

Pediatric Emergency Care Coordinators in EMS Agencies: Measuring the Influence, Magnifying the Impact

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2023 ALL-GRANTEE MEETING

CULTIVATING COMMUNITY GROWING COLLABORATION

Speaker Disclosure

- **“I have no financial interests or relationships to disclose.”**



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Funding Acknowledgement

- This work is sponsored by a HRSA/EMSC Targeted Issues Grant, #H34MC33245



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Background





Project PI:
Mark X Cicero



Project Science Team:

Simulation and Implementation Expert:
Marc Auerbach
Data Scientist: Janette Baird
EMSC Innovation & Improvement
Consultant: Samuel Vance



Colorado Site

PI: Kathleen Adalgais
RA: Carl Elston
CO EMSC State
Partnership



Connecticut Site

PI: M. Cicero
RA: Several
CT EMSC State
Partnership



Rhode Island Site

PI: Linda Brown
RA: Troy Xu
RI EMSC State
Partnership



EMS Agencies:

- AMR Colorado Springs
- Crested Butte FPD
- UC Health Fort Collins
- Upper Pine River FPD



EMS Agencies:

- Branford FD
- Bethany FD
- East Haven FD
- New Haven AMR
- North Haven FD



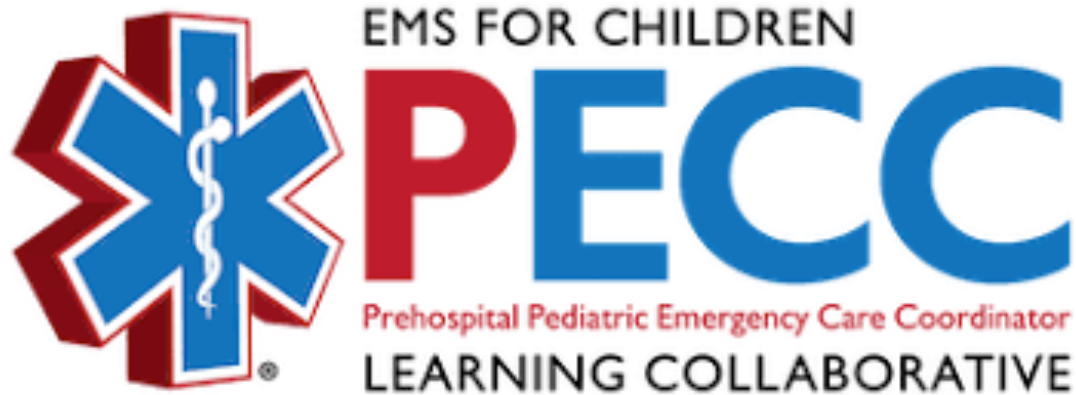
EMS Agencies:

- East Providence FD
- Exeter FD
- Providence FD
- South Kensington FD



Goals

1. Determine whether PECCs improve quality of care
2. Determine if PECCs lead to better patient outcomes for pediatric EMS patients
3. Explore roles and implementation:
 - Protocols
 - Training
 - Equipment
 - Quality activities



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Hypotheses

- Designated EMS agency PECCs lead to improvements in:
 - Quality of clinical care for children
 - Patient outcomes
 - Pediatric cognitive and psychometric skills for providers
 - Family satisfaction with EMS care
- Optimal means for implementing a PECC can be determined
- The best uses of PECC time can be determined
 - PECC Effectiveness
 - PECC Evaluation

Methods

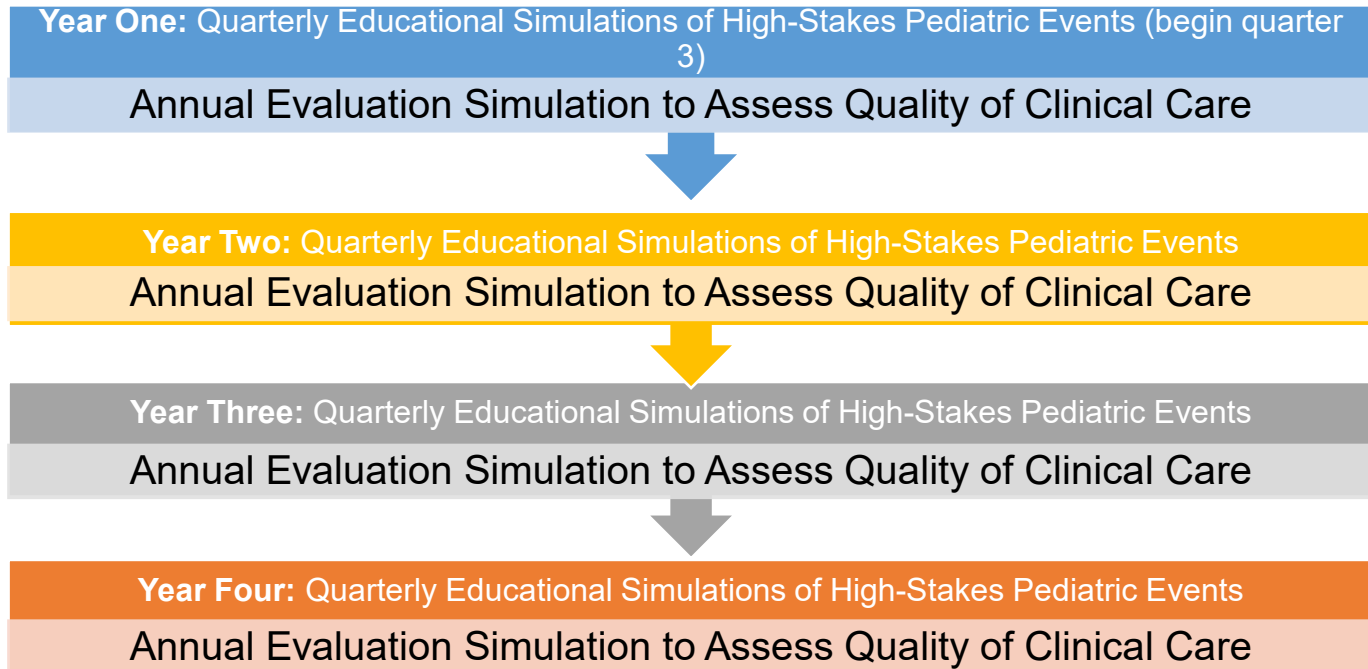


Methods: Goals 1&2

- Pediatric Prehospital Safety Event Detection System (PEDS)
- Detection of errors and adverse outcomes (ASEs, characterized into UNSEMs [(unintended injury, near miss, suboptimal action, error, management complication)])
- All patients aged 0-18 transported by participant EMS agencies to our hospitals followed from EMS encounter to hospital discharge



Methods, Goal 1: Provider Psychomotor and Cognitive Skills



We will use previously vetted pediatric simulation curriculum for EMS providers and previously derived and validated evaluation tools (ACEP SIMBOX & Lammers)



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Methods Goal 1: Assess Family Satisfaction with EMS Care for Children

The FAMILY (Family Assessment of Medical Interventions & Liaisons with the Young) Instrument will assess the family perception of:

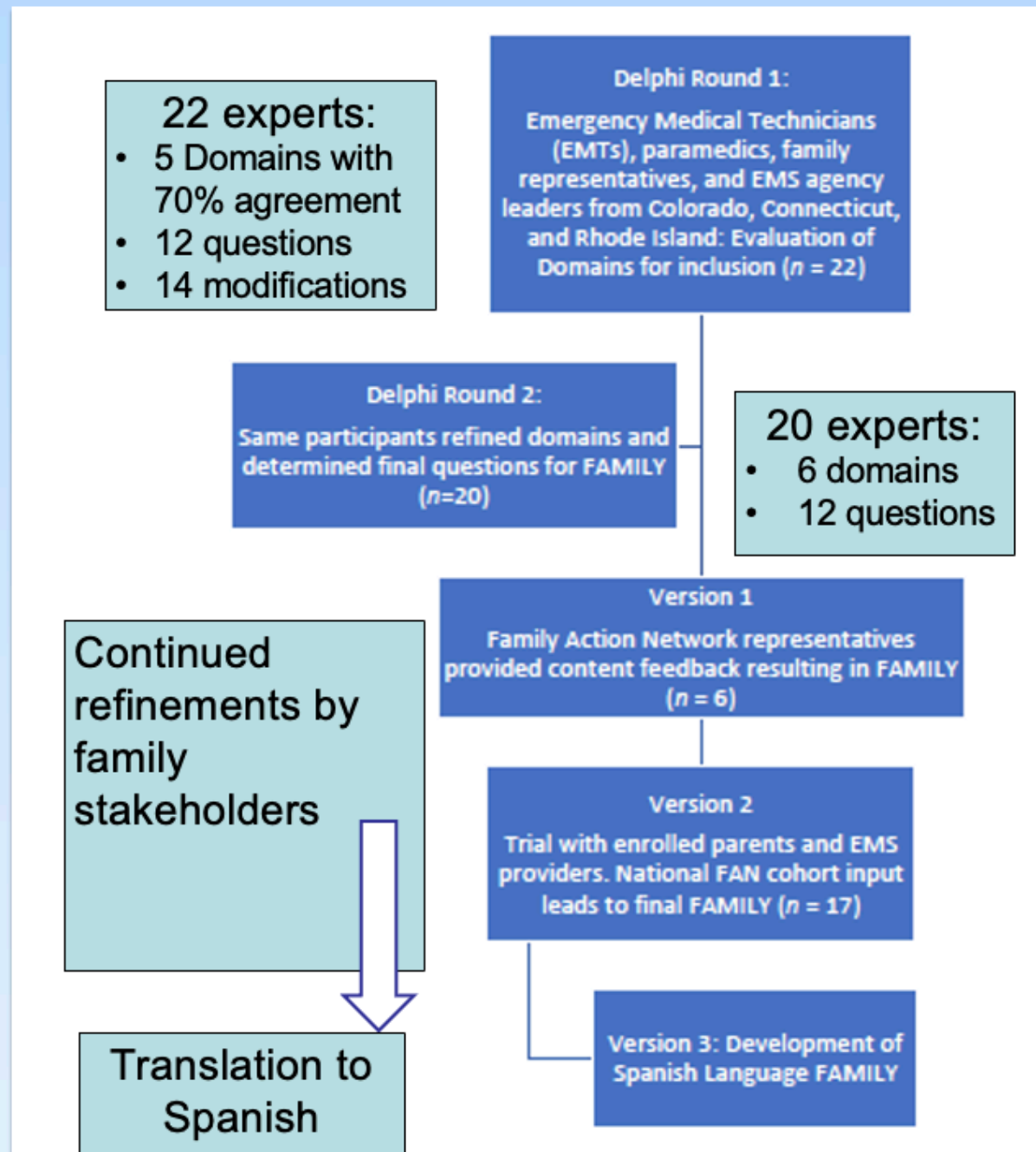
- Safety
- Communication
- Family Presence and Participation
- Awareness of Cultural Differences
- Approach to Children with Special Healthcare Needs
- Overall satisfaction



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Process for Deriving the Family Assessment of Medical Interventions and Liaisons (FAMILY)

Figure 1. Delphi method derivation of the FAMILY



Methods Goal 3:

Determine effective means for designating and implementing PECCs

Glasgow RE, Vogt TM, Boles SM.
Evaluating the public health impact of health promotion interventions: the RE-
AIM framework. *Am J Public Health*.
1999;89(9):1322-1327.



