS System Utilization in States (PEGASUS)



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An Evidence-based Guideline for Pediatric Prehospital Seizure Management Using GRADE Methodology

Manish I. Shah, MD, Charles G. Macias, MD, MPH, Peter S. Dayan, MD, MSc, Tasmeen S. Weik, DrPh, MPH, Kathleen M. Brown, MD, Susan M. Fuchs, MD, Mary E. Fallat, MD, Joseph L. Wright, MD, MPH, Eddy S. Lang, MDCM, CCFP (EM)

• Check a blood glucose	• Give rectal medication
• Give dextrose IV/IO (D10, 5ml/kg) or glucagon IM for hypoglycemia (<60 mg/dL)	• Place an IV/IO initially
• Give IM/IN benzodiazepines as 1st line treatment (midazolam 0.2 mg/kg)	• Require medical control for the 1st 2 doses of medication (apnea risk after 2 doses)
• IV/IO benzodiazepines (0.1 mg/kg) can be given subsequently – including diazepam	

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Shah MI et al. *Prehospital Emerg Care.* 2014; 18(1)

Asthma EBG

National Model EMS Clinical Guidelines

DO ☑	DON'T ☒
• Assess distress	• Routinely obtain an ECG
• Use pulse oximetry	• Give nebulized saline or steam
• Apply oxygen if SaO_2<90%	• Routinely place an IV
• Give **albuterol** (4-6 puffs or 2.5-5 mg neb) → multiple	• Routinely give IV fluids
• Give PO/IM/IV **steroids**	• Give inhaled magnesium
• Give **ipratropium 0.5 mg x 3**	• Use heliox
• Give IV/IO **magnesium (40 mg/kg,** max 2 g)	
• Give **IM epinephrine** 0.01 mg/kg (1:1000) (or 0.15-0.3 mg autoinj.)	
• Use CPAP	

<u>DO GIVE STEROIDS</u>

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

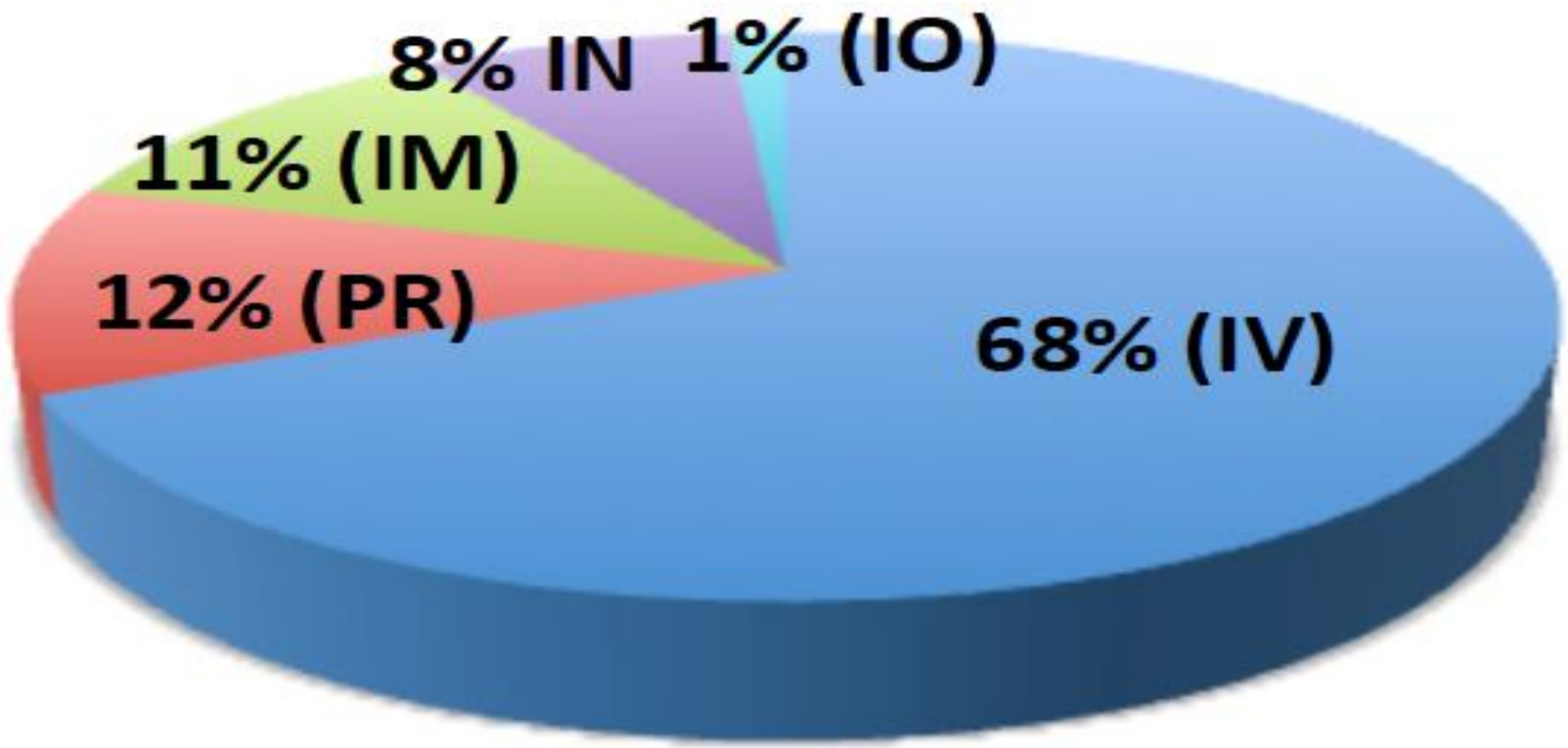
-Methylprednisolone: 2 mg/kg, IV/IM (max 125 mg)

Category	Measure Name	Quality Metric for SEIZURES	Measure Type	IOM Quality Domain
Treatment	Medication Route	% of **actively seizing** patients that receive IN/IM midazolam	Process	Effectiveness
Treatment	Time to Medication	Time to administration of a benzodiazepine	Process	Timeliness
Treatment	Medication Dose	% of patients that received a a weight appropriate dose (+/- 20% of what is in the protocol)	Process	Safe
Treatment	Multiple Doses	% of patients that received more than 2 doses of a benzodiazepine	Process	Safe
Patient Assessment	Glucose Assessment	% of patients who had a blood glucose checked	Process	Safe
Treatment	Hypoglycemia Treatment	% of patients with glucose <60 mg/dL who received IV/IO dextrose or IM glucagon	Process	Effectiveness
Outcome	Respiratory Failure	% of patients who received bag-mask ventilation, BiPAP, CPAP, supraglottic airway, or intubation	Balance	Safe
Outcome	Seizure Cessation	% of patients who were actively seizing upon emergency department arrival	Outcome	Timeliness

Category	Measure Name	Quality Metric for ASTHMA	Measure Type	IOM Quality Domain
Treatment	Time to Beta-Agonist	Time to administration of beta-agonist (albuterol) after provider arrival on scene	Process	Timely
Treatment	Steroid Administration	% of patients that receive steroids	Process	Effective
Risk Assessment	Pulse Oximetry	% of patients with documented pulse oximetry reading	Process	Safe
Treatment	Time to Ipratropium	Time to administration of ipratropium after provider arrival on scene	Process	Timely Effective
Outcome	Respiratory Failure	% of patients who had respiratory failure (received bag-mask ventilation, BiPAP, CPAP, supraglottic airway, or intubation)	Outcome	Effective Safe

Impact of High-Fidelity Pediatric Simulation on Paramedic Seizure Management

Manish I. Shah, MD, MS, John M. Carey, MD, Sarah E. Rapp, MD, Marina Masciale, MD, Wendy B. Alcanter, MD, Juan A. Mondragon, BS, Elizabeth A. Camp, PhD, Samuel J. Prater, MD, Cara B. Doughty, MD, MEd

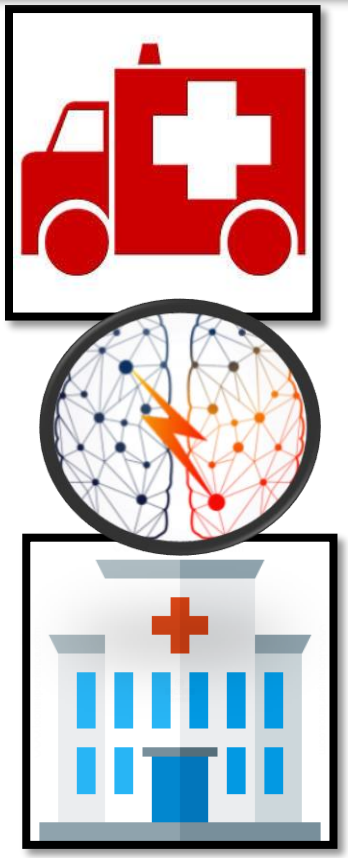


Routes of EMS Administered Midazolam to Seizing Children

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

Single-Site Sim Training: No Change

Impact of Simulation on Paramedic Seizure Management



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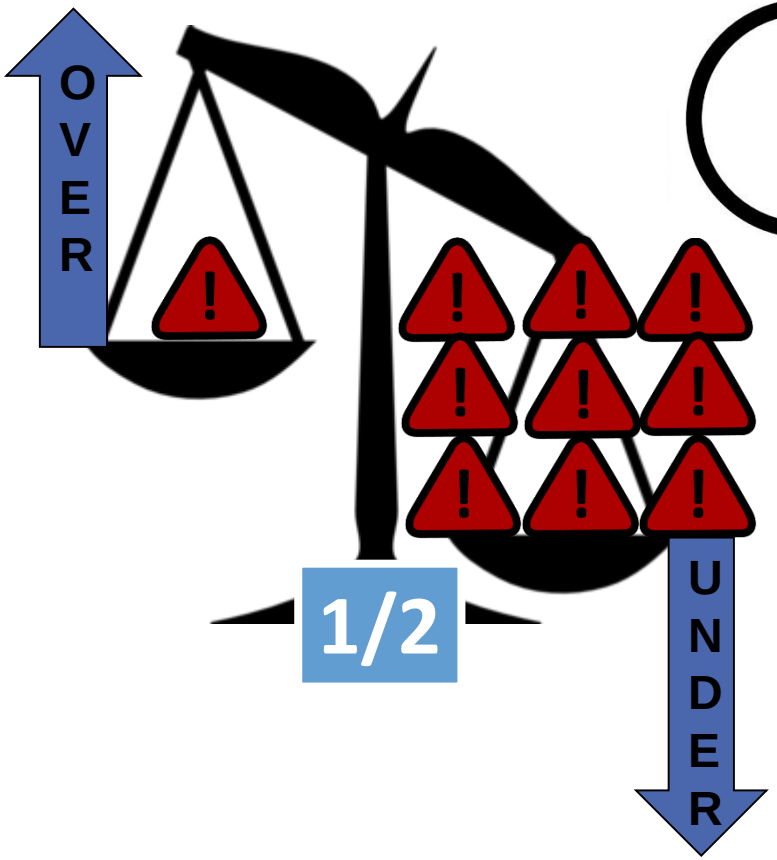

14 min

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

Improving Prehospital Protocol Adherence Using Bundled Educational Interventions

Megan C. Marino, MD, Daniel G. Ostermayer, MD, Juan A. Mondragon, Elizabeth A. Camp, PhD, Elizabeth M. Keating, MD, Louis B. Fornage, MD, Charles A. Brown, MD, MPH, Manish I. Shah, MD, MS

Preferred Routes

Received midazolam

Correct dose given

Paramedic Adherence After a Pediatric Seizure Protocol Change

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Marino MC. *Prehospital Emerg Care.* 2018; 22(3).

