



Faster Refill in an Urban EMS System Saves Lives: A Prospective Preliminary Evaluation of a Prehospital Advanced Resuscitative Care Bundle

Kristen D Nordham MD MS, Jacob M Broome MD, Sydney Caputo BS, Cameron Belding MD, Mark Piehl MD MPH, Valerie J De Maio MD MSc, Danielle Tatum PhD, Sharven Taghavi MD MPH MS, Olan Jackson-Weaver PhD, Charles Harris MD, Alison A Smith MD PhD, Emily Nichols MD, Tom Dransfield, David Rayburn MD, Meg Marino MD, Jennifer Avegno MD, Juan C Duchesne MD



Disclosures

Mark Piehl MD MPH: Founder and CMO, 410 Medical

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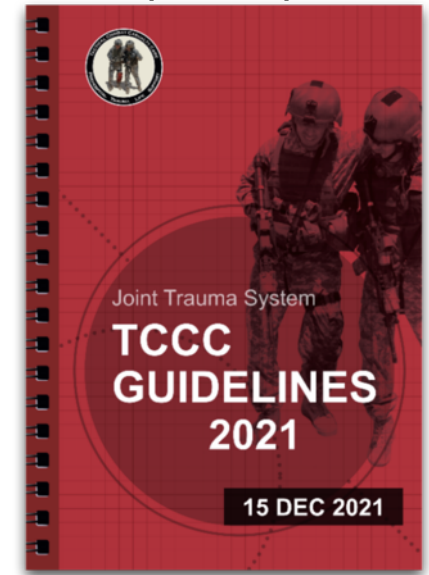
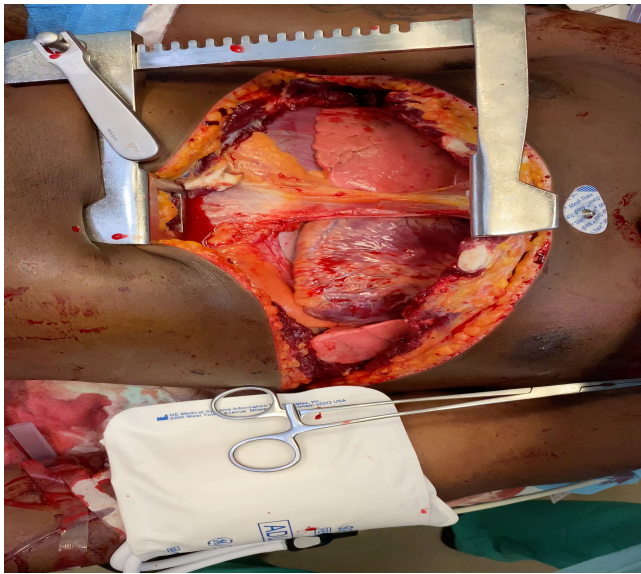
USAF SBIR AF211-CSO1 Phase II, F2-15254

Valerie J De Maio MD MSc: Director of Clinical Science & Research, 410 Medical

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Background

- Uncontrolled hemorrhage: #1 cause of preventable deaths after traumatic injury
- Military experience: ↓ mortality with pre-hospital blood
- Tactical Combat Casualty Care: 2u whole blood, 2g tranexamic acid (TXA)





Civilian Literature

Plasma-first resuscitation to treat haemorrhagic shock during emergency ground transportation in an urban area: a randomised trial

Prehospital Plasma d *Hunter B Moore, Ernest E Moore, Michael P Chapman, Kevin McVaney, Gary Bryskiewicz, Robert Blechar, Theresa Chin, Clay Cothren Burlew, Fredric Pieracci, F Bernadette West, Courtney D Fleming, Arsen Ghasabyan, James Chandler, Christopher C Silliman, Anirban Banerjee, Angela Savaia*

Prehospital whole blood reduces early mortality in patients with hemorrhagic shock

M.D., Darrell J. Triulzi, M.D., Barbara J. Early-Young, B.S.N., Peter W. ; M.D., Herb A. Phelan, M.D., M.S.C.S., et al., for the PAMPer Study

Resuscitation with blood products in patients with trauma-related haemorrhagic shock receiving prehospital care (RePHILL): a multicentre, open-label, randomised, controlled, phase 3 trial

Maxwell A. Braverman¹ | Alison Smith¹ | Douglas Benjamin Axtman¹ | Charles Patrick Shahan¹ | Laur Hannah Corral¹ | Rachele Babbitt Jonas¹ | Michael Randall Schaefer³ | Eric Epley³ | Christopher Winck Elizabeth Waltman⁵ | Brian J. Eastridge¹ | Susannah Ronald M. Stewart¹ | Donald H. Jenkins¹

*Nicholas Crombie, Heidi A Doughty, Jonathan R B Bishop, Amisha Desai, Emily F Dixon, James M Hancox, Mike J Herbert, Caroline Leech, Simon J Lewis, Mark R Nash, David N Naumann, Gemma Slinn, Hazel Smith, Iain M Smith, Rebekah K Wale, Alastair Wilson, Natalie Ives, Gavin D Perkins, on behalf of the RePHILL collaborative group**

Objective

Evaluate effects of prehospital acute resuscitative care (ARC) bundle in an urban ground EMS system with short transport times on outcomes in penetrating trauma patients with hemorrhagic shock.