R: Reach



E: Effectiveness



A: Adoption



I: Implementation



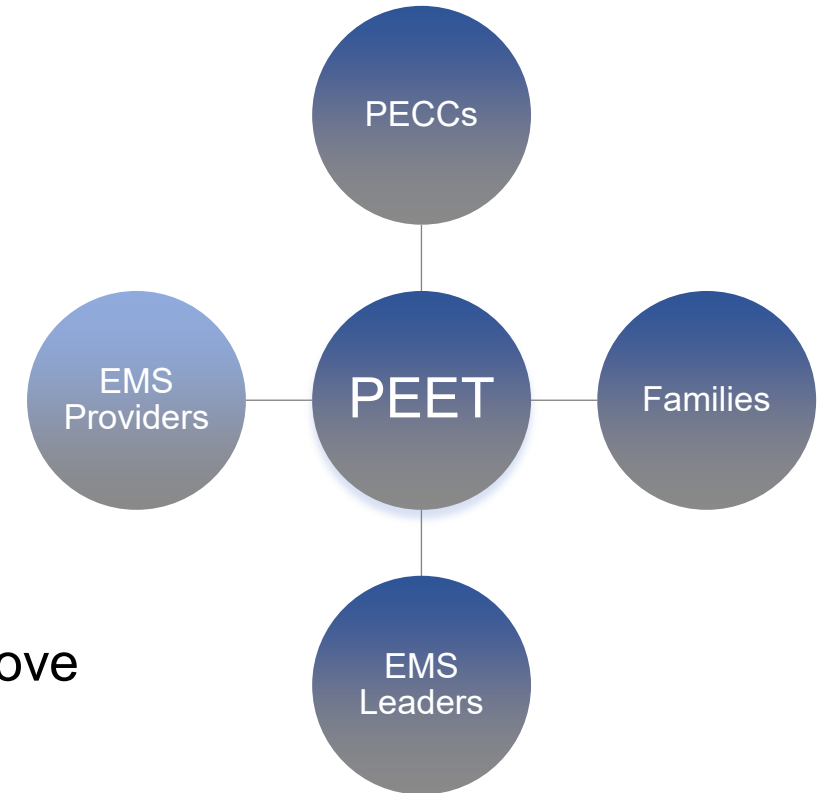
M: Maintenance



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Methods Goal 3: Define the characteristics of an effective PECC

- Derived the PECC Effectiveness Evaluation Tool (PEET)
- Validate with comparison of PEET scores to Aim 1 outcomes
- Implement the PEET
 - Share with PECC Community of Practice
 - Determine which PECC activities are associated with improve quality of care and patient outcomes



Results



FAMILY (Goal 3)

- **EMS personnel and caregivers of showed good concordance with:**
 - Satisfaction across family communication
 - Family participation
 - Overall satisfaction
- **Dyad agreement was poorest for:**
 - Safety
 - Cultural awareness
 - Listening to parent concerns

Table: Family-Centered Care Domains and Agreement Among Dyads

Transport Experience Domain	Survey Item Content	EMS Professional Response n=284 Median (IQR)	Parent/Guardian Response n=219 Median (IQR)	Dyad Agreement n=85 Spearman's (r)
Safety	Transport safety ensured	7 (7,7)	7 (7,7)	-0.04
	Conducted care in a professional manner/cared for child	7 (7,7)	7 (7,7)	0.47 (p=0.001)
Communication with Family	Explained what was happening during transport	7 (7,7)	7 (7,7)	0.01
	Listened to child/family concerns	7 (7,7)	7 (7,7)	0.14
	Answered child/family questions	7 (7,7)	7 (7,7)	0.11
Family Participation	Encouraged parent/guardian to be present	7 (7,7)	7 (7,7)	0.46 (p=0.001)
	Encouraged parent/guardian to support/calm patient	7 (7,7)	7 (7,7)	0.06
Cultural Awareness	Respect for child's/family's culture & beliefs	7 (7,7)	7 (7,7)	0.06
	Asked/respected child's/family's needs regarding modesty/religion/limits to care	7 (4,7)	7 (4,7)	0.23
	Understanding child's needs for adaptive equipment/Respectful of child's medical/social differences	7 (7,7)	7 (7,7)	0.38 (p=0.001)
Overall Satisfaction with EMS Care Received (On 1-5 Scale)		5 (5,5)	5 (5,5)	0.5 (p<0.001)



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Adverse Safety Events in Pediatric EMS Patients

Table 4: Emergency Medical Services Clinical Activities and Adverse Safety Events (ASEs)

Care category	Patients with Activities Performed	ASEs n	*UNSEM type n (%)	Clinical activity n (%)	ASE Potential Harm n (%)
Assessment, diagnosis, clinical decision making	508	52	U =1 (2.1) N =3 (6.1) S =35 (71.4) E = 10 (20.4) M = 0	Clinical history = 5 (9.6) Physical exam = 14 (26.9) Applying monitors = 4 (7.7) Monitoring vital signs = 19 (36.5) Performing diagnostic tests = 8 (15.4) Incorrect use of cognitive aids = 2 (3.9)	Harm unlikely = 38 (73.1) Mild temporary harm = 8 (15.3) Permanent /severe harm = 3 (5.8) Missing =3 (5.8)
**At least one Procedure (Including airway management)	170	64	U = 4 (6.3) N = 3 (4.7) S =21 (32.8) E = 26 (40.6) M = 10 (15.6)	Procedure performed was not indicated = 6 (9.4) Failure to perform indicated procedure= 34 (53.1) Delay in performing indicated procedure = 2 (3.2) Multiple attempts to perform indicated procedure = 7 (10.9) Unsuccessful procedure = 11 (17.2) Missing = 4 (6.2)	Harm Unlikely = 31 (48.4) Mild temporary harm = 20 (31.3) Permanent / severe harm = 7 (10.9) Missing = 6 (9.4)
***Medicine Administration and/or O ₂ administration	111	28	U = 3 (16.6) N = 2 (11.1) S =5 (27.8) E = 7 (38.9) M = 1 (5.6)	Medication given was not indicated = 3 (10.7) Wrong medication selected = 1 (3.6) Delay giving medication = 2 (7.1) Overdose of medication = 1 (3.6) Underdose of medication = 1 (3.6) Wrong route of administration = 0 Inadequate monitoring = 2 (7.1) Wrong concentration given = 0 Failure to perform indicated procedure-Oxygen administration = 6 (21.4) Missing = 12 (42.9)	Harm Unlikely = 10 (35.7) Mild temporary harm = 6 (21.54) Permanent /severe harm = 2 (7.1) Missing = 10 (35.7)
Fluid administration	31	18	U = 6 (33.3) N = 4 (22.2) S =5 (27.8) E = 3 (16.7) M = 0 	Delay in giving fluids = 0 Too much fluid given = 0 Too little fluid given = 7 (38.9) Inadequate monitoring = 2 (11.1) Wrong type fluid given = 0 Fluids were not indicated but given = 2 (11.1) Fluids indicated but not given = 7 (38.9)	Harm Unlikely = 9 (50.0) Mild temporary harm = 5 (27.8) Permanent /severe harm = 2 (11.1) Missing = 2 (11.1)



PEDS Tool Chart Extraction (Goals 1&2)

Site	PECC Agency Charts (<i>n</i>)	Non-PECC Agency Charts (<i>n</i>)	Three Most Common EMS Impressions
Colorado	454	210	Injuries, Respiratory distress, psychiatric emergency
Connecticut	59	1155	Injuries, Respiratory distress, psychiatric emergency
Rhode Island	122	0	Injuries, Respiratory distress, psychiatric emergency
Total	635	1365	---



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PEDS Tool Chart Extraction Patient Ages

Agency Caring for Pediatric Patient	Median Age, years (SD, Range)	Significance of the difference
PECC Designated	12.0 (5.42, 2.0 months - 17.97 years)	
No PECC Designated	10.9 (5.39, 2.4 months - 17.99 years)	
		$p = 0.001$



Chart Extraction and Summative Simulations Will be Used to Compare PECC and Non-PECC Agencies

- Comparison of patient care and outcomes based on:
 - Patient EMS impression (diagnosis)
 - Medications
 - Procedures
 - Lights-and-sirens vs. non-lights-and-sirens transport
- Simulation outcomes
 - Adverse safety events
 - Standardized performance evaluation
 - EMS experience and level of certification



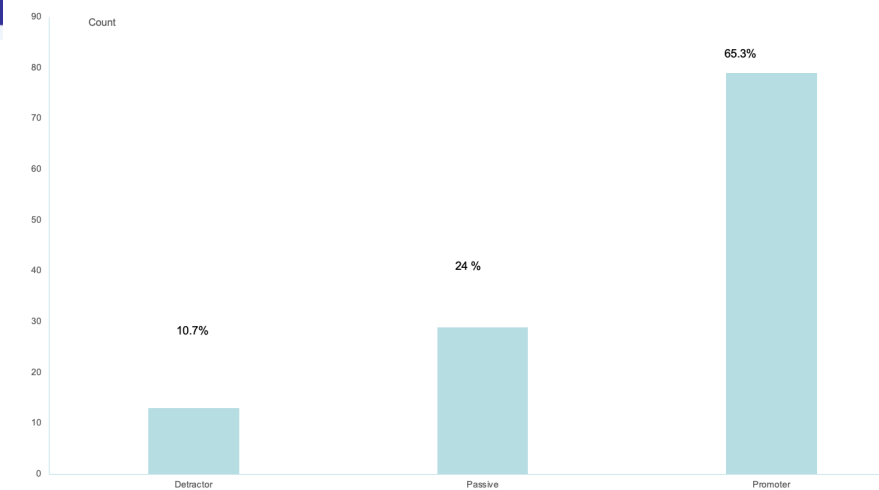
SimBox Dissemination (Goal 3)