Multi-Site Need for Improvement

50% → 77%	61% → 71%	61% ~ 56%
 		
Preferred Routes	**Received midazolam**	**Correct dose given**

Paramedic Adherence After a Pediatric Seizure Protocol Change

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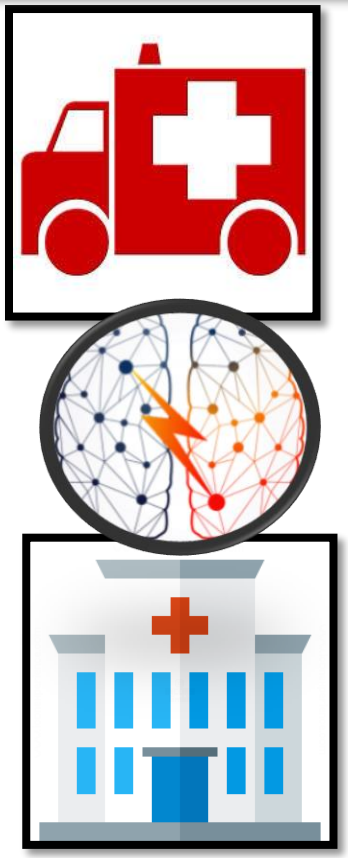
Shah MI. *Manuscript in Preparation*. 2019

Multi-Site Need for Improvement

Opportunities to Optimize Pediatric Seizure Management



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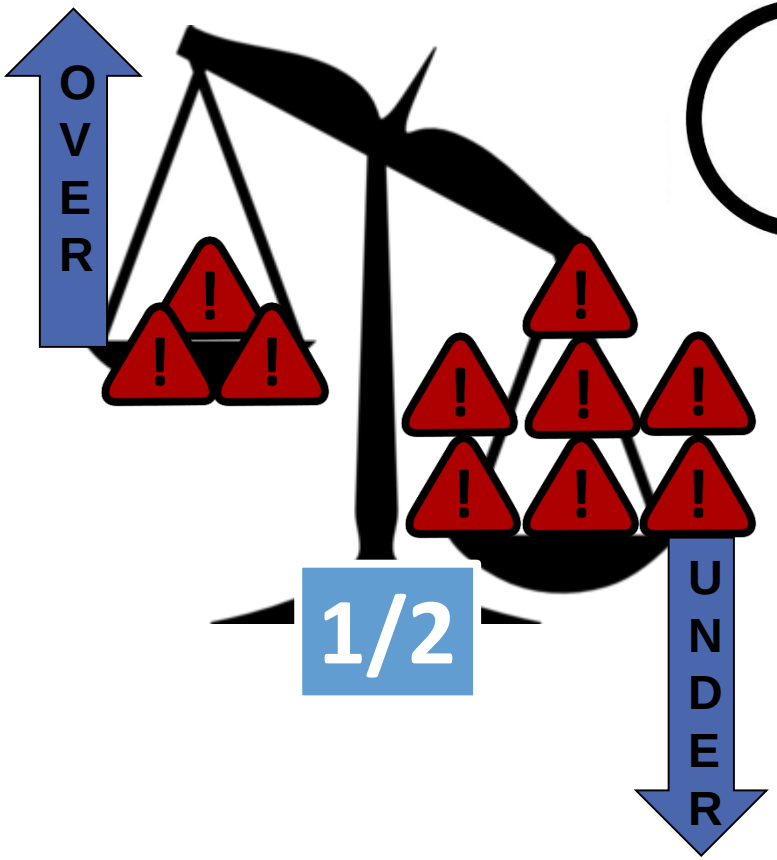

14 min

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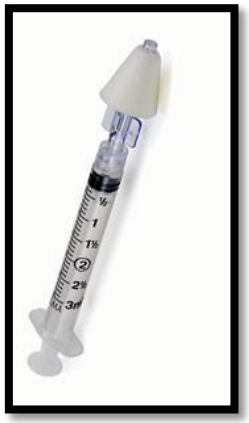
Shah MI. *Manuscript in Preparation.* 2019

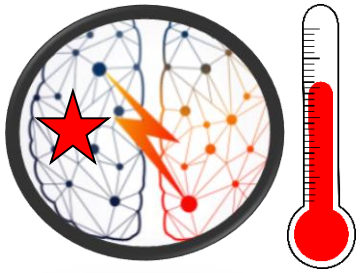
Paramedic-Identified Enablers of and Barriers to Pediatric Seizure Management: A Multicenter, Qualitative Study

John M Carey, Jonathan R Studnek, Lorin R Browne, Daniel G. Ostermayer, Thomas Grawey, Stephanie Schroter, E Brooke Lerner & Manish I Shah

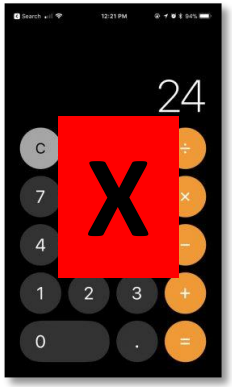
Systems Enablers



Systems Barriers



Paramedic Solutions



Carey JM. *Prehospital Emergency Care.* 2019; Epub

Implementation of a Prehospital Protocol Change For Asthmatic Children

Anriada Nassif, MD, Daniel G. Ostermayer, MD, Kim B. Hoang, MD, Mary K. Claiborne, MD, Elizabeth A. Camp, PhD, Manish I. Shah, MD MS

Table 4. Characteristics of steroid use pre- and post-protocol change

	Pre-Protocol Change N = 226 (47%) Median (95% CI)	Post-Protocol Change N = 256 (53%) Median (95% CI)	P-Value
Given prehospital steroids	24 (11%)	47 (18%)	0.020
Type of prehospital steroid			<0.001
Methylprednisolone	24 (100%)	9 (19%)	
Dexamethasone	0 (0%)	38 (81%)	
Prehospital steroid route			<0.001
PO	0 (0%)	36 (78%)	
IV	21 (87%)	9 (20%)	
IM	2 (8%)	1 (2%)	
IO	1 (4%)	0 (0%)	
Prehospital dose appropriate	19 (79%)	42 (91%)	0.260
Prehospital incorrect dose			0.440
Underdosed	0 (0%)	1 (25%)	
Overdosed	5 (100%)	3 (75%)	
Time from EMS arrival until first prehospital steroid (min)	167 (9–24)	16 (13–19)	0.660
Time from EMS arrival to first steroid, in prehospital or hospital setting (min)	88 (82–94)	80 (71–89)	0.010

ED: *emergency department*; PO: *oral administration*; IM: *intramuscular*; IO: *intraosseous*; IV: *intravenous*; IQR: *interquartile range*.

- More steroids given
- More PO steroids given

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Nassif A. *Prehospital Emerg Care.* 2018; 22(4).

Impact of Prehospital Steroids for Asthma

	Pre	Post	P value
Total hospital time, median (hours)	6.1 (95% CI: 5.4-6.8)	4.5 (95% CI: 4.2-4.8)	P<0.001
Total care time, median (hours)	6.6 (95% CI: 5.8-7.3)	5.2 (95% CI: 4.8-5.6)	P=0.01
Hospital admission rate	30%	21%	P=0.02
Admission to a critical care unit	82%	44%	P=0.02

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Guidelines

Metrics

Data

NATIONAL MODEL EMS CLINICAL GUIDELINES

NEMSQA
National EMS Quality Alliance

NEMSIS
BETTER DATA. BETTER CARE.

Coordinated effort is necessary to improve the quality of EMS care

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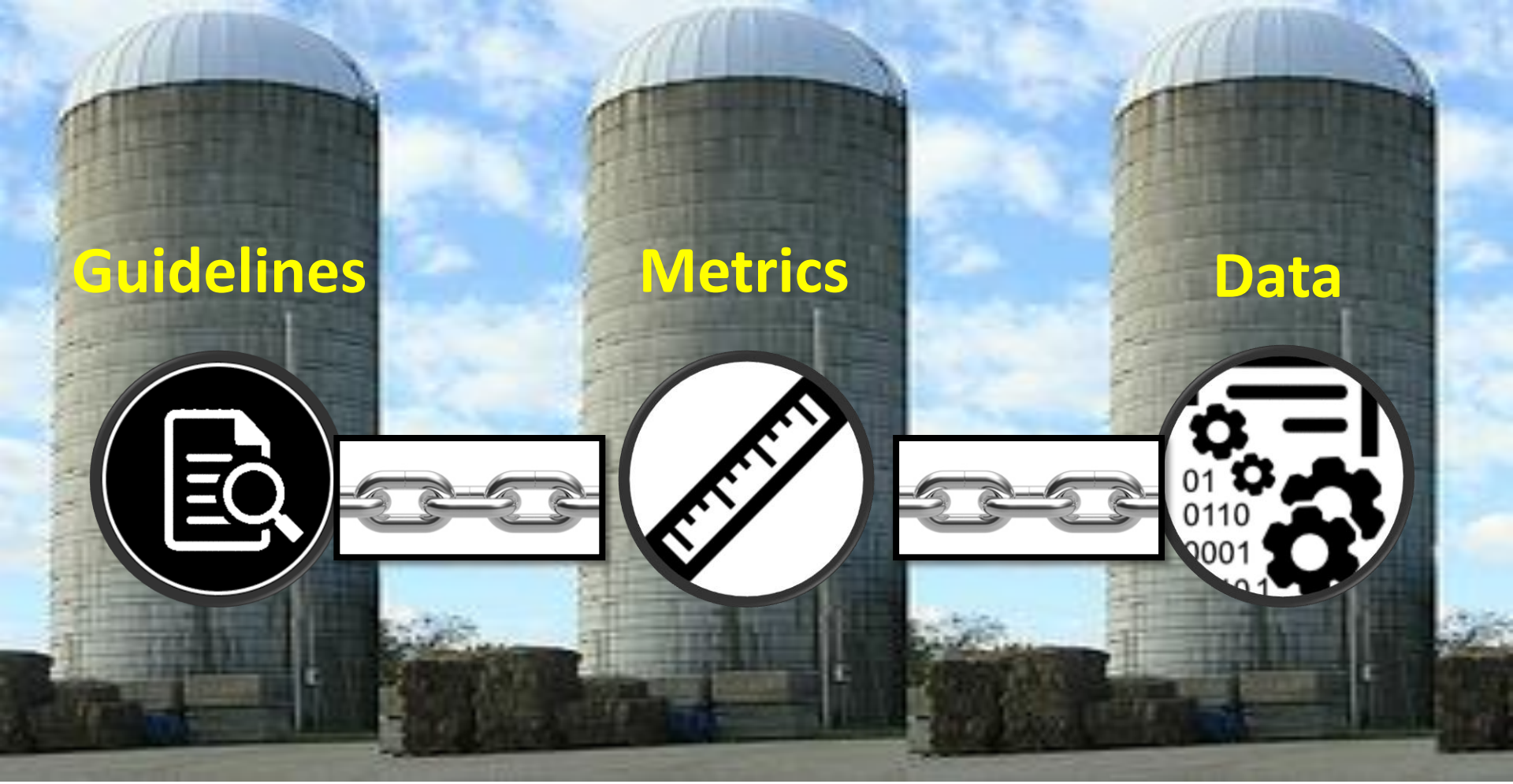

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Prehospital Evidence-Based Care for Traumatic Pain

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University of Colorado School of Medicine
Children's Hospital Colorado

Disclosures

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- Cooperative agreement between National Highway Traffic and Safety Administration and National Association of State EMS Officials (DTNH22-R-00604)

- HRSA/MCHB (H34MC26201)-EMSC Targeted Issues grant

Dr Adelgais has no financial conflicts of interest to disclose

Objectives

After this presentation, the learner should be able to:

- Recall barriers to prehospital analgesia administration to children
- Understand the elements of an evidence-based guideline for analgesia administration in traumatic pain
- Identify potential solutions to barriers of evidence-based guideline implementation in EMS agencies

How Big of a Deal is Pediatric Pain?