Pre-hospital ARC bundle

- 2u pRBCs via rapid infuser (non-warmed), 2g CaCl, 2g TXA
- Bundle triggers:
 - SBP \leq 70 mmHg
 - or
 - SBP \leq 90 mmHg & HR $>$ 110 at EMS arrival on-scene
- Implemented 10/2021



Hypothesis

A prehospital ARC bundle for penetrating trauma patients with hemorrhagic shock decreases in-hospital mortality in an urban setting with short EMS transport times.

Methods

- ARC bundle patients (10/2021-1/2023)
- vs.
- Control hypotensive penetrating trauma patients (1/2016-1/2019)
- Inclusion criteria: all patients with penetrating injuries and pre-hospital SBP ≤ 90 mmHg at EMS arrival
- Exclusion criteria: head injuries, pre-hospital cardiac arrest

Statistics

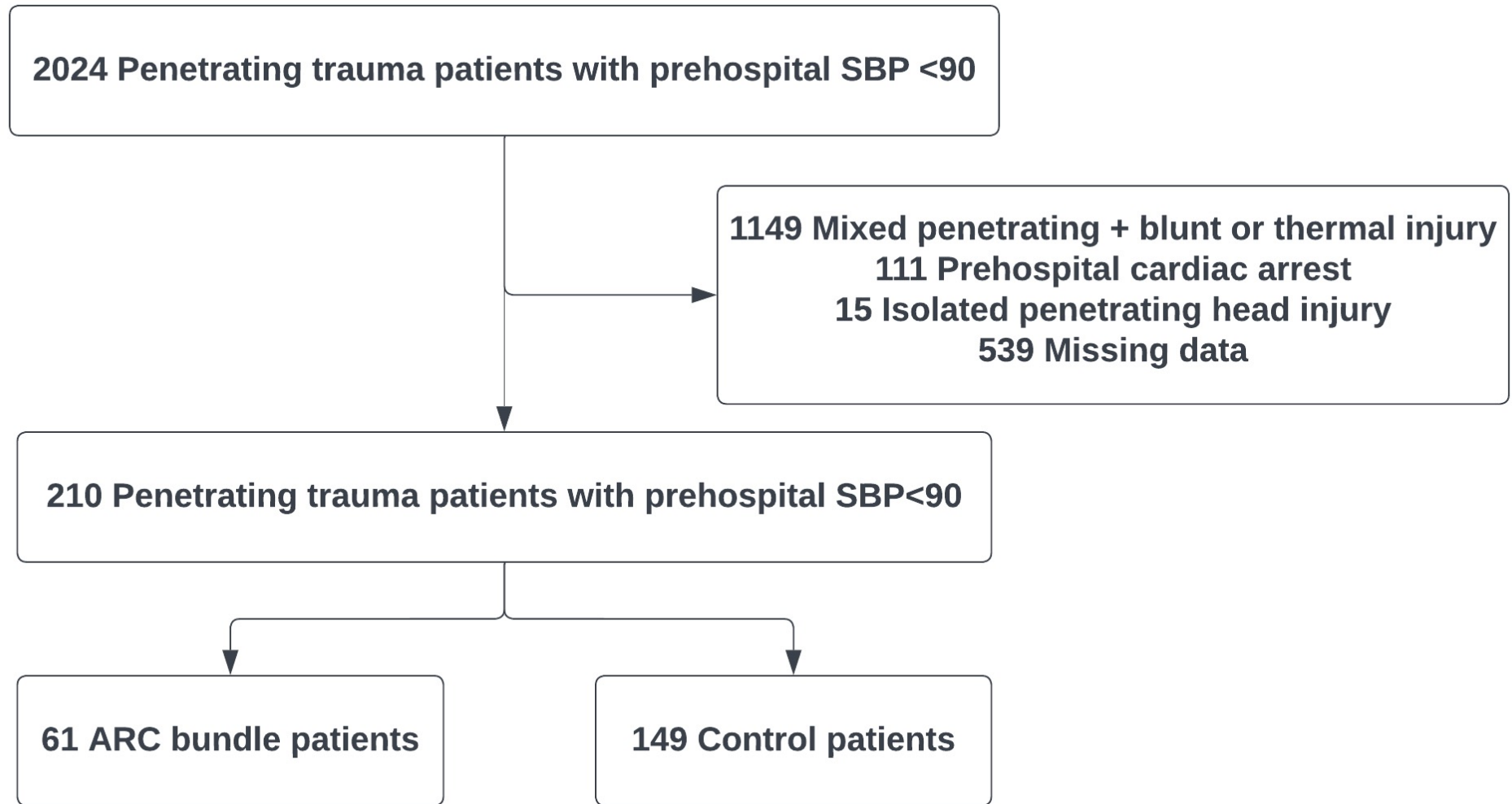
- Categorical variables: Chi-Square.
- Continuous variables: Independent sample Mann-Whitney U analysis.
- Univariate logistic regression & stepwise Akaike information criterion identified independent predictors of mortality.
- Multivariable logistic regression assess influence of independent predictors on in-hospital mortality.
- Receiver operating characteristic analysis evaluated performance of the prognostic model