Table 1: Study Participant and Scenario Characteristics

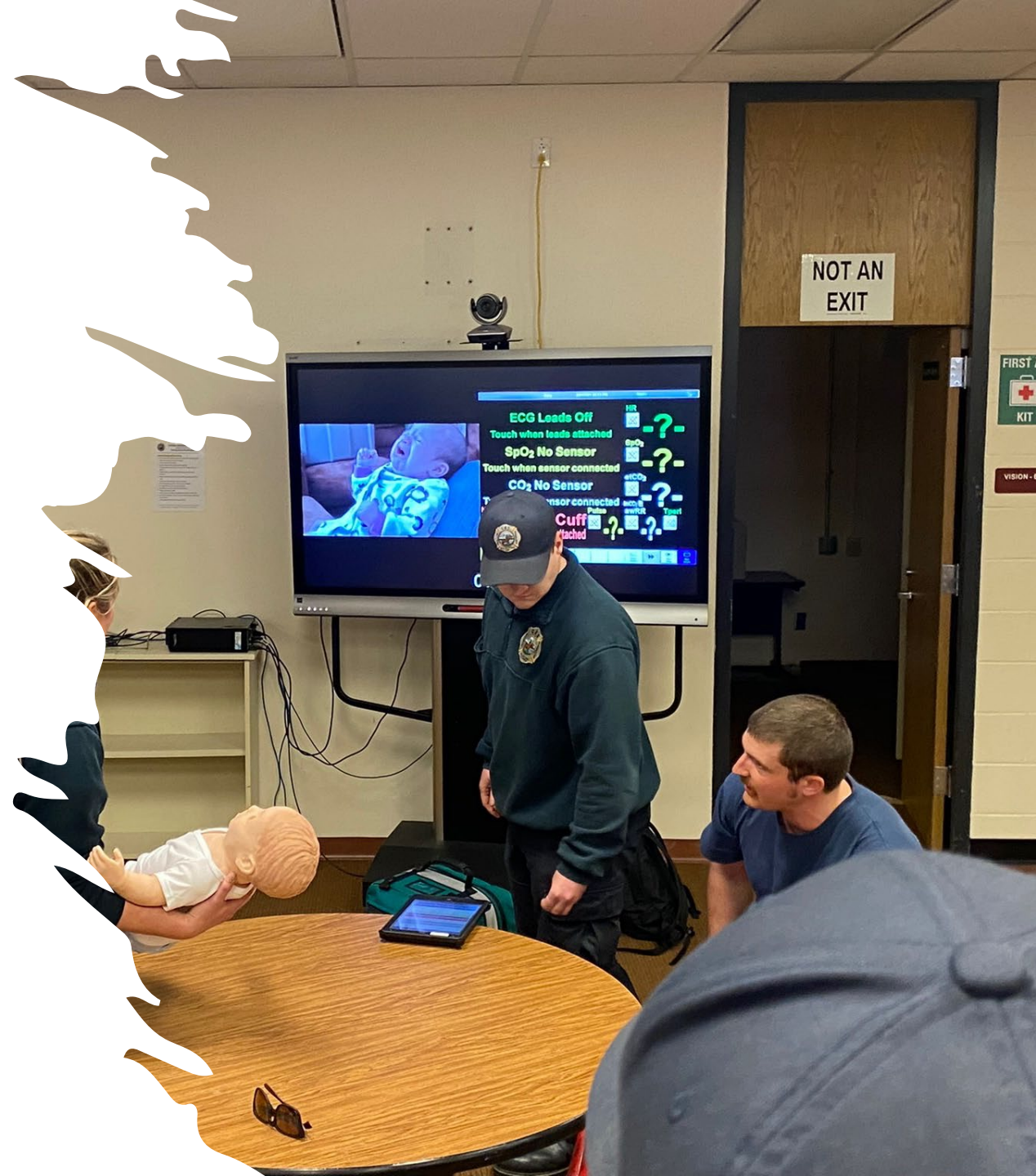
Characteristic		n (%)
EMS Certification Level	EMT	18 (14.9)
	Paramedic	103 (85.1)
Scenario (Patient age)	Child Abuse (Seven months)	40 (33)
	Seizure (Five years)	71 (58.7)
	Respiratory Depression (Six weeks)	3 (2.5)
	Septic Neonate Six weeks)	1 (<1)
Simulation Format	In-Person	95 (83.3)
	Virtual	10 (8.8)
	In-Person with Virtual	9 (7.9)
Session Facilitation	In-Person	67 (60.4)
	Virtual	4 (3.6)
	In-Person with Virtual	37 (33.3)
*Other scenario (n=4), Missing (n=2)		



Figure 2: SimBox Participant Net Promoter Scores



Conclusions



Conclusion

1) Linkages of PECC activity to:

- Patient outcomes
- Quality of clinical care
- Provider psychomotor and cognitive skills
- Family perceptions and satisfaction

2) PECC Implementation framework that serves as a model for states and individual EMS agencies

3) Understanding of PECC :

- Effectiveness
- Evaluation
- Strategies for improvement





ToolKit for EMS PECCs

- Family EMS Satisfaction survey
- ACEP SimBox Simulations
- Pediatric activity log

Forthcoming:

PECC onboarding and maintenance kit

EMS Family Satisfaction Survey

- Allows assessment of EMS by families
- EMS assesses interaction with families, too
- Individual and team feedback
- Tracking impact of family-centered care initiatives



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SIMBOX Simulations

- Low-resource, high educational reward
 - Low-fidelity manikin
 - Video depicts patient and vital sign monitor
 - Script for facilitator
 - Debriefing script



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SimBoX ReSources: Readily Available, Free of Charge



ACEP SimBox
+*Tele* SimBox



<https://www.acepsimbox.com/emstelesimbox>

<https://www.acepsimbox.com>



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Allows tracking of:

- Training
- Equipment in services
- Formal courses
- Quality assurance and improvement activities

Creates a record of what works well and where there are opportunities for improvement

Pediatric Activity Log

08/27/20	PALS Refresher	Agency headquarters	In-house only	EducationT EST	PALS Course	10--15	Paid	Paramedic	5 hours or more
09/03/20	PALS Refresher	Agency headquarters	In-house only	EducationT EST	PALS Course	16-20	Paid	Paramedic	5 hours or more
10/30/20	EPC Initial	Agency headquarters	In-house only	EducationT EST	EPC Course	3	Paid	Paramedic	5 hours or more
12/07/20	CME	Agency headquarters	Multiple agency	EducationT EST	Lecture	More than 20	Paid	Paramedic	3 hours

HRSA Targeted Issues Grant: ED Pediatric Readiness

Craig Newgard, MD, MPH
Department of Emergency Medicine
Oregon Health & Science University



2023 ALL-GRANTEE MEETING

CULTIVATING COMMUNITY GROWING COLLABORATION

Speaker Disclosure & Funding

- Health Resources and Services Administration Targeted Issues grant, # H34MC332430100
 - *A Multi-State Evaluation of Emergency Department Pediatric Readiness: Guideline Uptake and Association with Quality, Outcomes, and Cost*
 - 9/1/2019 – 8/31/2024
- National Institute of Child Health and Human Development (NICHD), #R24 HD085927
 - The Value of Pediatric Readiness in the Emergency Care of Injured Children
 - 9/30/2017 - 6/30/2023



Background: ED Pediatric Readiness

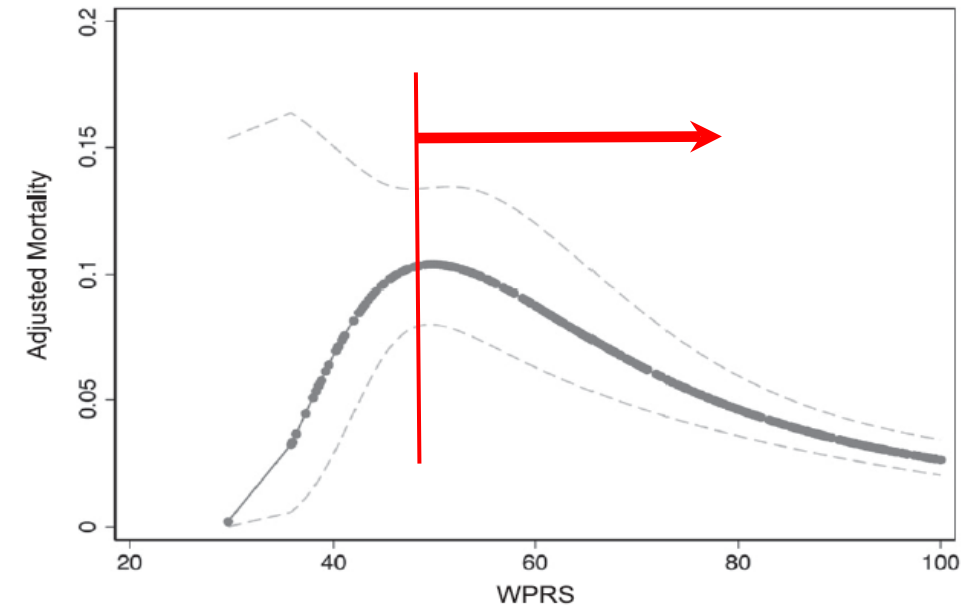
- Conducted 2013 and 2021 across 50 states and US territories
- Based on national guidelines for ED care of children
- 6 domains:
 - Policies, procedures, protocols
 - Patient safety
 - Equipment and supplies
 - Quality improvement
 - Personnel
 - Administration and coordination
- Overall score = Weighted Pediatric Readiness Score (wPRS) 0-100



Emergency Department Pediatric Readiness and Mortality in Critically Ill Children

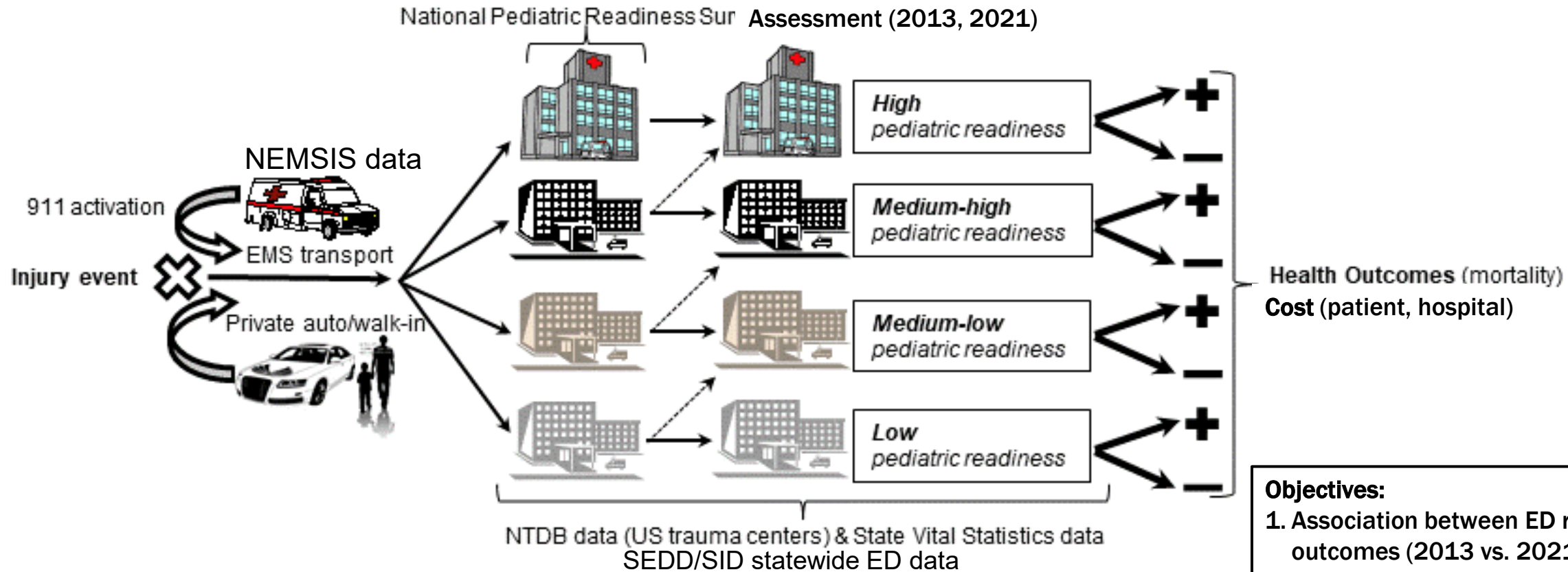
Stefanie G. Ames, MD, MS,^a Billie S. Davis, PhD,^a Jennifer R. Marin, MD, MSc,^{c,d} Ericka L. Fink, MD, MS,^{c,e}
Lenora M. Olson, PhD, MA,^g Marianne Gausche-Hill, MD,^{e,h,j} Jeremy M. Kahn, MD, MS^{e,f}

- 2019
- N = 20,483 children with critical illness
- 426 EDs



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Conceptual model for HRSA TI project



Objectives:

1. Association between ED readiness and outcomes (2013 vs. 2021).
2. Outcomes gains by improved matching of children with high-readiness EDs.
3. Costs (patient and hospital) of care across different levels of ED readiness.



