The Michigan Trauma Quality Improvement Program

Ypsilanti, MI
October 10, 2023

Disclosures

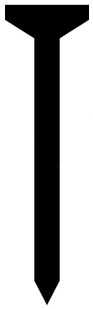
- Salary Support for MTQIP from BCBSM/BCN and MDHHS
  - Mark Hemmila
  - Bryant Oliphant
  - Judy Mikhail
  - Jill Jakubus

Disclosures

- Mark Hemmila Grants
  - Blue Cross Blue Shield of Michigan - MTQIP
  - Michigan Department of Health and Human Services - MTQIP
  - Toyota North America - ICAM
  - Insurance Institute for Highway Safety - ICAM

Welcome

Orthopaedic Surgery



Trauma Surgery

No Photos Please

Evaluations

- Link will be emailed to you following meeting
- Please answer the evaluation questions
- 3.75 CME credits for this meeting

Future Meetings

- Winter
  - Tuesday February 6, 2024
  - Virtual
- Spring
  - Wednesday May 1, 2024
  - Kalamazoo, Radisson Plaza Hotel
- Registrars
  - Tuesday June 4, 2024
  - Ypsilanti, EMU Marriott

Agenda

- Introductions
- Coffee Talk
  - McLaren Macomb
  - MTQIP Reports
- Hip Fractures
- Lunch

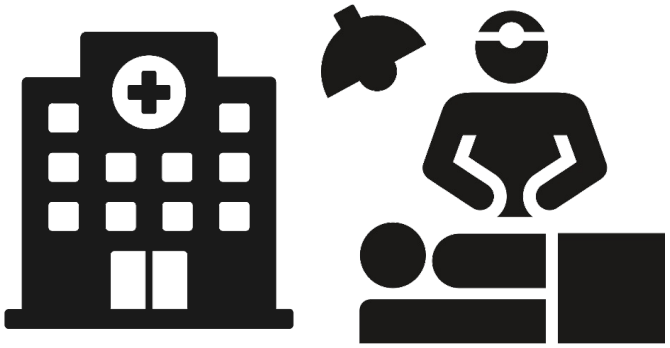
Agenda

- VTE Prophylaxis – Orthopaedic Perspective
- MTQIP Performance Index/Reports
- Whole Blood
- Patient Reported Outcomes
  - Current
  - Future
- Orthopaedic Updates
- Wrap Up

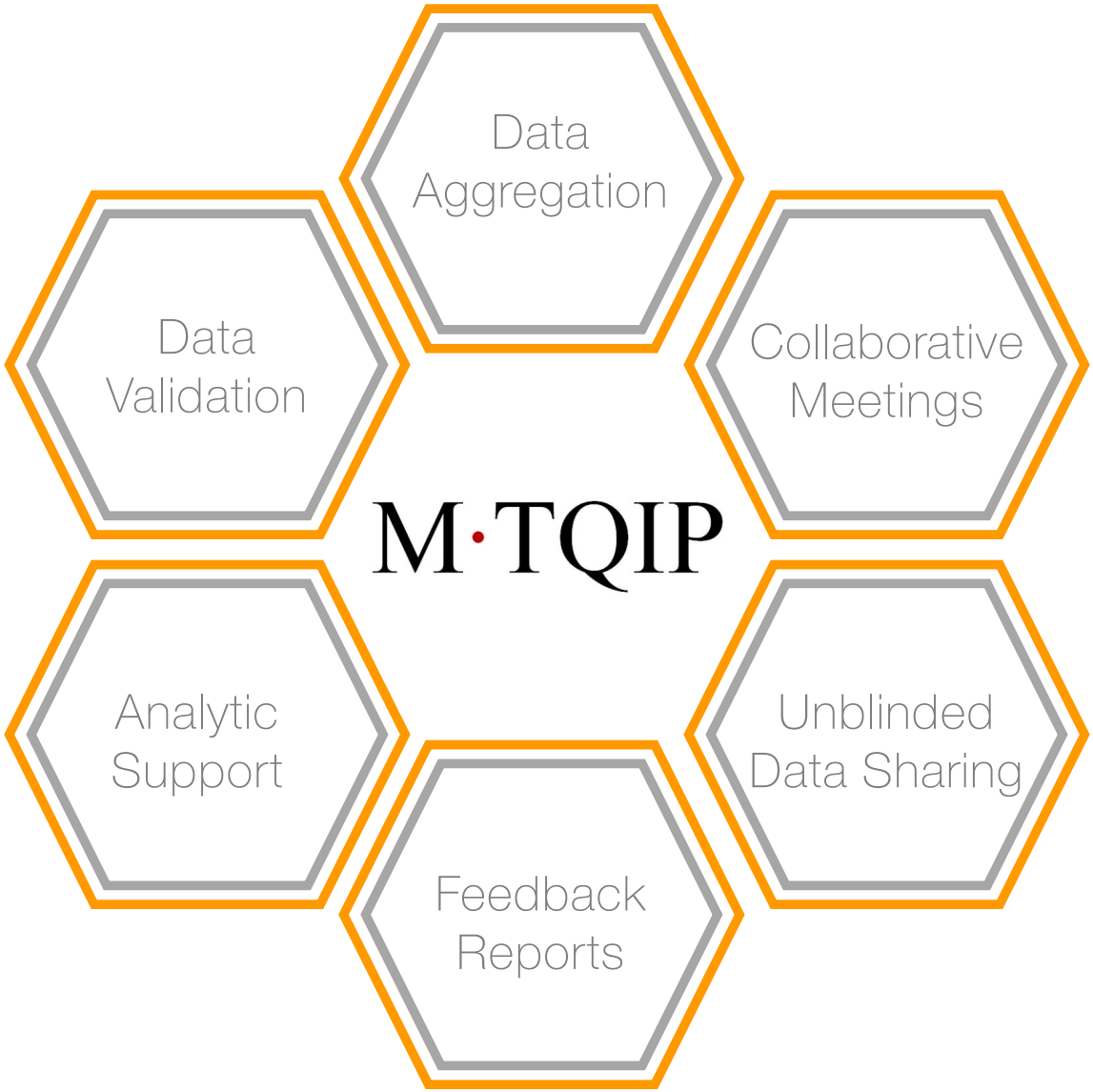
Objectives

- Information
  - Who we are
  - What do we do
- How can we help you and your patients
  - Data
  - Analysis
  - Projects
- Discussion
  - Suggestions > Better, Optimize, Ideas

Blue Cross Blue Shield of Michigan



35 Level 1 and 2 Trauma Centers




Sta auma Sys m
Re orts
M tality
Po e

What is the evidence?

The Impact

2015	2015	2016	2017	2017
Decreased Resource Utilization	Improved Outcomes	Improved Outcomes & Decreased Resource Utilization	Identification of Best Practice	Identification of Variability in Pelvic Fracture Rx
Ann Surg: Prophylactic IVC filter placement had no effect on mortality and increased DVT events	J Am Coll Surg: Collaborative structure allowed for center-identification and improvement of DVT events	J Trauma ACS: CQI participation improves outcomes, decreases resource use	J Trauma ACS: LMWH superior to UHF in reducing mortality and VTE events	AAST Presentation: Level II centers with increased in-hospital mortality and less likely to use angio or ICU admission

The Impact

2018

CQI Approach Improves Outcomes

JAMA Surg: Association of hospital participation in a regional trauma quality improvement collaborative with patient outcomes

2019

Economics of Traumatic Injury in Medicare

JAMA: Prevalence and payments for traumatic injury compared with common acute diseases by episode of care in Medicare

2020

Data Validation

J Trauma ACS: Pull back the curtain: external data validation is an essential element of quality improvement benchmark reporting

2021

Timing of VTE Prophylaxis

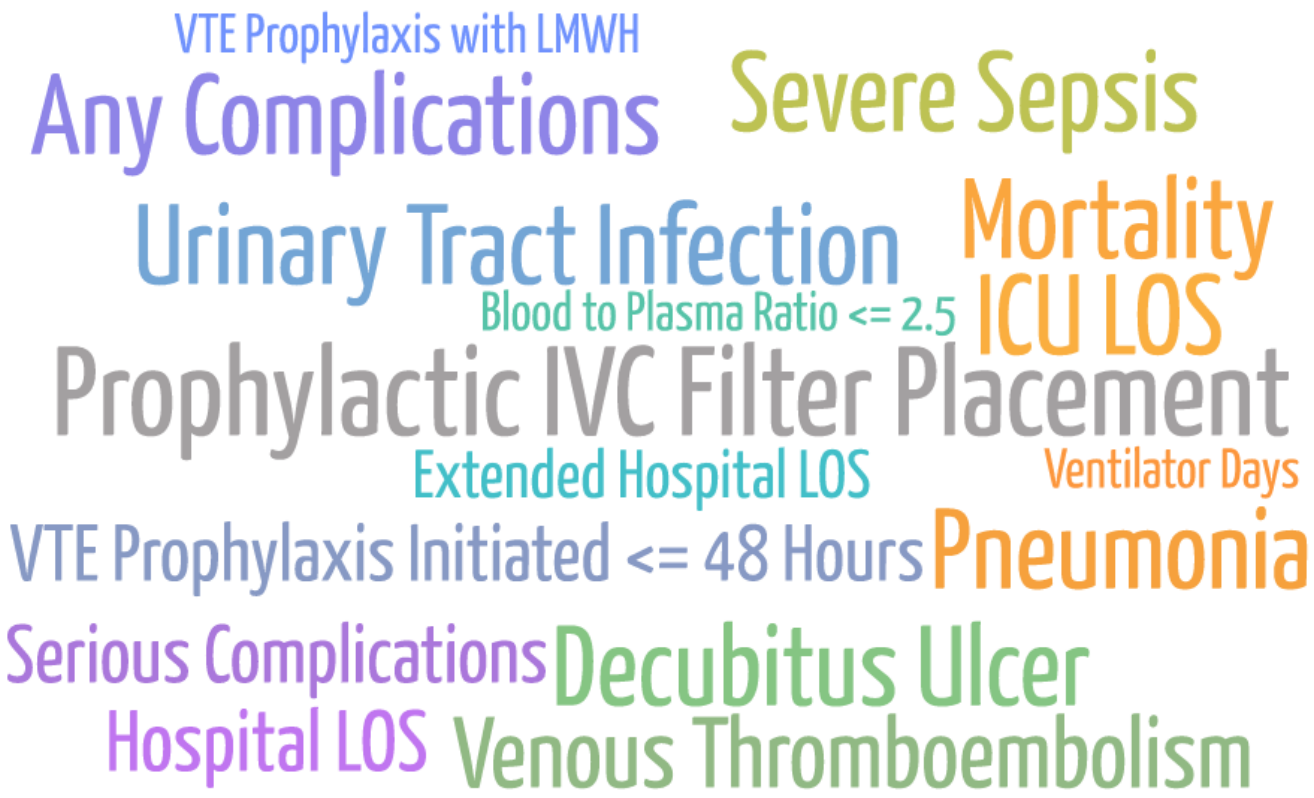
J Trauma ACS: Association of timing of initiation of pharmacologic venous thromboembolism prophylaxis with outcomes in trauma patients

2022

Timeliness of Antibiotic in Open Fracture

Surgery: Timeliness of antibiotic administration in open fractures of the femur and tibia: performance improvement in a collaborative quality initiative

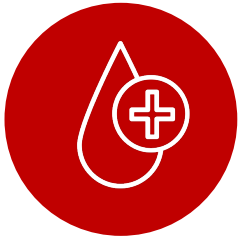
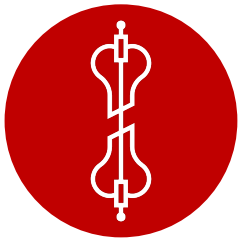
The Return on Investment



Michigan Trauma Quality Improvement Program

Dedicated to improving the quality of care delivered to trauma patients

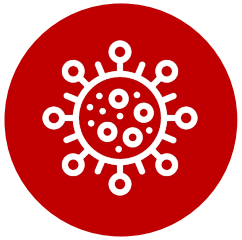
M·TQIP

VTE Prophylaxis Administration	Timely Hip Fracture Repair	Massive Transfusion Resuscitation	Traumatic Brain Injury	Open Fracture Antibiotic
				
23% → 59% 2012 2021 ↑8.6K patients/yr	79% → 93% 2016 2021 ↑543 patients/yr	54% → 88% 2013 2021 ↑118 patients/yr	65% → 86% 2016 2021 ↑107 patients/yr	77% → 90% 2017 2021 ↑100 patients/yr
Getting trauma patients the right drug at the right time	Getting elderly patients to the operating room to get the right care	Getting patients with bleeding the right blood products	Getting patients with traumatic injury the right imaging	Getting patients with an open fracture the right antibiotic

Michigan Trauma Quality Improvement Program

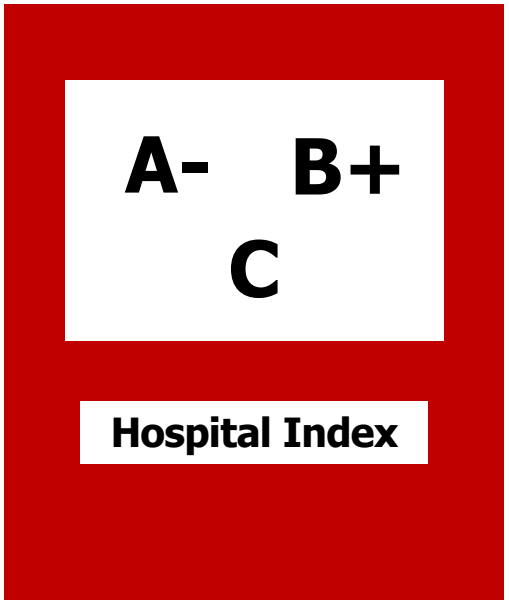
Dedicated to improving the quality of care delivered to trauma patients

M·TQIP

Mortality	Major Complications	Sepsis	Venous Thromboembolism	Hospital Length of Stay
				
4.4% → 3.7% 2011 2021 ↓209 patients/yr	8.7% → 6.3% 2011 2021 ↓730 patients/yr	0.9% → 0.4% 2011 2021 ↓147 patients/yr	1.7% → 1.1% 2011 2021 ↓188 patients/yr	6.3 → 4.8 days 2011 2021 ↓45K days/yr
Decreasing trauma-related deaths	Decreasing trauma-related morbidity	Decreasing critical illness	Decreasing life-threatening blood clots	Decreasing time away from family

How do you create change?

Motivation Levers

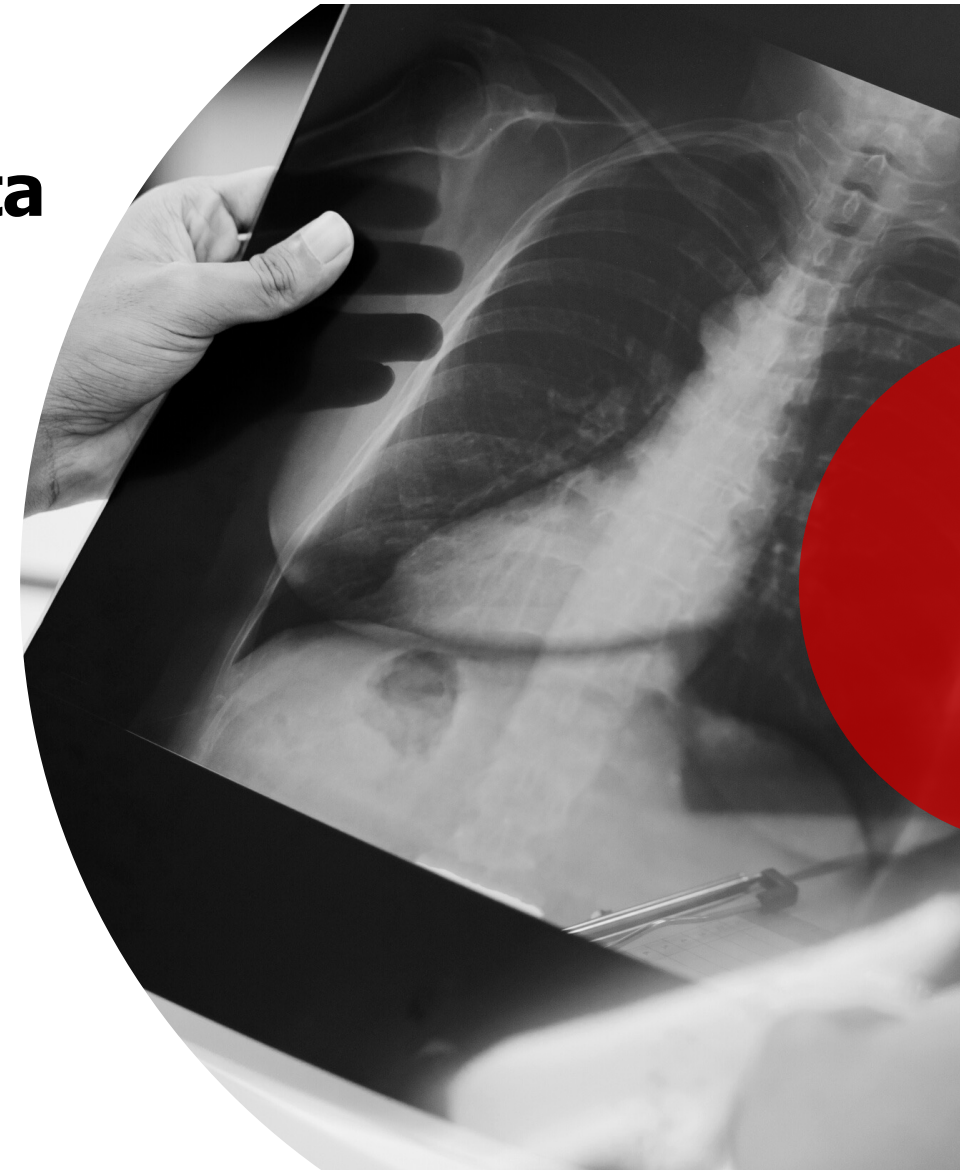


M·TQIP

Create meaningful feedback

What do people want in data reports?

- How do I look
- Timely
- Easy to read



Provider Feedback

Shock Drill Down

Trauma #	Age	Mechanism	ED SBP	Lowest ED BP	ISS	4 hr PRBC/FFP	24 hr PRBC/FFP	First Intervention	Both	Time to (hrs)	Mortality	Surgeon
	67	Blunt	153	62	33	4.0	4.0	None	0	0.0	1	Jim Harbaugh
	45	Blunt	124	79	29	4.0	2.5	Angio	1	7.0	0	John Adams
	30	Blunt	44	24	20	3.5	3.5	Operation	0	0.0	1	Jim Harbaugh
	67	Blunt	83	74	33	3.0	4.0	None	0	0.0	0	John Adams
	45	Penetrating	101	86	19	3.0	2.0	Operation	0	1.1	0	Thomas Jefferson
	30	Blunt	61	61	57	3.0	3.0	None	0	0.0	1	James Madison
	67	Blunt	133	83	16	2.7	3.0	Operation	0	0.9	0	James Monroe
	45	Blunt	155	46	34	2.5	2.5	None	0	0.0	1	Urban Meyer
	30	Blunt	84	84	48	2.5	2.5	Angio	1	1.4	0	Jim Harbaugh
	67	Blunt	105	66	34	2.0	3.0	Operation	0	2.1	1	John Adams
	30	Blunt	182	63	43	1.3	1.3	None	0	0.0	0	Urban Meyer
	67	Blunt	144	78	33	1.3	1.3	None	0	0.0	0	Jim Harbaugh
	45	Blunt	148	44	34	1.0	1.0	Operation	0	1.0	1	John Adams
	30	Penetrating	81	75	8	1.0	1.0	Operation	0	0.9	0	Thomas Jefferson
	83	Blunt	100	47	38	1.0	5.0	Operation	0	4.7	1	James Madison
	80	Blunt	106	70	8	0.2	0.6	Operation	0	1.6	0	James Monroe
	46	Blunt	116	71	43			None	0	0.0	0	Urban Meyer

Send clear signals

Aggregate Feedback

Outcomes/Mortality Dashboard

Outcomes	Center	MTQIP	95% CI
Failure to Rescue	20.2	23.4	
Superficial SSI	0.4	0.2	
Deep SSI	0.3	0.2	
Organ/Space SSI	0.2	0.2	
Wound Disruption	0.1	0.1	
Abd. Fascia Left Open	0.2	0.4	
Acute Lung Injury/ARDS	0.9	0.5	
Pneumonia	5.5	2.8	
Unpl Intubation	2.2	1.5	
Pulmonary Embolism	0.7	0.4	
Renal Insufficiency	0.0	0.1	
Acute Renal Failure	0.8	0.6	
Urinary Tract Infection	3.0	1.1	

Mortality	Center	MTQIP	95% CI
Dead	4.4	4.9	
Dead or Hospice	5.0	5.9	
Cohort 2 (Admit to Trauma Service)	4.3	4.8	
Cohort 3 (Blunt Multi-System)	14.4	16.4	
Cohort 4 (Blunt Single-System)	4.1	4.4	
Cohort 5 (Penetrating)	10.4	12.3	
Age16-24	3.6	4.5	
Age 25-44	2.7	4.0	
Age 45-64	3.4	4.0	
Age 65-84	5.7	5.9	
Age >84	6.7	7.2	
White	4.4	4.9	
Non-white	1.7	4.7	

Aggregate Feedback

Orthopedic Dashboard

Processes of Care	Center	MTQIP	P Value	Status
LMWH VTE Prophylaxis <= 48 Hours	56.8%	61.9%	0.19	
Average Time to OR (hrs)	23.3	27.5		
Time to OR > 48 Hours	5.3%	9.2%		

Complications	Center	MTQIP	P Value	Status
Serious Complications	5.7%	4.9%	0.44	
Any Complication	6.8%	6.0%	0.51	
Failure to Rescue	15.6%	18.6%	0.21	
Venous Thromboembolism	1.1%	0.7%	0.33	

Top Collaborative Complications	Center	MTQIP	P Value	Status
1. Unplanned Admission to ICU	2.3%	2.0%	0.61	
2. Unplanned Intubation	0.0%	0.7%	0.26	
3. Myocardial Infarction	1.1%	0.7%	0.37	
4. Pneumonia	1.4%	0.6%	0.022	
5. Catheter Associated Urinary Tract Infection	2.4%	0.5%	0.033	

Provide opportunities for all members to improve

Make it easy to do the right thing

Make it hard to do the wrong thing

Performance Feedback

Scorecard

Michigan Trauma Quality Improvement Program (MTQIP) 2024 Performance Index January 1 to December 31, 2024				
Measure	**Weight**	**Measure Description**	**Points**	
#1	10	**Data Submission**		PARTICIPATION (30%)
		On time and complete 3 of 3 times	10	
		On time and complete 2 of 3 times	5	
		On time and complete 1 of 3 times	0	
#2	10	**Meeting Participation**	0-10	
		Surgeon and TPM or MCR attend 3 of 3 meetings	9	
		Surgeon and TPM or MCR attend 2 of 3 meetings	6	
		Surgeon and TPM or MCR attend 0-1 of 3 meetings	0	
		Registrar or MCR attend the annual June data abstractor meeting	1	
#3	10	**Data Validation Error Rate**		
		0.0-3.0%	10	
		3.1-4.0%	8	
		4.1-5.0%	5	
		> 5.0%	0	

#4	5	**PI Death Determination Documentation** (12 mo: 7/1/23-6/30/24)		PERFORMANCE (70%)
		0-2 Cases missing documentation	5	
		3-4 Cases missing documentation	3	
		> 4 Cases missing documentation	0	
#5A	8	**Timely LMWH VTE Prophylaxis in Trauma Admits** (18 mo: 1/1/23-6/30/24)		
		≥ 52.5 % of patients (≤ 48 hr)	8	
		≥ 50.0 % of patients (≤ 48 hr)	6	
		≥ 45.0 % of patients (≤ 48 hr)	3	
		< 45.0 % of patients (≤ 48 hr)	0	
#5B	2	**Weight Based LMWH Protocol in Use** (12mo: 7/1/23-6/30/24)		
		Yes	2	
		No	0	
#6	10	**Timely Surgical Repair in Geriatric (Age ≥ 65) Isolated Hip Fxs** (12 mo: 7/1/23-6/30/24)		
		≥ 92.0 % of patients (≤ 42 hr)	10	
		≥ 87.0 % of patients (≤ 42 hr)	8	
		≥ 85.0 % of patients (≤ 42 hr)	5	
		< 85.0 % of patients (≤ 42 hr)	0	
#7	10	**RBC to Plasma Ratio in Massive Transfusion** (18 mo: 1/1/23-6/30/24)	0-10	
		Weighted Mean Points in Patients Transfused ≥ 5 Units 1st 4 hr		
#8	10	**Serious Complication Z-Score Trend in Trauma Admits** (3 yr: 7/1/21-6/30/24)		
		< -1 (major improvement)	10	
		-1 to 1 or serious complications low outlier (average or better rate)	7	
		> 1 (rates of serious complications increased)	5	
#9	10	**Mortality Z-Score Trend in Trauma Admits** (3 yr: 7/1/21-6/30/24)		
		< -1 (major improvement)	10	
		-1 to 1 or mortality low outlier (average or better)	7	
		> 1 (rates of mortality increased)	5	
#10	5	**Patient Reported Outcomes Participation** (12 mo: 7/1/23-6/30/24)		
		Signed agreement and ≥90% of patients contact information submitted	5	
		No agreement OR Signed agreement and <90% of patients contact information submitted	0	
#11	10	**Timely Antibiotic in Femur/Tibia Open Fractures - COLLABORATIVE WIDE MEASURE** (12 mo: 7/1/23-6/30/24)		
		≥ 85% patients (≤ 90 min)	10	
		< 85% patients (≤ 90 min)	0	
		Total (Max Points) =	100	

Why do I have these results?