- Contributing factor in up to 20% of pediatric EMS encounters *(McLean, 2002)*
  - fractures, burns, sickle pain crises, headache, abdominal pain
- Multicenter study of EMS agencies (>500,000 pediatric encounters)
  - 28% of encounters related to trauma
  - 1% of patients given analgesia

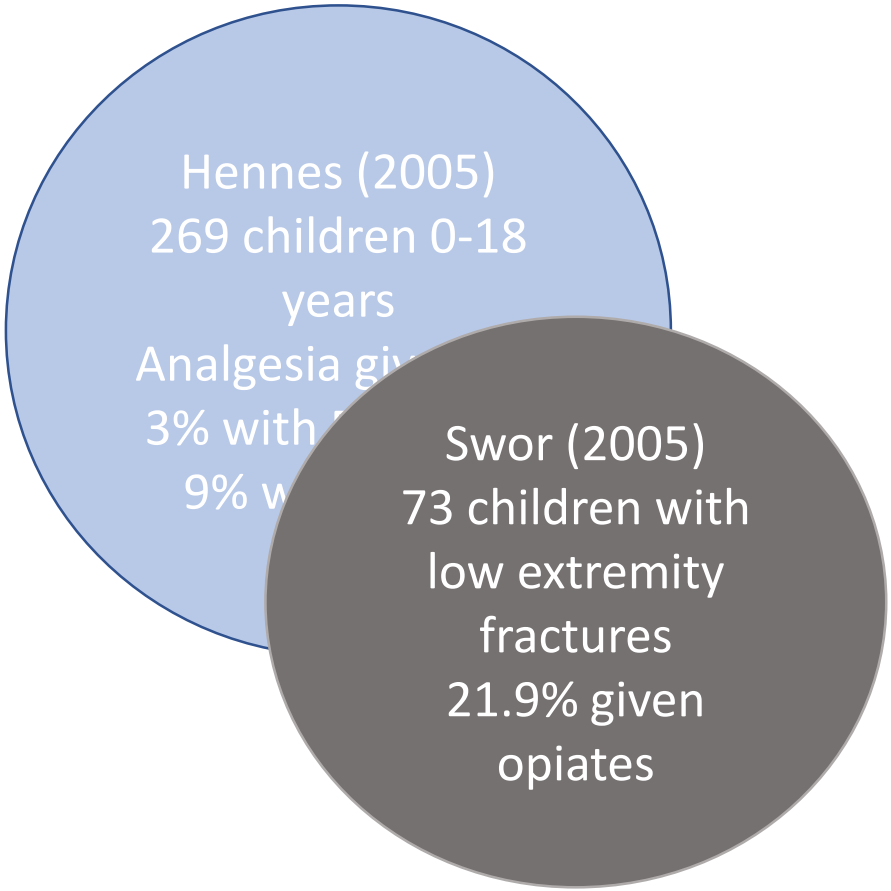
Underutilization of analgesia for children in the out-of-hospital setting is frequent and problematic

What does the literature show?

What does the literature show?

Hennes (2005)
269 children 0-18 years
Analgesia given to:
3% with Fractures
9% with Burns

What does the literature show?



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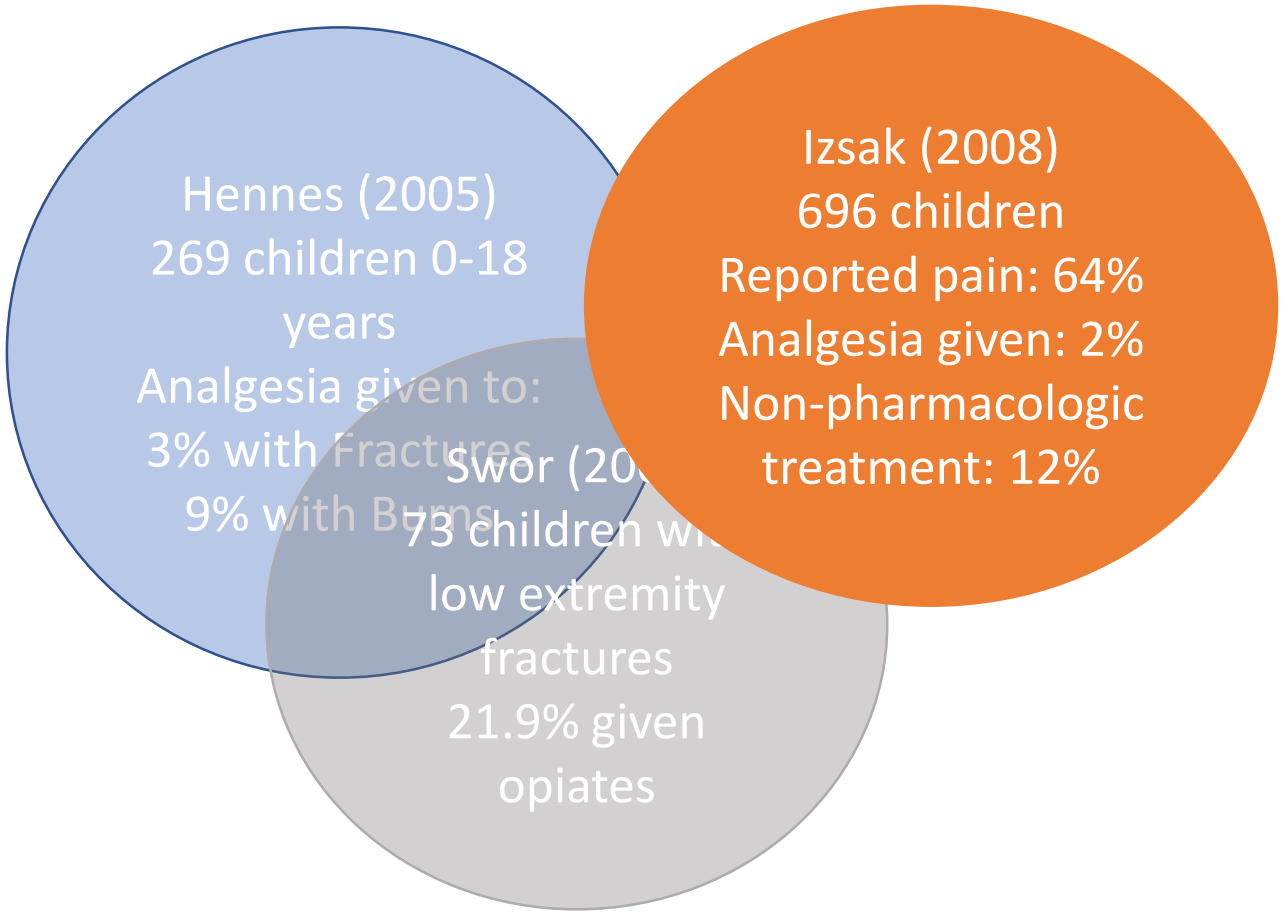

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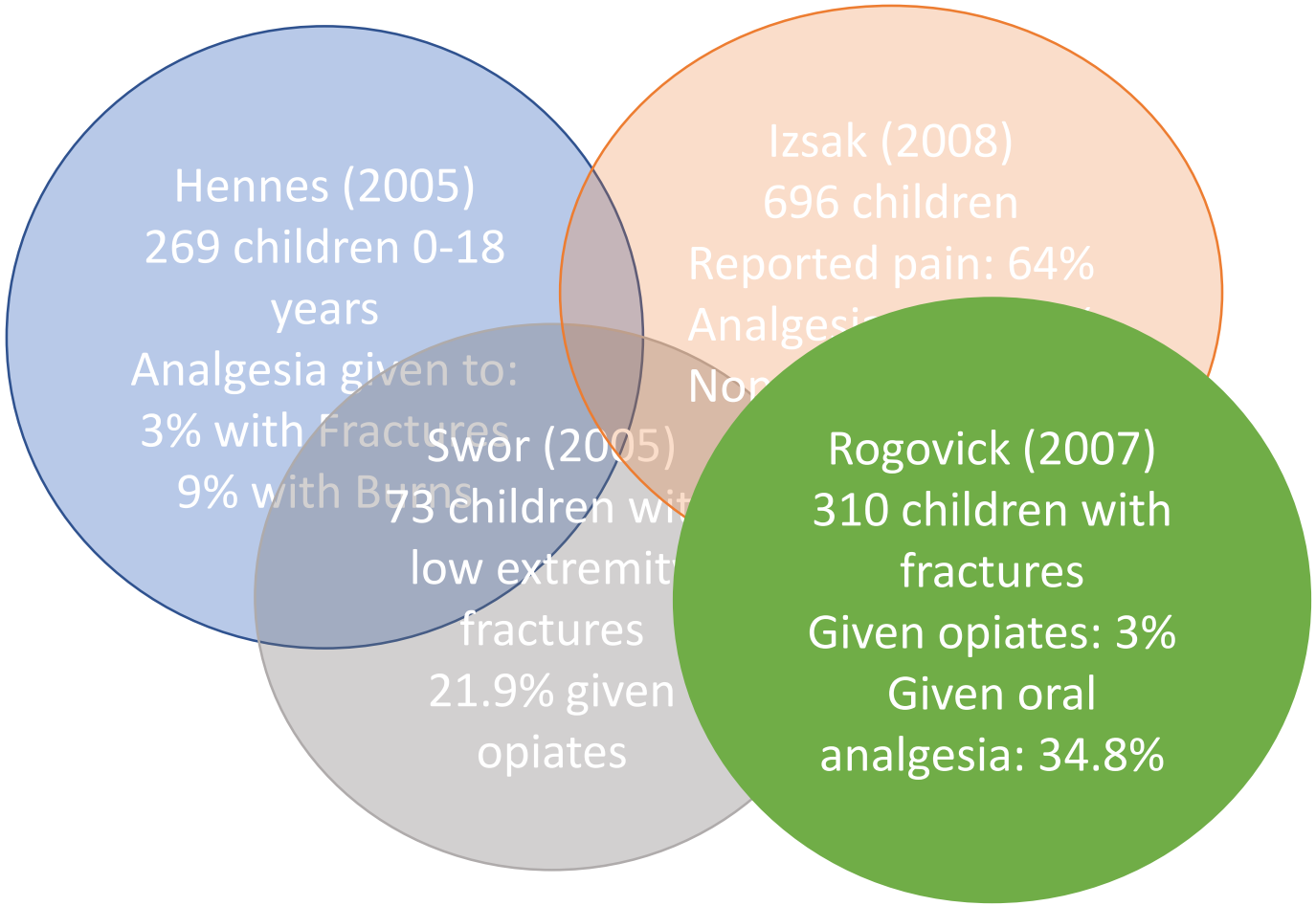

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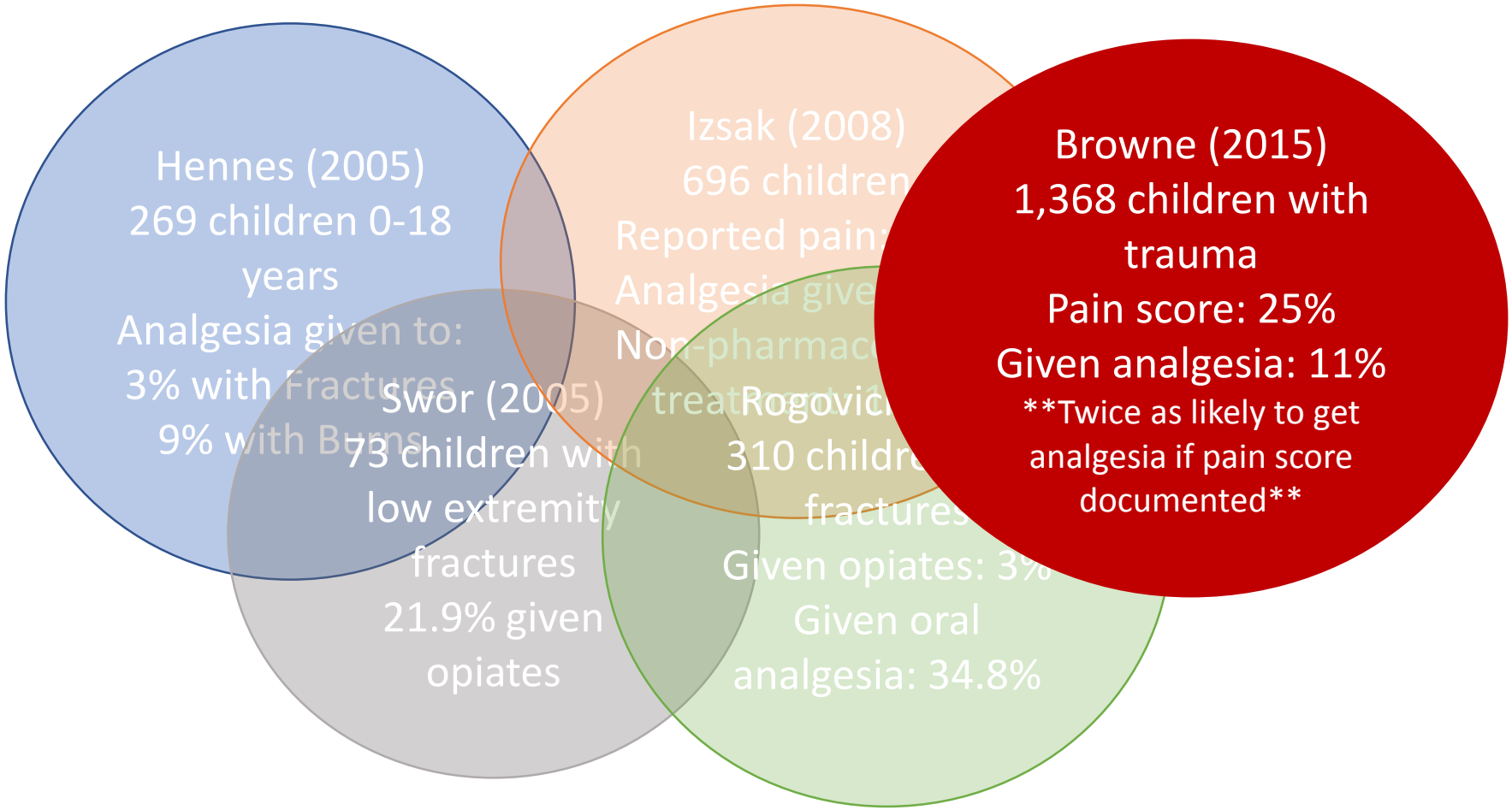