Outcomes

- Primary
 - 24-hour and in-hospital mortality
- Secondary
 - EMS transport times
 - Vital sign changes
 - Prehospital advanced airway use
 - ED interventions
 - Length of stay



Cohort



Demographics

	All (n=210)	ARC Bundle (n=61)	Control (n=149)	p-value
Age (years), median (IQR)	32 (24-41)	35 (25-47)	30 (23-39)	0.05
Male, n (%)	191 (91%)	55 (90%)	136 (91%)	0.8
African American, n (%)	175 (83%)	51 (84%)	124 (83%)	0.95

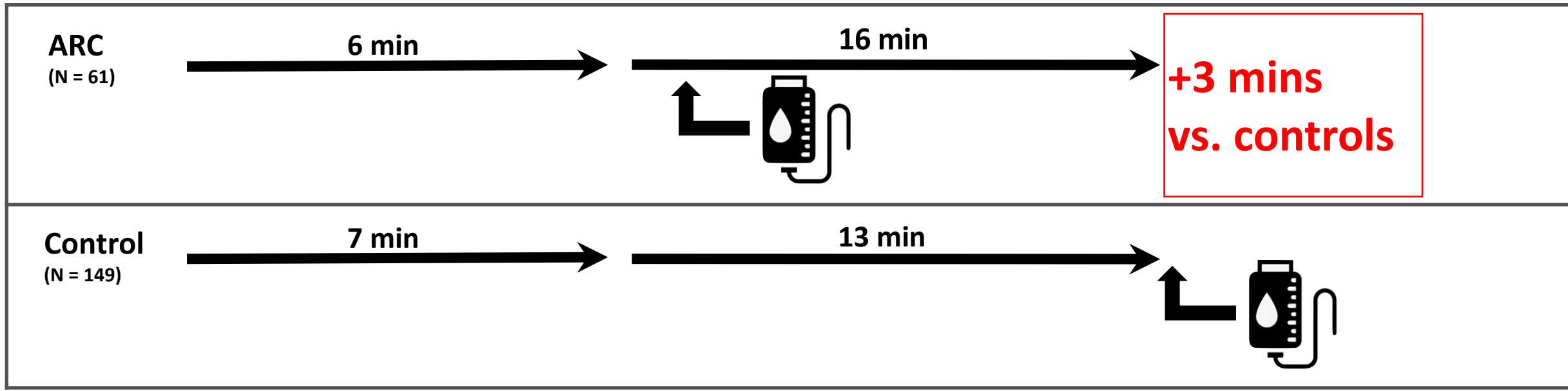
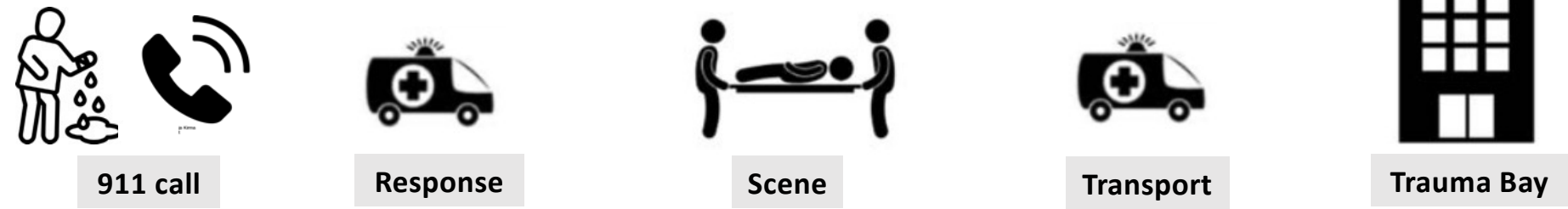
Injuries