Feedback does not always correlate with performance

Delve into the data

Coffee Talk

Coming Together Over QI Reports @ McLaren Macomb

Mandip Atwal, DO
Christopher Vitale, DO
Marleen Nowakowski, RN

McLaren MACOMB

M·TQIP

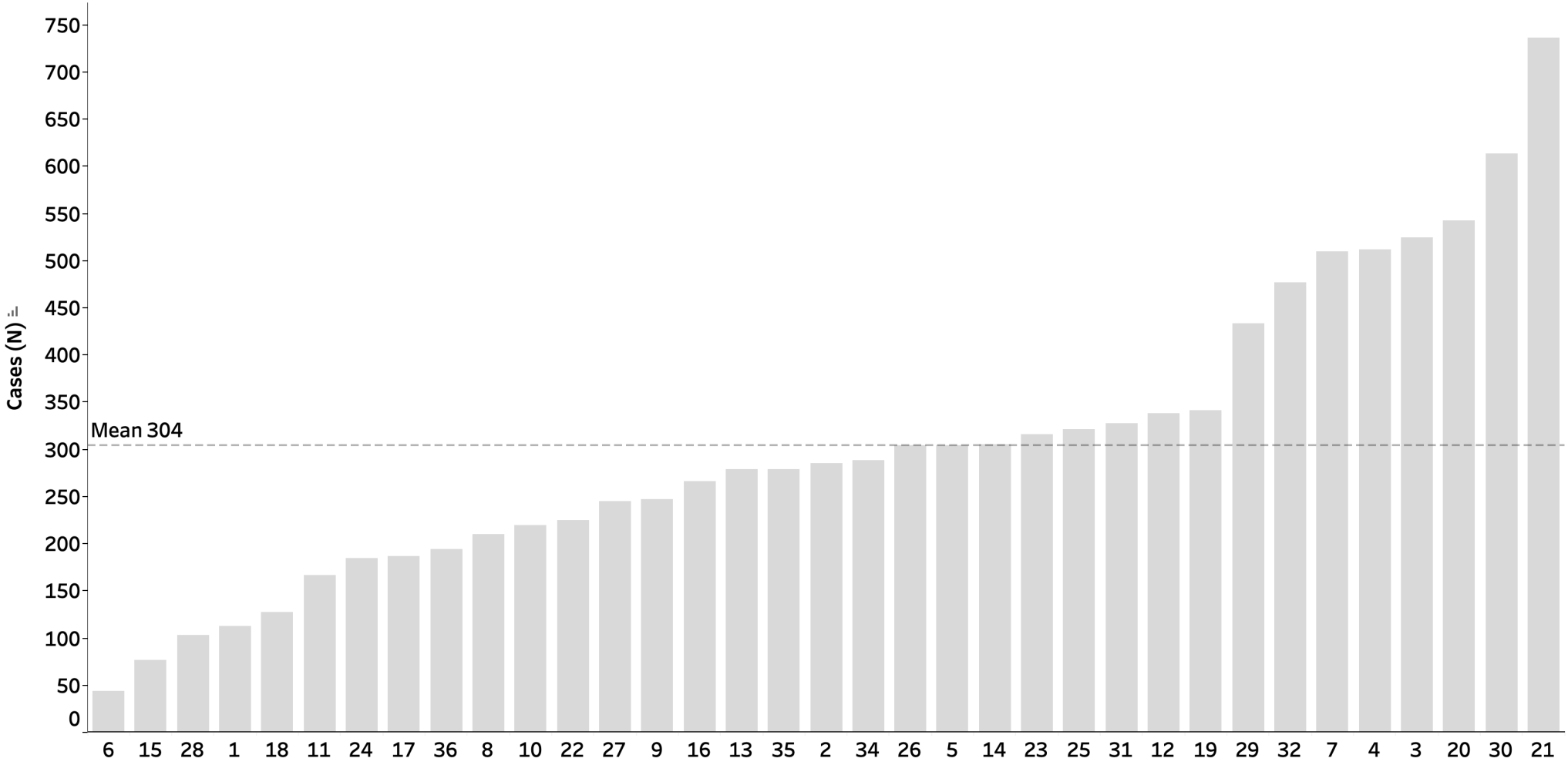

The TEAM
The TEAM
The TEAM
GO BLUE

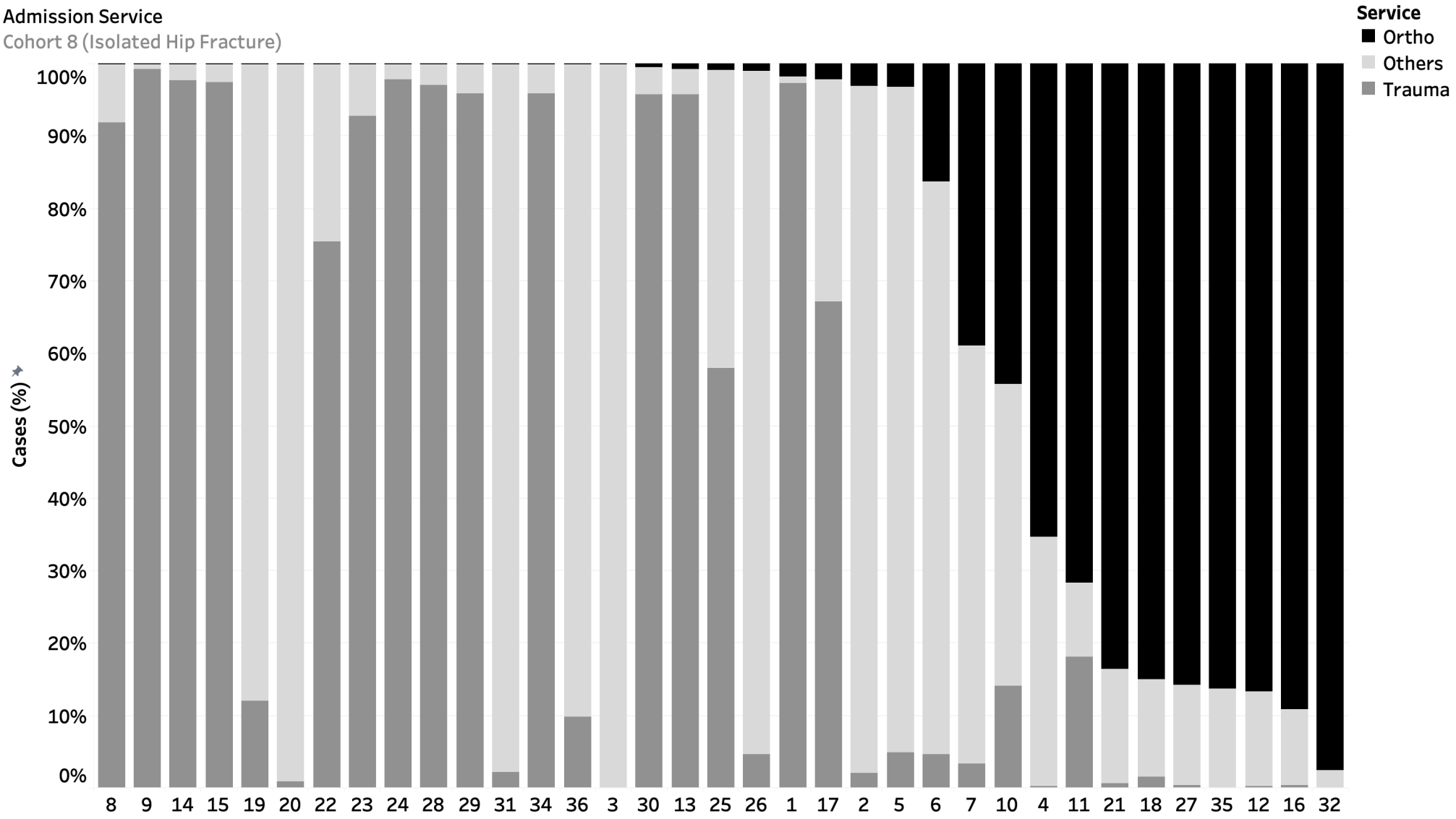
Hip Fractures

Case Volume, Age >= 65

Cohort 8 (Isolated Hip Fracture)

Graph ID 91

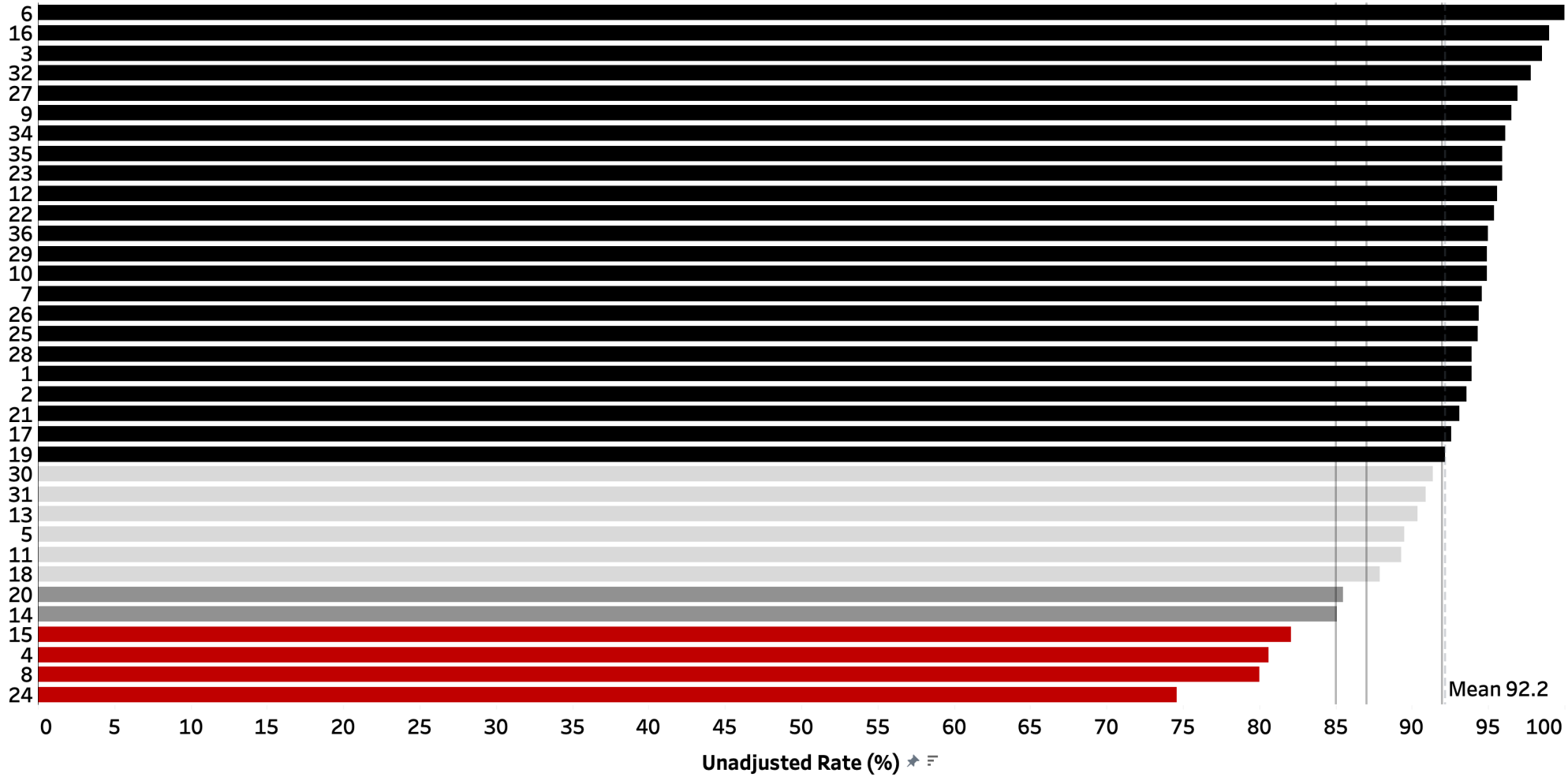



Admission Service
Cohort 8 (Isolated Hip Fracture)
Service
Ortho
Others
Trauma
Cases (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
8 9 14 15 19 20 22 23 24 28 29 31 34 36 3 30 13 25 26 1 17 2 5 6 7 10 4 11 21 18 27 35 12 16 32

Metric 6 | Timely Surgical IHF Repair

Cohort 8 (Isolated Hip Fracture) | 7/1/22 - 5/31/23

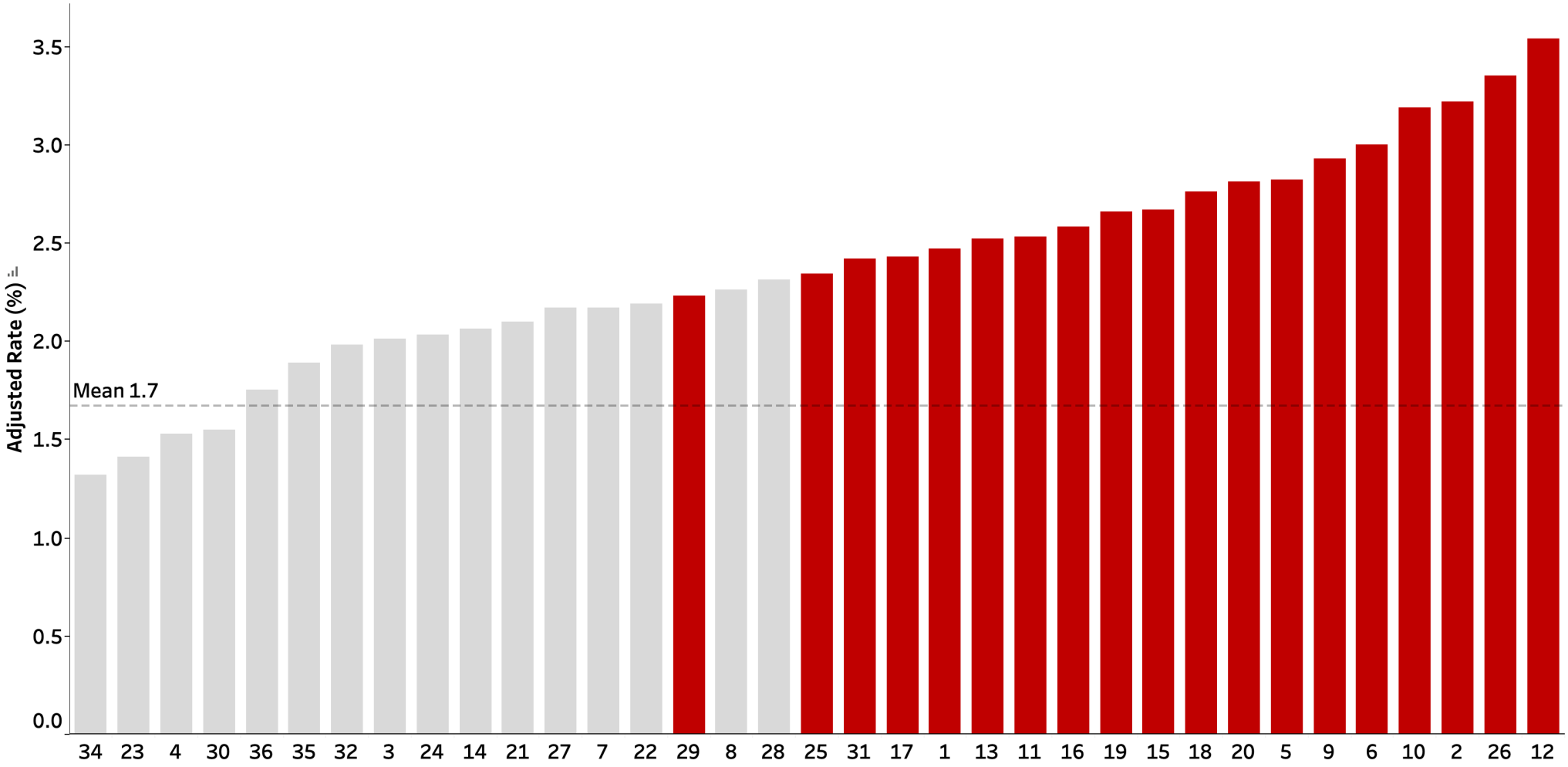
Graph ID 99



Mortality w/o DOA, Age >= 65

Cohort 8 (Isolated Hip Fracture)

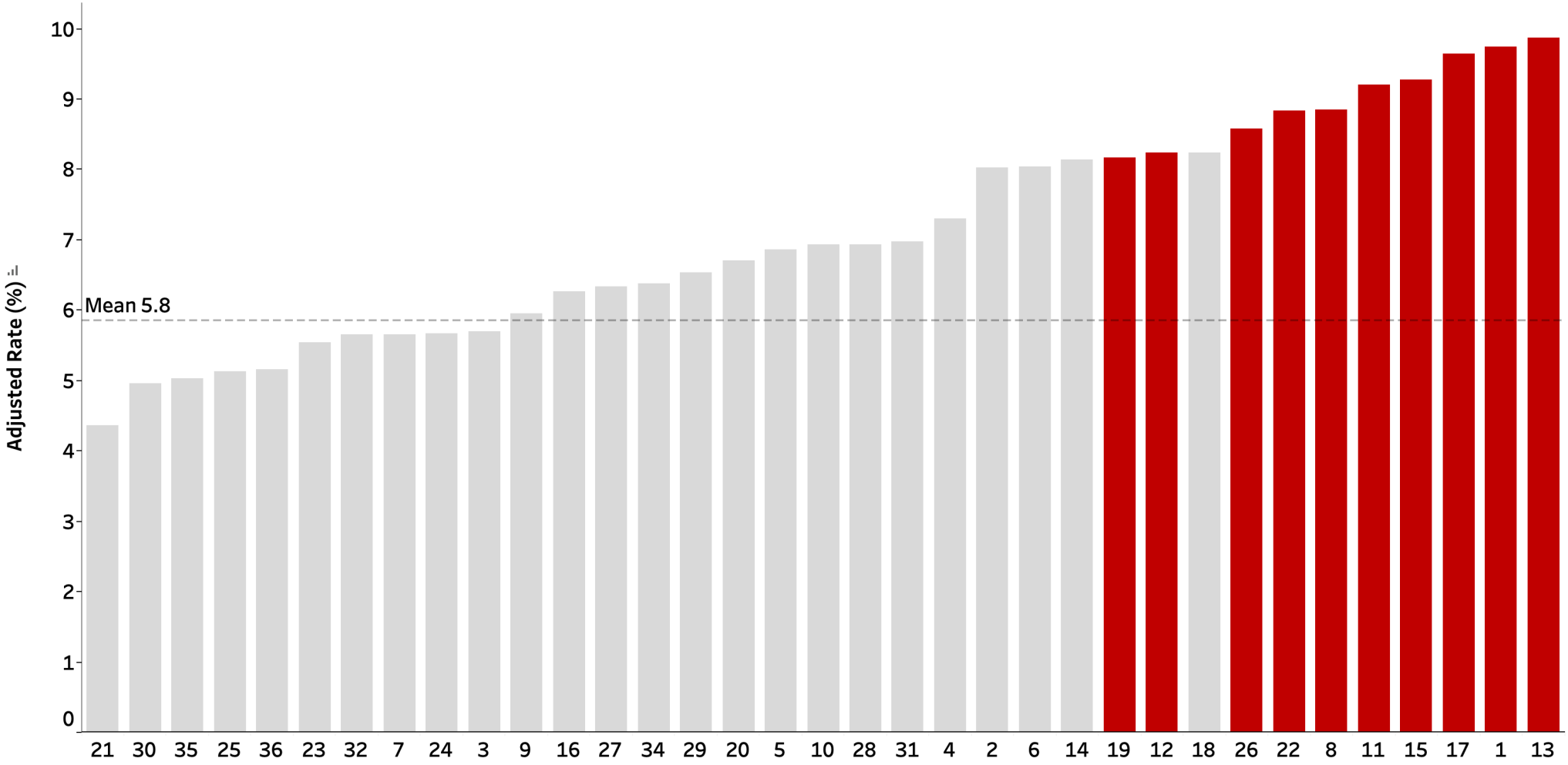
Graph ID 75



Serious Complication, Age >= 65

Cohort 8 (Isolated Hip Fracture)

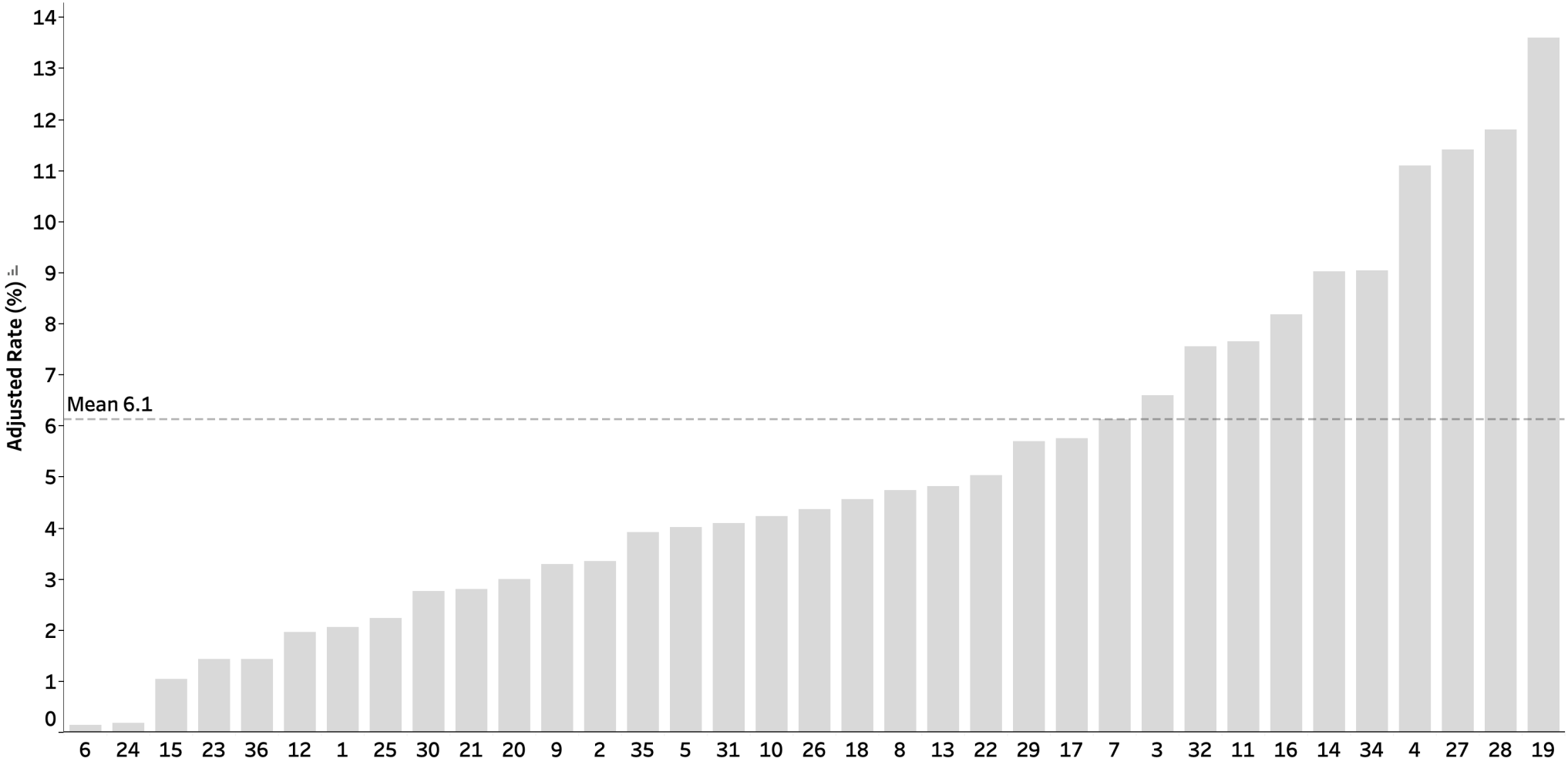
Graph ID 77



Delirium, Age >= 65

Cohort 8 (Isolated Hip Fracture)