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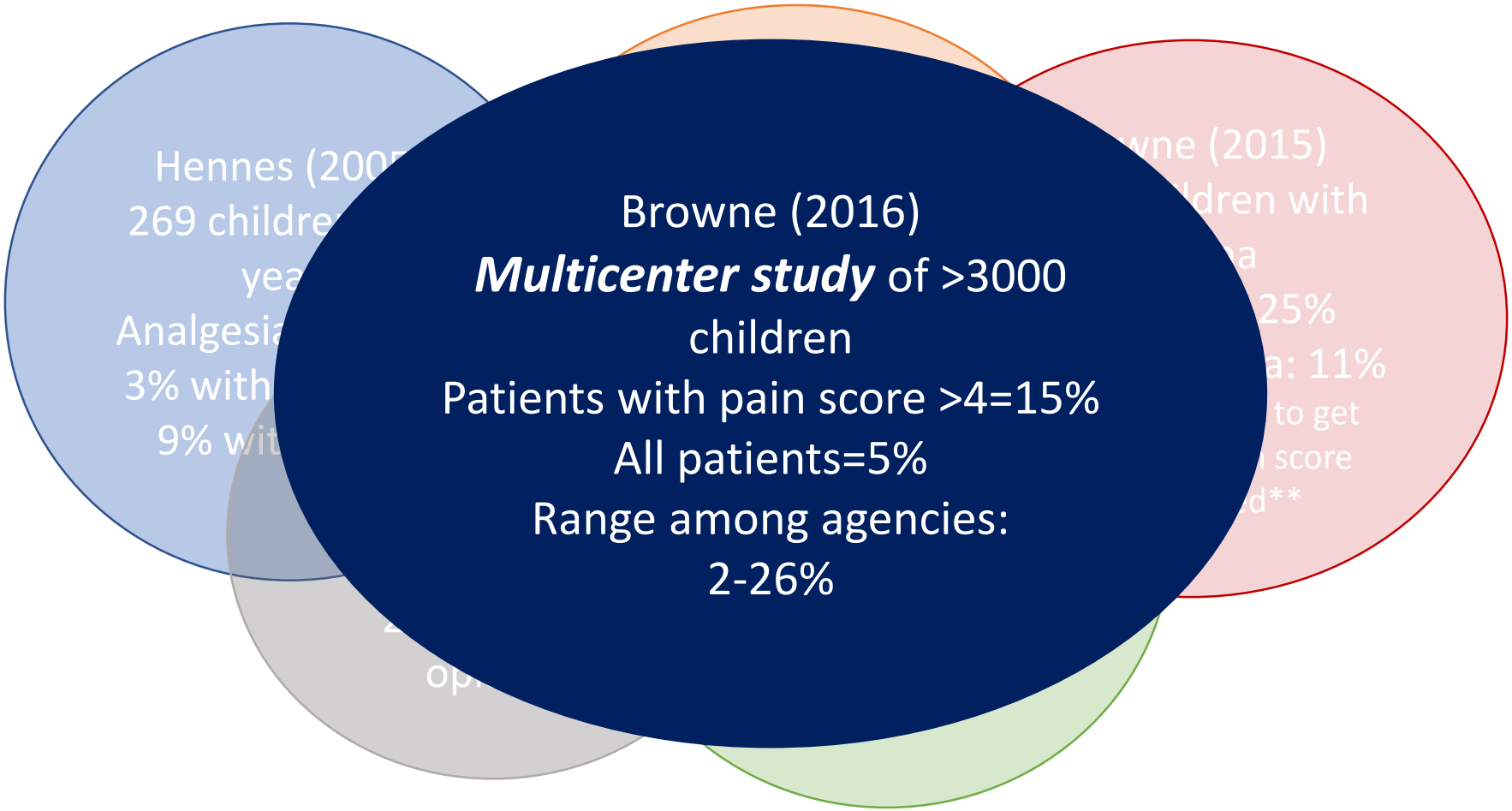
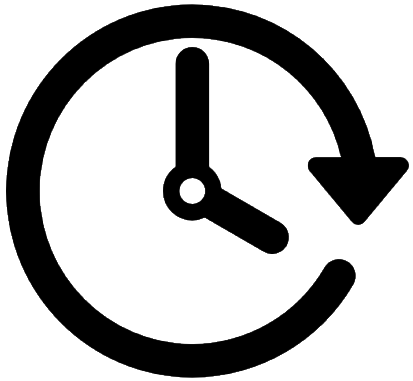


Other effects:
The clock is ticking….



- McEachin et.al (2002) (n=124 children)
  - 22 (18.3%) received prehospital analgesia (91% received ED analgesia)
  - EMS analgesia given in 30 minutes compared to 2 hours

- Swor (2005) (n=73 children)
  - EMS analgesia given in 22 minutes compared to 88 minutes when given in ED

Is There a Down Side?

Inadequate pain control has negative implications in children

- Most studies from procedural pain and chronic conditions but….
- Neonates have long-standing alterations in their response to and perceptions of painful experiences
- Pediatric oncology patients have increased pain scores in subsequent painful procedures
- Documented PTSD in previously normal children
- Extends average length of stay

Continued disparities. . .

Administration of analgesia in children:

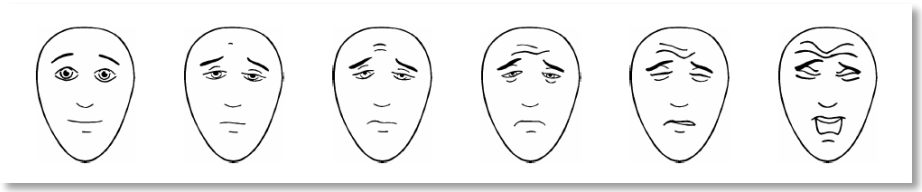
- ***Varies by age:*** Younger patients are less likely to receive adequate analgesia

- ***Varies by ethnicity and social economic status***: Racial minorities, publicly insured less likely to receive analgesia

- ***Varies by practitioner***: EMS providers with more experience are more willing to provide analgesia to children

Hewes, Prehosp Emerg Care, 2018
Williams, Prehosp Emerg Care, 2012

Prioritizing Traumatic Pain Management in EMS



Barriers to Pediatric Analgesic Administration

- Inability to assess pain
- Low pain score
- Patient refusal of medication
- Difficult vascular access
- Vascular access not needed
- Delay of transport
- Fear of complication
- Record keeping
- Perception of possible drug seeking

Additional Barriers

Focus groups of EMS Providers reveal:

Anxiety with children

Insufficient training

Often will defer to EDs

Having a ***positive relationship with online medical control*** would enable analgesia administration

Access to Online and Offline Pediatric Protocols

EMSC Priority and Performance Measures

- Goal: That 90% of EMS Agencies in the state have access to ALS and BLS on line and offline protocols guidelines for pediatric care

Offline protocols for traumatic pain

Utah EMSC disseminated guideline for offline treatment of traumatic pain (2009):

- Improved self-efficacy among providers
- Statewide increase in analgesia administration to pediatric trauma patients ***(18.5% →26.6%)***
- Provision of analgesia associating with:
  - Documentation of pain score
  - EMS agency training on protocol

NHTSA
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

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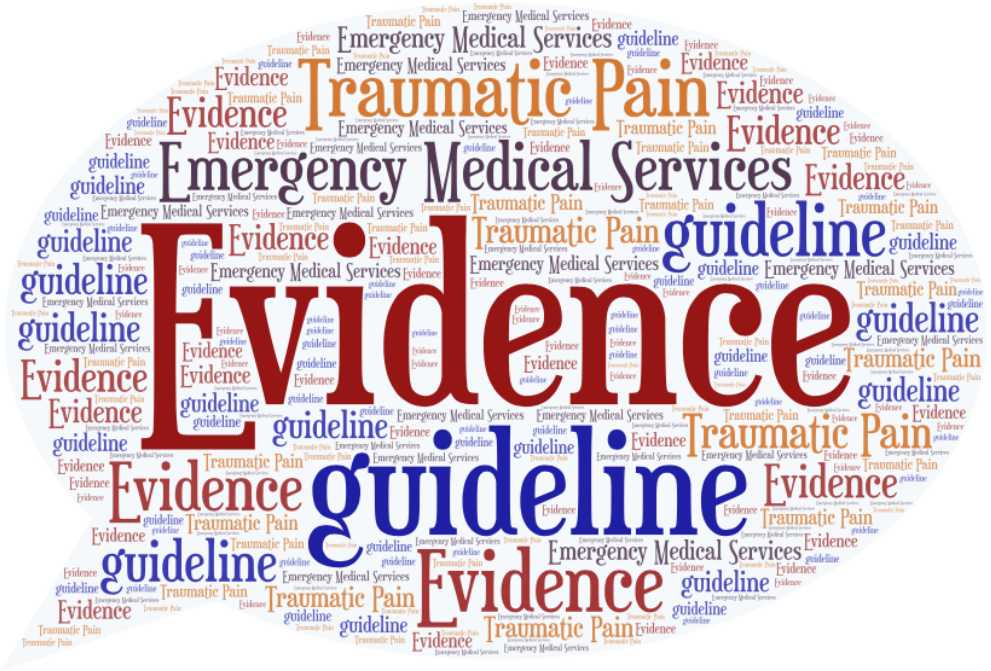


Traumatic Pain EBG

Content

Dissemination and Implementation

An Evidence-based Guideline for Prehospital Analgesia in Trauma

Marianne Gausche-Hill, MD, Kathleen M. Brown, MD, Zoë J. Oliver, MD, CCFP (EM), Comilla Sasson, MD, MS, Peter S. Dayan, MD, MSc, Nicholas M. Eschmann, EMT-P, MS (Epidemiology), Tasmeen S. Weik, DrPh, MPH, Benjamin J. Lawner, DO, EMT-P, FAAEM, Ritu Sahni, MD, MPH, Yngve Falck-Ytter, Joseph L. Wright, MD, MPH, Knox Todd, MD, MPH, Eddy S. Lang, MDCM, CCFP (EM)

Known Barriers:

- Disparities in the prehospital environment
- Fear of dosing mistakes = undertreating
- Need for medical direction for opiates

EBG Solution:

- Consistency across all ages
- Easy to remember dosing & use of pain scales
- Standing orders to avoid calling medical direction