	All (n=210)	ARC Bundle (n=61)	Control (n=149)	p-value
NISS	17 (6-29)	18 (10-31)	17 (5-29)	0.13
AIS-Head	0 (0-1)	0 (0-1)	0 (0-1)	0.99
AIS-Chest	3 (3-5)	3 (3-5)	3 (3-4)	0.29
AIS-Abdomen	3 (3-4)	3 (3-4)	3 (3-4)	0.51
AIS-Extremity	2 (1-3)	2 (2-3)	2 (1-3)	0.18

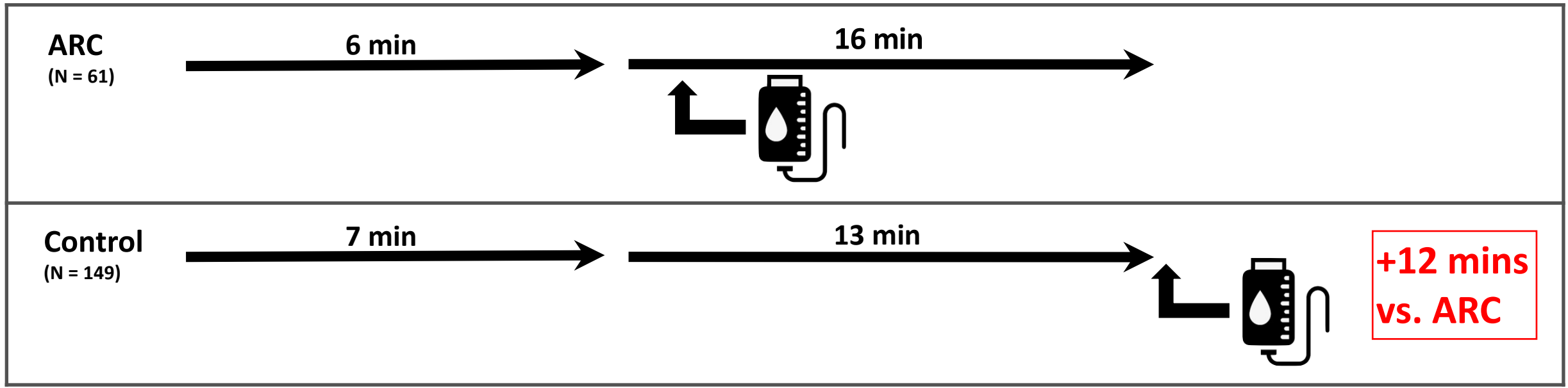
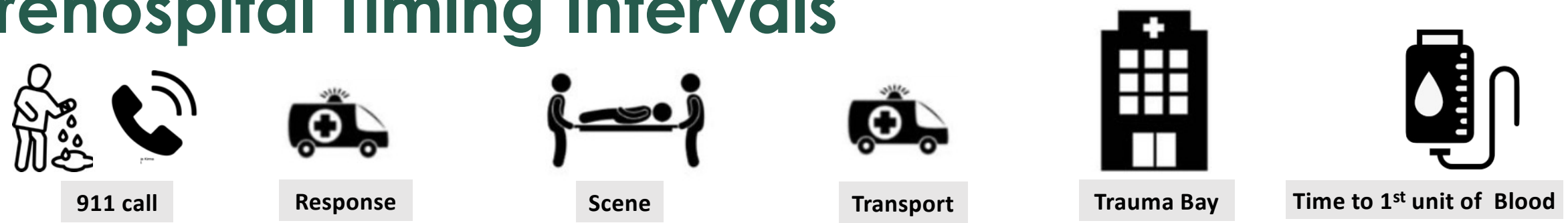
Prehospital Vital Signs

	All (n=210)	ARC Bundle (n=61)	Control (n=149)	p-value
SBP, mmHg	80 (62-88)	70 (62-87)	80 (62-88)	0.6
Heart Rate, bpm	107 (130-73)	110 (87-136)	103 (72-126)	0.08
Shock Index	1.29 (0.90-1.66)	1.44 (1.01-1.91)	1.21 (0.89-1.60)	0.05
Glasgow Coma Scale	15 (11-15)	14 (10-15)	15 (12-15)	0.01