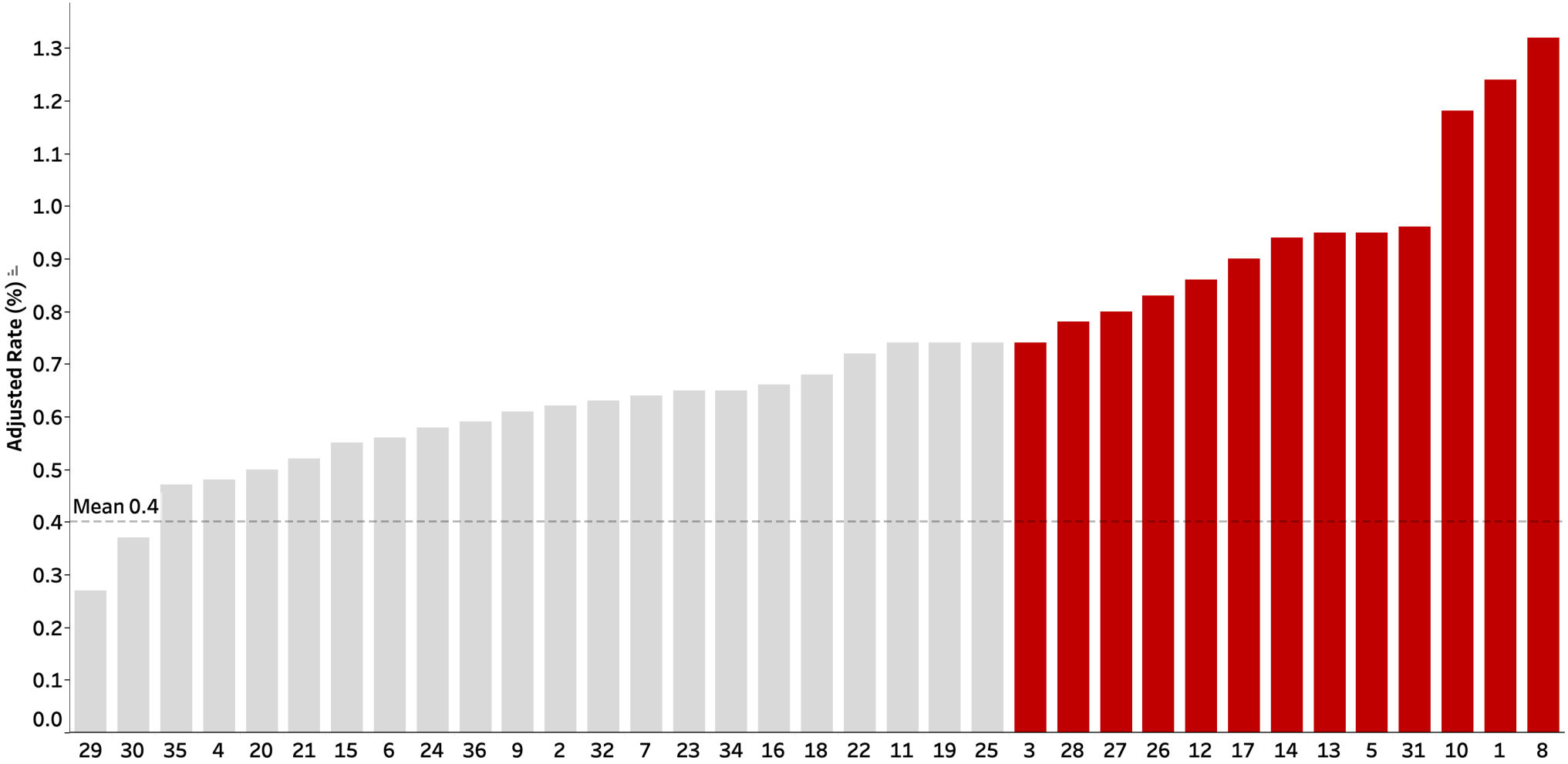
Graph ID 14



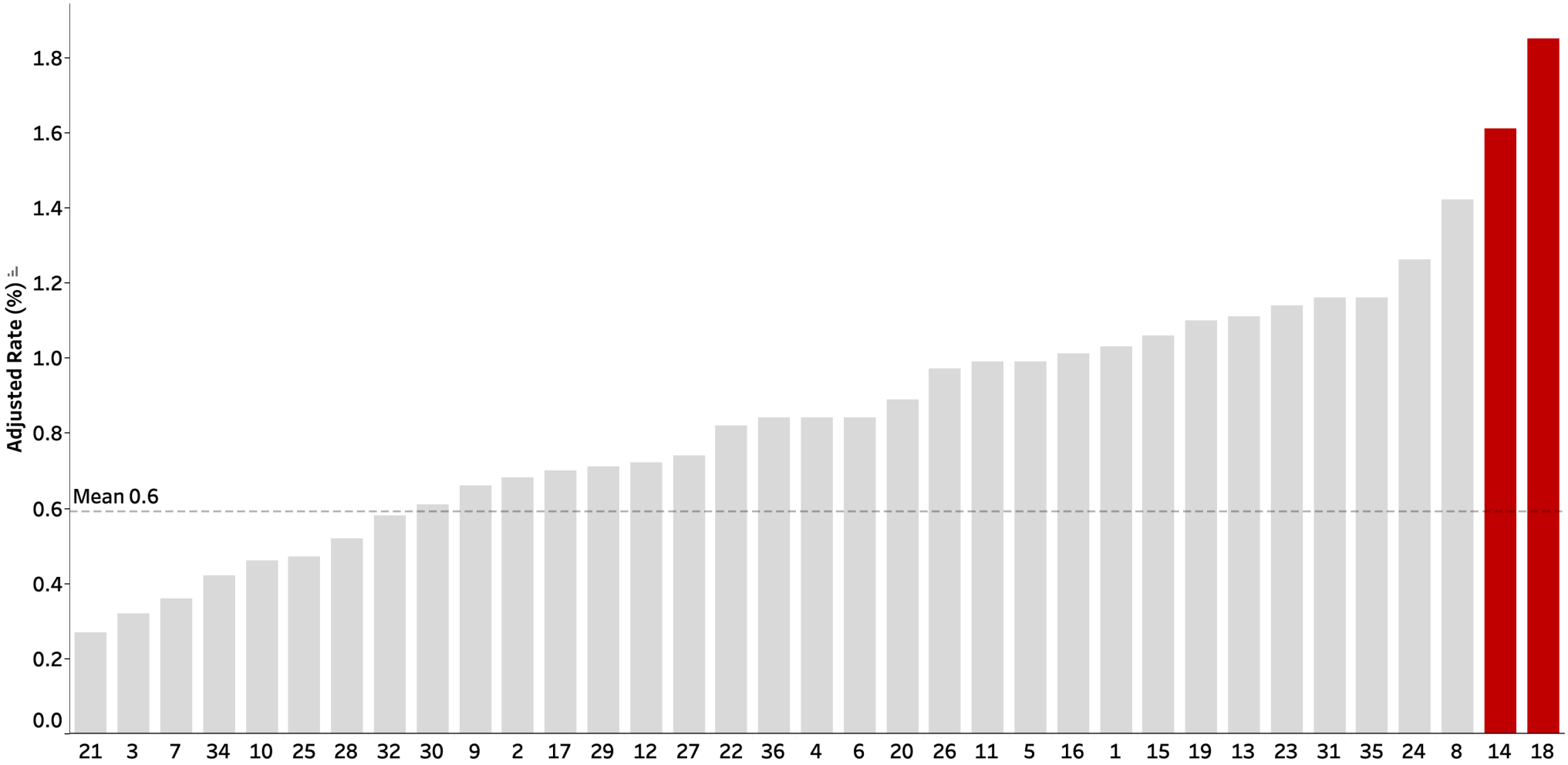
Cardiac Arrest with CPR, Age >= 65

Cohort 8 (Isolated Hip Fracture)

Graph ID 78



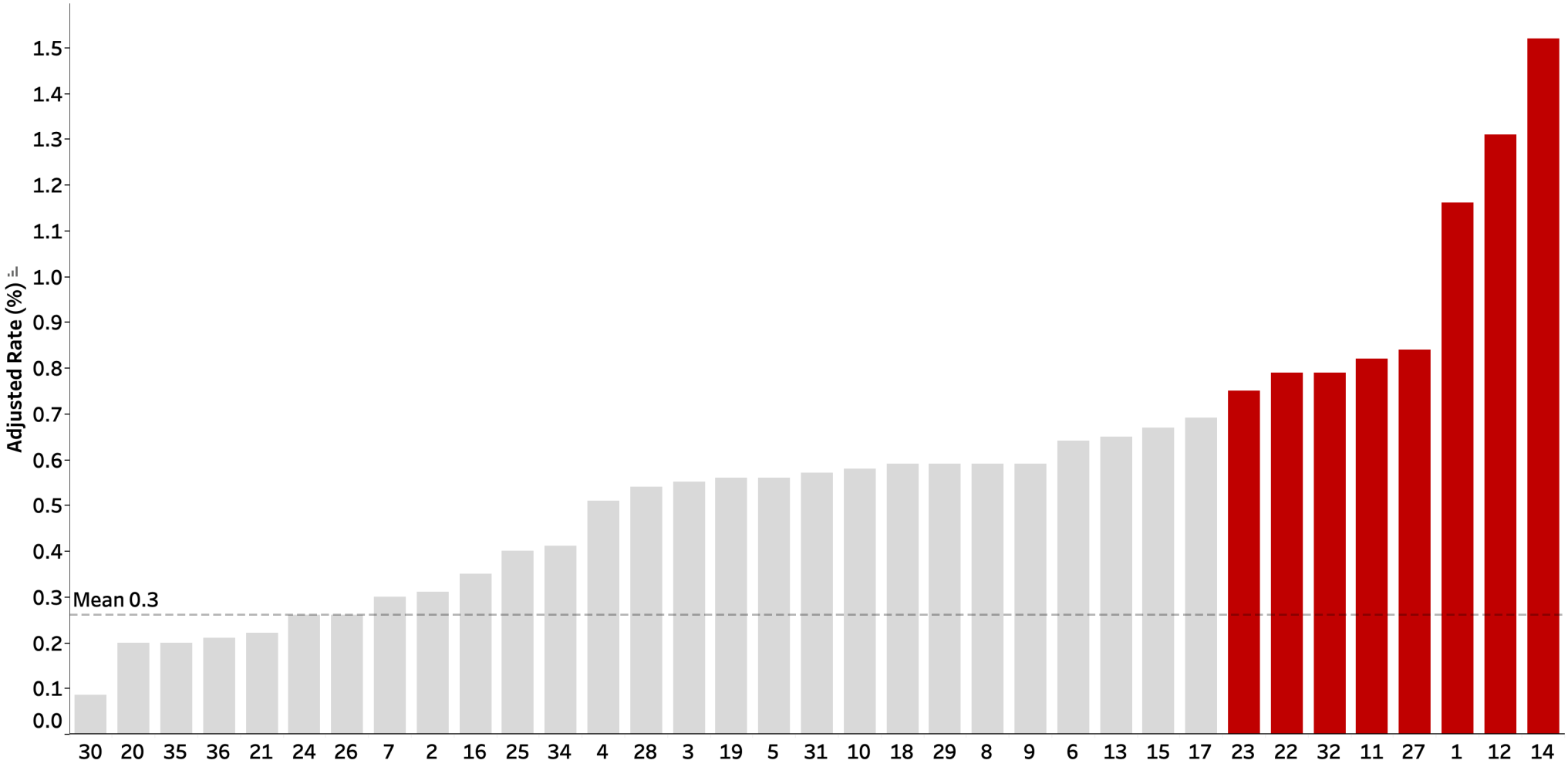
Myocardial Infarction, Age >= 65
Cohort 8 (Isolated Hip Fracture)
Graph ID 79



Pneumonia, Age >= 65

Cohort 8 (Isolated Hip Fracture)

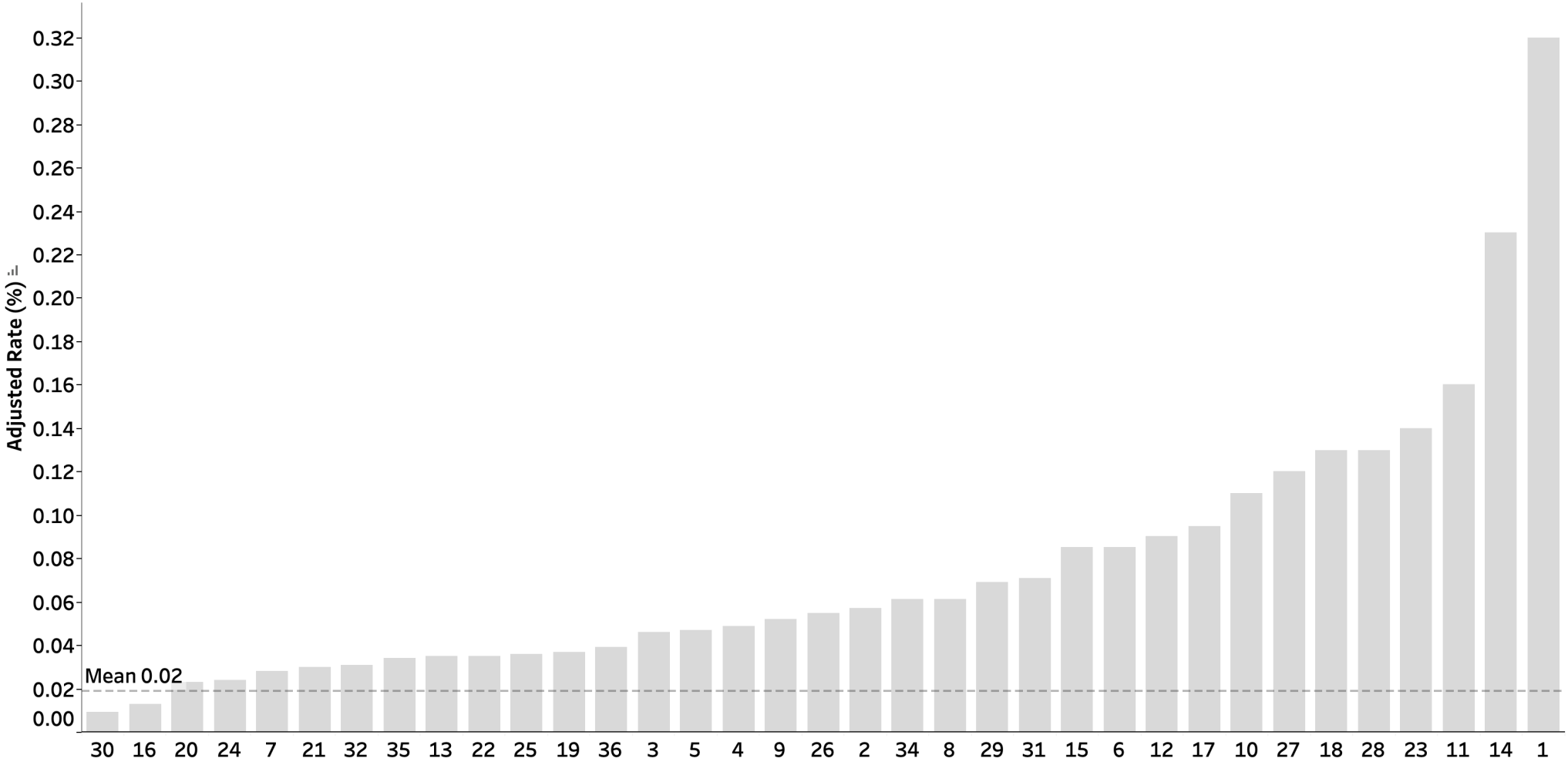
Graph ID 80



Ventilator-associated Pneumonia, Age >= 65

Cohort 8 (Isolated Hip Fracture)

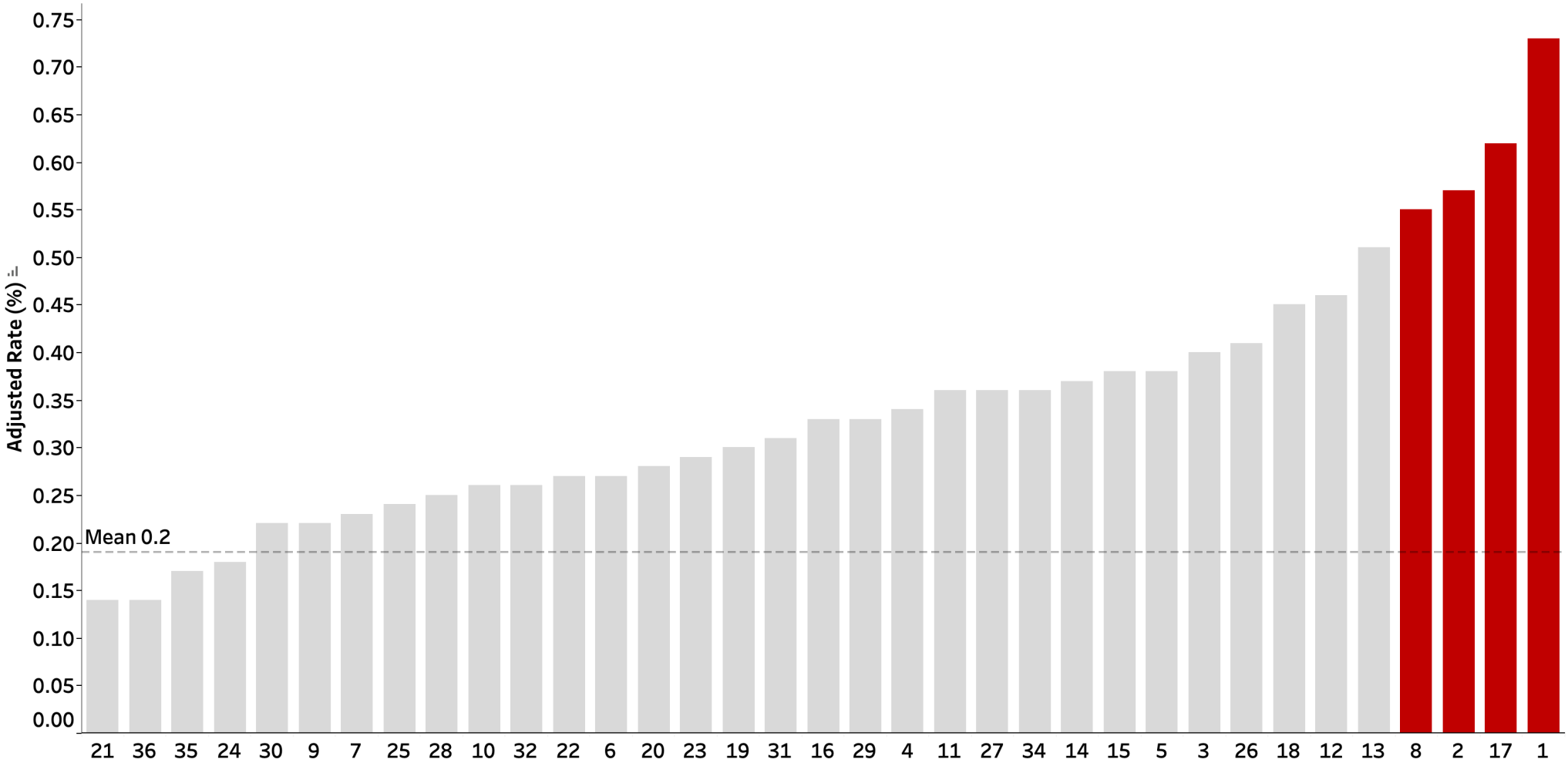
Graph ID 81



Acute Kidney Injury, Age >= 65

Cohort 8 (Isolated Hip Fracture)

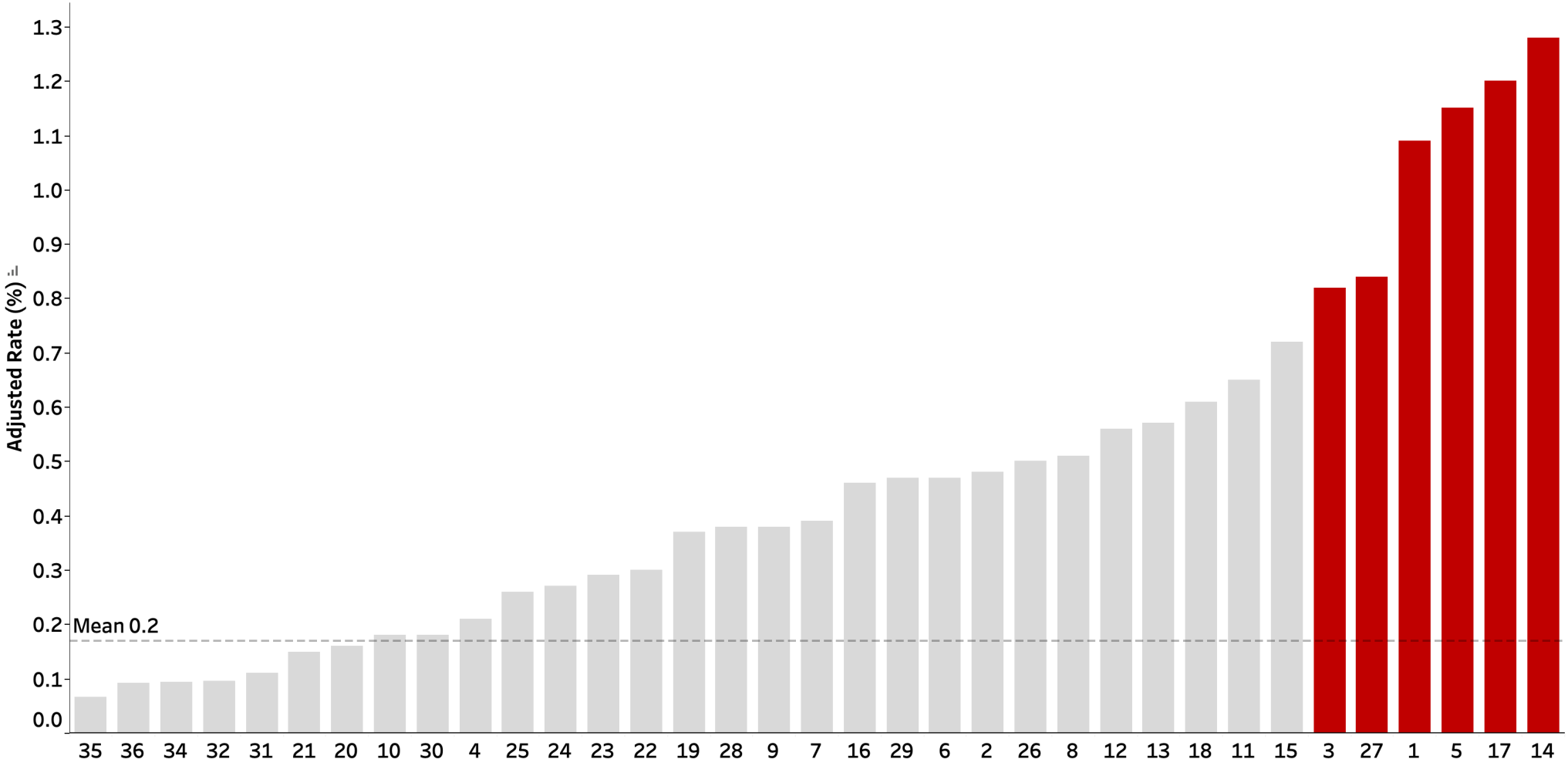
Graph ID 82



Catheter-associated Urinary Tract Infection, Age >= 65

Cohort 8 (Isolated Hip Fracture)

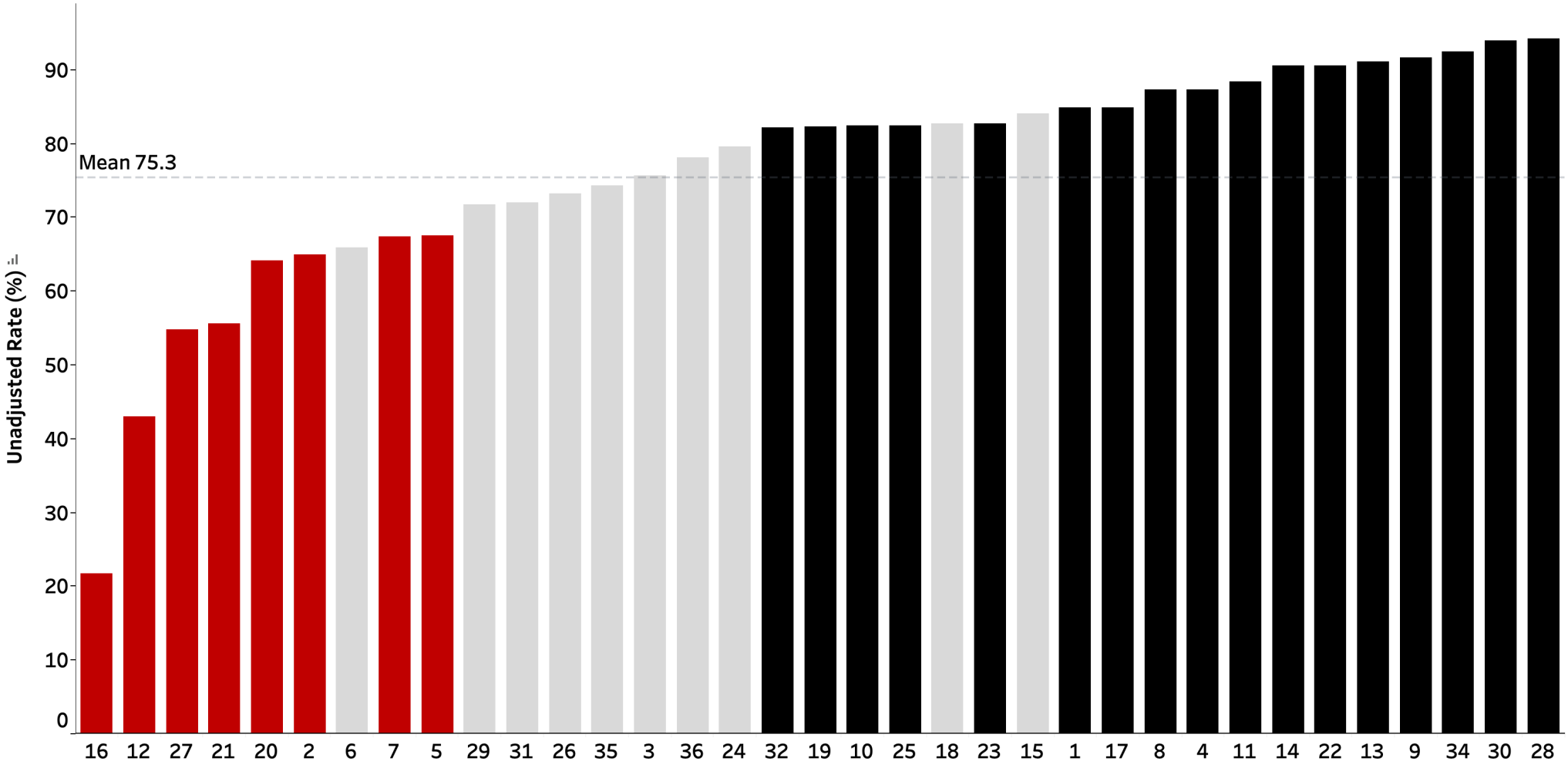
Graph ID 83



LMWH, Heparin VTE Prophylaxis <= 48 hours, Age >= 65

Cohort 8 (Isolated Hip Fracture)