Traumatic Pain EBG

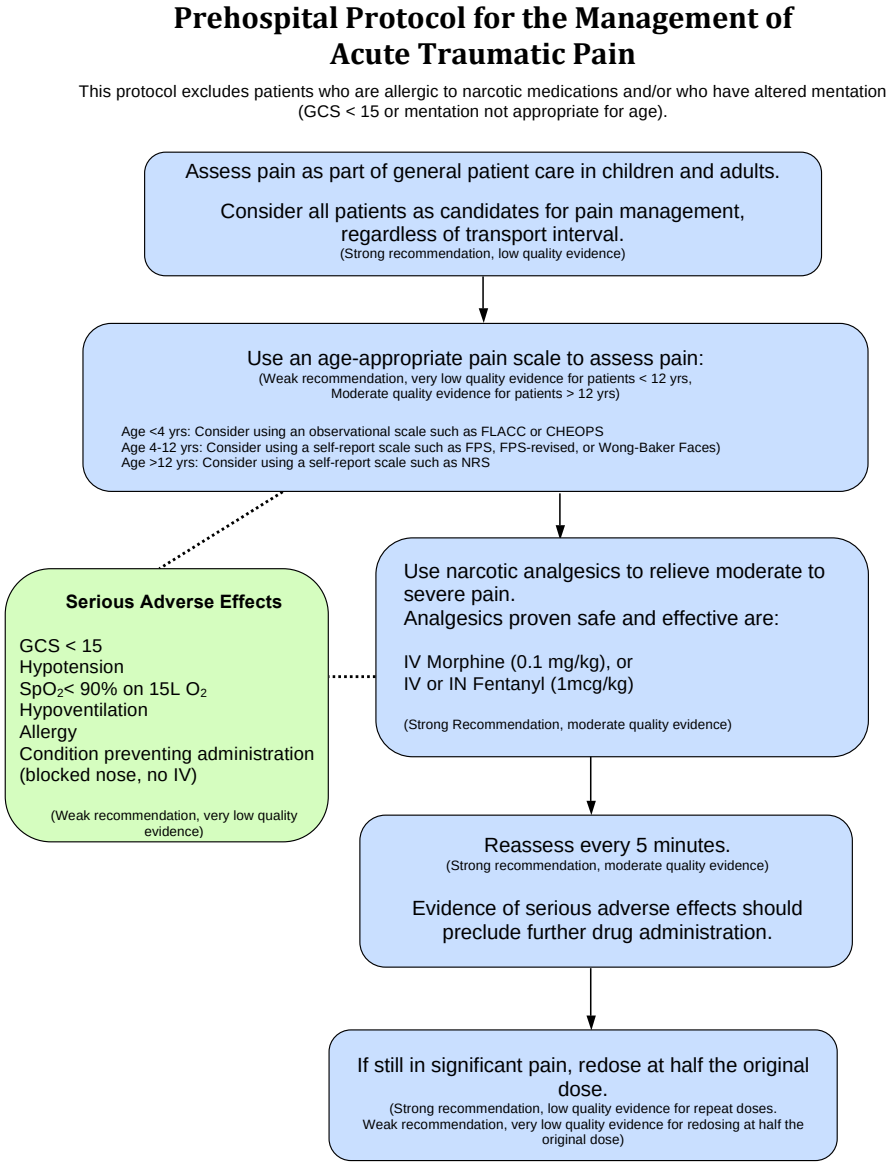
4 easy steps:

1-Assess pain

2-Treat pain

3-Reassess pain

4-Treat persistent pain



Prehospital Protocol for the Management of Acute Traumatic Pain

This protocol excludes patients who are allergic to narcotic medications and/or who have altered mentation (GCS < 15 or mentation not appropriate for age).

Use an age-appropriate pain scale to assess pain:
(Weak recommendation, very low quality evidence for patients < 12 yrs,
Moderate quality evidence for patients > 12 yrs)

Age <4 yrs: Consider using an observational scale such as FLACC or CHEOPS
Age 4-12 yrs: Consider using a self-report scale such as FPS, FPS-revised, or Wong-Baker Faces)
Age >12 yrs: Consider using a self-report scale such as NRS

Behavioral-Observational scales

Self Report Scales

- **Face-based scales**
- **Numeric rating scales**

Serious Adverse Effects

GCS < 15
Hypotension
SpO_2< 90% on 15L O_2
Hypoventilation
Allergy
Condition preventing administration (blocked nose, no IV)

(Weak recommendation, very low quality evidence)

Use narcotic analgesics to relieve moderate to severe pain.
Analgesics proven safe and effective are:

IV Morphine (0.1 mg/kg), or
IV or IN Fentanyl (1mcg/kg)

(Strong Recommendation, moderate quality evidence)

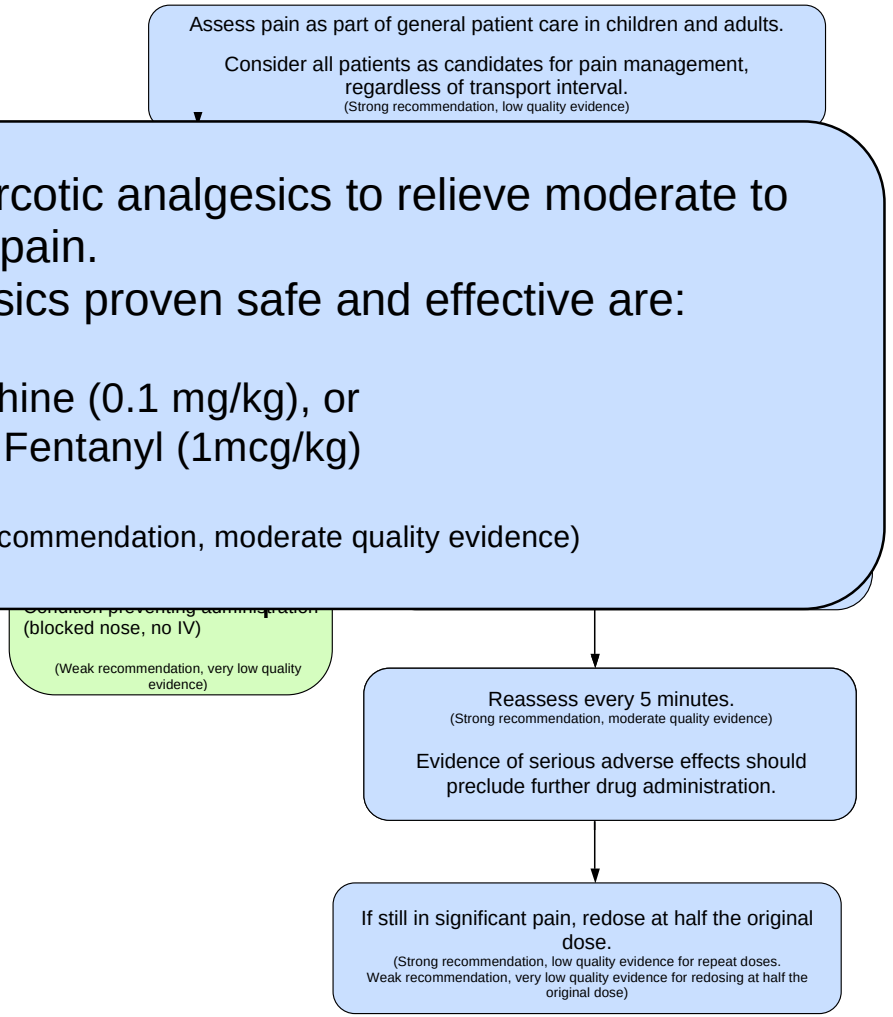
Reassess every 5 minutes.
(Strong recommendation, moderate quality evidence)

Evidence of serious adverse effects should preclude further drug administration.

If still in significant pain, redose at half the original dose.
(Strong recommendation, low quality evidence for repeat doses.
Weak recommendation, very low quality evidence for redosing at half the original dose)

Prehospital Protocol for the Management of Acute Traumatic Pain

This protocol excludes patients who are allergic to narcotic medications and/or who have altered mentation (GCS < 15 or mentation not appropriate for age).



Analgesia:

- **IV or IN only**
- **Opiate analgesia**
- **No recommendations for oral medications**

What about IN Fentanyl?

Indianapolis Fire Department

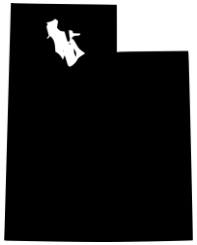
IN fentanyl introduced into protocols

Examined charts of 946 pediatric trauma patients

Findings:

- No difference in frequency of use of fentanyl: 30.4% vs 37.8%
- Shift toward giving fentanyl via the IN route→36%

What about IN Fentanyl?



Indianapolis Fire Department

IN fentanyl introduced into protocols
Examined charts of 946 pediatric trauma patients

Findings:

- No difference in frequency of use of fentanyl: 30.4% vs 37.8%
- Shift toward giving fentanyl via the IN route→36%

State of Utah

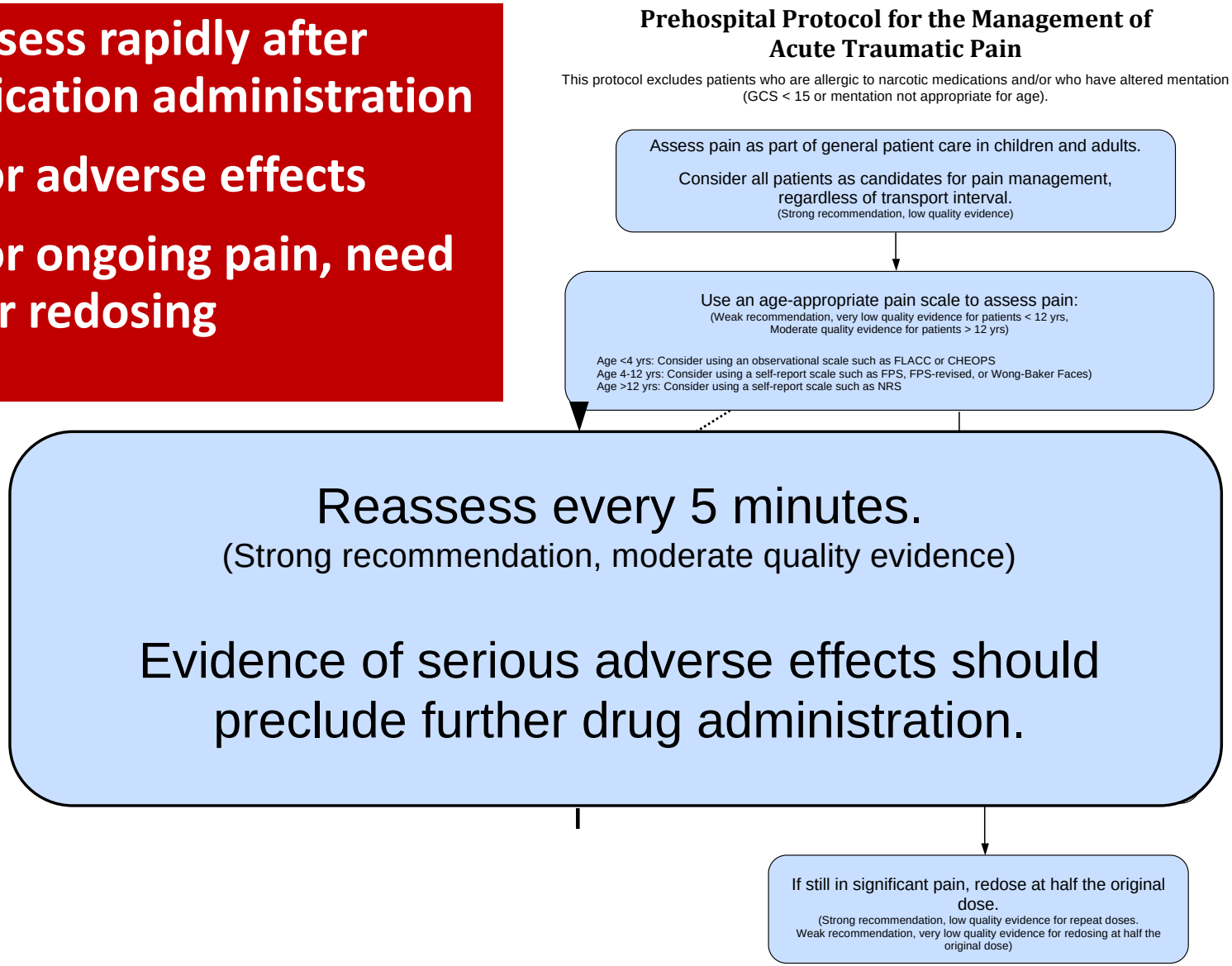
Traumatic Pain Guideline in 2009
Data from state EMS registry (POLARIS): 1155 children with trauma