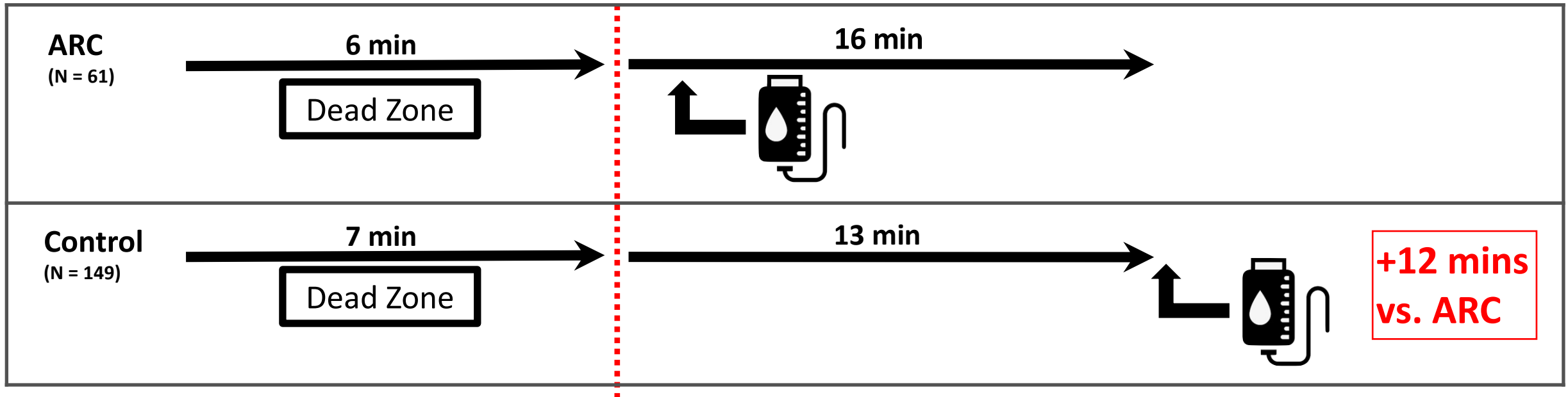
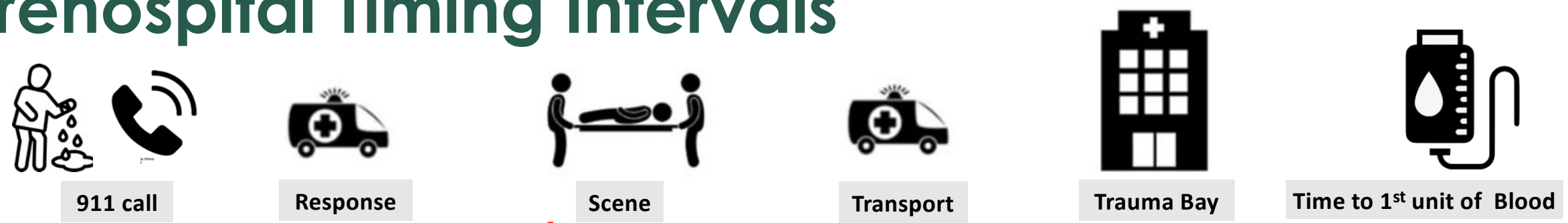
Prehospital Timing Intervals



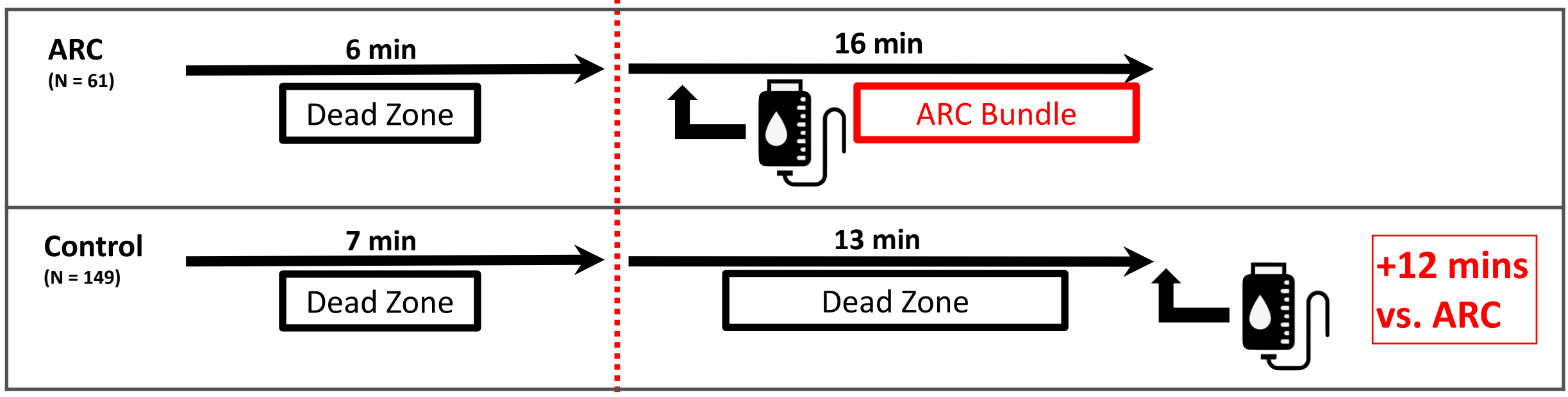
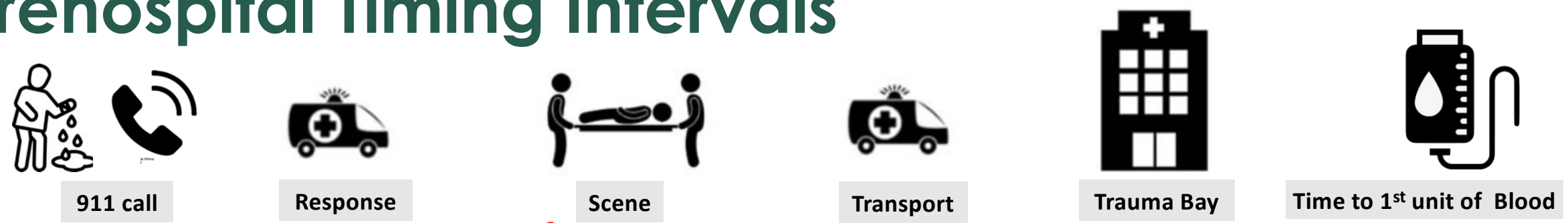
Prehospital Timing Intervals