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Objective 1: ED Pediatric Readiness and Outcomes



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Evaluation of Emergency Department Pediatric Readiness and Outcomes Among US Trauma Centers

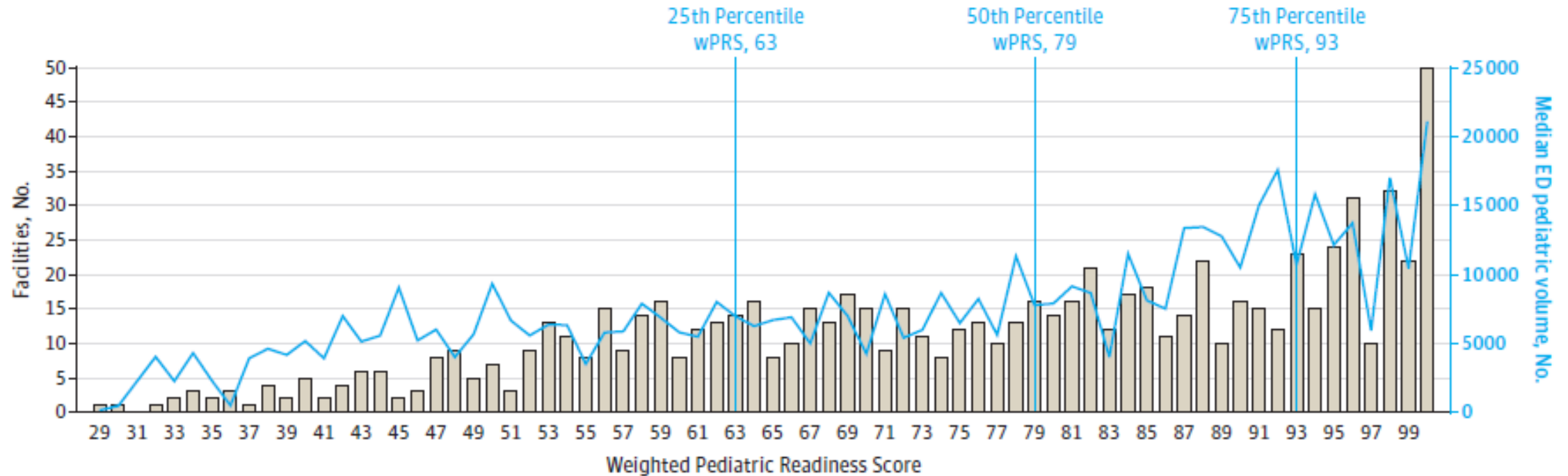
Craig D. Newgard, MD, MPH; Amber Lin, MS; Lenora M. Olson, PhD; Jennifer N. B. Cook, GCPH; Marianne Gausche-Hill, MD; Nathan Kuppermann, MD, MPH; Jeremy D. Goldhaber-Fiebert, PhD; Susan Malveau, MS; McKenna Smith, BS; Mengtao Dai, MS; Avery B. Nathens, MD, PhD; Nina E. Glass, MD; Peter C. Jenkins, MD, MSc; K. John McConnell, PhD; Katherine E. Remick, MD; Hilary Hewes, MD; N. Clay Mann, PhD, MS; for the Pediatric Readiness Study Group

- Published 2021
- 832 trauma centers across U.S. (2012 – 2017)
- n = 372,004 injured children 0-17 years
 - 5,700 (1.5%) in-hospital mortality
 - 5,018 (1.3%) complications
 - 10,375 (2.8%) death or complications



Quartiles of ED pediatric readiness in 832 TCs

Figure 1. Emergency Department (ED) Pediatric Readiness and Annual ED Pediatric Volume in 832 Trauma Center EDs



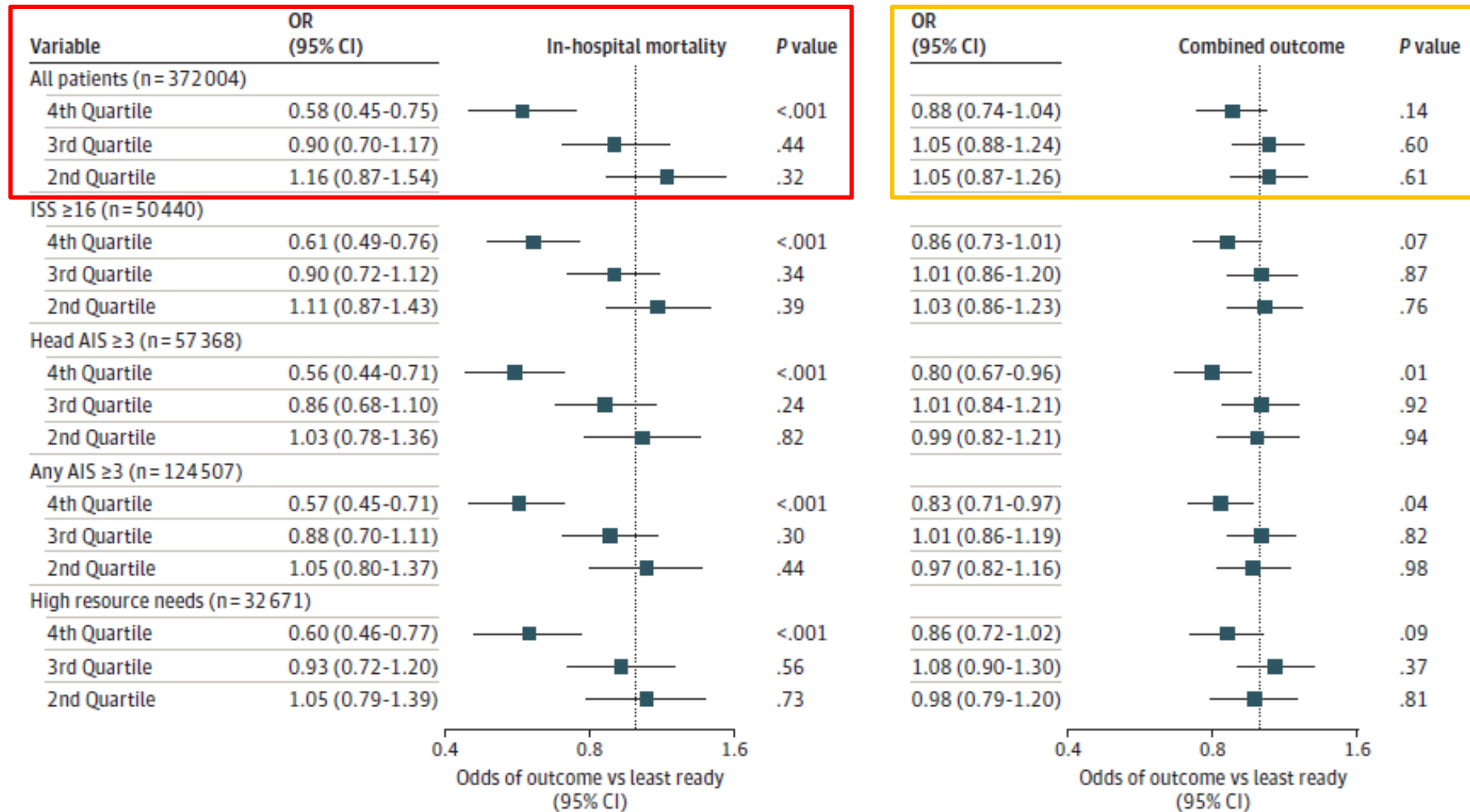
Gray bars indicate the number of EDs at each weighted pediatric readiness score (wPRS) and the blue line indicates the median annual ED volume of children at each wPRS.



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Adjusted OR of outcomes (compared to least ready quartile)

Figure 2. Adjusted In-Hospital Mortality and Composite Outcome (In-Hospital Mortality or Complication) Across Quartiles of Emergency Department (ED) Pediatric Readiness for Injured Children



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ED pediatric readiness was measured using the weighted Pediatric Readiness Score (wPRS). The x-axis is in the natural logarithm (ln) scale.

Additional lives that *could have been* saved by increasing ED pediatric readiness at U.S. TCs

% of patients shifted to highest quartile	<u>lowest</u> quartile ED readiness to highest quartile n lives saved per year (95% CI)	<u>second</u> quartile ED readiness to highest quartile n lives saved per year (95% CI)	<u>third</u> quartile ED readiness to highest quartile n lives saved per year (95% CI)	<u>Across all quartiles</u> n lives saved per year (95% CI)
0% (no change)	0	0	0	0
25%	7 (5-8)	11 (9-13)	13 (9-18)	31 (23-38)
50%	13 (10-17)	23 (19-27)	27 (18-35)	63 (49-77)
75%	20 (15-25)	34 (28-40)	40 (27-53)	94 (72-116)
100%	27 (20-34)	46 (37-54)	53 (36-70)	126 (97-154)

756 pediatric lives over 6 years



Association of Emergency Department Pediatric Readiness With Mortality to 1 Year Among Injured Children Treated at Trauma Centers

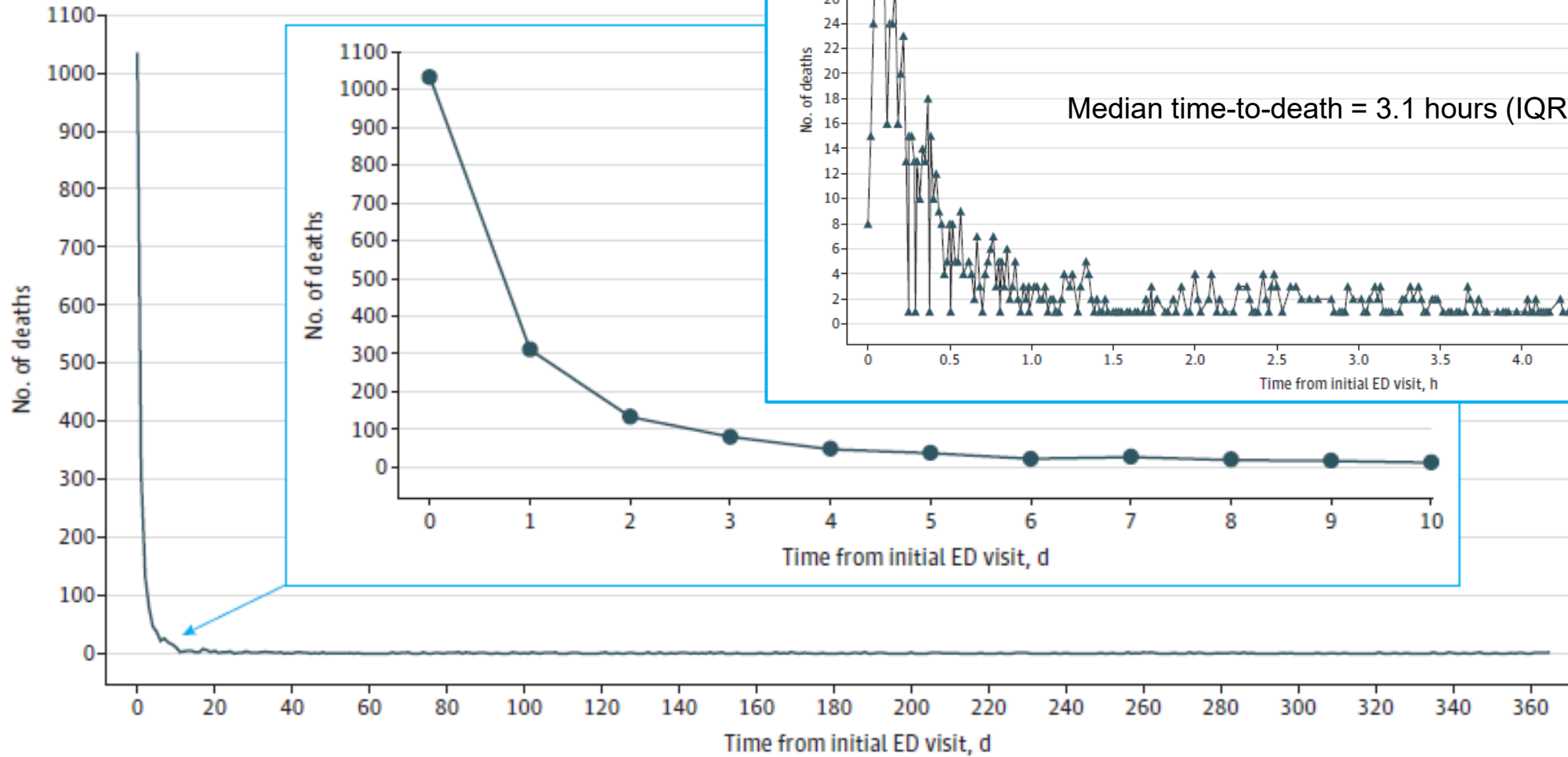
Craig D. Newgard, MD, MPH; Amber Lin, MS; Jeremy D. Goldhaber-Fiebert, PhD; Jennifer R. Marin, MD, MSc; McKenna Smith, MPH; Jennifer N. B. Cook, GCPH; Nicholas M. Mohr, MD, MS; Mark R. Zonfrillo, MD, MSCE; Devin Puapong, MD; Linda Papa, MD, MSc; Robert L. Cloutier, MD, MCR; Randall S. Burd, MD, PhD; for the Pediatric Readiness Study Group