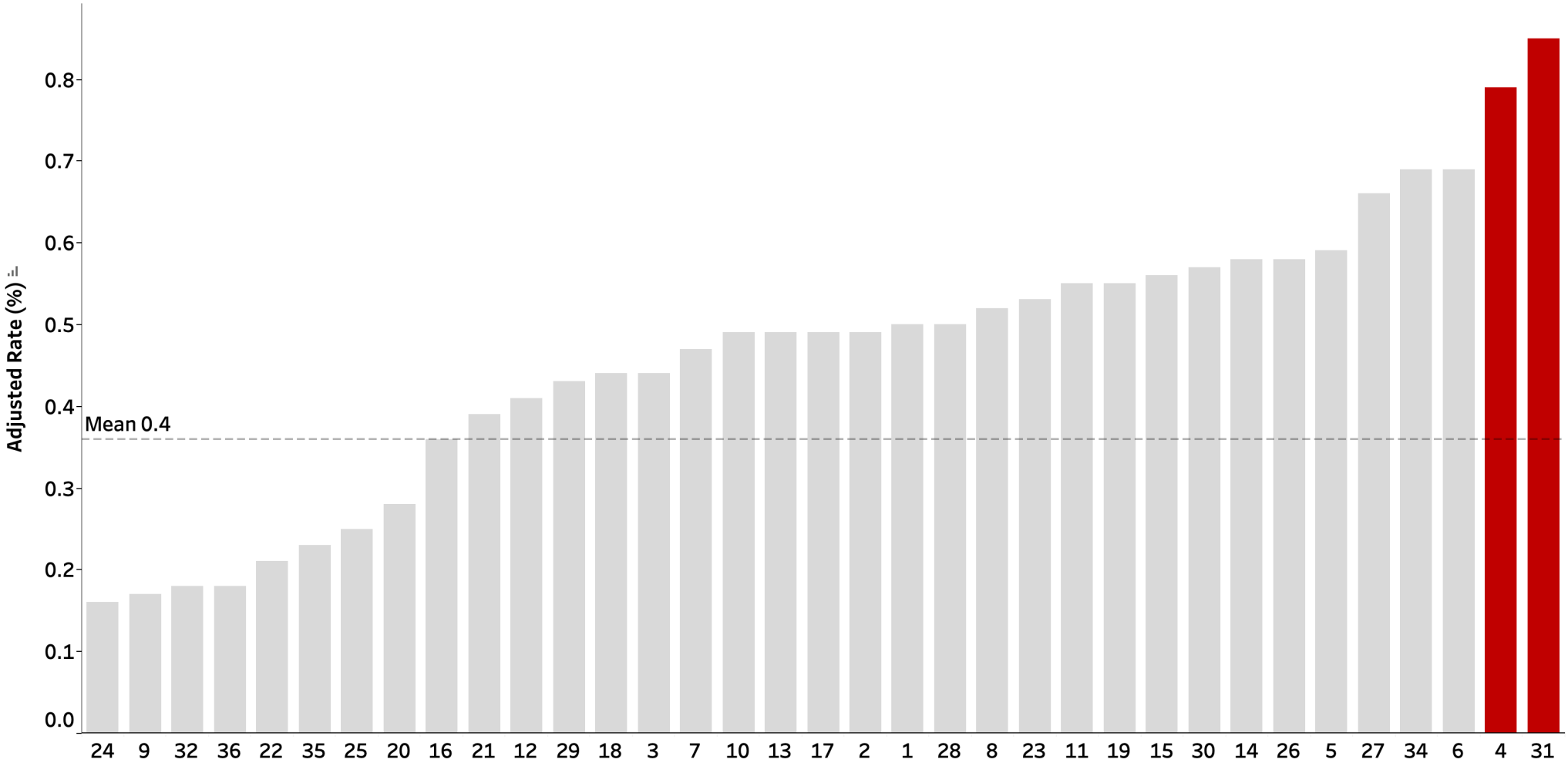
Graph ID 84



Deep Vein Thrombosis, Age >= 65

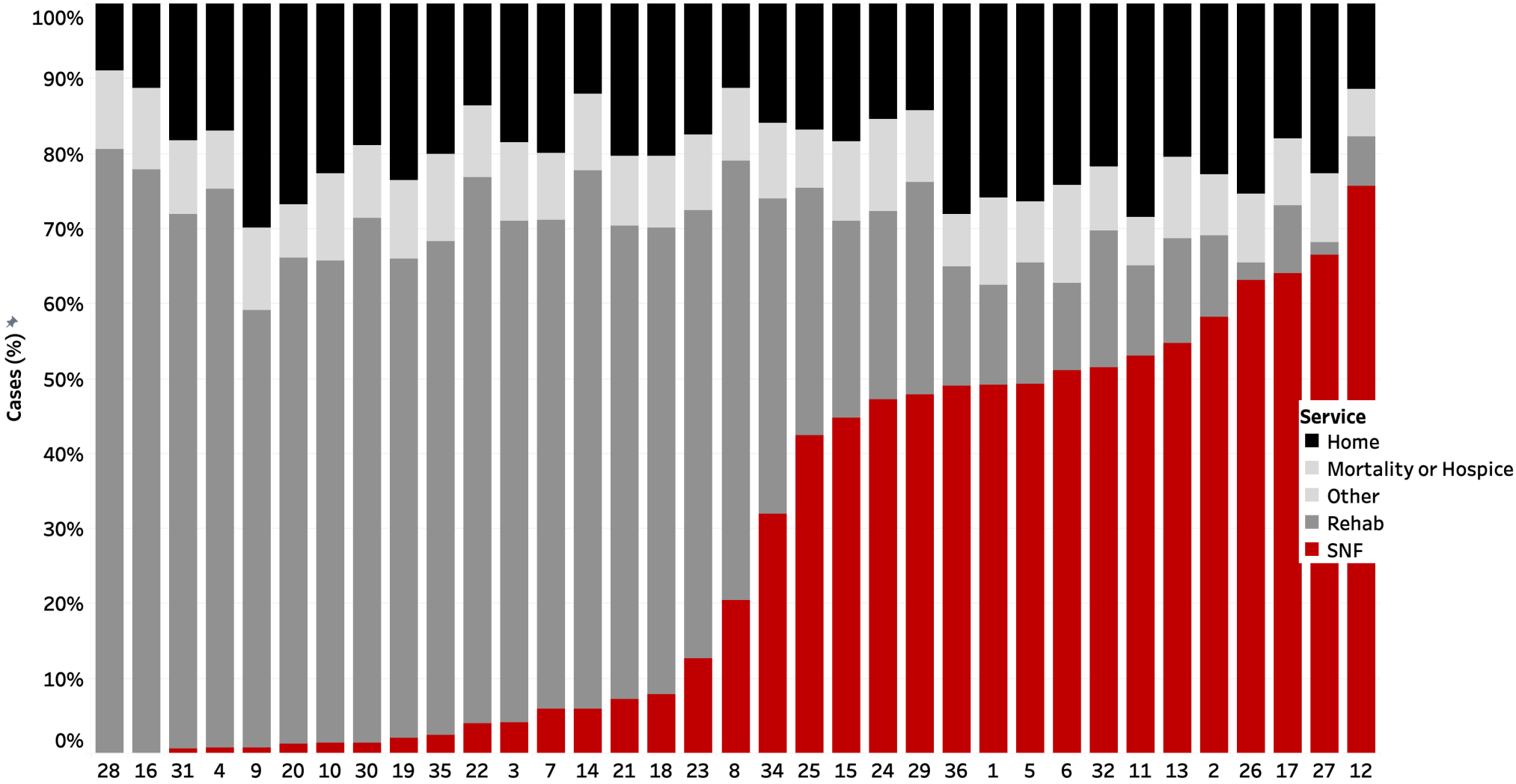
Cohort 8 (Isolated Hip Fracture)

Graph ID 85



Hospital Disposition

Cohort 8 (Isolated Hip Fracture)



McLaren Oakland Elderly Hip Fracture Protocol

Trevor Crean, DO

Current ACS Guidelines

- "…Once diagnosed with a hip fracture, these patients are typically admitted to the hospital, medically optimized, and should be surgically treated as soon as able, ***preferably within 48 hours***."

  -ACS TQIP Best Practices Orthopedic Trauma

Goal

- Safely and effectively evaluating, optimizing and addressing patients with elderly hip fractures in a timely manner that ideally is within 48 hours of presentation, per current ACS guidelines.

Time of Presentation

- Acute care trauma team notified of at least Level 3 page
- Orthopedic on-call resident notified

- Both evaluate patient in a timely fashion based off standard Trauma activation criteria

Trauma Team

- After evaluation, patient is admitted with the trauma team as the primary service
- VTE Prophylaxis initiated
- Consults to:
  - Orthopedics (likely already involved with care)
  - Anesthesia (in-house)
  - Internal Medicine Team (in majority of cases)
- Additional necessary consults placed as seen fit by Trauma team and/or anesthesia team IF it is felt that additional medical testing/optimization is necessary prior to OR

Orthopedic Surgery Team

- After evaluating the patient, on-call resident coordinates with:
  - Orthopedic Attending
  - OR Scheduling desk
  - Vendor Reps
  - Trauma/Anesthesia to discuss any need for further consultation/testing

OR Scheduling

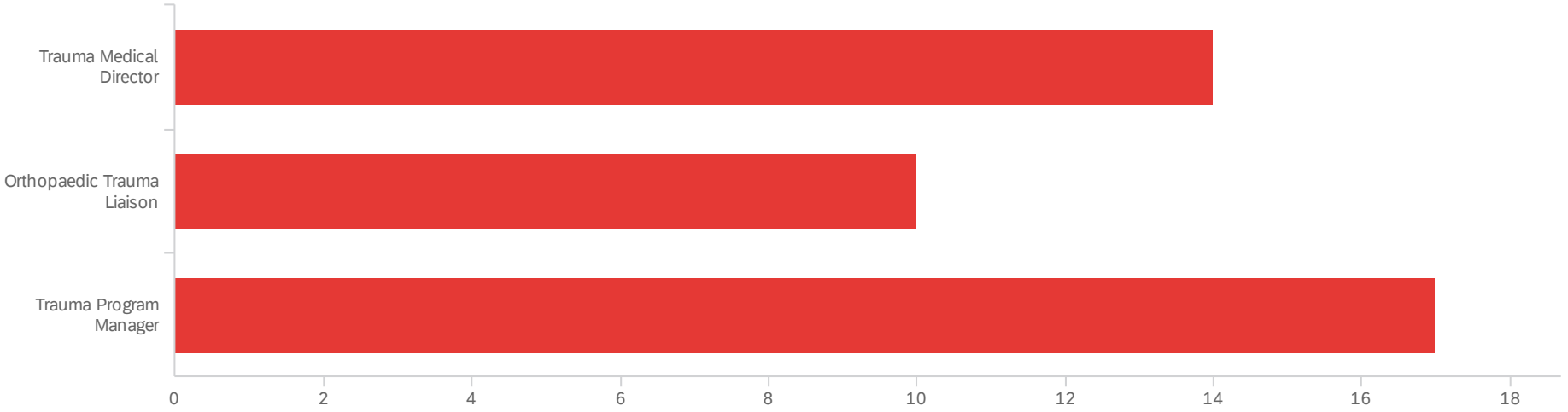
- Upon scheduling, case is flagged as “Time-Sensitive”
- Once Patient is deemed optimized:
  - IF OR time available, case scheduled when surgeon available within next 24-48 hours
  - IF OR time unavailable within first 24-36 hours after patient admission, case not becomes urgent/emergent, and if necessary, elective block surgeon’s will be bumped based off agreed upon OR policy

Why it works

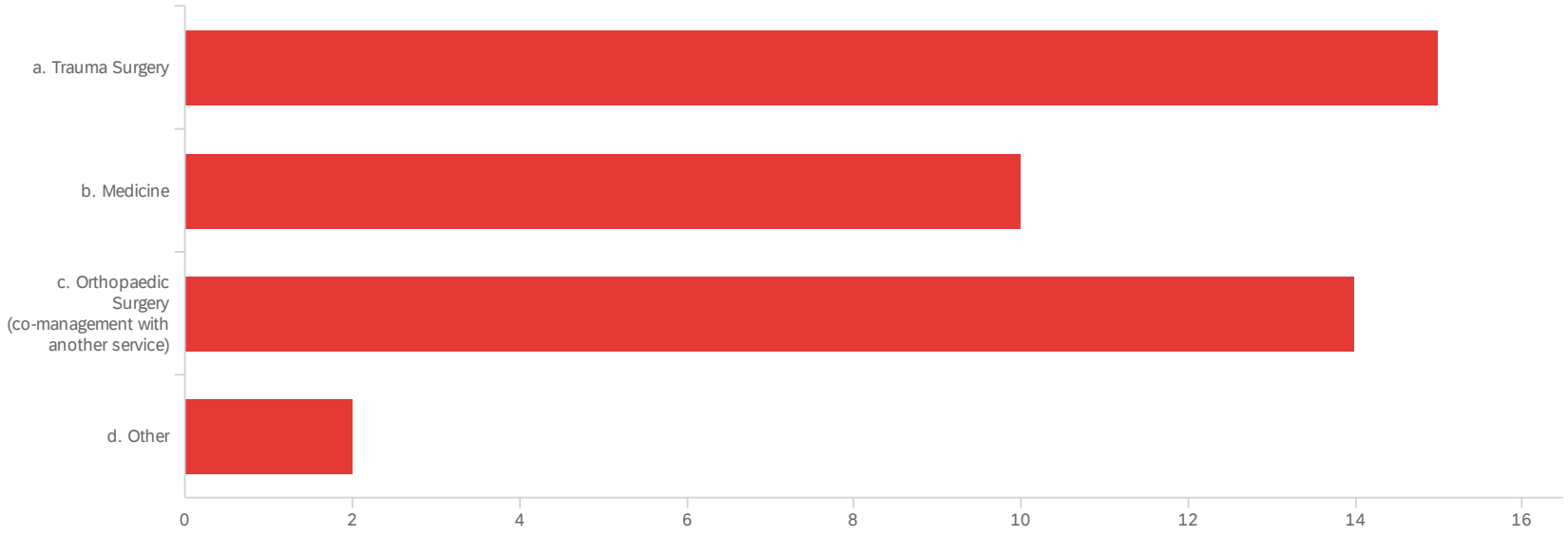
- Both trauma attending and anesthesia attending in house 24/7
  - Admissions to medicine service may take up to 12 hours for attending level evaluation of patient as no attending hospitalist in-house 24/7
  - Prevents admissions from stand-alone ER from “slipping through the cracks”
- Anesthesia able to prepare for case early
  - Can recommend additional testing/consults as they see fit
  - Echo/Cardiology consults kept to only higher risk patients and decrease unnecessary testing
  - Added patient benefit of regional block, if indicated, while patient is still in ER
- OR Scheduling is monitoring case from beginning to optimize OR workflow, especially during busy elective-heavy days

Hip Fracture Survey

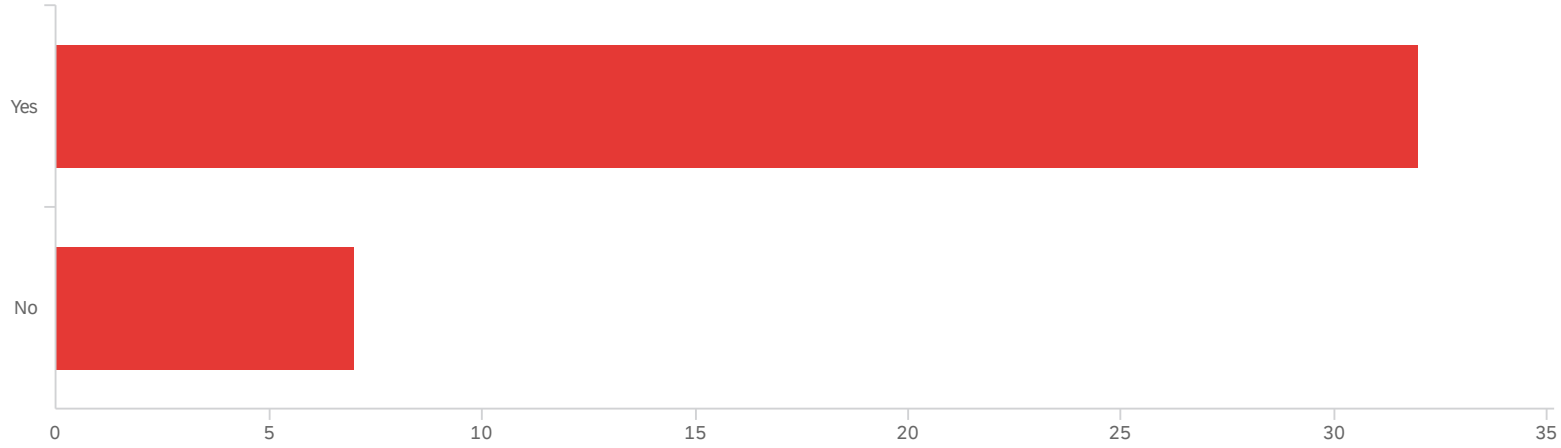
What is your role at your institution?



Who admits hip fxs at your institution?



Do you have a hip fx pathway/guideline?



What are some barriers to timely fixation?

- OR Availability/OR Staffing
- Medical Clearance
- Cardiac Clearance
- Ortho Surgery
  - Operate at inconvenient times
  - Surgeon works elsewhere
  - Patient has a relationship with an orthopedic surgeon who is not on call.

- No Barriers

Additional Questions?

- Best practices regarding medical optimization – Trauma vs. Medicine vs. Geriatric
- How to limit unnecessary consults/testing
- Hip Blocks and Pain Control
- Conveying a sense of urgency, i.e. Cardiology
- Protocol for occult fxs rule out in ER vs admit.
- Minimize time from surgery to D/C to IPR/SNF/Other

More Discussion

- Reasons for Delay
- Barriers to Timely Fixation
- Role of Non-operative Treatment
- Role of Specialty Surgeons – e.g. arthroplasty
- Discharge Destination – IPR vs. SNF vs. Home
- Stakeholders for Pathway – Buy-in & Turf Wars

Lunch

Back at 1:00p

VTE Session

JAMA Surgery | Original Investigation

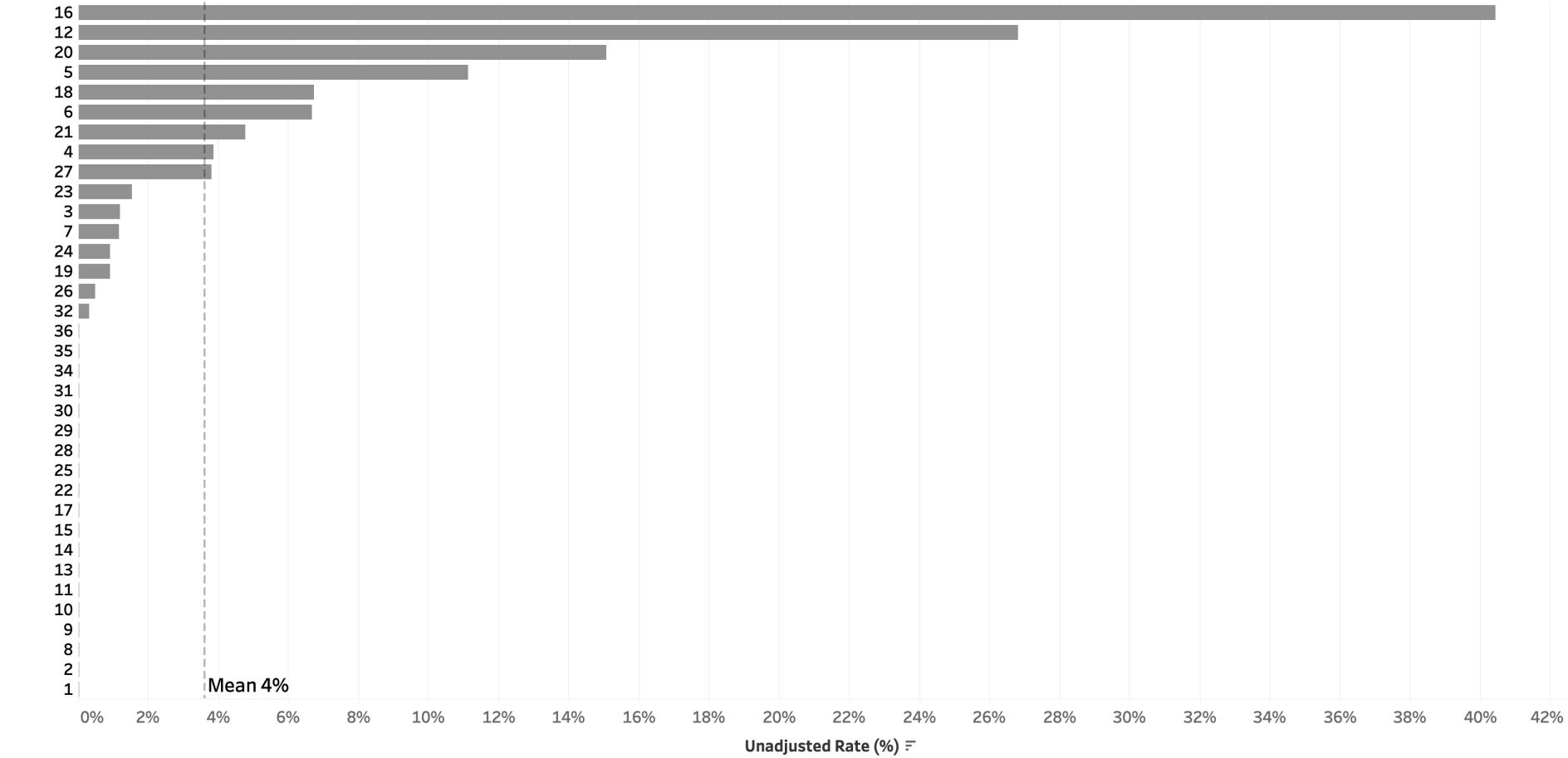
Association of Aspirin With Prevention of Venous Thromboembolism in Patients After Total Knee Arthroplasty Compared With Other Anticoagulants

A Noninferiority Analysis

Brandon R. Hood, MD; Mark E. Cowen, MD, SM; Huiyong T. Zheng, PhD; Richard E. Hughes, PhD; Bonita Singal, MD, PhD; Brian R. Hallstrom, MD

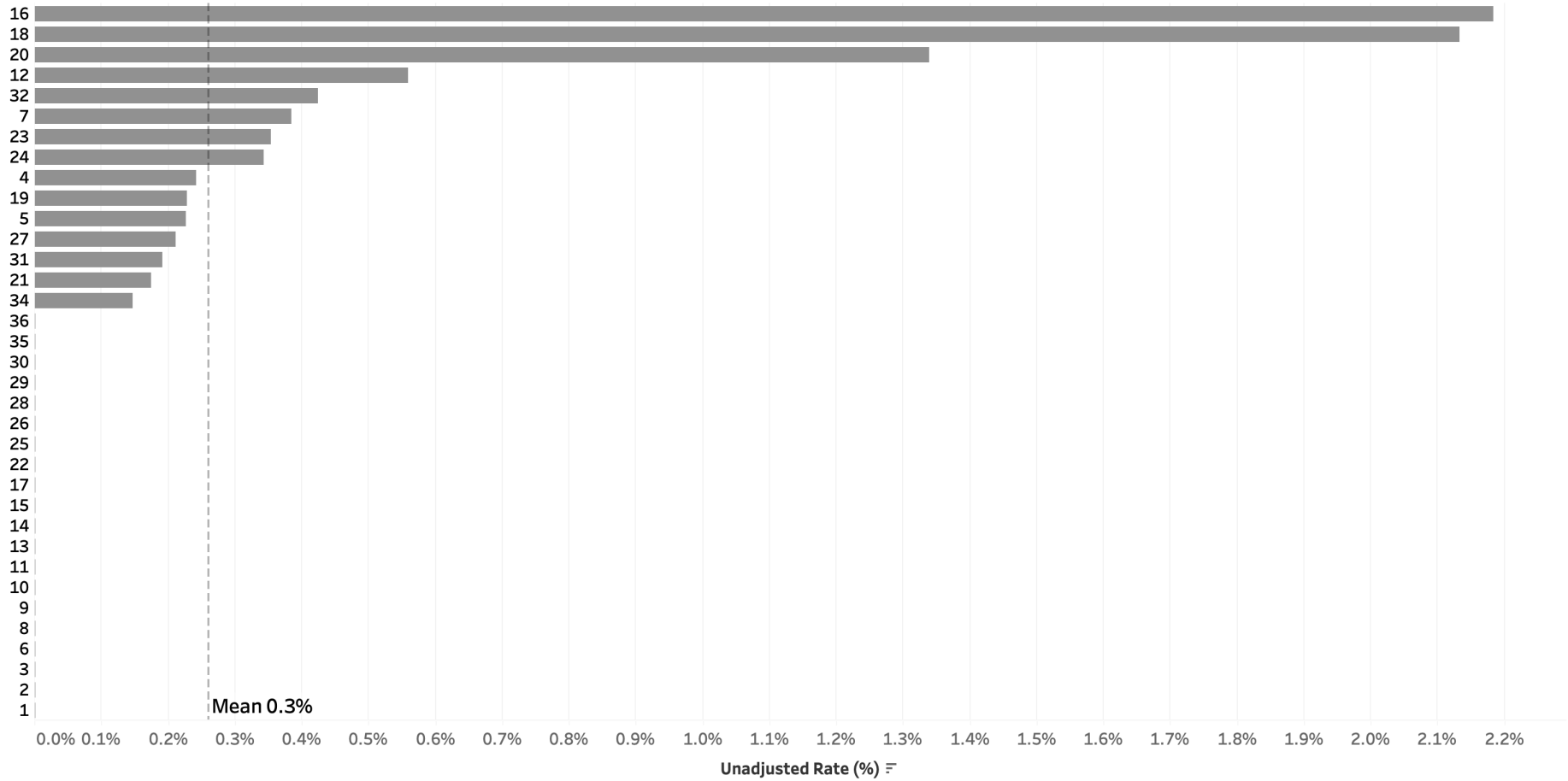
ASA VTE Prophylaxis <= 48 Hours

Cohort 8 (Isolated Hip Fracture) | 1/1/22 - 5/31/23



ASA VTE Prophylaxis <= 48 Hours

Cohort 2 (Admit to Trauma) | 1/1/22 - 5/31/23



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JANUARY 19, 2023 VOL. 388 NO. 3

Aspirin or Low-Molecular-Weight Heparin for Thromboprophylaxis after a Fracture

Major Extremity Trauma Research Consortium (METRC)*

Lovenox

Alistair Chapman, MD
General & Critical Care Surgeon
Corewell Health – Grand Rapids

Vs.