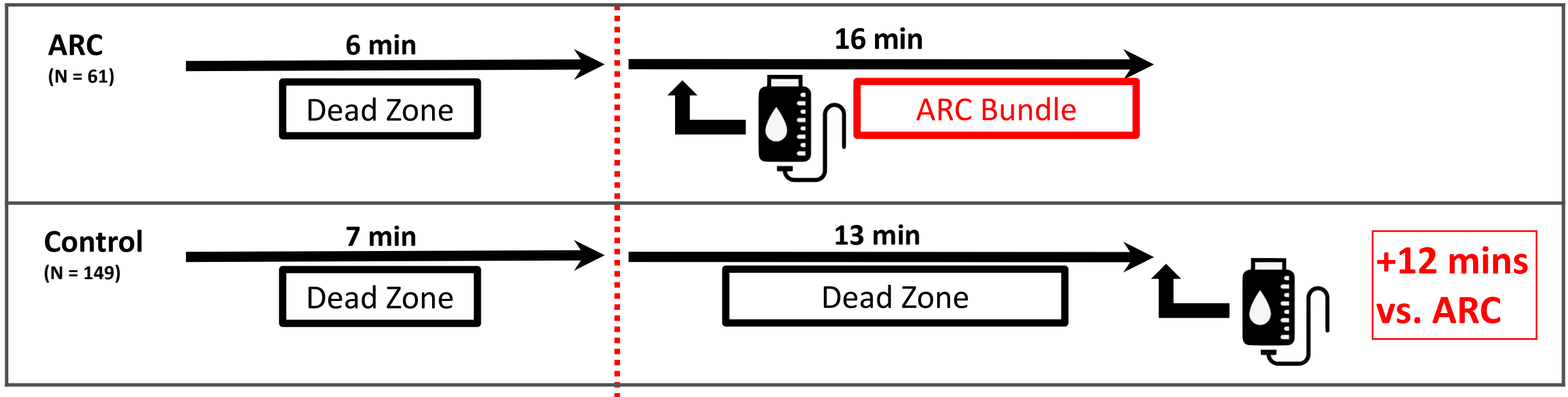
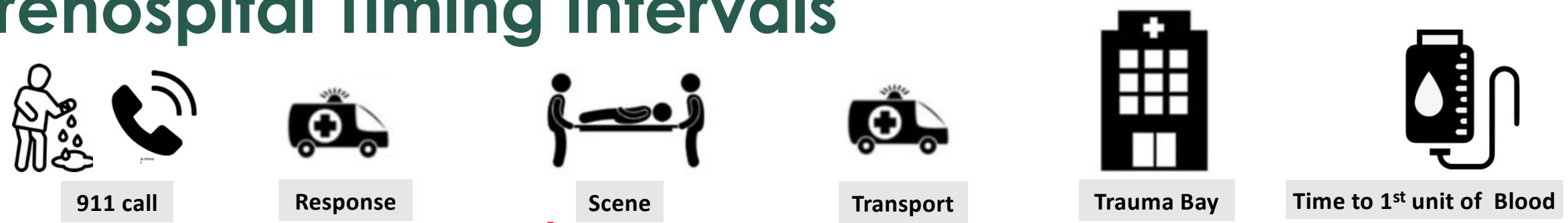
Prehospital Timing Intervals