- Published 2022
- ED peds ready and long-term outcomes (1-year)
- 146 trauma centers in 15 states
- n = 88,071
 - In-hospital mortality: 2.0% (n = 1,768 deaths)
 - 1-year mortality: 2.2% (n = 206 deaths after discharge)

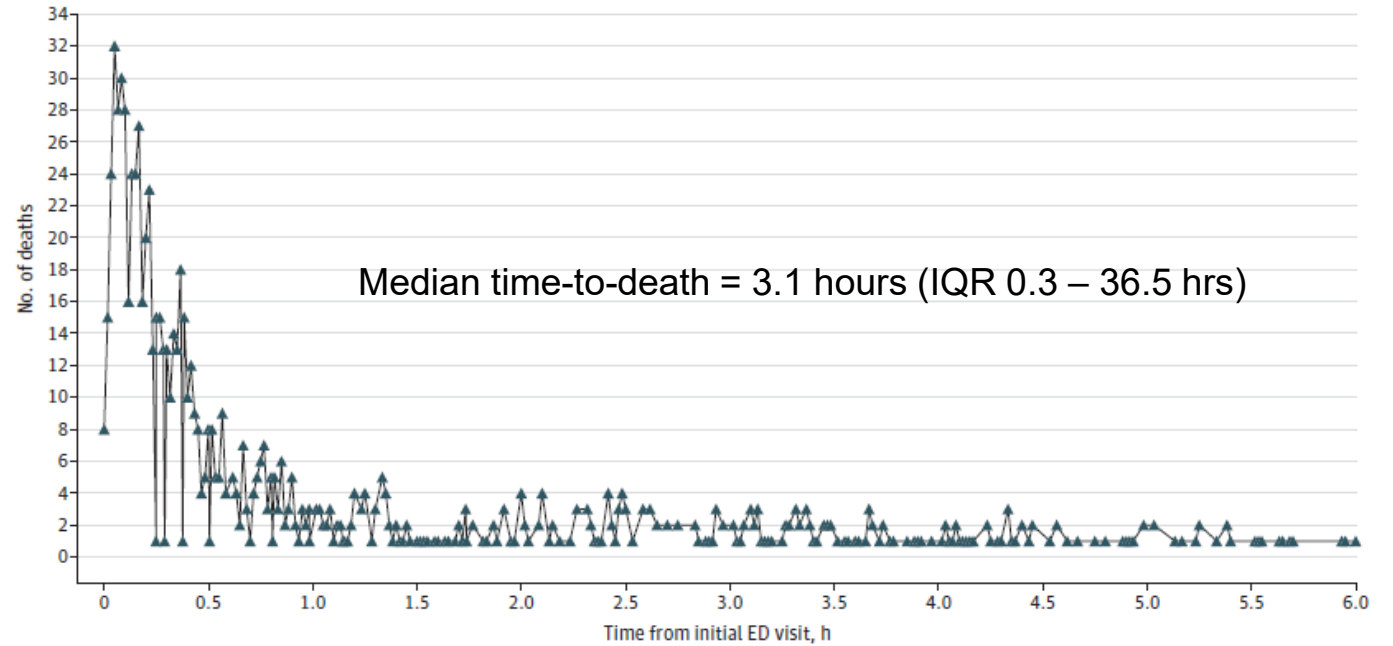


Time-to-death

A Time to death to 1 y for all patients who died



B Time to death among patients who died in the ED or during hospitalization



Median time-to-death = 3.1 hours (IQR 0.3 – 36.5 hrs)

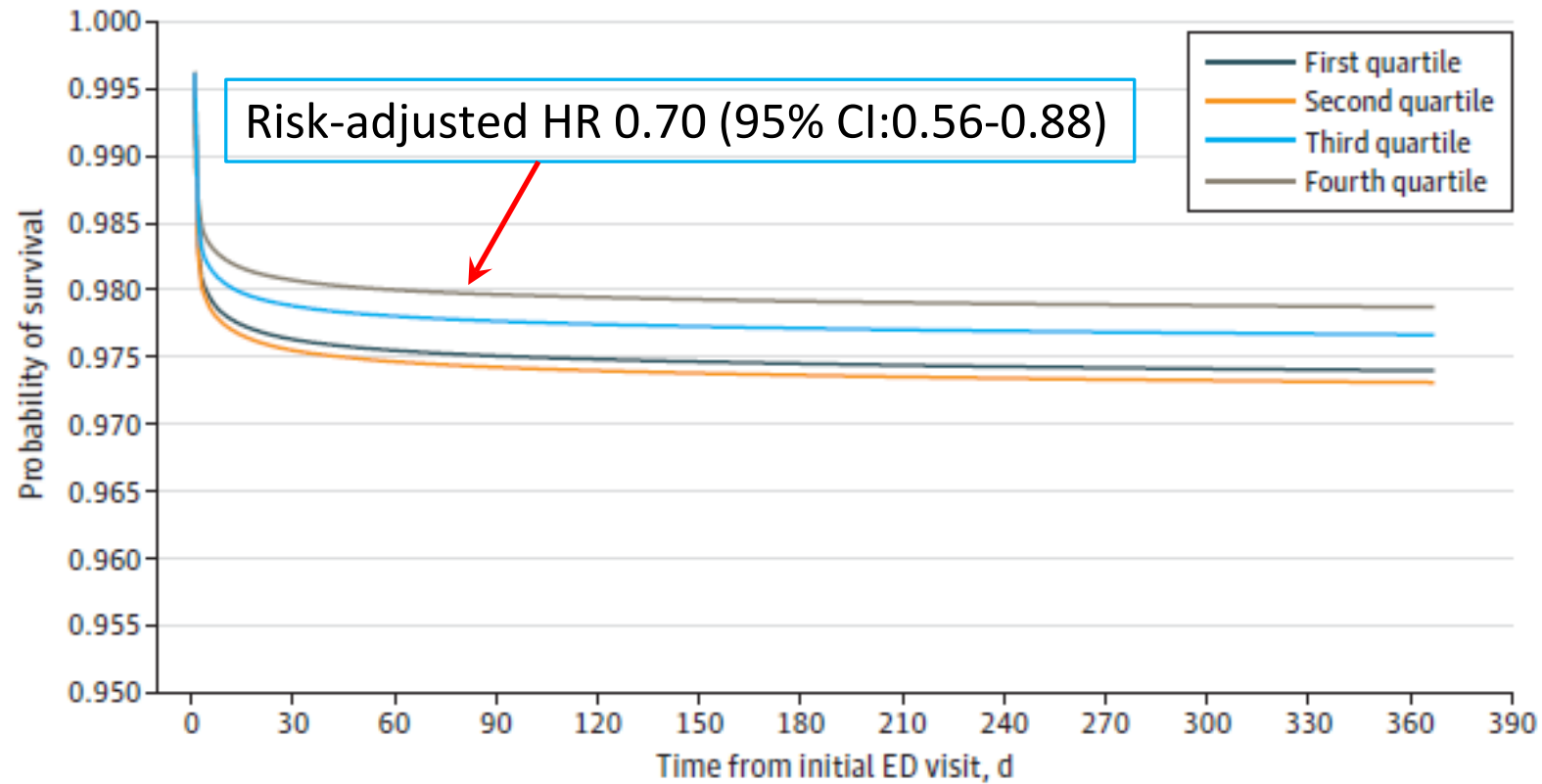
Median time-to-death = 1 day (IQR 1-4)



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Adjusted time-to-death (1-year)

Figure 3. Adjusted Time-to-Death Analysis Among 88 071 Injured Children Presenting to 146 Trauma Centers by Emergency Department (ED) Pediatric Readiness





Original Investigation | Emergency Medicine

Emergency Department Pediatric Readiness and Short-term and Long-term Mortality Among Children Receiving Emergency Care

Craig D. Newgard, MD, MPH; Amber Lin, MS; Susan Malveau, MS; Jennifer N. B. Cook, GCPH; McKenna Smith, MPH; Nathan Kuppermann, MD, MPH; Katherine E. Remick, MD; Marianne Gausche-Hill, MD; Jeremy Goldhaber-Fiebert, PhD; Randall S. Burd, MD, PhD; Hilary A. Hewes, MD; Apoorva Salvi, MS; Haichang Xin, PhD; Stefanie G. Ames, MD, MS; Peter C. Jenkins, MD, MSc; Jennifer Marin, MD, MS; Matthew Hansen, MD, MCR; Nina E. Glass, MD; Avery B. Nathens, MD, PhD; K. John McConnell, PhD; Mengtao Dai, MS; Brendan Carr, MD, MS; Rachel Ford, MPH; Davis Yanez, PhD; Sean R. Babcock, MS; Benjamin Lang, MD; N. Clay Mann, PhD, MS; for the Pediatric Readiness Study Group

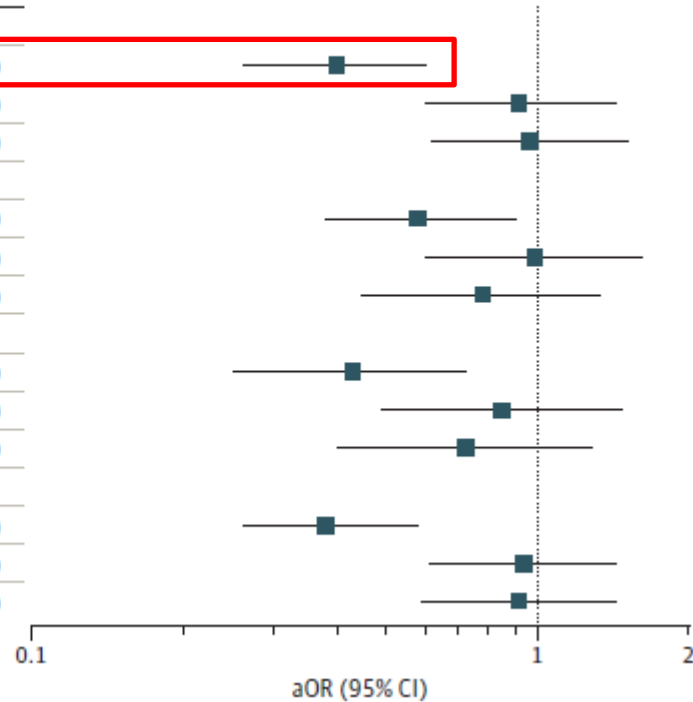
- Published 2023
- 983 EDs in 11 states
- n = 796,937 children receiving emergency services
 - 90,963 (11.4%) injured
 - 705,974 (88.6%) medically ill