Aspirin

William “Bill” Hakeos, MD
Orthopaedic Trauma Surgeon
Henry Ford Health - Detroit

Rules

- No leg sweeping
- Respect you opponent
- May the best agent win!

Full Reversal of Anticoagulants Before Cephalomedullary Fixation of Geriatric Hip Fractures May Not Be Necessary

Mark Hake, MD

October 10th, 2023

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Disclosures

- None pertinent to this talk

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Introduction

- Timely surgical treatment of geriatric hip fractures within 24-48 hours is recommended
- Some advocate for delay in treatment for patients on DOACs.
- Goal: Evaluate blood loss in patients taking anticoagulants undergoing CMN

AAOS
American Academy of Orthopaedic Surgeons

Management of Hip Fractures in Older Adults

Evidence-Based Clinical Practice Guideline

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Methods

- Retrospective review
  - All patients 60 years and older
  - Acute, isolated extracapsular hip fracture treated with CMN
  - 10 years of data from THAA and U of M
- Exclusion criteria:
  - Missing data, path fracture, other procedures

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Methods

- Study Groups
  - Direct Oral Anticoagulants
  - Warfarin
  - Antiplatelet
  - Control
- Primary Outcome
  - Calculated blood loss
  - Transfusion Risk
  - Hospital LOS
  - Overall 1-year mortality

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Methods

Direct Oral Anticoagulants

	Phase 1: Recommended Initial Anticoagulant Dosing	Phase 2: Completion of Anticoagulation Dosing (Finish after 3-6 months)	Phase 3: Extended Anticoagulation Prophylaxis Dosing
Apixaban[a]	10mg daily x 7 days	5mg twice daily	3-6 months after treatment, dose reduction to 2.5mg twice daily
Dabigatran[b]	5-10 days of parenteral anticoagulation	150mg twice daily	150 mg twice daily[e]
		Not recommended if CrCl<30mL/min	
Edoxaban[c]	5-10 days of parenteral anticoagulation then initiate drug	60mg daily if CrCl >51 ml/min	60mg daily if CrCl >51 ml/min
		30mg daily if CrCl 30-	30mg daily if CrCl 30-50mL/min[e]
		Not recommended if CrCl<30mL/min	Not recommended if CrCl<30mL/min[e]
		30mg daily if body weight ≤60kg or in combination with a P-glycoprotein inhibitor	30mg daily if body weight ≤60kg or in combination with a P-glycoprotein inhibitor
		Avoid use if CrCl >95 ml/min	Avoid use if CrCl >95 ml/minee
Rivaroxaban[d]	15mg twice daily x 21 days	20mg daily	3-6 months after treatment, dose reduction to 10mg daily
		Avoid use if CrCl<15mL/min	Avoid use if CrCl<15mL/min[e]

Antiplatelet

Drug	*Mechanism of action*
Aspirin	**COX inhibitors**
Dipyridamole	**Phosphodiesterase inhibitors**
Treprostinil	**Analogue of prostacyclin**
Clopidogrel Prasugrel Ticagrelor Ticlopidine	**ADP antagonists**
Abciximab Eptifibatide Tirofiban	**GP IIb/IIIa inhibitors**

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Methods

- Retrospective review
  - All patients 60 years and older
  - Acute, isolated extracapsular hip fracture treated with CMN
  - 10 years of data from THAA and U of M
- Exclusion criteria:
  - Missing data, path fracture, other procedures

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Methods

- Original project
  - Blood loss for Short vs Long CMNs
  - Calculated blood loss for accuracy
  - 26% reduction in CBL and 21% transfusion risk using short CMNs

$$\mathrm{CBL} = (V_{\mathrm{blood}} \times (\mathrm{Hct}_0 - \mathrm{Hct}_1)/100 + V_{\mathrm{RBC}} \times 0.6) \times 200 / (\mathrm{Hct}_0 + \mathrm{Hct}_1)$$

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Results

- 1,442 patients
  - 47 DOACs
  - 148 Warfarin
  - 657 antiplatelet
  - 590 controls
- Calculated blood loss was significant only between Antiplatelet vs Control groups
  - 1386 mL (SD 837 mL) vs. 1254 mL (SD 864 mL) ($p<0.001$)
- Rate of transfusion was significant between Antiplatelet (42.7%) versus Control (33.1%) ($p < 0.001$)

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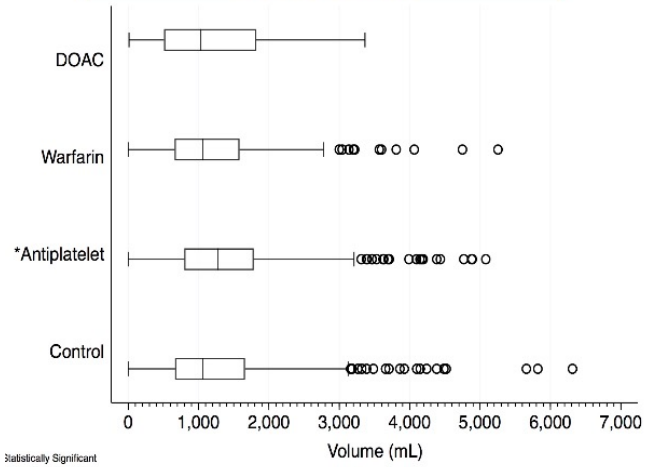
Results

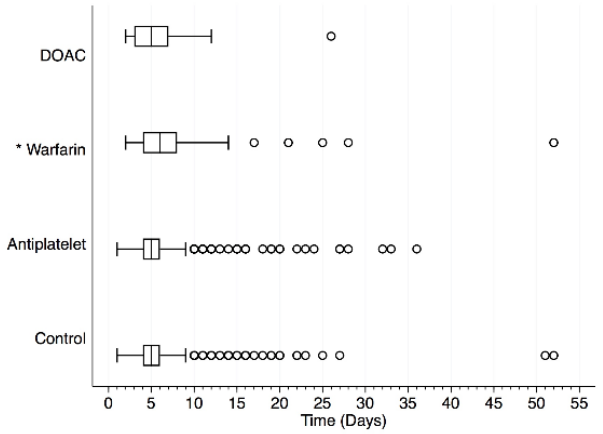
Blood Loss



Transfusion

Treatment Group	Transfused Patients	Total Cohort
DOAC	14 (29.8%)	47
Warfarin	60 (40.6%)	148
Antiplatelet*	281 (42.7%)	657
Control	195 (33.1)	590
Totals	550 (38.1%)	1,442
*Statistically Significant		

Length of Stay



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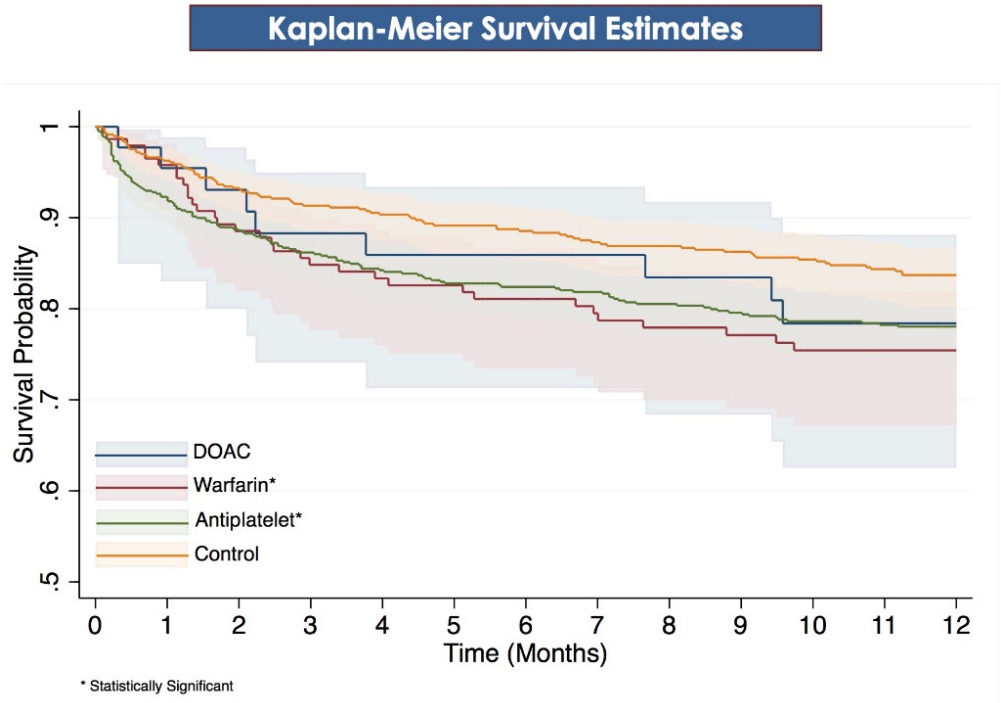
Results



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Conclusions

- Delaying surgery or reversing DOACs does not appear to change the risks of bleeding or risk of transfusion
- Antiplatelet drugs appear to increase blood loss and transfusion risk
- Unclear if this trend continues for hip fracture patients requiring arthroplasty.

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Questions?

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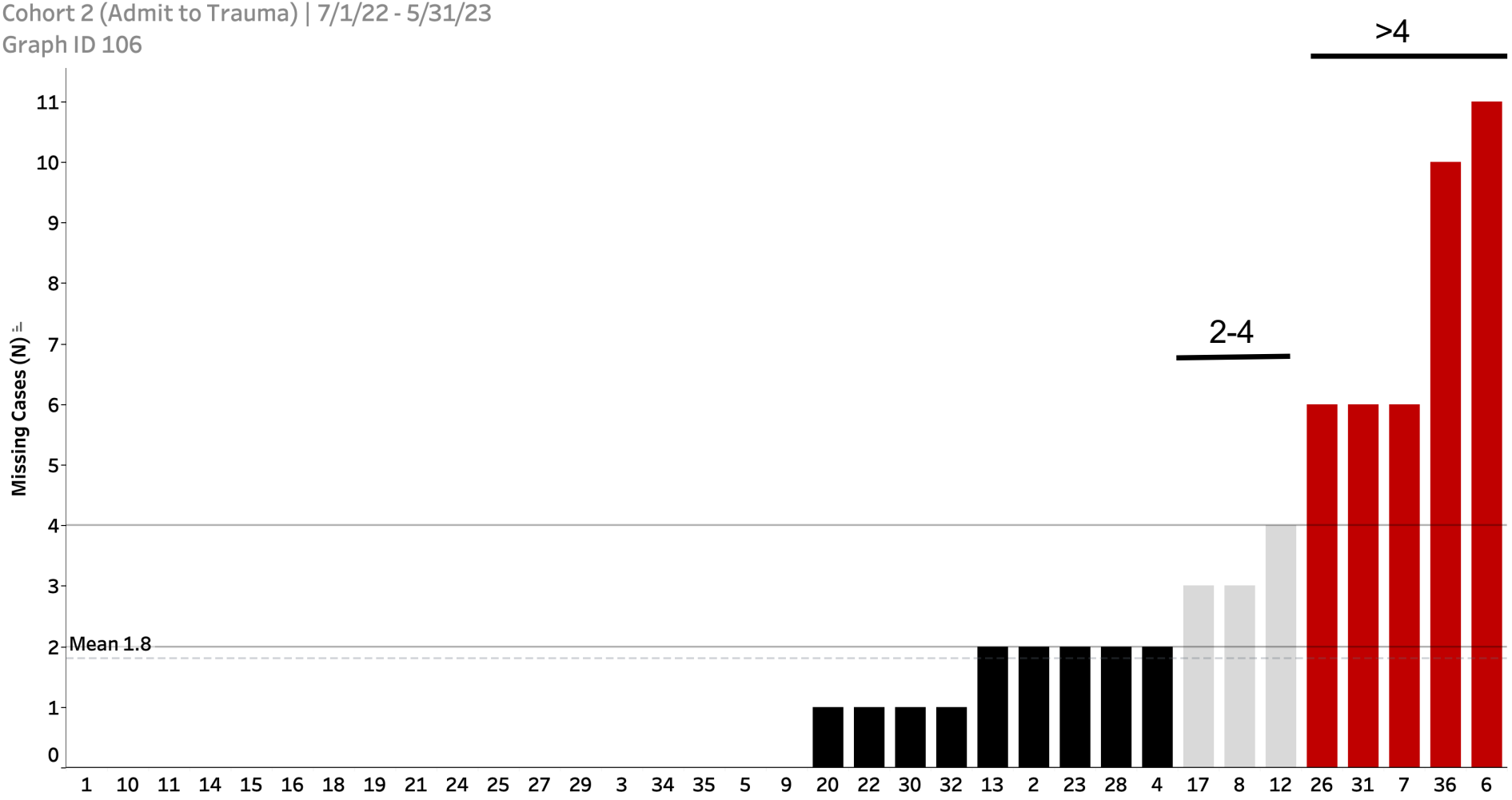
MTQIP Data &
Hospital Scoring Index Results

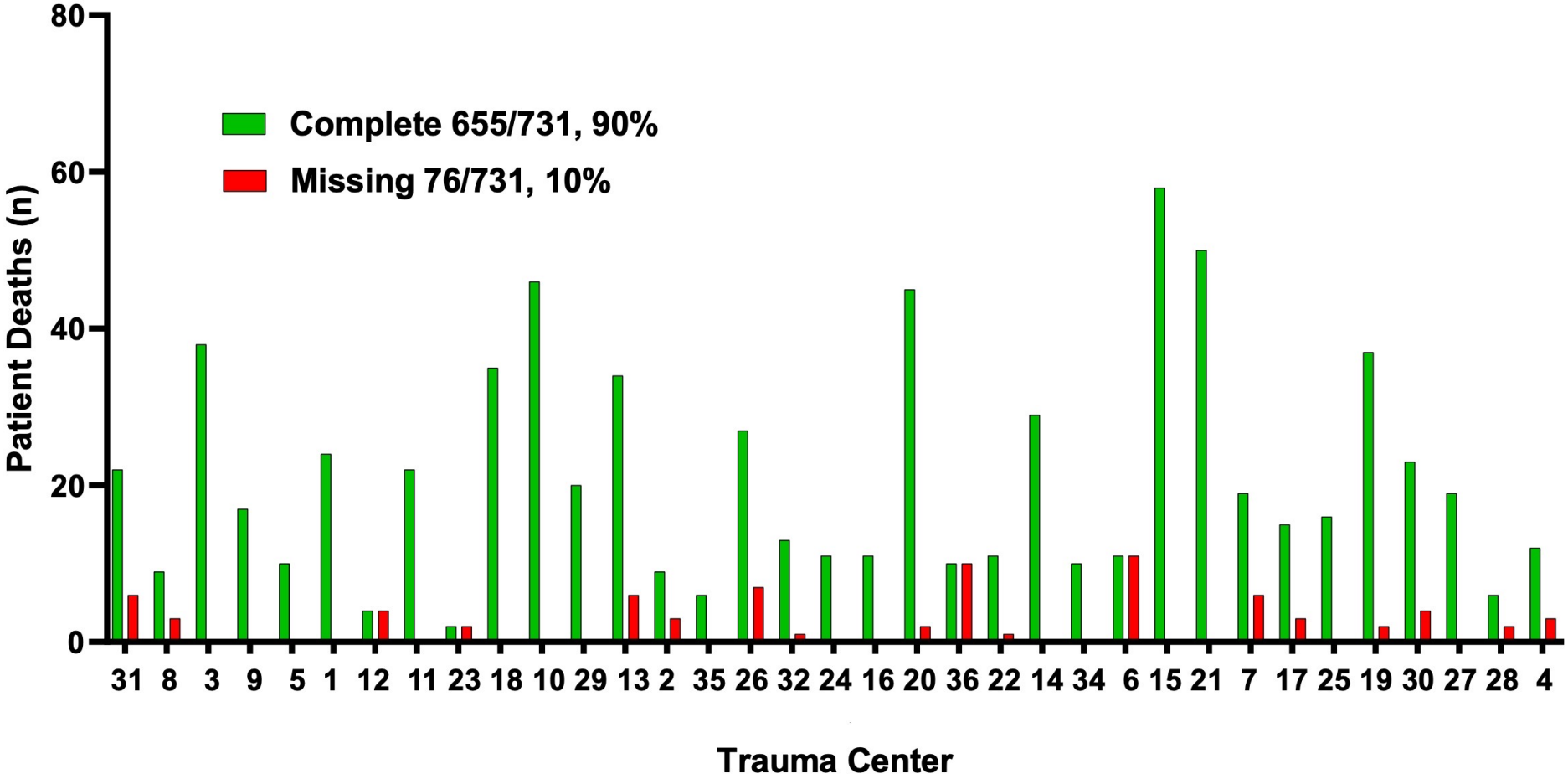
Mark Hemmila, MD

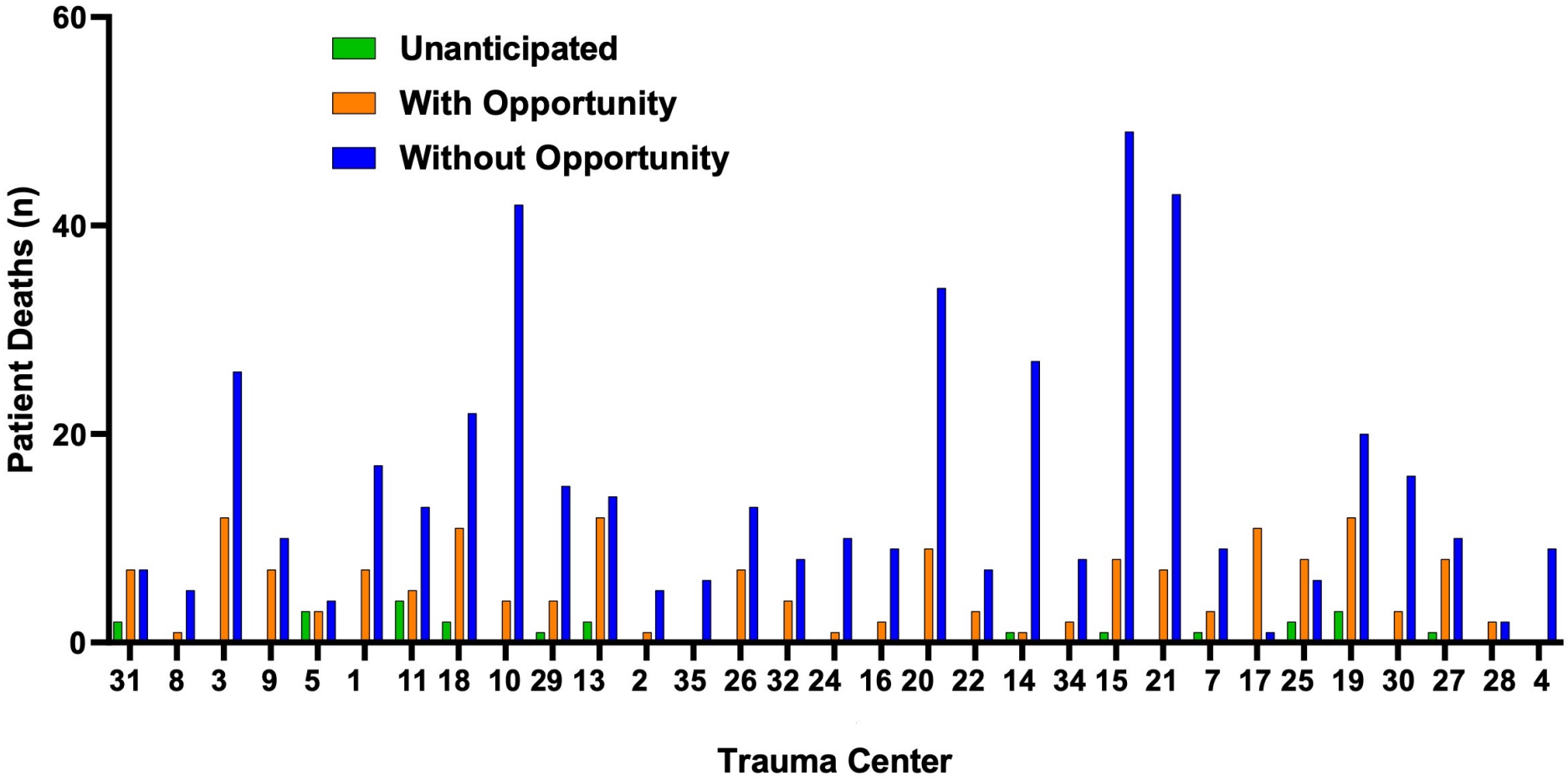
#4 PI Death Determination Documentation

- Completed PI death determination (12 mo: 7/1/22-6/30/23)
- Cohort 2 (Admit trauma)
- Exclude no signs of life
  - 0-2 patients missing = 5 points
  - 3-4 patients missing = 3 points
  - > 4 patients missing = 0 points

Metric 4 | PI Death Determination Documentation
Cohort 2 (Admit to Trauma) | 7/1/22 - 5/31/23
Graph ID 106



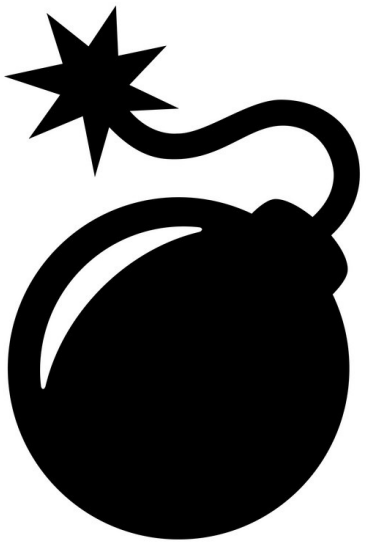

Complete 655/731, 90%
Missing 76/731, 10%
Patient Deaths (n)
0
20
40
60
80
31 8 3 9 5 1 12 11 23 18 10 29 13 2 35 26 32 24 16 20 36 22 14 34 6 15 21 7 17 25 19 30 27 28 4
Trauma Center


Unanticipated
With Opportunity
Without Opportunity
Patient Deaths (n)
60
40
20
0
31 8 3 9 5 1 11 18 10 29 13 2 35 26 32 24 16 20 22 14 34 15 21 7 17 25 19 30 27 28 4
Trauma Center

Are these patients having complications before they die, and does it matter?