Prehospital Timing Intervals



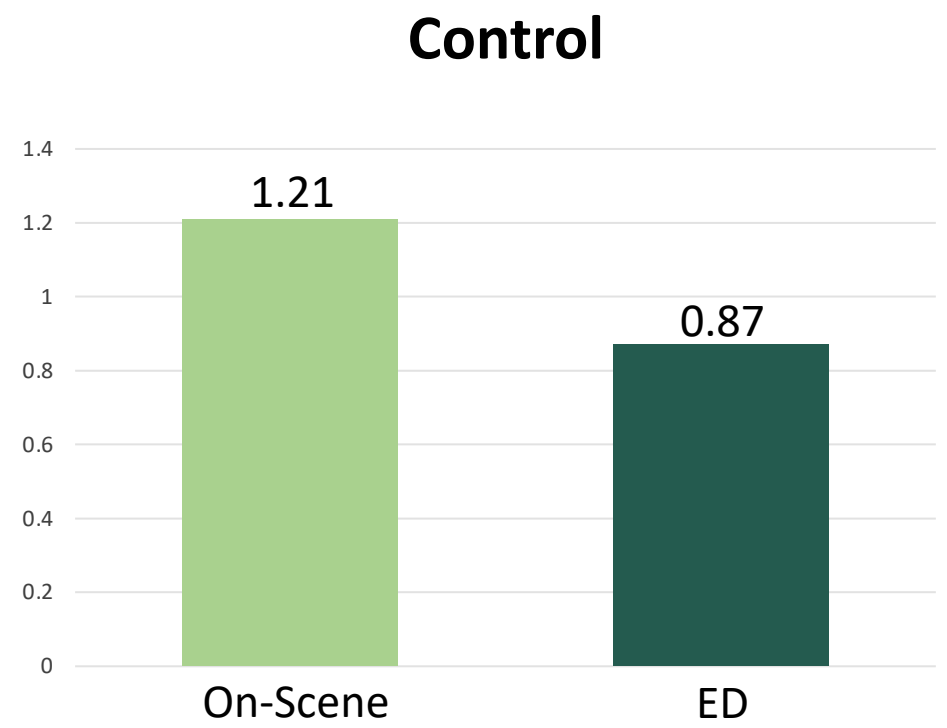
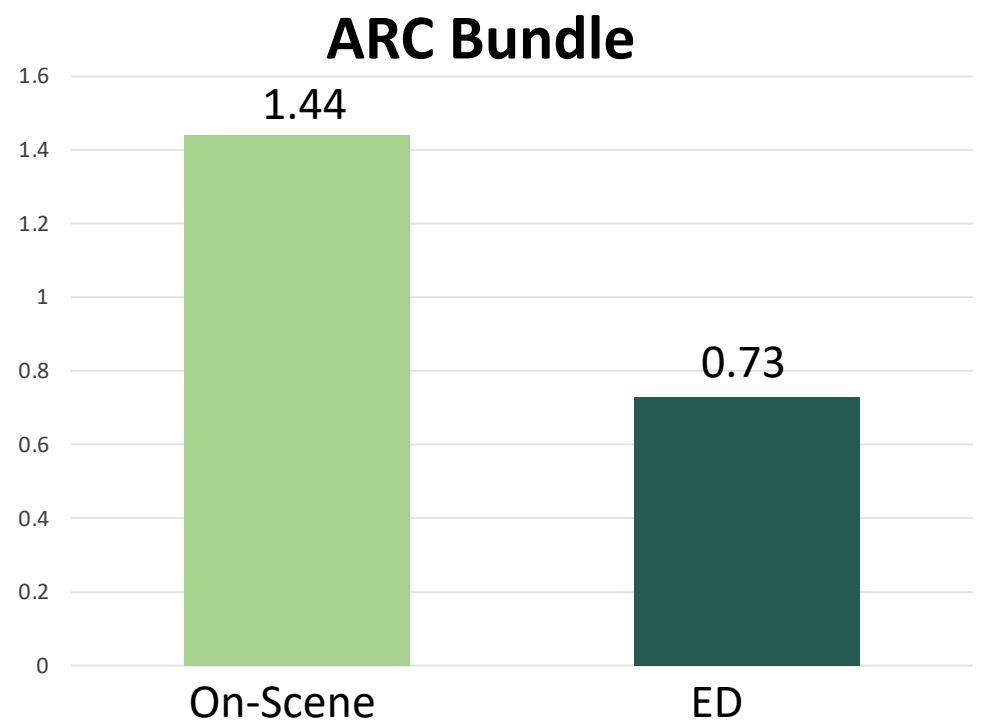
Prehospital Timing Intervals



At Hospital Arrival

	All (n=210)	ARC Bundle (n=61)	Control (n=149)	p-value
Initial ED Characteristics				
ED SBP, mmHg	107 (82-133)	117 (88-140)	106 (72-132)	0.1
ED Heart Rate, bpm	93 (68-118)	79 (62-102)	95 (74-120)	0.03
ED Shock Index	0.84 (0.65-1.15)	0.73 (0.50-1.03)	0.87 (0.70-1.25)	<0.01
ED Glasgow Coma Scale	15 (13-15)	15 (13-15)	15 (12-15)	0.97
Arrived at ED intubated, n (%)	14 (6.8)	1 (1.6)	18 (12.1)	0.04
Intubated in ED, n (%)	47 (22.0%)	14 (23.0%)	33 (22.1%)	0.9