ED/in-hospital risk-adjusted mortality

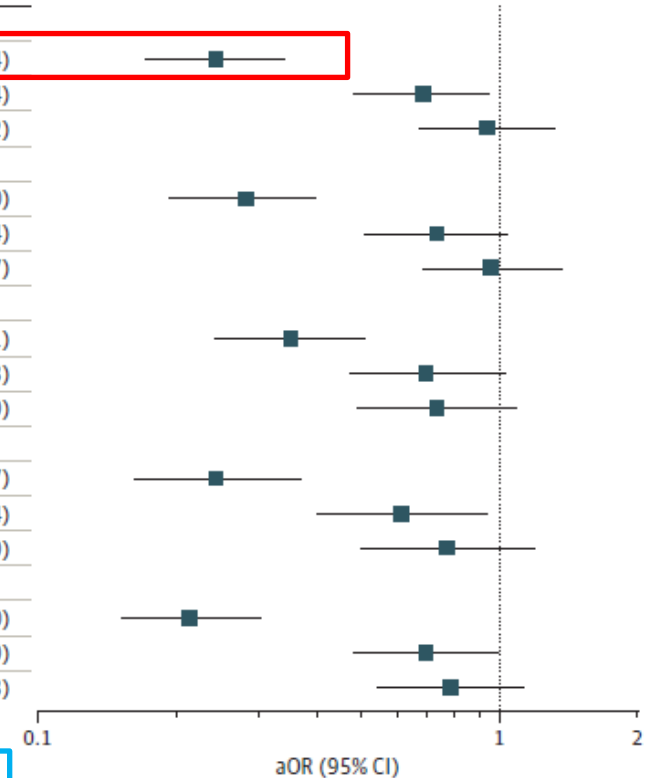
A Injured

Subgroup and ED readiness	aOR (95% CI)
Injured patients (n= 90 963)	
Fourth quartile	0.40 (0.26-0.60)
Third quartile	0.92 (0.60-1.43)
Second quartile	0.97 (0.62-1.51)
ISS ≥16 (n=6577)	
Fourth quartile	0.58 (0.38-0.91)
Third quartile	0.99 (0.60-1.61)
Second quartile	0.78 (0.45-1.33)
Head AIS ≥3 (n= 12 959)	
Fourth quartile	0.43 (0.25-0.72)
Third quartile	0.85 (0.49-1.48)
Second quartile	0.72 (0.40-1.29)
Severity score ≥4 (n=46 262)	
Fourth quartile	0.38 (0.26-0.58)
Third quartile	0.94 (0.61-1.45)
Second quartile	0.92 (0.59-1.43)



B Medically ill

Subgroup and ED readiness	aOR (95% CI)
Medically ill patients (n= 705 974)	
Fourth quartile	0.24 (0.17-0.34)
Third quartile	0.68 (0.17-0.34)
Second quartile	0.94 (0.67-1.32)
Severity score ≥4 (n= 377 574)	
Fourth quartile	0.28 (0.19-0.40)
Third quartile	0.73 (0.51-1.04)
Second quartile	0.96 (0.68-1.37)
Respiratory diagnosis (n= 292 508)	
Fourth quartile	0.35 (0.24-0.51)
Third quartile	0.69 (0.47-1.03)
Second quartile	0.73 (0.49-1.09)
Neurologic diagnosis (n= 89 058)	
Fourth quartile	0.24 (0.16-0.37)
Third quartile	0.61 (0.40-0.94)
Second quartile	0.77 (0.50-1.19)
Cardiovascular diagnosis (n= 64 219)	
Fourth quartile	0.21 (0.15-0.30)
Third quartile	0.69 (0.48-0.99)
Second quartile	0.78 (0.54-1.13)

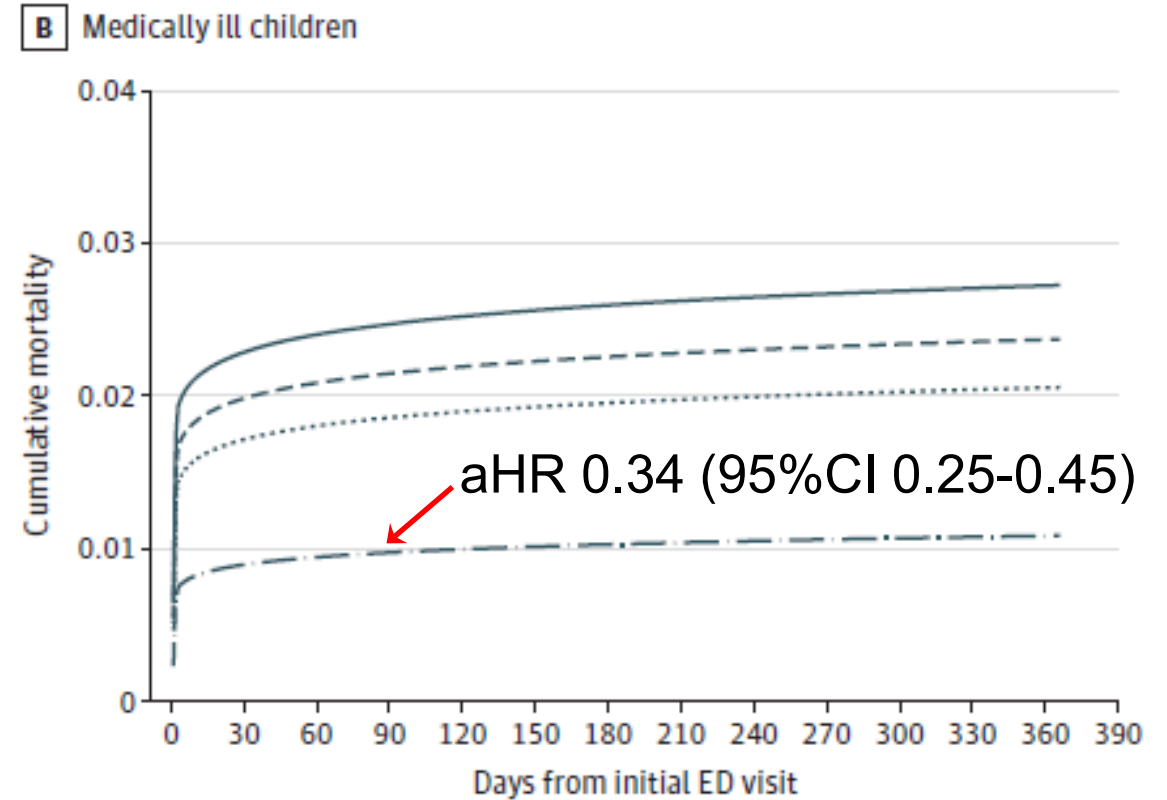
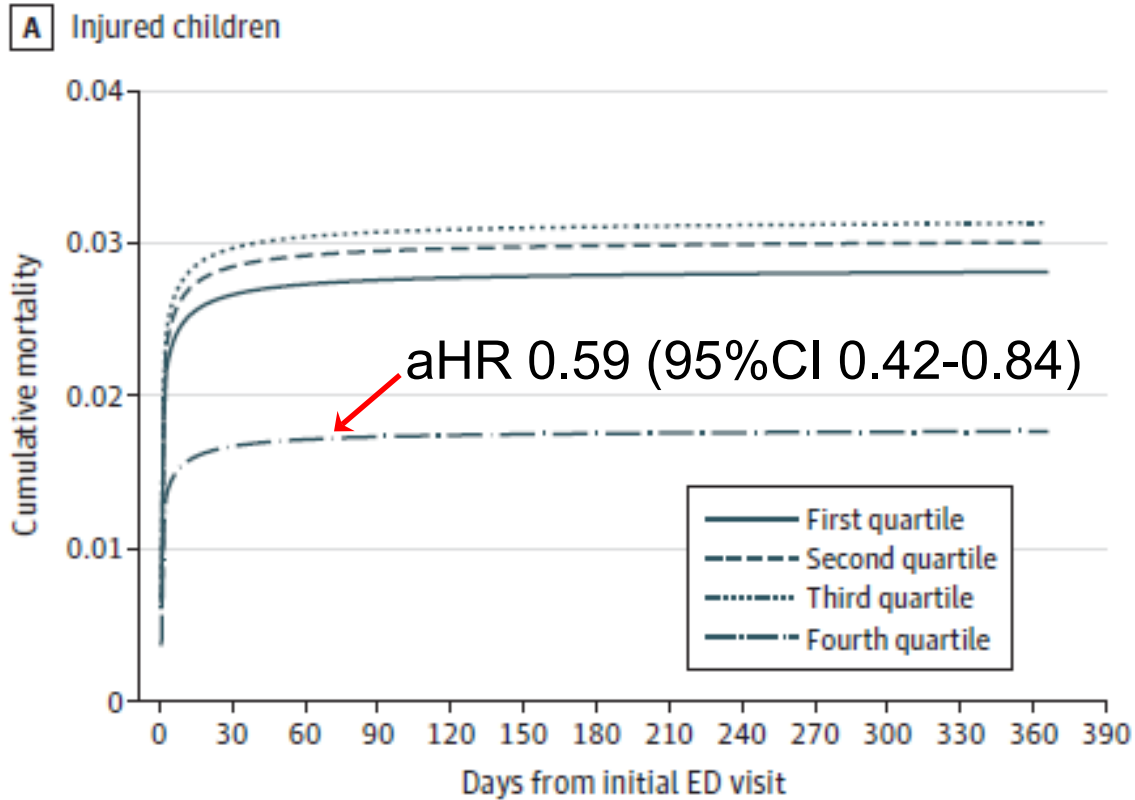


Additional lives that could have been saved if all EDs in the 11 states were high-ready = **1,442** children over 6 years (288 injured + 1,154 medical)



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Adjusted mortality to 1-year (n = 545,921)