Findings:

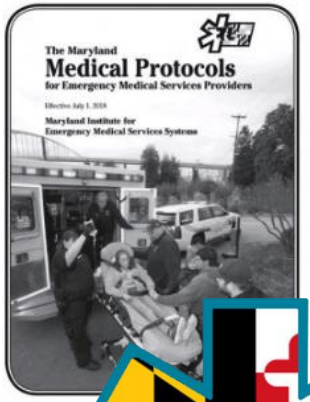
- Increase in analgesia administration
- Agencies carrying IN Fentanyl ***5 times*** more likely to administer analgesia

Reassess rapidly after medication administration

- For adverse effects
- For ongoing pain, need for redosing



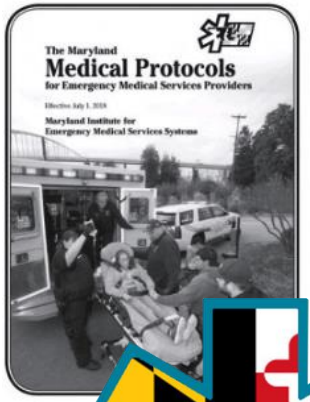
The Maryland Experience…



Maryland: Statewide Protocols

- Implemented a pain protocol based on the Traumatic Pain EBG
- Examined ALS transports of trauma and burns ***(2128 encounters from 2010-2012)***

The Maryland Experience…



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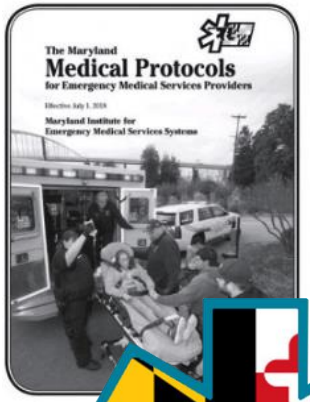

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- Examined ALS transports of trauma and burns ***(2128 encounters from 2010-2012)***
  - Increase from **71%→84%** in children 1-15 years
  - ***Increase in amount of opiate*** administered →specifically in those 1-15 years

EBG Dissemination and Implementation

How can this EBG be disseminated at the state level?

What are the best practices to do this?

What barriers will be identified?

What patient outcomes can be measured?

NHTSA
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

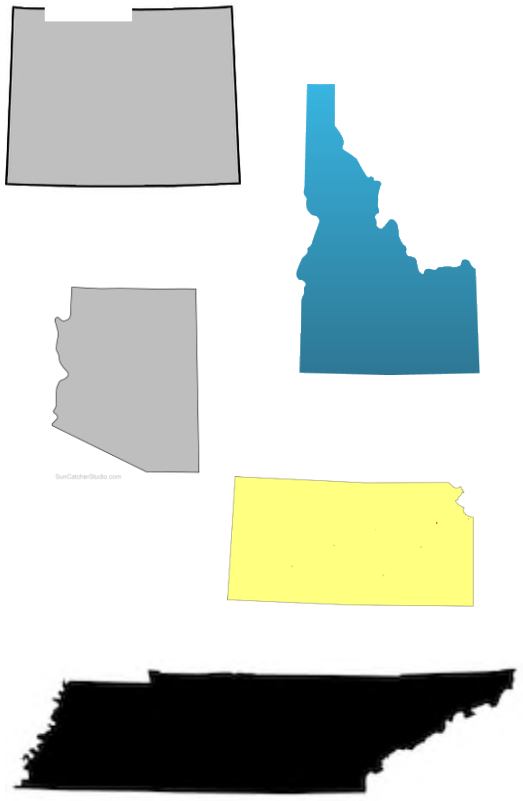
NASEMSO

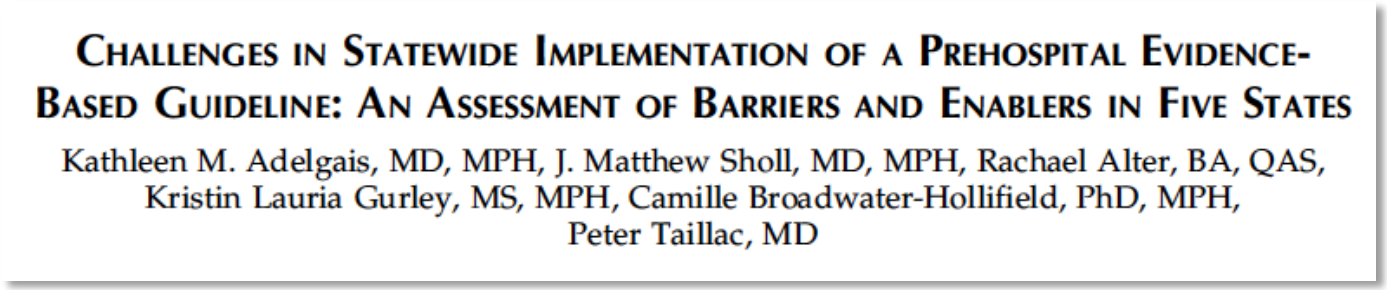
Challenges in Statewide Implementation of a Prehospital Evidence-Based Guideline: An Assessment of Barriers and Enablers in Five States

Kathleen M. Adelgais, MD, MPH, J. Matthew Sholl, MD, MPH, Rachael Alter, BA, QAS, Kristin Lauria Gurley, MS, MPH, Camille Broadwater-Hollifield, PhD, MPH, Peter Taillac, MD

- **Objective:** To examine barriers and enablers to dissemination and implementation of an evidence-based guideline for traumatic pain management across 5 states

- **State Participants:**
  - Arizona, Idaho, Kansas, Tennessee, Wyoming





CHALLENGES IN STATEWIDE IMPLEMENTATION OF A PREHOSPITAL EVIDENCE-BASED GUIDELINE: AN ASSESSMENT OF BARRIERS AND ENABLERS IN FIVE STATES

Kathleen M. Adelgais, MD, MPH, J. Matthew Sholl, MD, MPH, Rachael Alter, BA, QAS, Kristin Lauria Gurley, MS, MPH, Camille Broadwater-Hollifield, PhD, MPH, Peter Taillac, MD

Project Accomplishments:

- Toolkit for implementation, dissemination, and evaluation ***(www.nasemso.org)***
- Individual implementation plans for each state
  - Program Plan
  - Evaluation Roadmap
- Created online training/PPTs
  - For EMS Personnel (1 hour)
  - Hospital ED staff (15 minutes)

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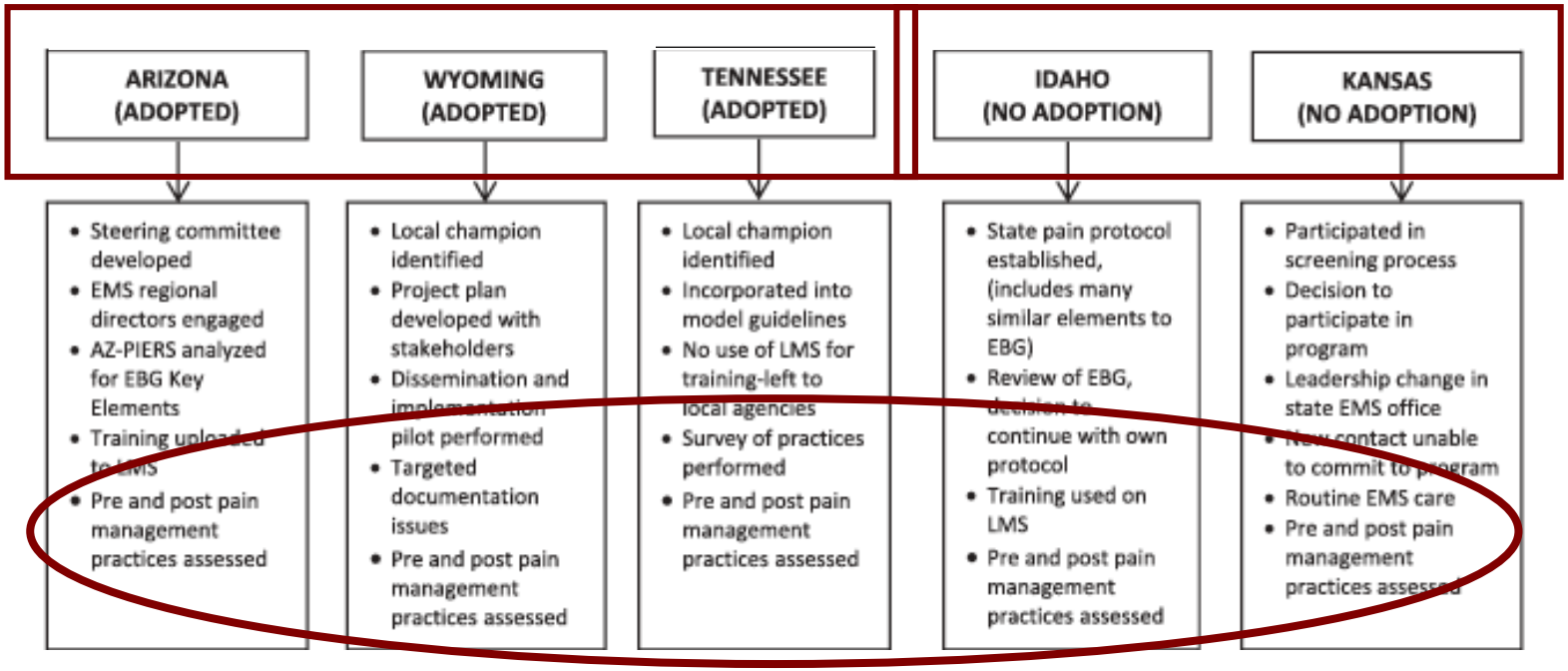
State Dissemination Outcomes:



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Barriers:

- **Lack of authority** to mandate a new protocol
- **Lack of statewide infrastructure** to support program
- **Technical challenges** with Learning Management Systems (LMS)
- **Lack of statewide granular data** to track implementation

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Barriers:

- **Lack of authority** to mandate a new protocol
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- **Technical challenges** with Learning Management Systems (LMS)
- **Lack of statewide granular data** to track implementation

Enablers:

- **Having a champion**
  - Identify strategies for states
  - Work with stakeholders
  - Assist state in protocol development
  - Develop regional infrastructure
- **Use of a toolkit**

Challenges in Statewide Implementation of a Prehospital Evidence-Based Guideline: An Assessment of Barriers and Enablers in Five States

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State	Before (April–June 2014)	After (April–June 2016)
Arizona[a]	20.0%	No data available
Idaho[b]	33.7%	35.0%
Kansas[c]	11.6%	15.0%
Tennessee	No data available	No data available
Wyoming[d]	7.0%	7.0%

- **No measurable improvement in analgesia** administration among 4 states
  - Wyoming had a *measurable Increase in pain score documentation*
  - Arizona *identified problems* with restocking of controlled substances

Next Steps

Traumatic Pain EBG developed and published in 2014

- Additional modalities such as ketamine, nitrous oxide not addressed
- Findings on barriers to dissemination can help states address gaps in protocols and patient care
- Prospective studies on barriers to treating pain are underway

What tools in your toolbox can you use to improve pain in children?

Questions….

Thank you!!!!

kathleen.adelgais@childrenscolorado.org

Pediatric Non-Traumatic Out-of-Hospital Cardiac Arrest: Should We Hit the Brakes?