Yes

- Cardiac
  - Arrest
  - Myocardial infarction
- Respiratory
  - Unplanned intubation
  - Pneumonia/VAP
- Acute Renal Failure
- Return to ICU
- Return to OR



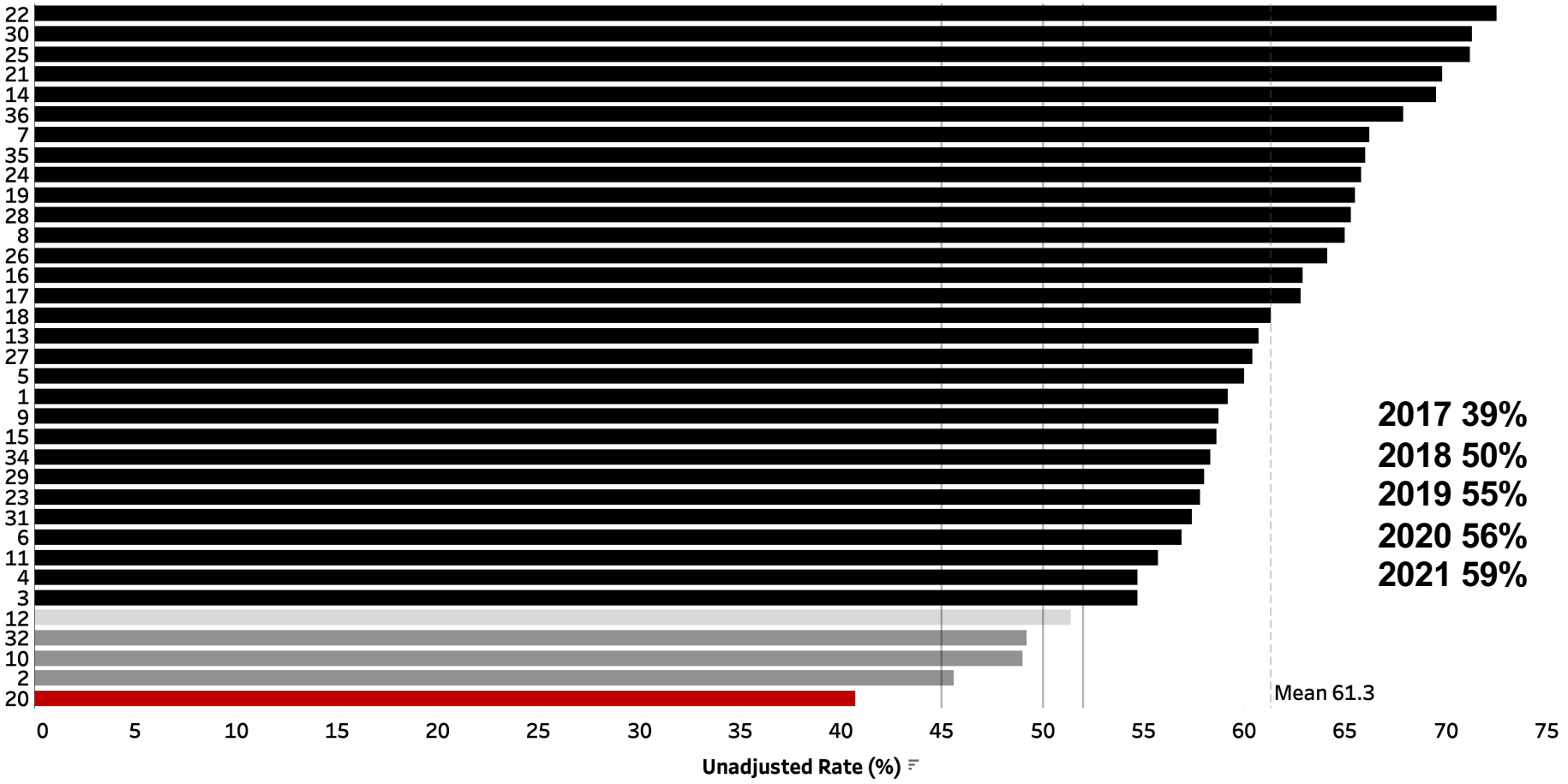
#5 Timely LMWH VTE Prophylaxis in Trauma Service Admits

- Venous Thromboembolism (VTE) Prophylaxis with LMWH Initiated Within 48 Hours of Arrival in Trauma Service Admits with > 2 Day Length of Stay (18 mo: 1/1/22-6/30/23)
  - ≥ 52.5% of patients (≤ 48 hr)
  - ≥ 50% of patients (≤ 48 hr)
  - ≥ 45% of patients (≤ 48 hr)
  - < 45% of patients (≤ 48 hr)

Metric 5 | LMWH VTE Prophylaxis <= 48 Hours

Cohort 2 (Admit to Trauma) | 1/1/22 - 5/31/23

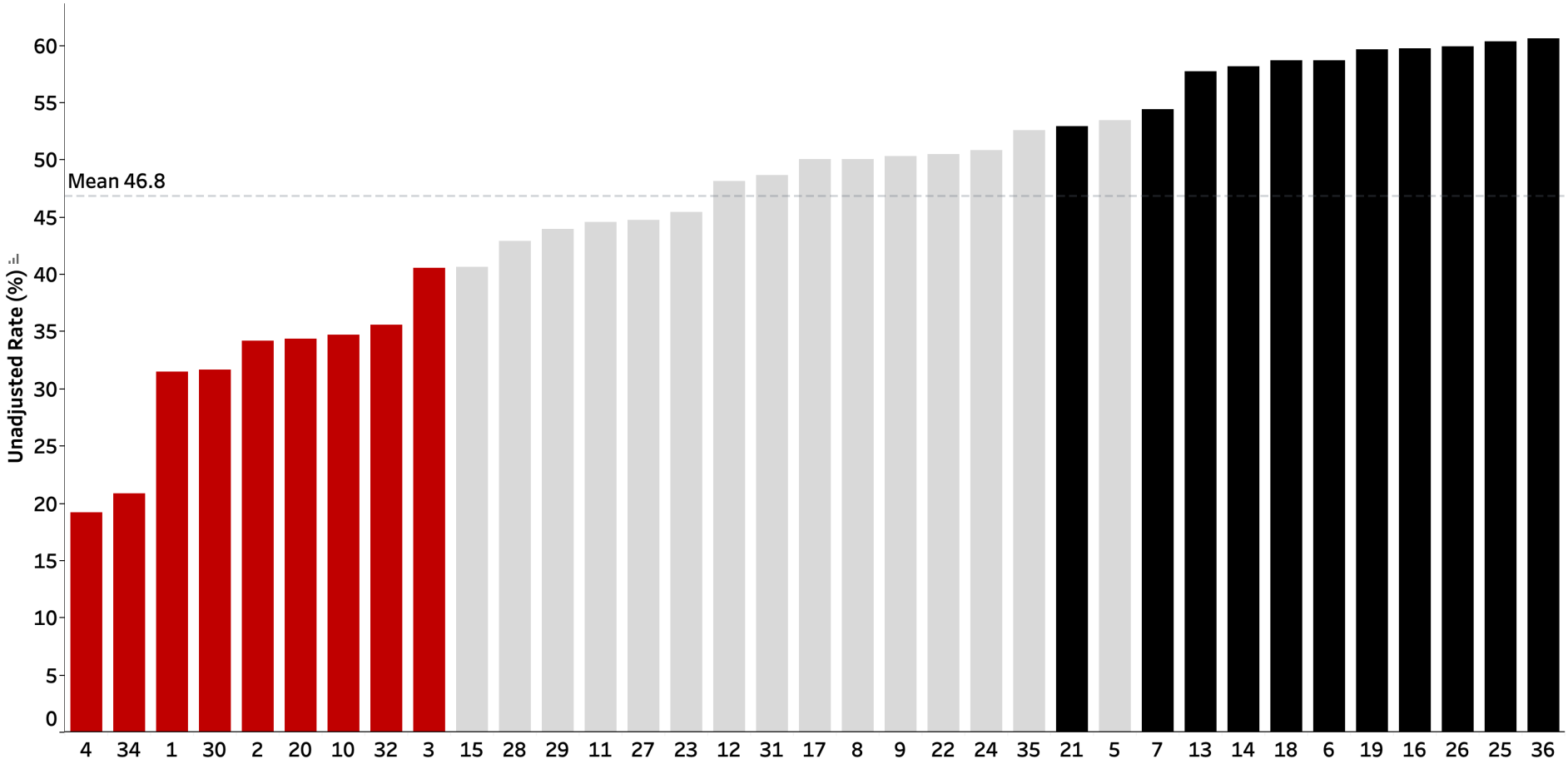
Graph ID 97



LMWH VTE Prophylaxis <= 48 Hours

Cohort Spine Injury | 1/1/22 - 5/31/23

Graph ID 95



CNTR

COALITION FOR NATIONAL TRAUMA RESEARCH

2022 CONSENSUS CONFERENCE

TO IMPLEMENT OPTIMAL VTE PROPHYLAXIS IN TRAUMA

CNTR and Trauma Societies > Weight Based LMWH

International Consensus Meeting VTE-Trauma

Orthopaedics representation

LMWH

Recommendations from the ICM-VTE: Trauma

The ICM-VTE Trauma Delegates*

1 - What is the most optimal VTE prophylaxis in patients with multiple orthopaedic injuries?

Response/Recommendation: Although multiple forms of prophylaxis against venous thromboembolism (VTE) with variable effectiveness are available for patients with multiple orthopedic injuries, low-molecular-weight heparin (LMWH) is considered the most optimal choice based on available literature.

Strength of Recommendation: Acceptable.

Delegates vote: Agree 86.36% Disagree 9.09% Abstain 4.55% (Strong Consensus).

and safe method in preventing DVT in high-risk trauma patients[15]. Geerts et al., also concluded in a randomized double blinded study that LMWH was more effective than LDH in preventing VTE after major trauma[16]. Aggarwal et al., concluded in their guidelines for prevention of VTE in hospitalized patients with pelvis and acetabular fractures that LMWH is the preferred agent of choice[8].

In the updated Western Trauma Association (WTA) guidelines to reduce VTE in trauma patients[1], LMWH was the recommended agent of choice for most trauma patients with a standard dose of 40 mg subcutaneously twice daily. However, in some cases

“Not so fast, my friend”

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JANUARY 19, 2023 VOL. 388 NO. 3

Aspirin or Low-Molecular-Weight Heparin for Thromboprophylaxis after a Fracture

Major Extremity Trauma Research Consortium (METRC)*

ABSTRACT

BACKGROUND

Clinical guidelines recommend low-molecular-weight heparin for thromboprophylaxis in patients with fractures, but trials of its effectiveness as compared with aspirin are lacking.

METHODS

In this pragmatic, multicenter, randomized, noninferiority trial, we enrolled patients 18 years of age or older who had a fracture of an extremity (anywhere from hip to midfoot or shoulder to wrist) that had been treated operatively or who had any pelvic or acetabular fracture. Patients were randomly assigned to receive low-molecular-weight heparin (enoxaparin) at a dose of 30 mg twice daily or aspirin at a dose of 81 mg twice daily while they were in the hospital. After hospital discharge, the patients continued to receive thromboprophylaxis according to the clinical protocols of each hospital. The primary outcome was death from any cause at 90 days. Secondary outcomes were nonfatal pulmonary embolism, deep-vein thrombosis, and bleeding complications.

RESULTS

A total of 12,211 patients were randomly assigned to receive aspirin (6101 patients) or low-molecular-weight heparin (6110 patients). Patients had a mean (±SD) age of 44.6±17.8 years, 0.7% had a history of venous thromboembolism, and 2.5% had a history of cancer. Patients received a mean of 8.8±10.6 in-hospital thromboprophylaxis doses and were prescribed a median 21-day supply of thromboprophylaxis at discharge. Death occurred in 47 patients (0.78%) in the aspirin group and in 45 patients (0.73%) in the low-molecular-weight–heparin group (difference, 0.05 percentage points; 96.2% confidence interval, −0.27 to 0.38; P<0.001 for a noninferiority margin of 0.75 percentage points). Deep-vein thrombosis occurred in 2.51% of patients in the aspirin group and 1.71% in the low-molecular-weight–heparin group (difference, 0.80 percentage points; 95% CI, 0.28 to 1.31). The incidence of pulmonary embolism (1.49% in each group), bleeding complications, and other serious adverse events were similar in the two groups.

CONCLUSIONS

In patients with extremity fractures that had been treated operatively or with any pelvic or acetabular fracture, thromboprophylaxis with aspirin was noninferior to low-molecular-weight heparin in preventing death and was associated with low incidences of deep-vein thrombosis and pulmonary embolism and low 90-day mortality. (Funded by the Patient-Centered Outcomes Research Institute; PREVENT CLOT ClinicalTrials.gov number, NCT02984384.)

The members of the writing committee (Robert V. O'Toole, M.D., Deborah M. Stein, M.D., M.P.H., Nathan N. O'Hara, Ph.D., Katherine P. Frey, Ph.D., R.N., Tara J. Taylor, M.P.H., Daniel O. Scharfstein, Sc.D., Anthony R. Carlini, M.S., Kuladeep Sudini, Ph.D., Yasmin Degani, M.P.H., Gerard P. Slobogean, M.D., M.P.H., Elliott R. Haut, M.D., Ph.D., William Obremskey, M.D., M.P.H., Reza Firoozabadi, M.D., Michael J. Bosse, M.D., Samuel Z. Goldhaber, M.D., Debra Marvel, M.A., and Renan C. Castillo, Ph.D.) assume responsibility for the overall content and integrity of this article.

The affiliations of the members of the writing committee are listed in the Appendix. Dr. O'Toole can be contacted at rotoole@som.umaryland.edu or at the Department of Orthopaedics, University of Maryland School of Medicine, 22 S. Greene St., Baltimore, MD 21201.

*A complete list of the METRC trial investigators is provided in the Supplementary Appendix, available at NEJM.org.

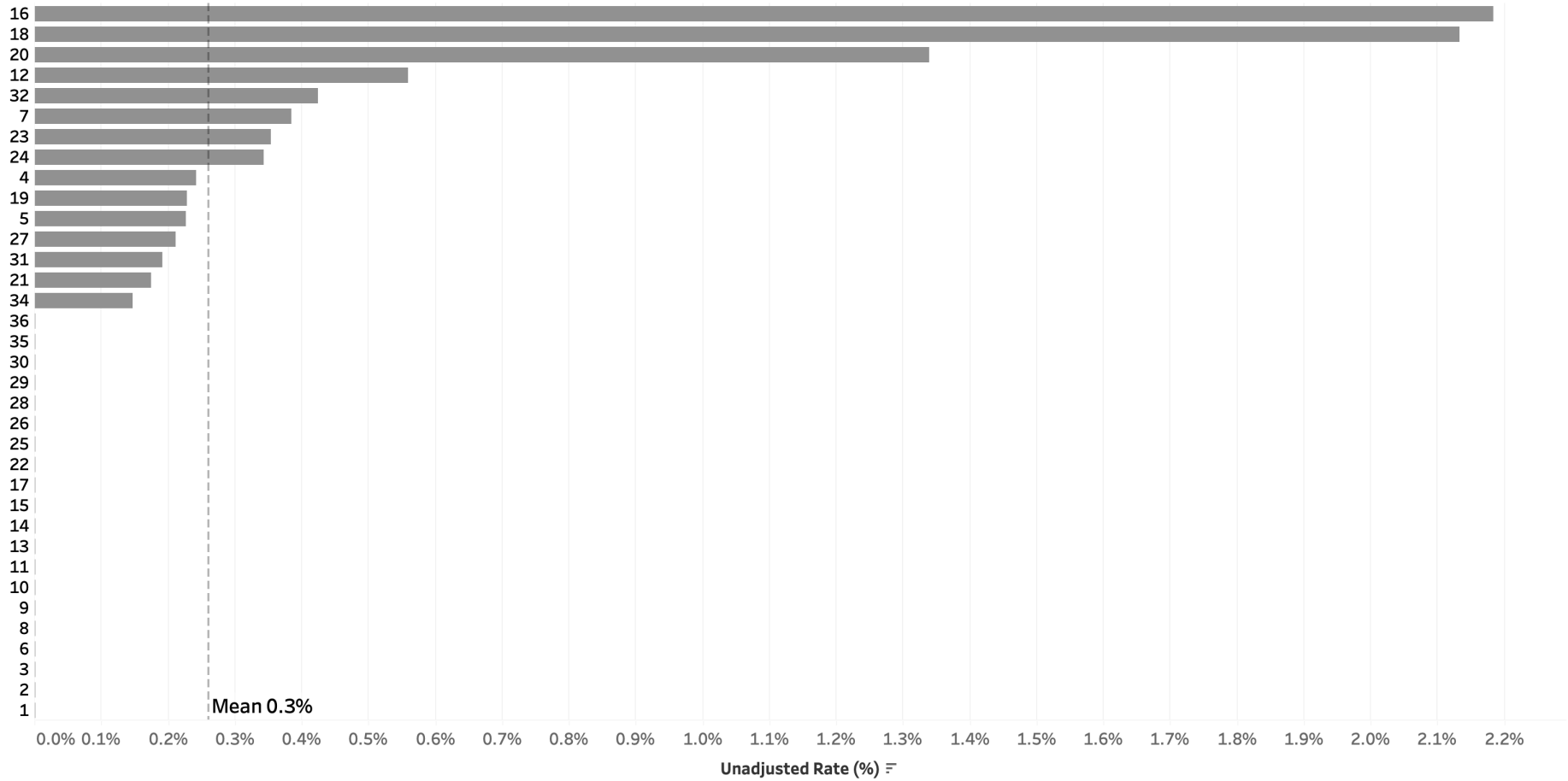
This article was updated on January 23, 2023, at NEJM.org.

N Engl J Med 2023;388:203-13.
DOI: 10.1056/NEJMoa2205973

CME at NEJM.org

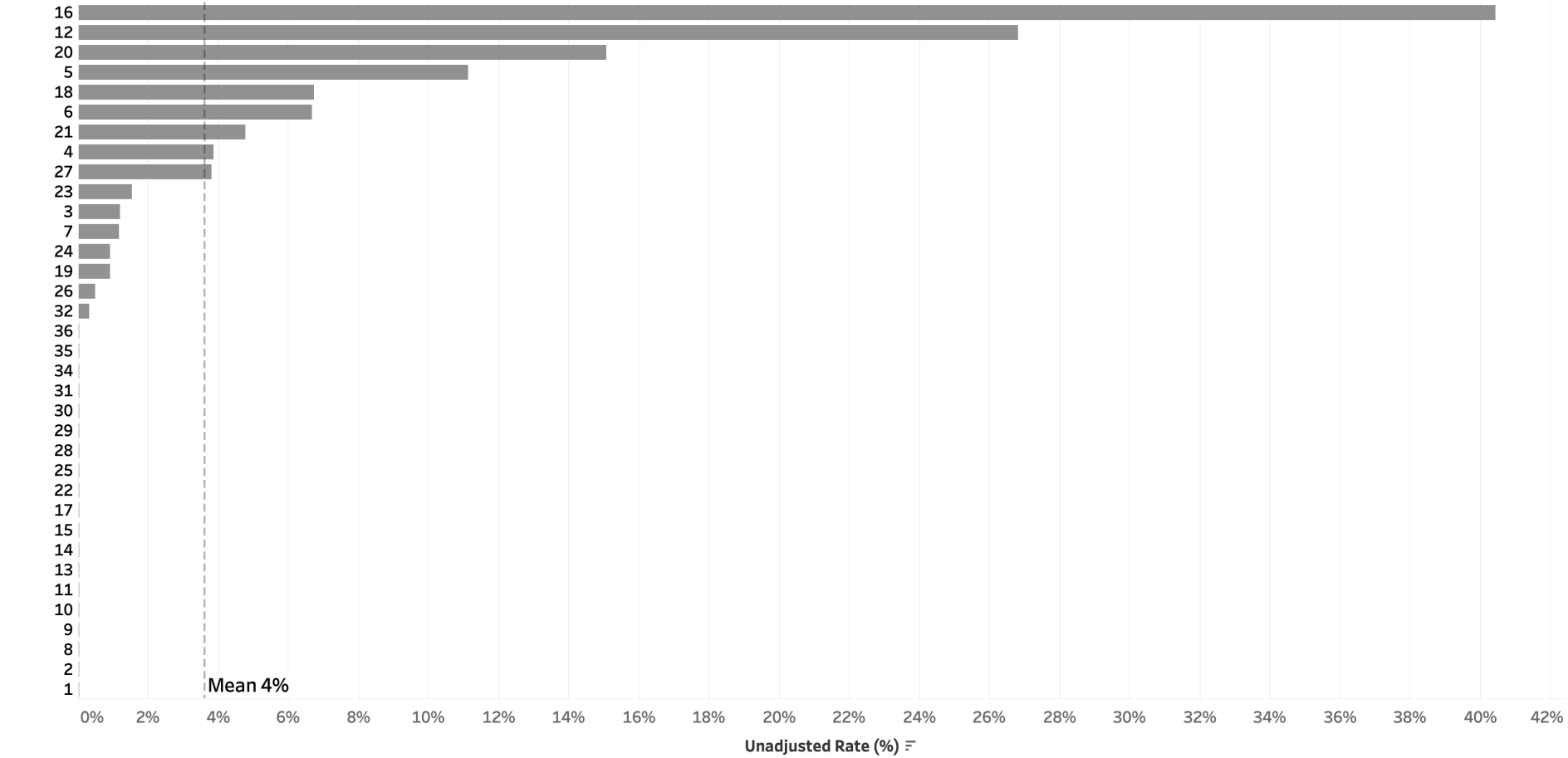
ASA VTE Prophylaxis <= 48 Hours

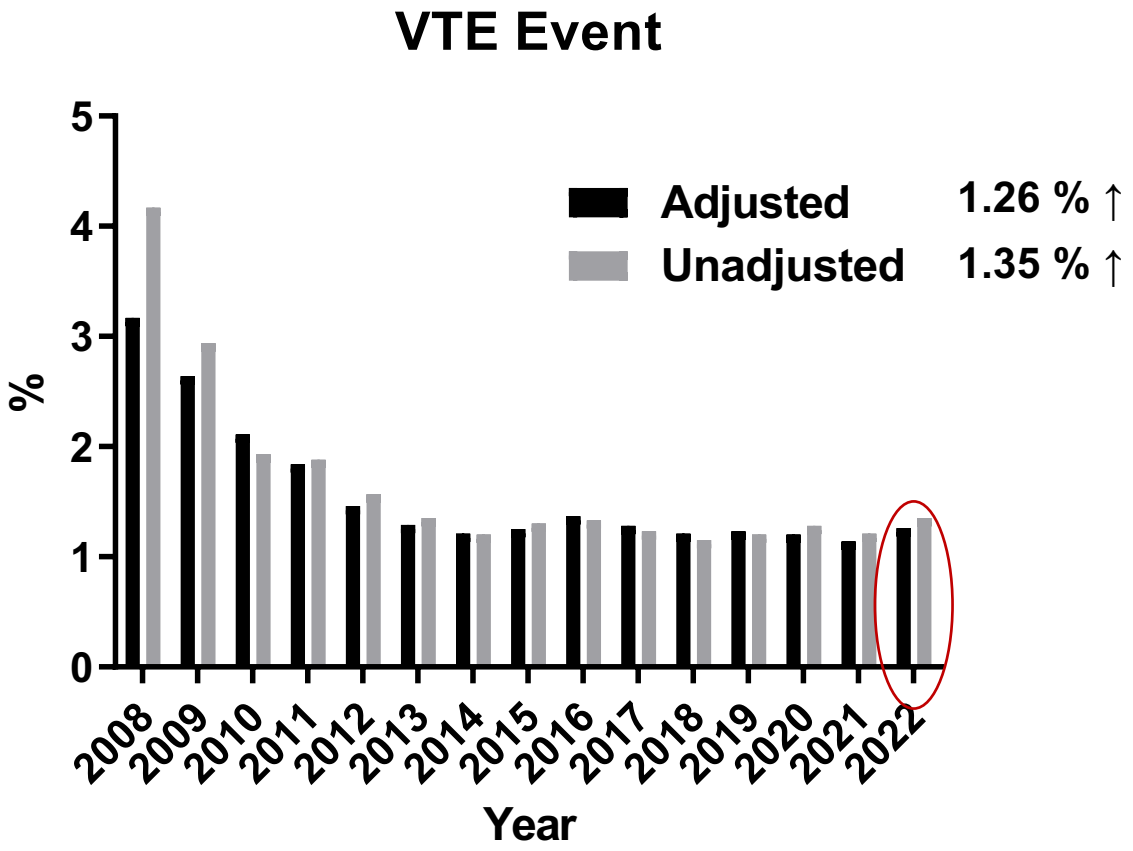
Cohort 2 (Admit to Trauma) | 1/1/22 - 5/31/23



ASA VTE Prophylaxis <= 48 Hours

Cohort 8 (Isolated Hip Fracture) | 1/1/22 - 5/31/23




VTE Event
5
4
3
2
1
0
%
Adjusted
1.26 % ↑
Unadjusted
1.35 % ↑
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year