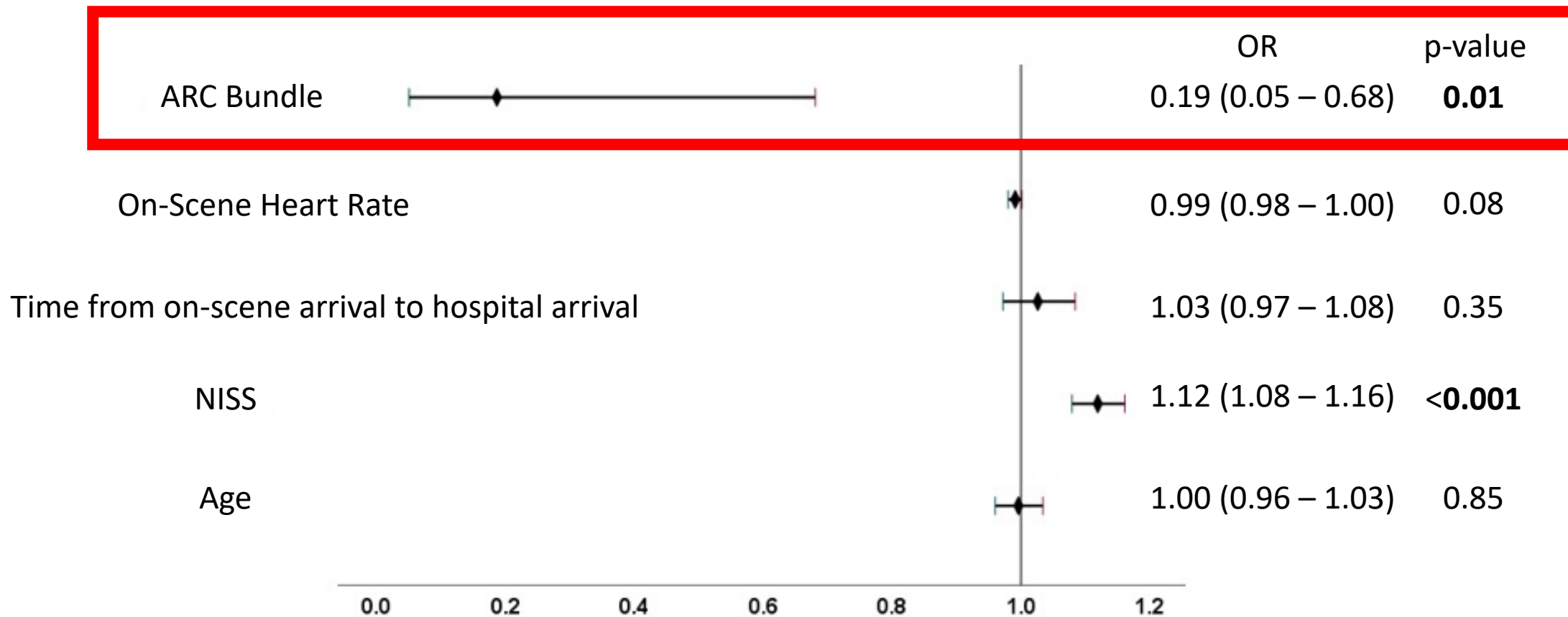
ARC Impact on Shock Index



Mortality Outcomes

	All (n=210)	ARC Bundle (n=61)	Control (n=149)	p-value
24-Hour Mortality, n (%)	36 (17.1%)	4 (6.6%)	32 (21.5%)	0.04
In-hospital Mortality n (%)	45 (21.4%)	7 (11.5%)	38 (25.5%)	0.03

Factors Associated with Mortality



Discussion

- First study investigating ARC bundle in US urban ground EMS for penetrating trauma with hemorrhagic shock
- First study of prehospital blood in this setting to show mortality improvement to hospital discharge
- Prehospital ARC bundle utility with short pre-hospital times
 - Despite +3 mins transport time, ARC bundle patients received blood 12 mins sooner than controls
- Non-warmed blood
 - No temperature difference between groups in the ED



Limitations

- Missing data
- Single EMS system
- Historical controls

Conclusions

In an urban EMS system with short transport times, a pre-hospital ARC bundle decreased mortality in penetrating trauma patients with shock compared to previous standard of care.



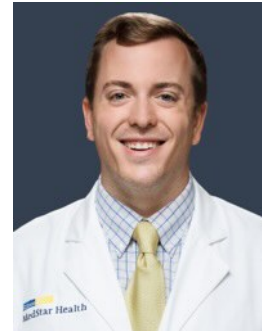
Conclusions

Pre-hospital ARC bundle can be effectively integrated into an urban EMS system with short prehospital times.



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New Orleans Pre-Hospital Blood Registry

Juan Duchesne

jduchesn@tulane.edu



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