Katherine Remick, MD, FAAP, FACEP, FAEMS
Medical Director, San Marcos Hays County EMS System
Executive Lead, National EMS for Children Innovation and Improvement Center
Associate Medical Director, Austin-Travis County EMS System
Assistant Professor of Pediatrics, Dell Medical School at the University of Texas at Austin

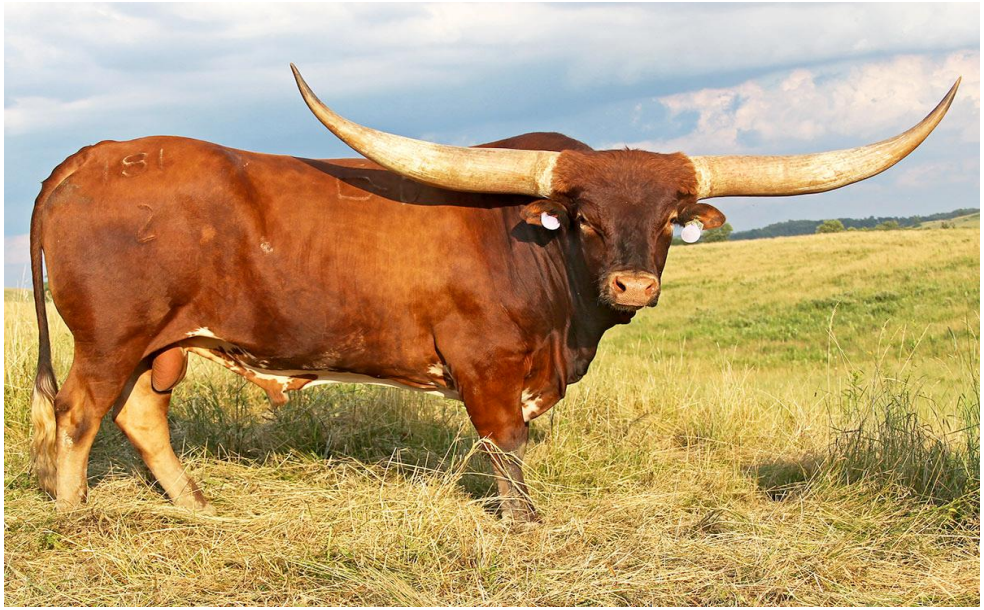
The University of Texas at Austin
Dell Medical School

Seton

GRADUATE MEDICAL EDUCATION

Disclosures

- No relevant disclosures to report



Objectives

- Review the epidemiology of pediatric out-of-hospital cardiac arrest
- Identify factors associated with improved survival from pediatric cardiac arrest
- Discuss the pros and cons of termination of resuscitation efforts on scene for pediatric out-of-hospital cardiac arrest (OHCA)
- Discuss efforts EMS providers can take to engage and support families following pediatric OHCA

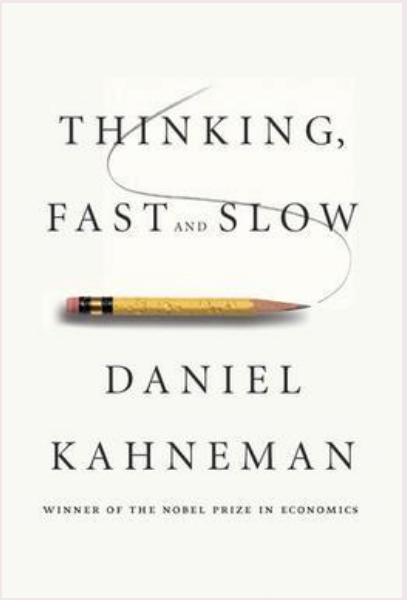
Why Not Talk About Traumatic Pediatric OHCA?

- Outcome is dismal
- 4-5% survival, essentially all neurologically devastated
- National guidelines exist

POLICY STATEMENT

Withholding or Termination of Resuscitation in Pediatric Out-of-Hospital Traumatic Cardiopulmonary Arrest

What if we could save 1000 more children suffering non-traumatic OHCA each year than we do now?



Epidemiology of Non-traumatic Pediatric OHCA

- >5000 children per year (Topjian and Berg, 2012)
- Survival rate: 5-10% (8% Jayaram 2015, 6.7-10.2% Fink 2016)
- ~70-80% associated with respiratory failure
- No improvement over last decade (Jayaram, 2015)

EMS and CPR

- We do it best!
- “Resuscitologists”
- We do high quality CPR (*… better than in-hospital CPR!*)

Epidemiology of Non-traumatic Adult OHCA

- Increased survival over last decade
  - Overall: Increased from 7.6% to now 10-18% (Yamaguchi 2017)
  - Witnessed VF/VT: 14% to 31% (Yamaguchi 2017)
- What has the literature teased out
    - Early defibrillation
    - Minimize interruptions
    - Full chest recoil
    - Optimal chest compression rates and depth
    - Choreographed “pit crew” CPR
    - Variability of CPR en route (and DANGEROUS!)
    - BVM over advanced airway?
    - Mechanical CPR… ?
    - National guidelines for TOR in adults

Kids Are Not Just Little Adults… Or Are They?

- Special focus:
  - Make airway management a priority
  - Watch drug dosing safety
  - Family-centered care
- Same Principles:
  - Assess
  - Monitor
  - Effective Interventions
  - Quality improvement
  - Evidence base

No increase in survival from non-traumatic pediatric OHCA in the last decade. Survival remains low, 5-10%.

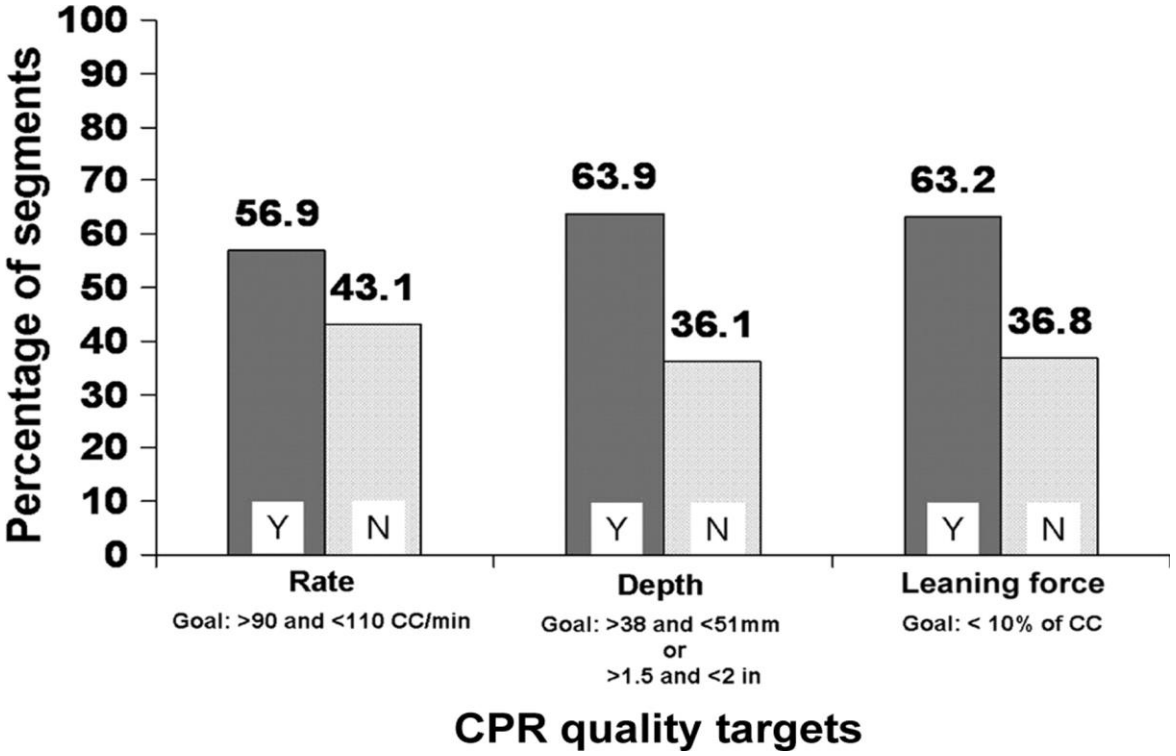
Why Aren't Kids More Resilient?

1. Are children less likely to survive cardiac arrest due to inherent factors?
2. Is the physiology of pediatric cardiac arrest such that once they fall of the cliff there is no turning back?
3. Is the science of pediatric resuscitation lagging behind that of adult medicine?

What Can We Glean from Pediatric In-Hospital Cardiac Arrest Literature?

- Improved survival in last decade
  - 10% 1980s
  - 27% 2005 (Nadkarni)
  - 43% 2009 (Girotra)
- Why?
  - Rapid response teams
  - Early interventions
  - High quality CPR

What Can We Glean from Pediatric In-Hospital Cardiac Arrest Literature?



2013:
AHA compliant depth 26.2%;
AHA compliant rate 83.7%;
Systolic and Diastolic BP threshold(80/30) attained in ~60% of compressions

Sutton, Pediatrics 2009
Sutton, Resuscitation 2013

What Can We Glean from Pediatric In-Hospital Cardiac Arrest Literature?

- New Findings
  - Early epinephrine administration, <5min associated with increased survival 33% vs 21% (Andersen, JAMA 2015)
  - Longer epinephrine intervals may be better (Hoyme, Resuscitation 2017)
    - – 5-8min OR 1.99, 8-10min OR 2.67
  - Intubation associated with decreased survival 36% vs 41% (Andersen, JAMA 2016)

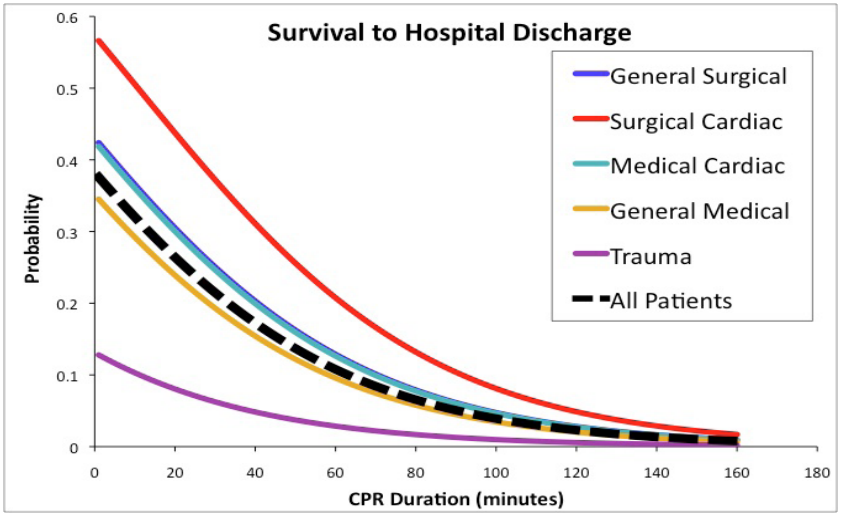
Can we identify children who are likely to benefit from prolonged resuscitation?

Duration of CPR – When is it Futile?

Duration of Cardiopulmonary Resuscitation and Illness Category Impact Survival and Neurologic Outcomes for In-hospital Pediatric Cardiac Arrests

Renée I. Matos, R. Scott Watson, Vinay M. Nadkarni, Hsin-Hui Huang, Robert A. Berg, Peter A. Meaney, Christopher L. Carroll, Richard J. Berens, Amy Praestgaard, Lisa Weissfeld and Philip C. Spinella
for the American Heart Association s Get With The Guidelines Resuscitation (Formerly the National Registry of Cardiopulmonary Resuscitation) Investigators

- Median duration of CPR:
  - Survivors 10min
  - Non-survivors 25min
- Adjusted probability of survival:
  - CPR 15min 29%
  - CPR 35min 19%