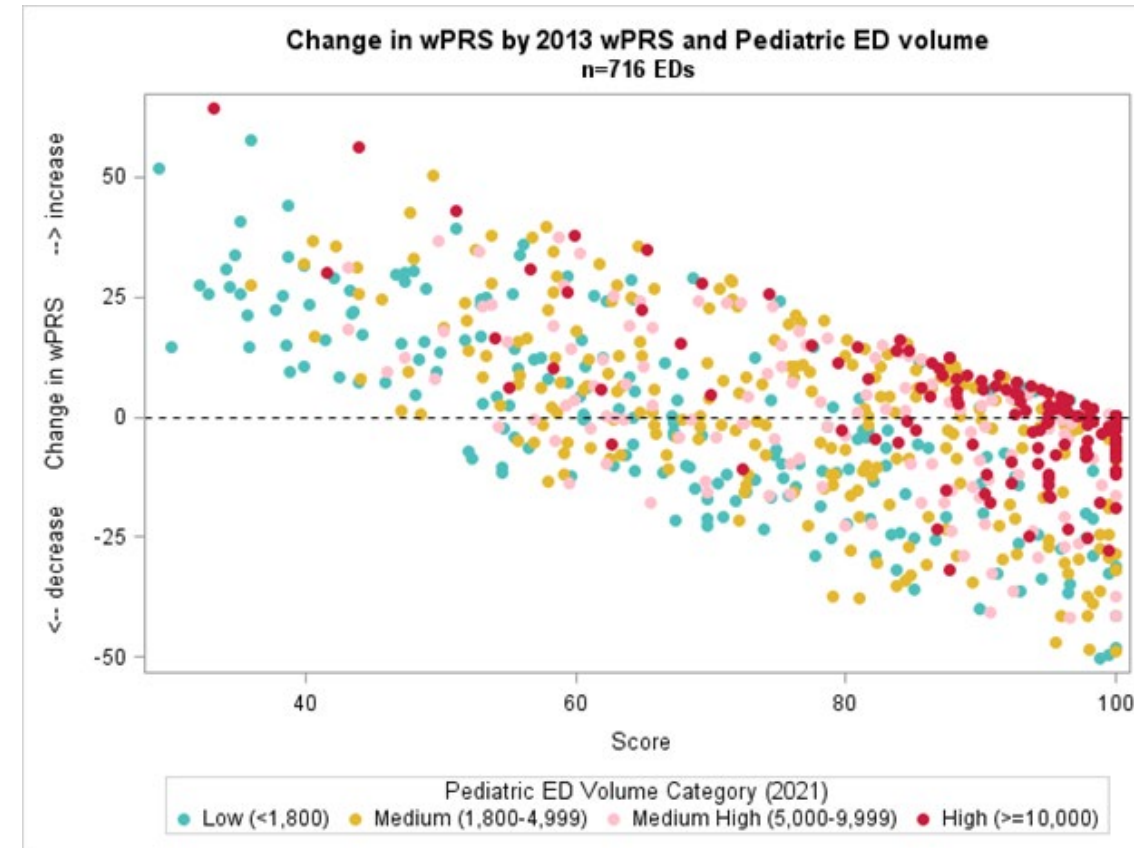
Death to 1-year (children in 6 states)

- 1,136 deaths in the ***injury cohort***; 2.1% 1-year mortality
 - 693 (52.7%) in ED
 - 477 (36.2%) inpatient
 - 146 (11.1%) after discharge
 - Median time-to-death = 0 days (IQR 0-2 days)
- 6,635 deaths in the medical cohort, 1.4% 1-year mortality
 - 4,150 (62.5%) in ED
 - 759 (11.4%) inpatient
 - 1,726 (26.0%) after discharge
 - Median time-to-death = 0 days (IQR 0-7 days)



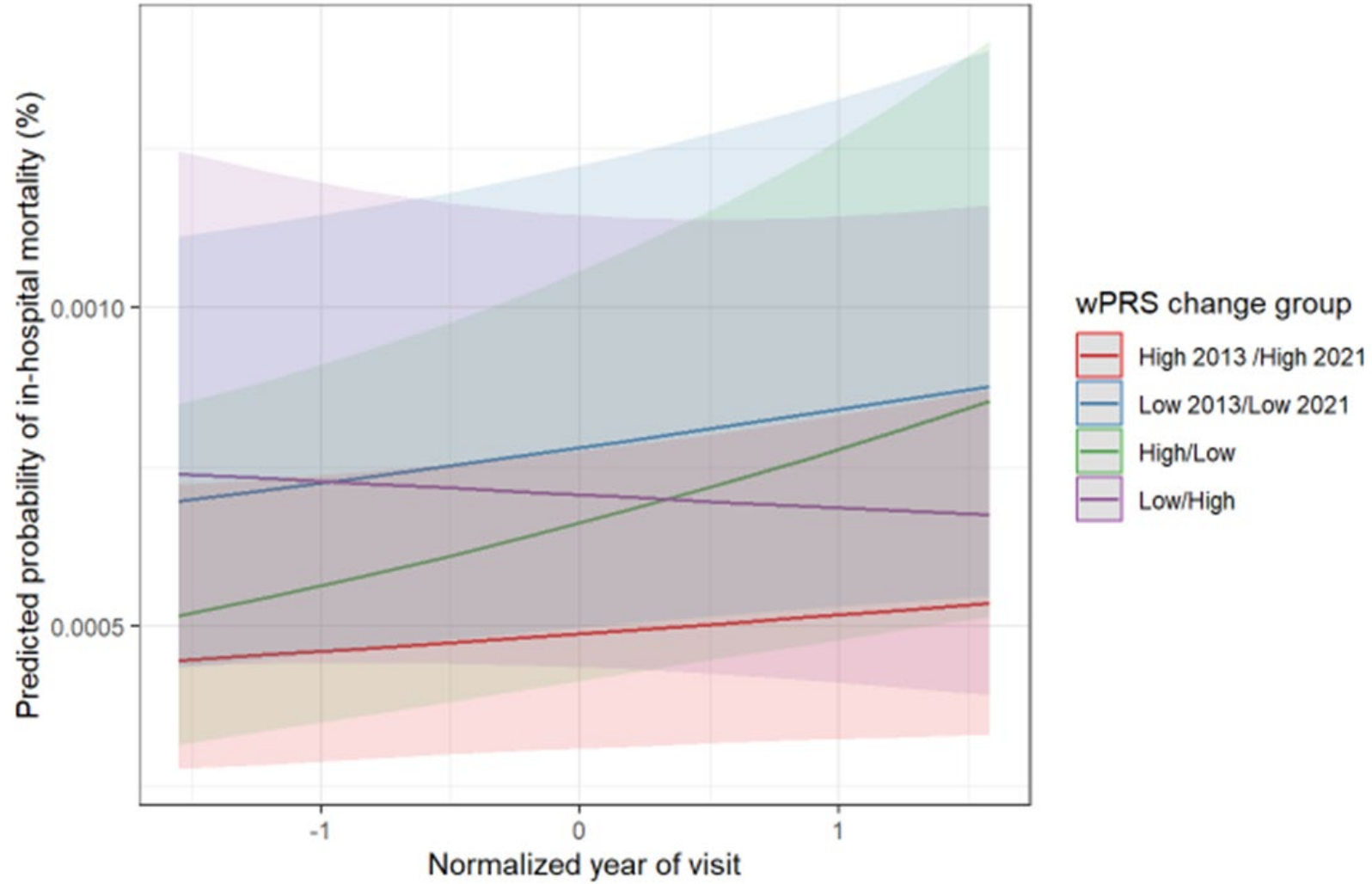
Changes in ED pediatric readiness over time at US Trauma Centers

- N = 467,932; 417 trauma centers
- Decreased ED peds readiness
- Similar association 2013 vs 2021 between high ED readiness and lower mortality
 - 2012-2016: aOR 0.69 (95% CI 0.49–0.97)
 - 2018-2021: aOR 0.63 (95% CI 0.47-0.84)



RIRS model
First imputed dataset

Preliminary model results – changes over time on mortality



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Objective 2: Outcome gains by improved matching of children to high-readiness EDs



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Association of Transport Time, Proximity, and Emergency Department Pediatric Readiness With Pediatric Survival at US Trauma Centers

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- 765 trauma centers; n = 212,689
- 105,871 (49.8%) of children in TCs with high readiness EDs
- Additional 36,330 (17.1%) had high-readiness ED within 30 minutes



Impact Analysis

- Scenario 1: Transport all injured children to TCs with high-readiness EDs within 30 minutes (optimized transport plan) = *would have saved 468 lives*
- Scenario 2: Raise ED readiness to high among all TCs = *would have saved 1,655 lives*













Objective 3: Costs (patient, hospital) of care across different levels of ED pediatric readiness

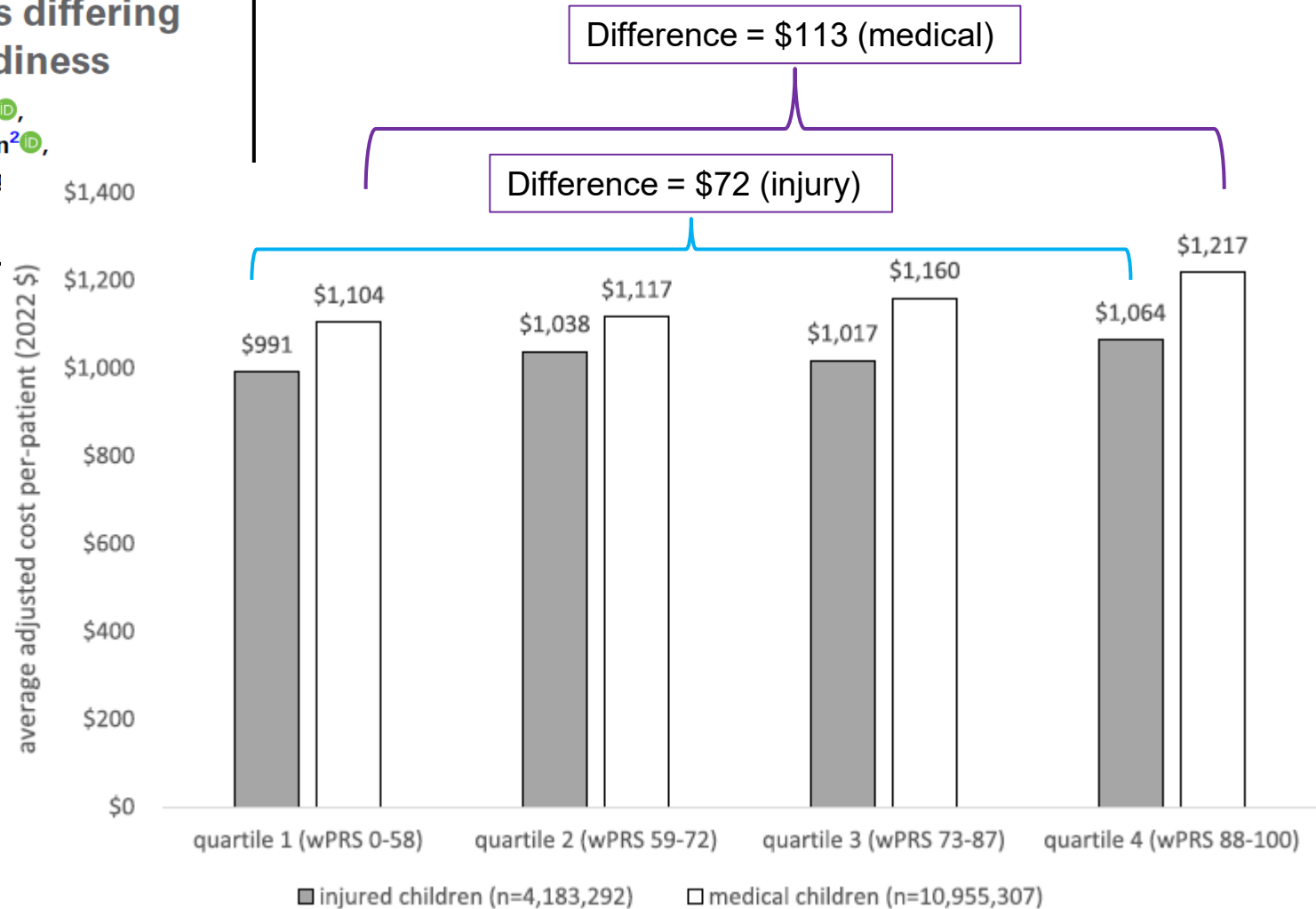


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The cost of emergency care for children across differing levels of emergency department pediatric readiness