#6 Timely Surgical Repair in Geriatric (Age ≥ 65) Isolated Hip Fracture

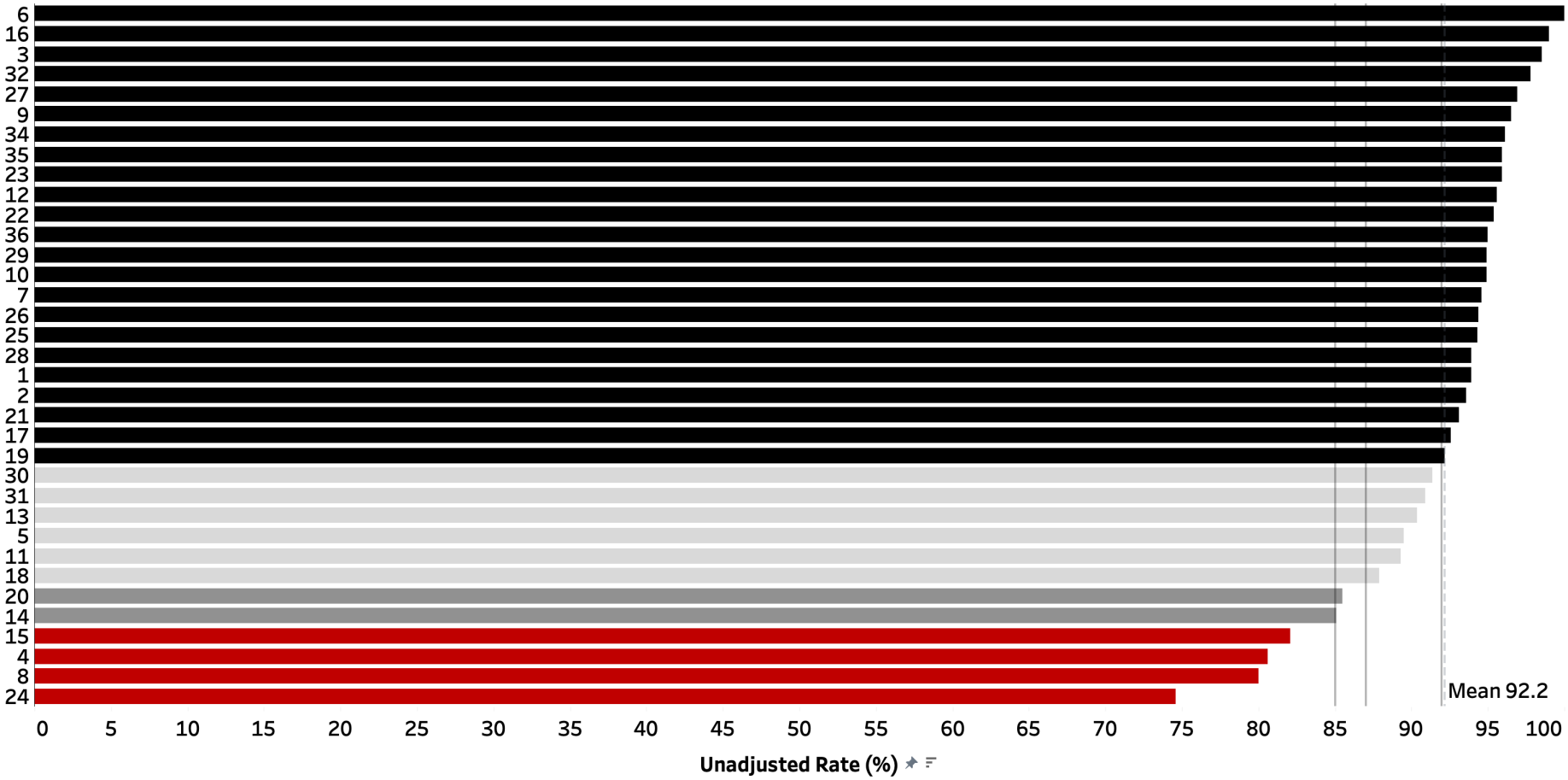
- Time to surgical repair of isolated hip fracture in patients age 65 or older (12 mo: 7/1/21-6/30/22)
  - ≥ 92% of patients (≤ 48 hr)
  - ≥ 87% of patients (≤ 48 hr)
  - ≥ 85% of patients (≤ 48 hr)
  - < 85% of patients (≤ 48 hr)

Metric 6 | Timely Surgical IHF Repair

Cohort 8 (Isolated Hip Fracture) | 7/1/22 - 5/31/23

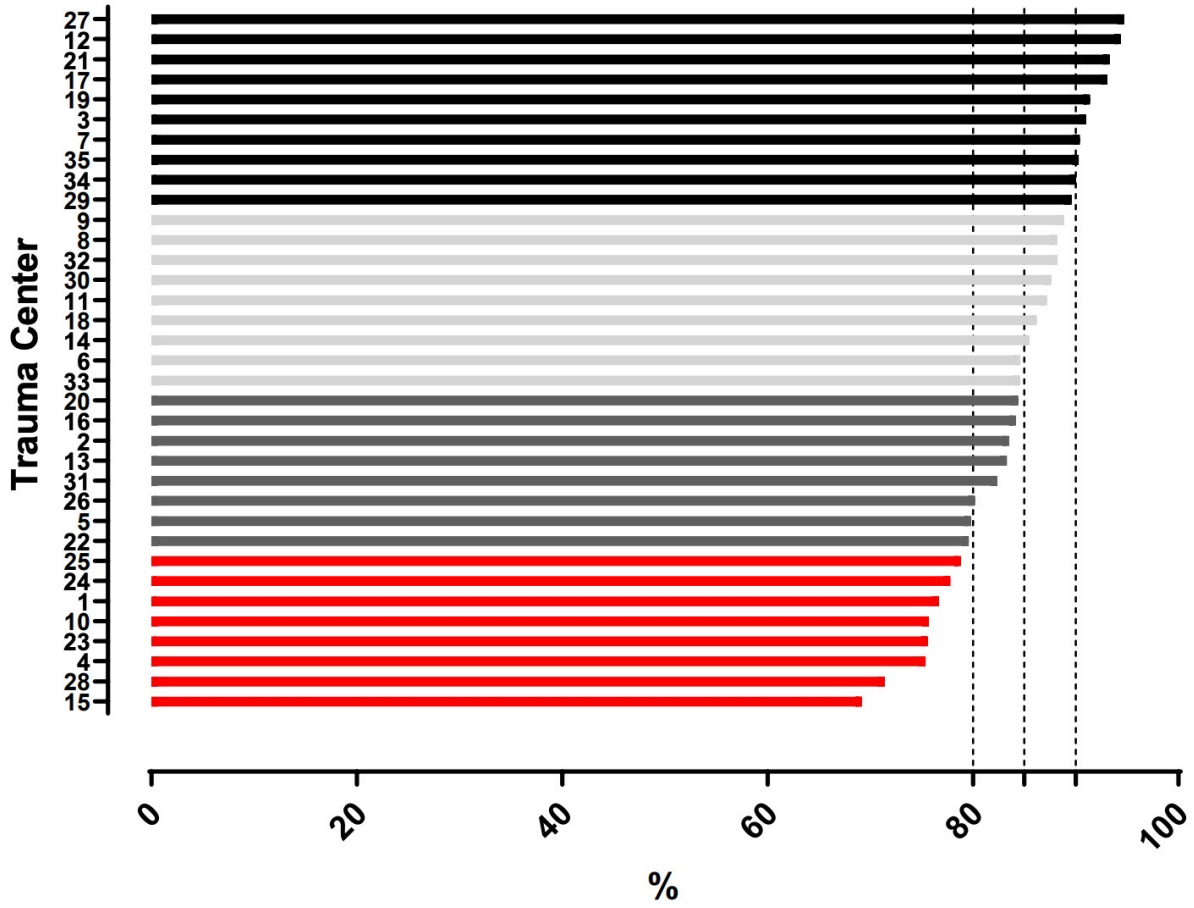
Graph ID 99

Non-op excluded



2-3 Years Ago

Metric #6 - Timely Surgical Hip Repair ≥ 65 years
Cohort 8 - Isolated Hip Fracture
7/1/19 - 1/31/20



Mean 85.3%

ASPIRE

- Multicenter Perioperative Outcomes Group
  - Parent
  - 60 Hospitals
- ASPIRE
  - In Michigan
  - BCBSM CQI

Data Cohorts

- MTQIP uses ICD10 procedure codes
- ASPIRE uses CPT procedure codes
- Date range from 1/2021 to 12/2021
- Cohorts
  - Isolated Hip Fracture (91% match rate, 2609/2856)
  - Femur Fracture (87% match rate, 2652/3044)
  - Hemorrhage control (69% match rate, 71/103)
  - Spleen (76% match rate, 25/33)

Isolated Hip Fractures

- Time to OR
  - *ED arrival to OR
  - <=24hrs
  - >24 to <=48 hrs
  - >48 hrs
- Surgery duration
- Anesthesia duration
- Anesthesia technique
  - General (ETT or LMA)
  - Epidural or Block

Isolated Hip Fractures

- Outcomes
  - Dead or Hospice = 3.9% (102 pts)
  - Serious complication = 5.3% (138 pts)

ASPIRE

4 quantiles of anesthesia _duration	serious 0	1	Total
1	634 96.79	21 3.21	655 100.00
2	624 94.69	35 5.31	659 100.00
3	612 94.88	33 5.12	645 100.00
4	601 92.46	49 7.54	650 100.00
Total	2,471 94.71	138 5.29	2,609 100.00

Pearson chi2(3) = 12.2770 Pr = 0.006

4 quantiles of n_surgery_ duration	serious 0	1	Total
1	639 95.95	27 4.05	666 100.00
2	613 95.04	32 4.96	645 100.00
3	603 94.37	36 5.63	639 100.00
4	583 93.43	41 6.57	624 100.00
Total	2,438 94.72	136 5.28	2,574 100.00

Pearson chi2(3) = 4.3675 Pr = 0.224

ASPIRE

time_to_room_cat_enc	dead_or_hospice 0	1	Total
1. <=24h	1,508 96.79	50 3.21	1,558 100.00
2. 24h to 48h	811 95.19	41 4.81	852 100.00
3. >48h	186 94.42	11 5.58	197 100.00
Total	2,505 96.09	102 3.91	2,607 100.00

Pearson chi2(2) = 5.3477 Pr = 0.069

time_to_room_cat_enc	serious 0	1	Total
1. <=24h	1,494 95.89	64 4.11	1,558 100.00
2. 24h to 48h	795 93.31	57 6.69	852 100.00
3. >48h	180 91.37	17 8.63	197 100.00
Total	2,469 94.71	138 5.29	2,607 100.00

Pearson chi2(2) = 12.0571 Pr = 0.002

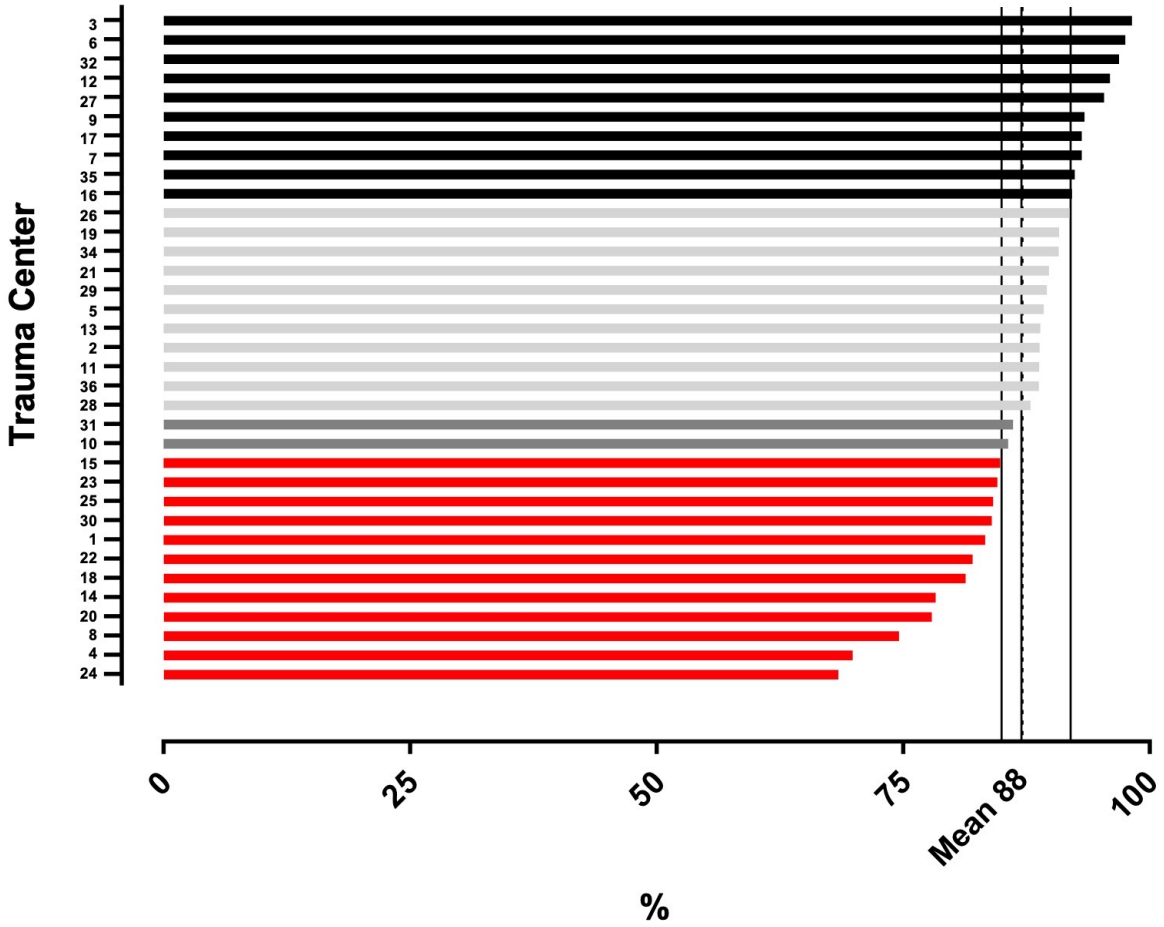
#6 Timely Surgical Repair in Geriatric (Age ≥ 65) Isolated Hip Fracture

- Time to surgical repair of isolated hip fracture in patients age 65 or older (12 mo: **7/1/23-6/30/24**)
  - ≥ 92% of patients (≤ 42 hr)
  - ≥ 87% of patients (≤ 42 hr)
  - ≥ 85% of patients (≤ 42 hr)
  - < 85% of patients (≤ 42 hr)

< 42 hours

42 hours

Metric 6 - Timely Surgical Hip Repair > 65 years
Cohort 8 - Isolated Hip Fracture
7/1/22 - 8/31/23



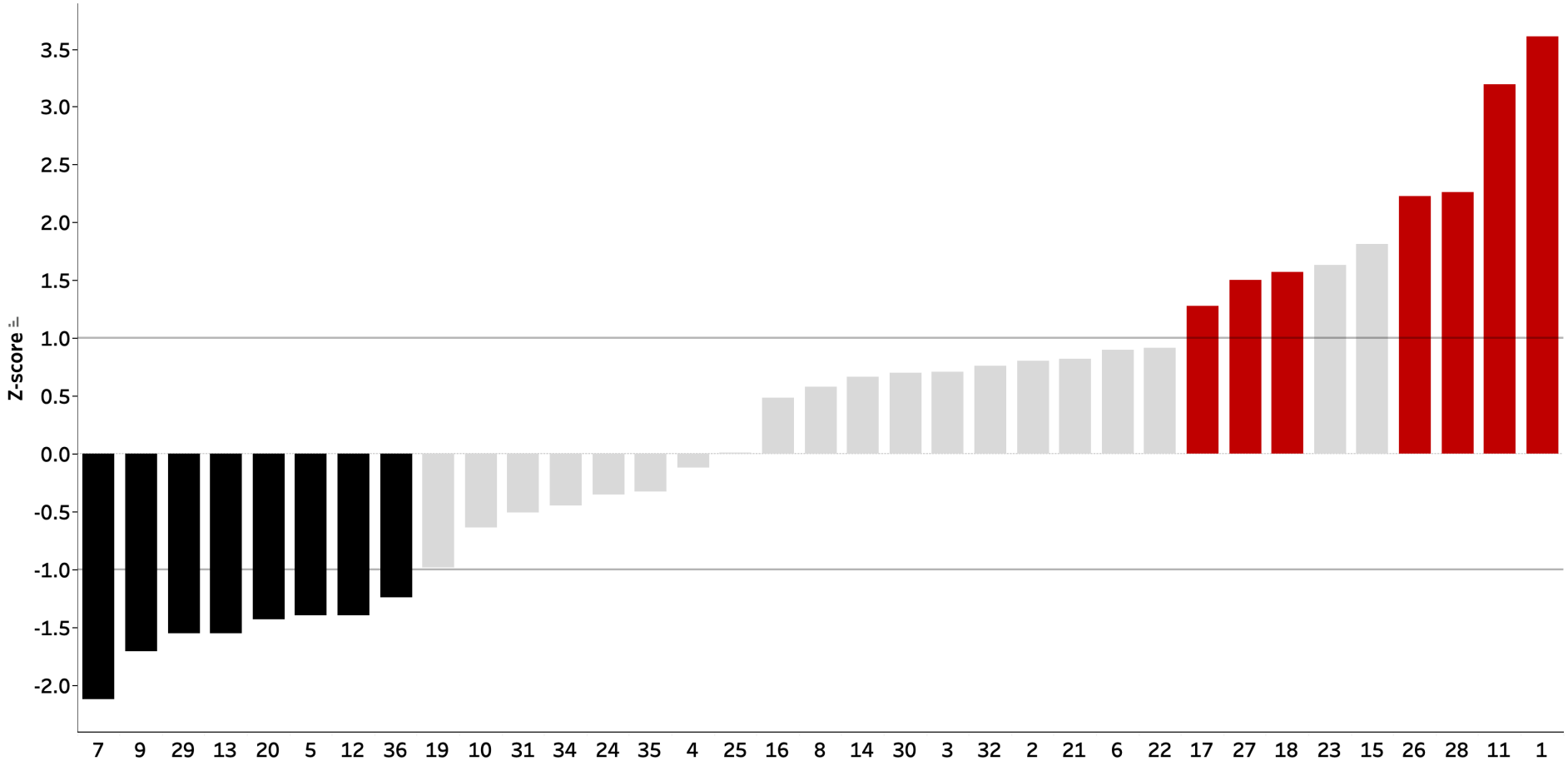
Z-score

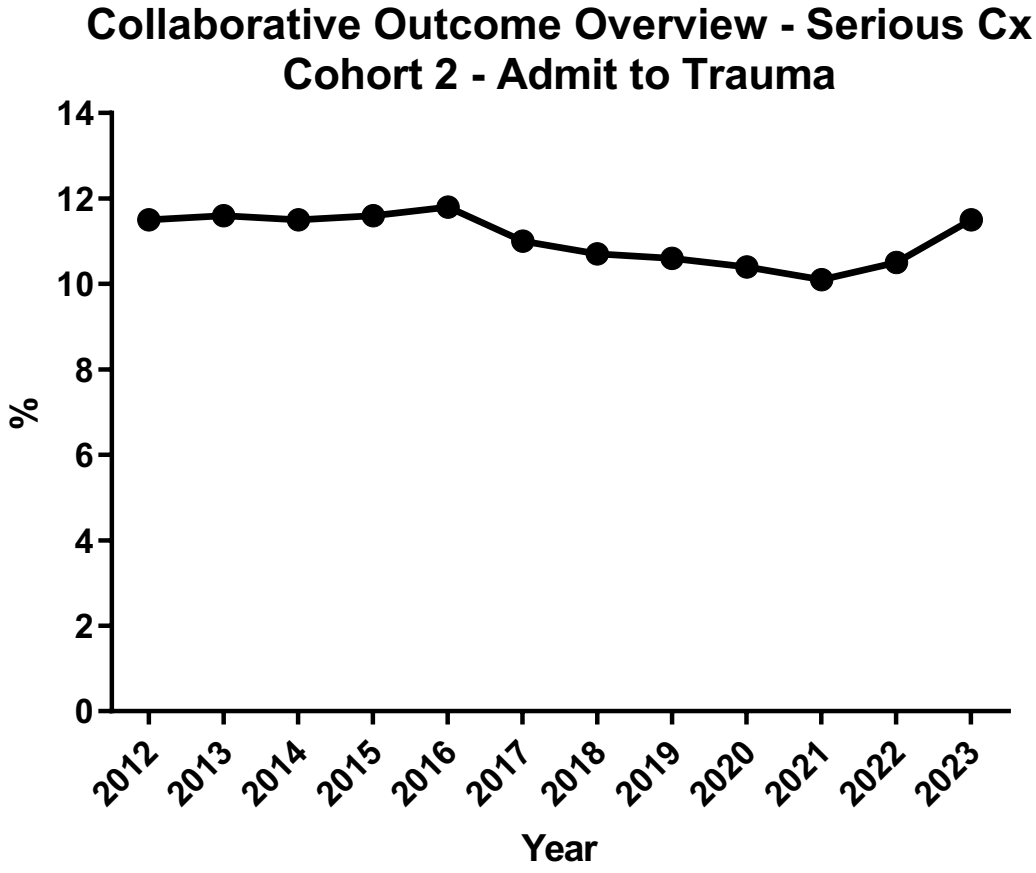
- Measure of trend in outcome over time
- Hospital specific
  - Compared to yourself
- Standard deviation
- > 1 getting worse
- 1 to -1 flat
- < -1 getting better

Metric 8 | Z-score Serious Complication Rate

Cohort 2 (Admit to Trauma) | 7/1/20 - 5/31/23

Graph ID: 72

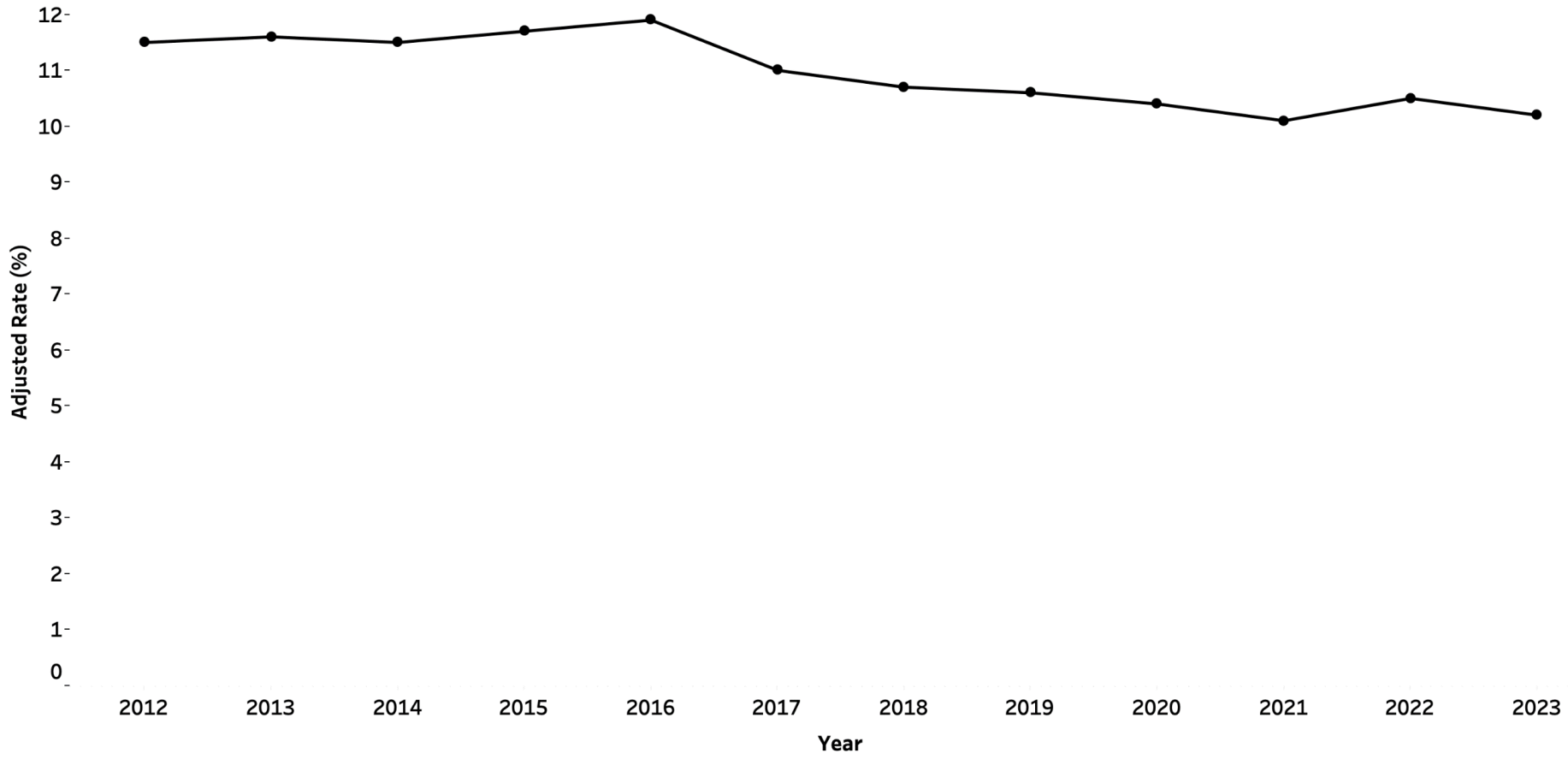



Collaborative Outcome Overview - Serious Cx
Cohort 2 - Admit to Trauma
14
12
10
8
6
4
2
0
%
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year