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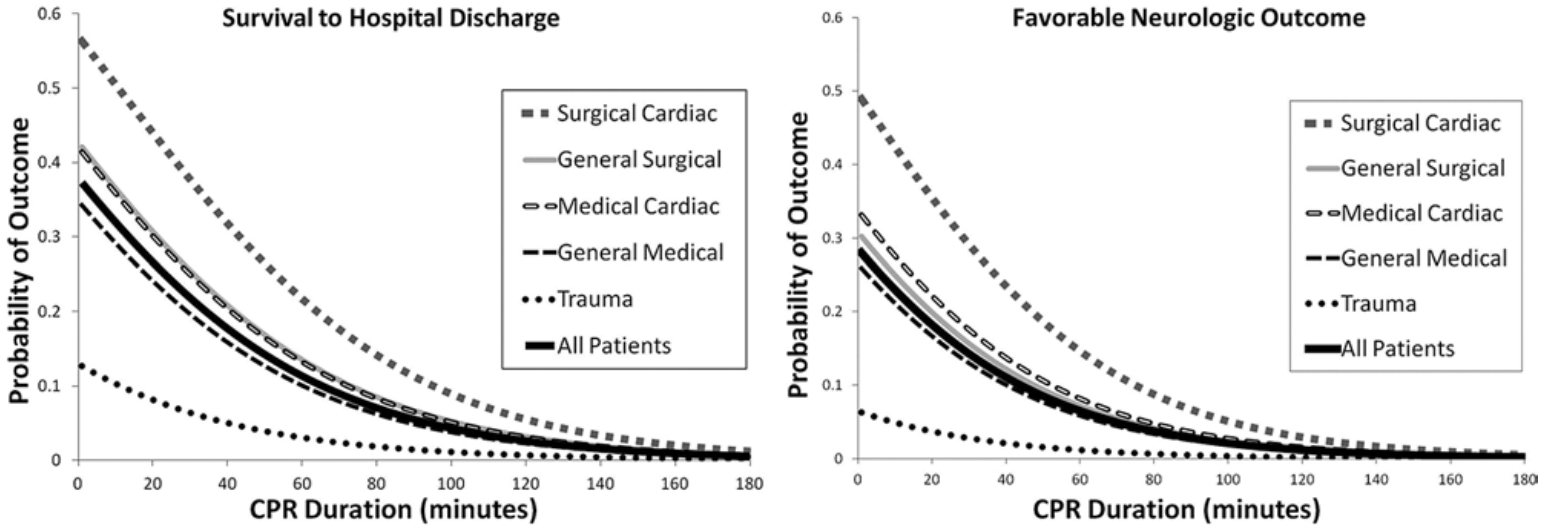

The State of Pediatric OHCA

- 1mo survival with CPC 1-2 of transported pediatric OHCA without ROSC is extremely low: 1%

- Increased chance of survival if:
  - Witnessed arrest (aOR 3.22)
  - VF/VT (aOR 16)
  - PEA (aOR 5.2)

Goto et al, 2015

The State of Pediatric OHCA?

- Pediatric advanced airway management infrequent, lower success rates if <1yr (Hansen 2015)
- BVM seems better than ETI/SGA (OR 0.39 and 0.32) (Hansen 2017)
- Longer scene time (10-35min) associated with increased survival 10.2% vs 5.3% (Tijssen, 2016)
- On-scene resuscitation versus early transport associated with increased survival 0% to 23% (Banerjee, 2017 & 2019)
- Pit crew approach to pediatric OHCA associated with higher survival (17%) (Friesen, 2018)

What Increases Chances of Survival?

- Bystander CPR
- Early compressions with effective ventilations (C-A-B)
- High quality CPR

Kitamura, 2010

	No CPR (n=2719)	Bystander CPR (n=2439)	Bystander CPR vs no CPR*	Compression-only CPR (n=888)	Conventional CPR (n=1551)	Conventional CPR vs compression-only CPR*
Non-cardiac origin						
Total	2010	1654		599	1055	
Age 1–17 years	1293	1004		380	624	
ROSC before hospital arrival	60 (4·6%)	82 (8·2%)	1·97 (1·35–2·87)	20 (5·3%)	62 (9·9%)	2·17 (1·24–3·82)
1-month survival	89 (6·9%)	133 (13·2%)	2·09 (1·55–2·83)	34 (8·9%)	99 (15·9%)	1·89 (1·23–2·91)
Neurologically favourable 1-month survival	20 (1·5%)	51 (5·1%)	4·17 (2·37–7·32)	6 (1·6%)	45 (7·2%)	5·54 (2·52–16·99)
Age 0–<1 years	717	650		219	431	
ROSC before hospital arrival	30 (4·2%)	23 (3·5%)	0·92 (0·32–2·71)	9 (4·1%)	14 (3·2%)	NA
1-month survival	56 (7·8%)	51 (7·8%)	1·08 (0·71–1·65)	17 (7·8%)	34 (7·9%)	NA
Neurologically intact 1-month survival	14 (2·0%)	13 (2·0%)	1·19 (0·54–2·61)	2 (0·9%)	11 (2·6%)	NA

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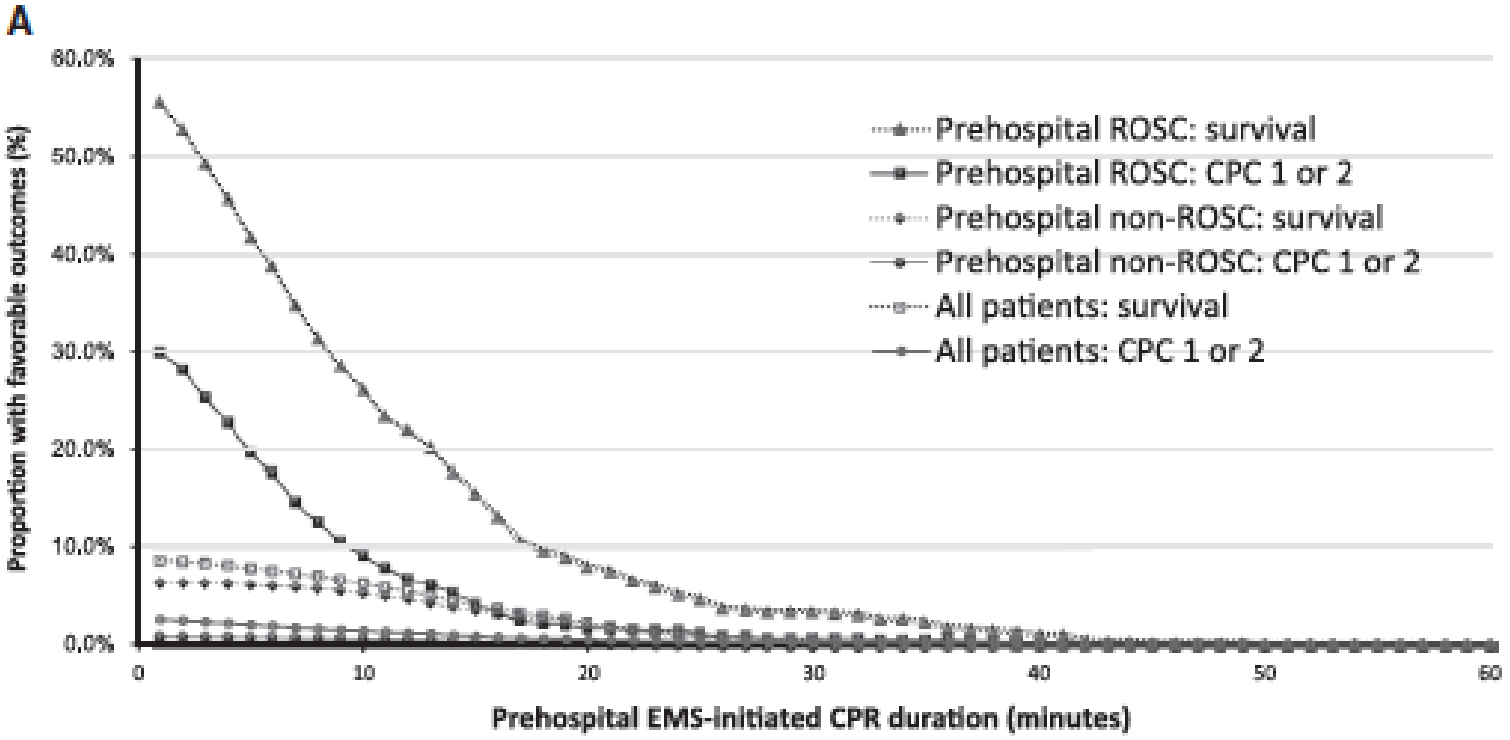
Kitamura, Lancet 2010

Duration of CPR and Favorable Outcomes for Pediatric OHCA



Goto , 2016

Paramedics' Perspective on Pediatric OHCA

- Experience with pediatric OOHCA:
  - 33% performed CPR on >20 children
  - 72% on >5 children
  - 7% had experience with pediatric TOR

- Beliefs regarding pediatric outcome:
  - 81% - pediatric patients had same or better chance of survival
  - 56% - felt uncomfortable with pediatric TOR despite worse prognosis

	Pediatric TOR
State	31.9%
EMS Agencies	30.4%

Fallat, Childress Grant

Hall, et al. Resuscitation. 2004; 60: 175-187

Pros and Cons of Pediatric TOR

Pros	Cons
Survival is dismal, resuscitation futile	Devastated family members
Does not give false hope	Provider training
Assists with coroner's investigation	Concern for legal liability
Limits financial burden	Limited personnel to provide support
Resource and cost savings	Organ procurement

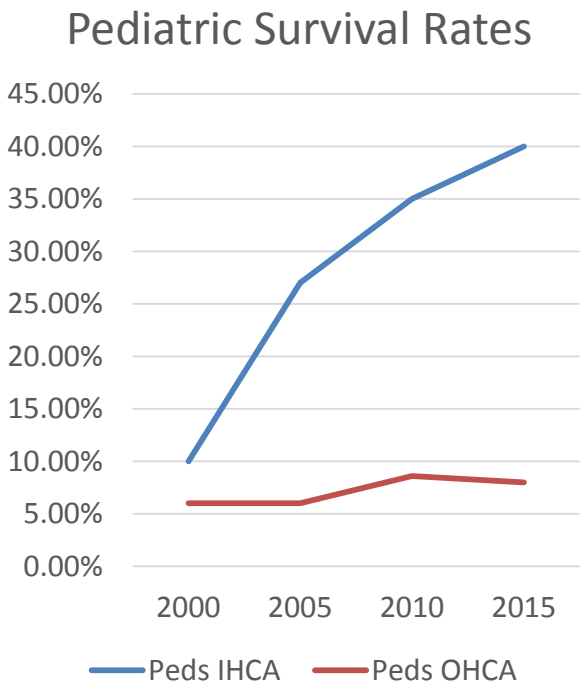
Compassionate Options for Pediatric EMS (COPE)

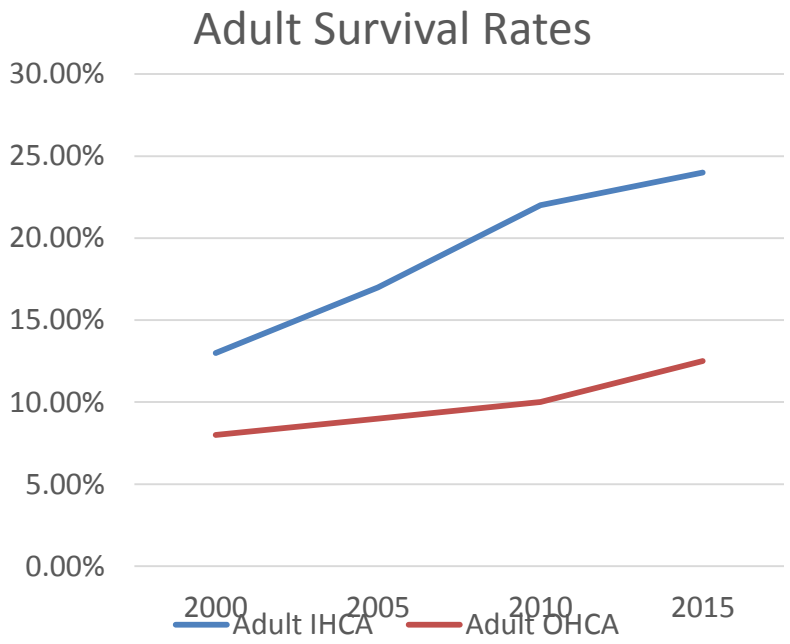
1. Equips EMS providers with the knowledge and skills to help families cope with pediatric OHCA and death
2. Educate EMS providers in how to provide “self help” to prevent secondary trauma

- Improved communication skills and self-insight

https://apps.doornsa.com/COPEWeb
Email: aaron.calhoun@louisville.edu

Can We Close the Gap?





A New Vision for Management of Pediatric OHCA

- Support dispatcher-assisted bystander CPR for children and CPR training for the public
- Providing high-quality CPR on scene immediately to children suffering non-traumatic cardiac arrest (QI essential)
- Consider a pit-crew approach to pediatric resuscitation
- Discourage a “scoop and run” approach for non-traumatic OHCA
- Include children in TOR protocols
- Foster family-centered care and EMS provider training in communicating a child’s death

Questions?