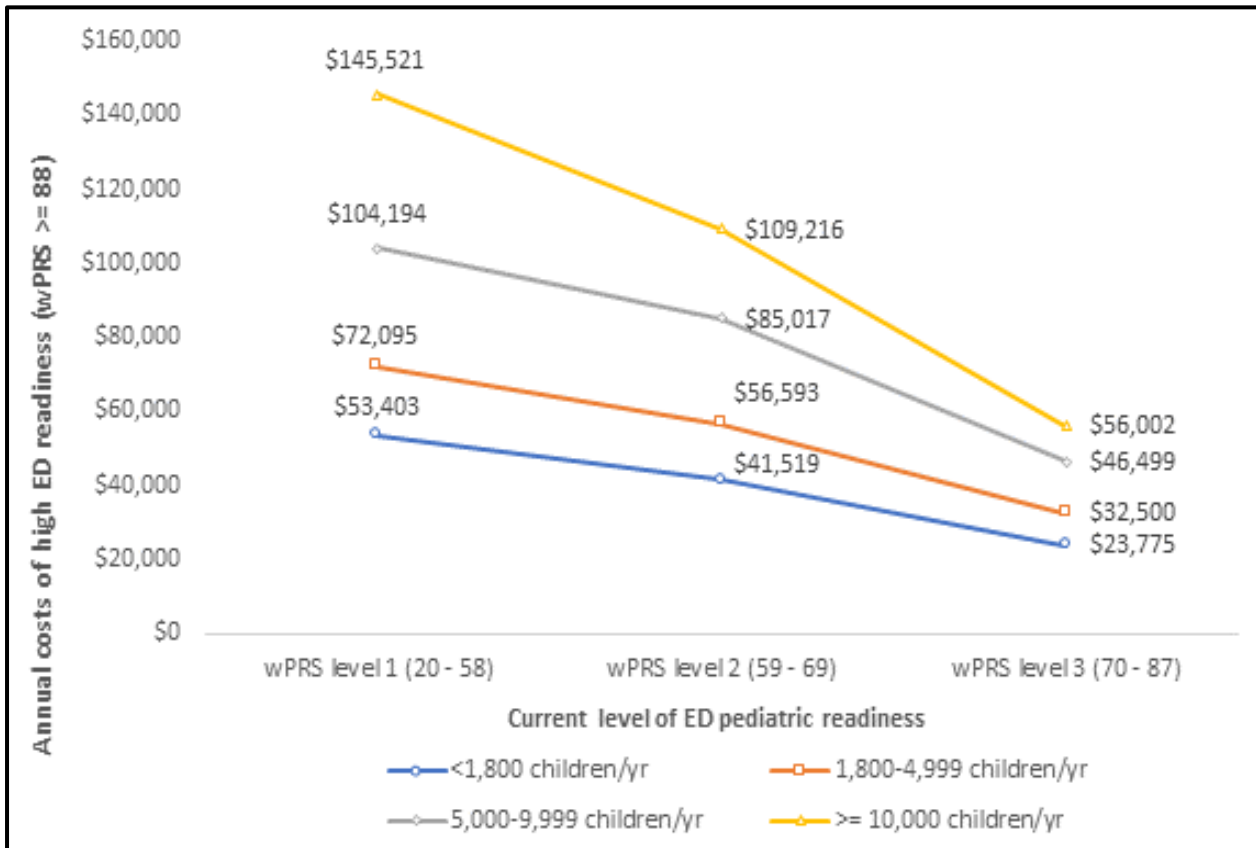
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- N = 15,138,599 children
- 747 EDs in 9 states
- Outcome = patient-level cost of ED visit

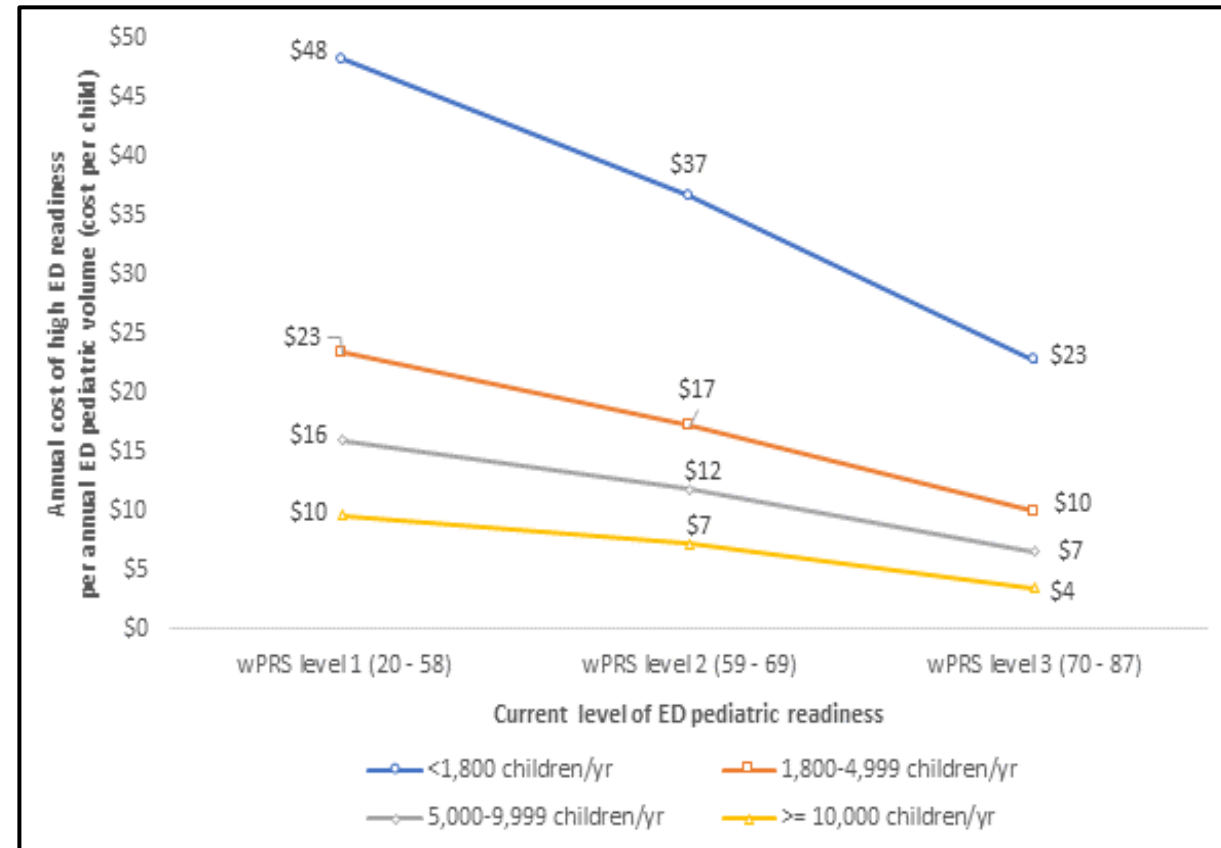


Hospital cost to reach and maintain high ED readiness

A. Absolute cost to reach high ED readiness from current levels

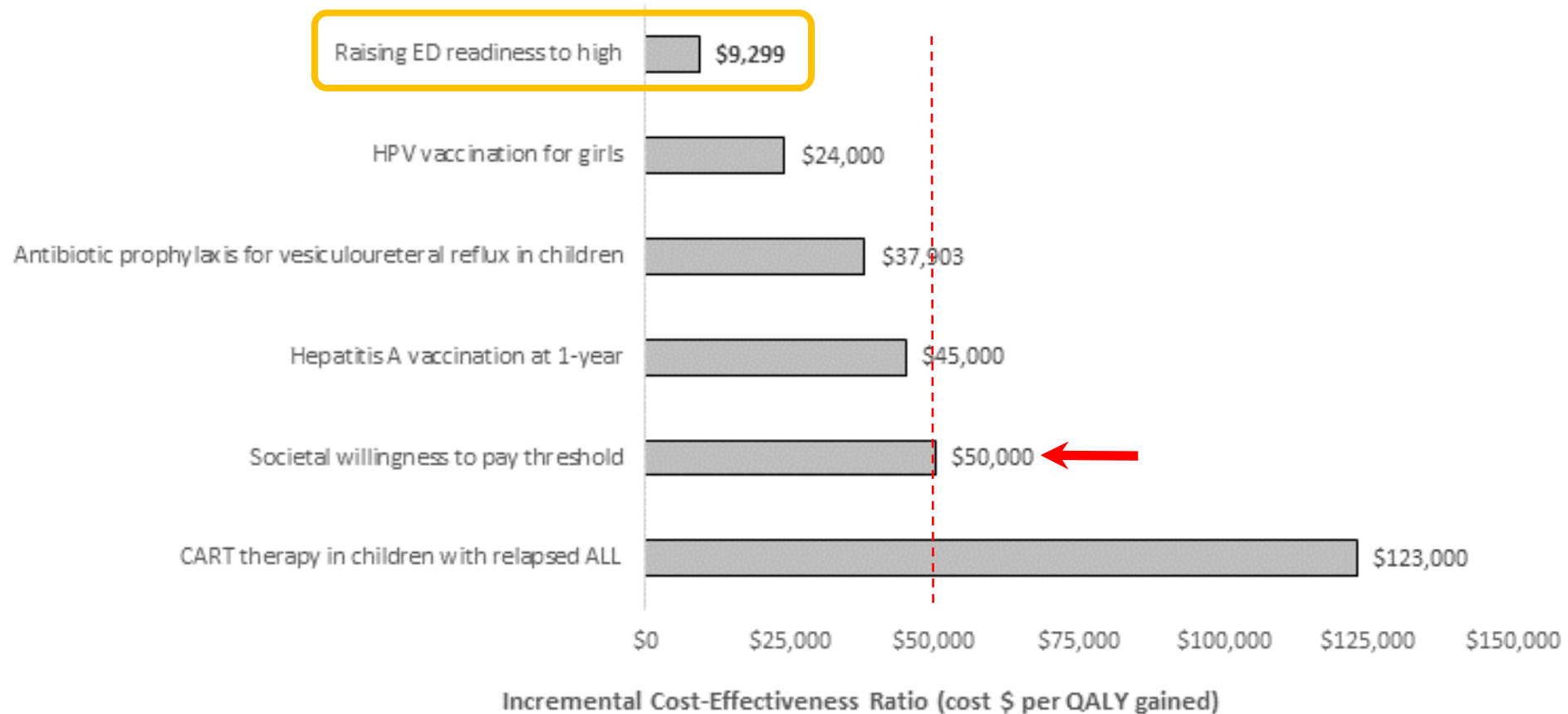


B. Cost-per-patient to reach high ED readiness from current levels



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Cost-effectiveness of increasing EDs to high pediatric readiness



Conclusions

Outcomes

- High ED pediatric readiness is associated with improved survival
- Impact is measureable (# of additional lives that *could be saved*)
- Among children who die, death occurs early

Costs

- Modest patient cost of receiving care in high-readiness EDs
- Modest hospital cost to reach/maintain high ED readiness
- Raising all ED to high-readiness is highly cost-effective



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Thank you!