Collaborative Serious Complication Trend

Cohort 2 (Admit to Trauma)

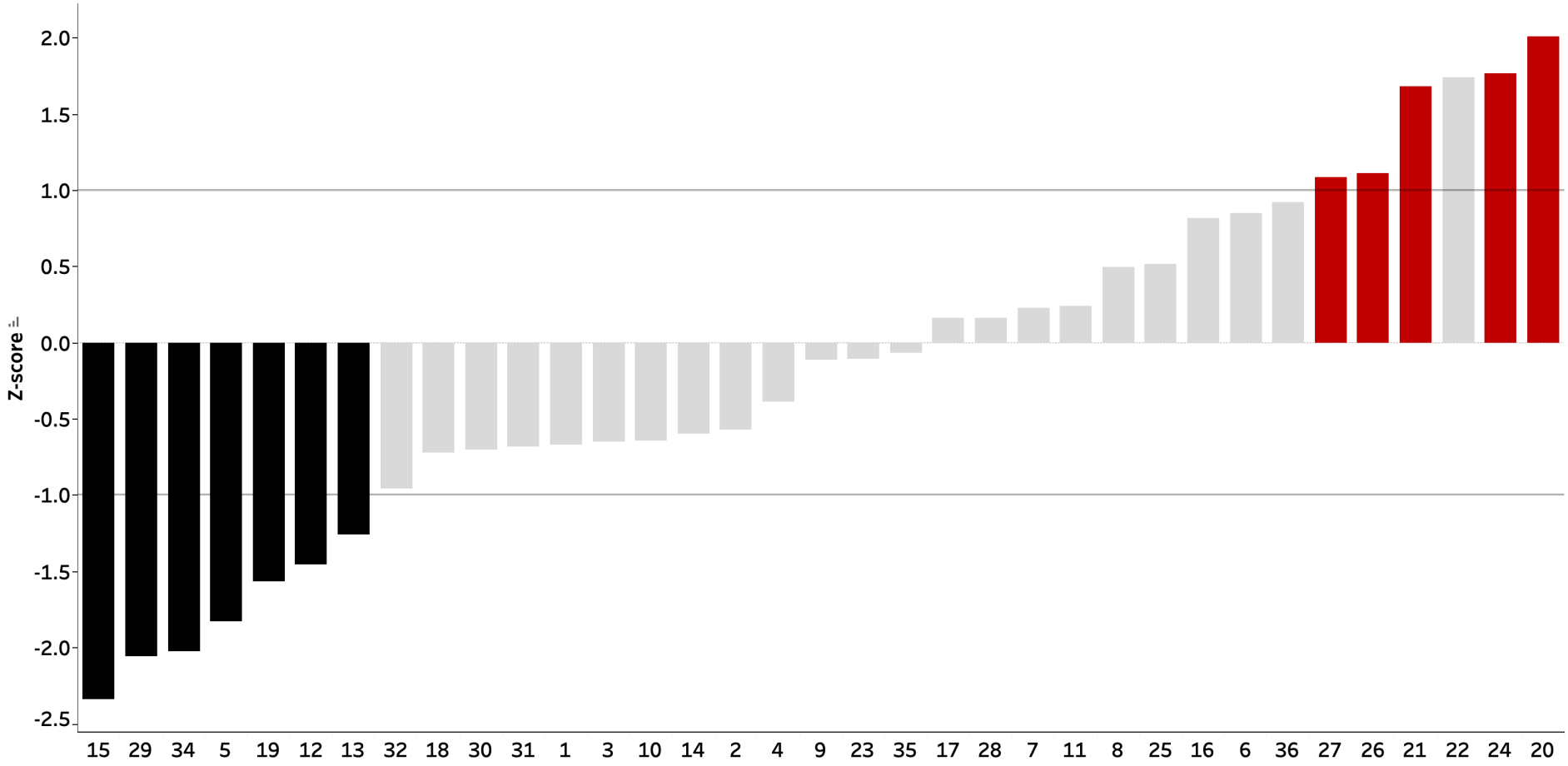
Graph ID 28



Metric 9 | Z-score Mortality Rate

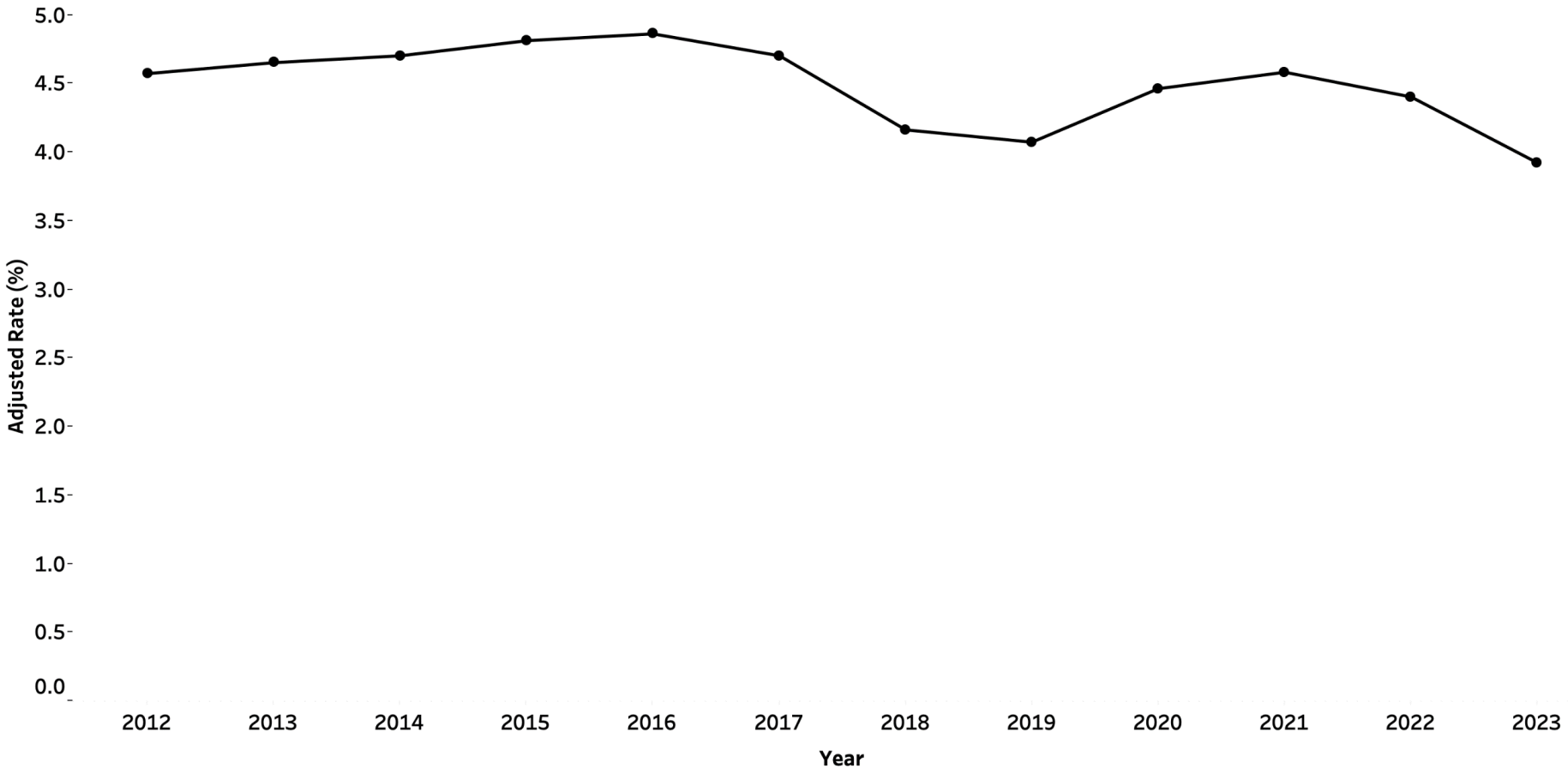
Cohort 2 (Admit to Trauma) | 7/1/20 - 5/31/23

Graph ID 73




Collaborative Outcome Overview - Mortality
Cohort 2 - Admit to Trauma
6
5
4
3
2
1
0
%
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year

Collaborative Mortality Trend
Cohort 2 (Admit to Trauma)
Graph ID 27



#11 Timely Antibiotic in Femur/Tibia Open Fractures - Collaborative Wide Measure

- Type of antibiotic administered along with date and time for open fracture of femur or tibia
- Presence of acute open femur or tibia fracture based on AIS or ICD10 codes (See list)
- Cohort = Cohort 1 (All)
- Exclude direct admissions and transfer in
- No Signs of Life = Exclude DOAs
- Transfers Out = Include Transfers Out
- Time Period = 7/1/22 to 6/30/23

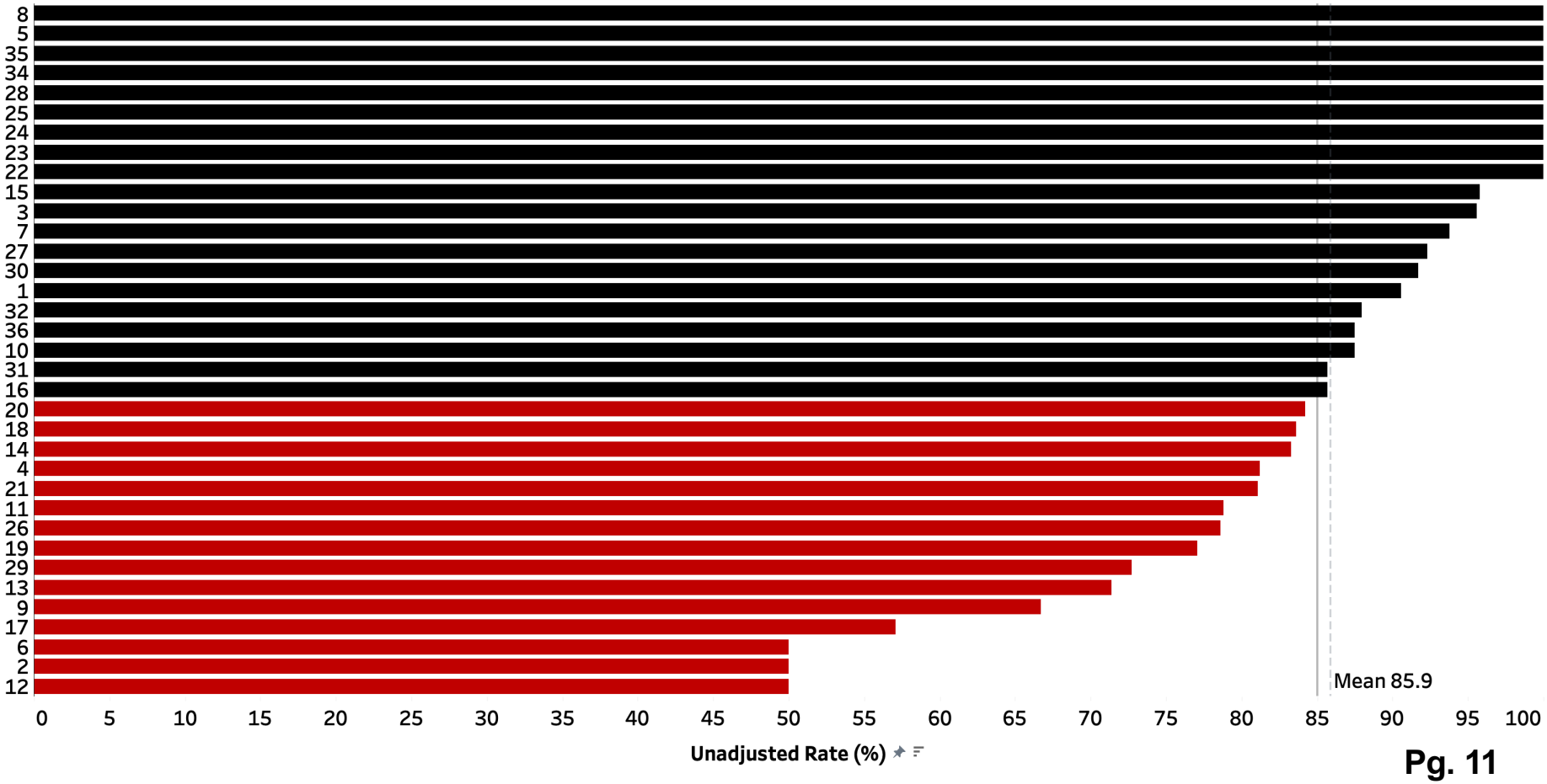
#11 Open Fracture Antibiotic Usage

- Measure = % of patients with antibiotic type, date, time recorded ≤ 90 minutes
  - ≥ 85% patients (≤ 90 min) > 10 points
  - All or nothing
- ACS-COT Orange Book – VRC resources
  - Administration within 60 minutes
    - ACS OTA Ortho Update
    - ACS TQIP Best Practices Orthopedics

Metric 11 | Open Fracture Antibiotic Administration <= 90 Min

Cohort 1 (MTQIP All) | 7/1/22 - 5/31/23

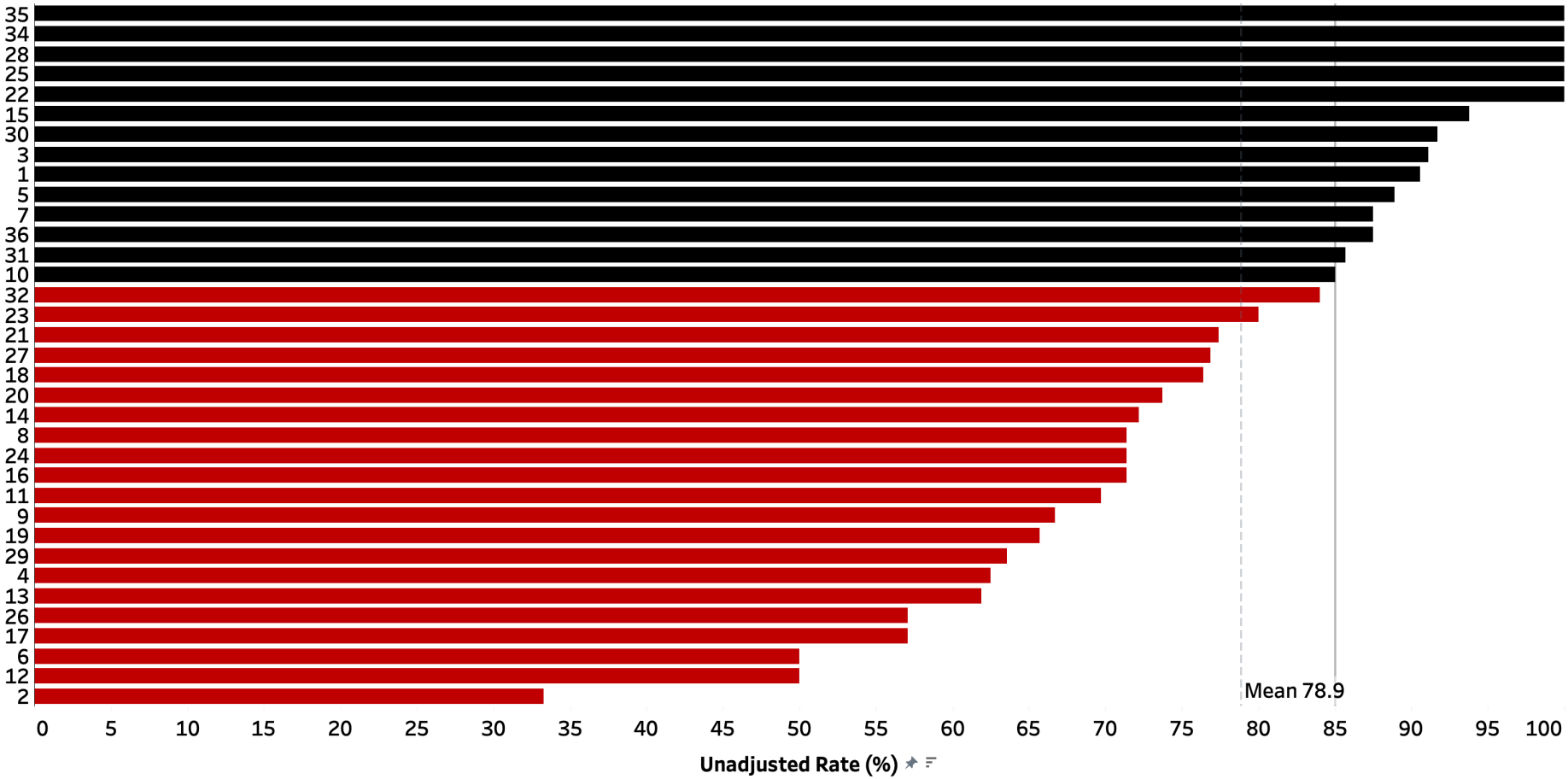
Graph ID 96



Open Fracture Antibiotic Administration <= 60 Min

Cohort 1 (MTQIP All) | 7/1/22 - 5/31/23

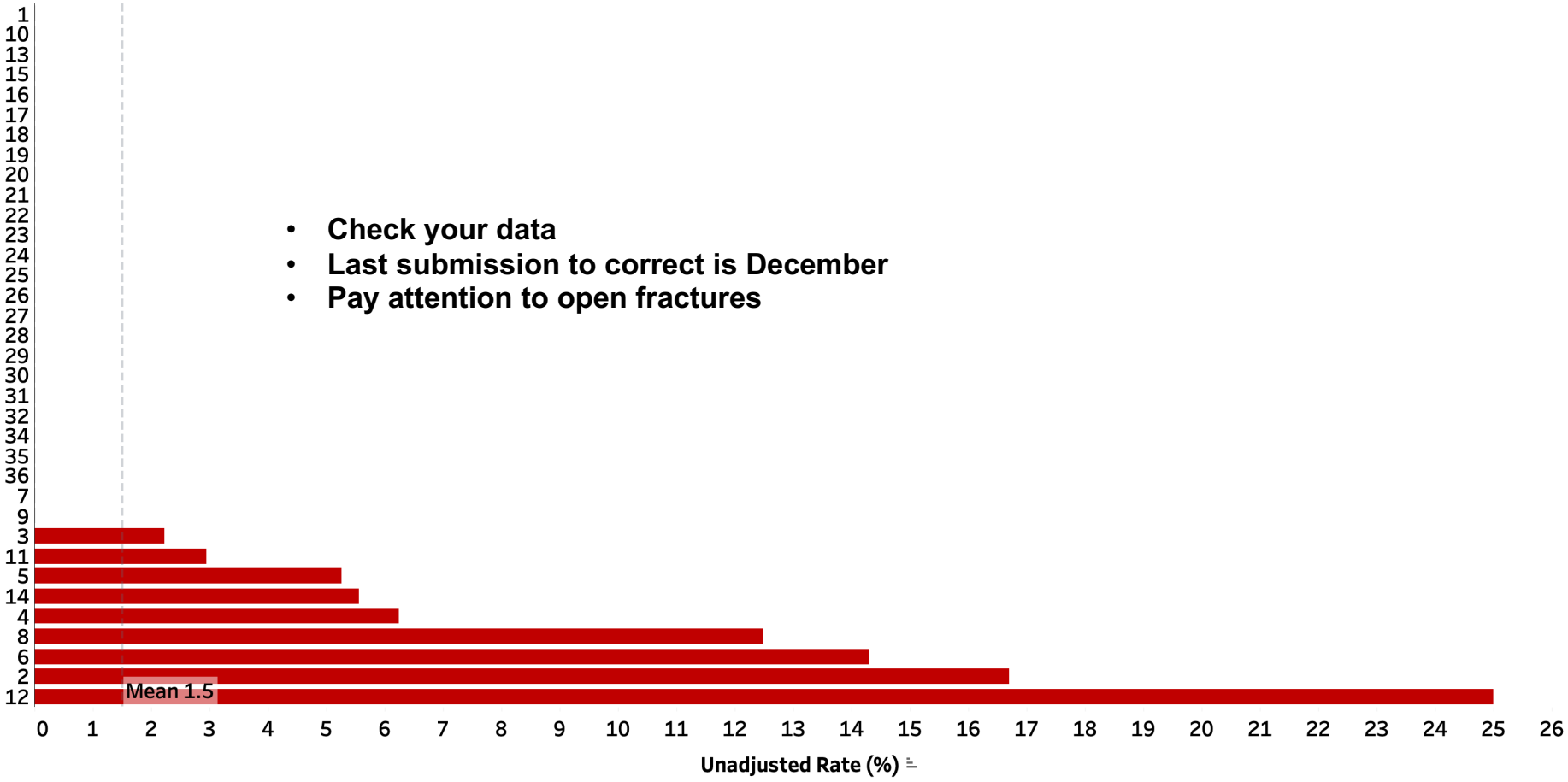
Graph ID 87



Open Fracture Missing/Negative Metric Data

Cohort 1 (MTQIP All) | 7/1/22 - 5/31/23

Graph ID 86



- **Check your data**
- **Last submission to correct is December**
- **Pay attention to open fractures**

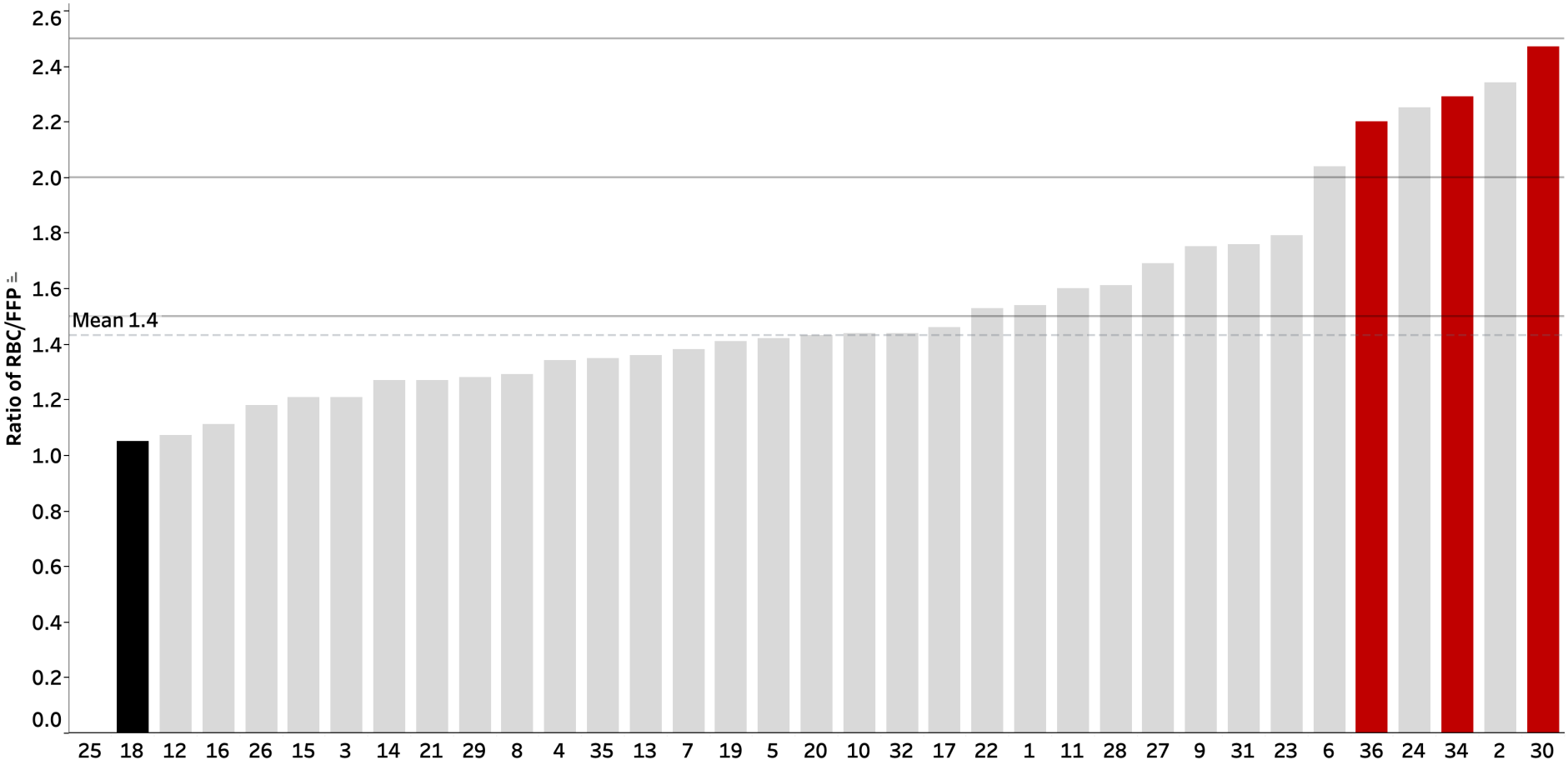
#7 Red Blood Cell to Plasma Ratio

- Red blood cell to plasma ratio (weighted mean points) of patients transfused ≥5 units in first 4 hours (18 Mo's: 1/1/22-6/30/23)

Metric 7 | RBC/FFP Mean Ratio in Massive Transfusion

Cohort 1 (MTQIP All) | 1/1/22 - 5/31/23

Graph ID 38



JAMA Surgery | Original Investigation

Association of Whole Blood With Survival Among Patients Presenting With Severe Hemorrhage in US and Canadian Adult Civilian Trauma Centers

Crisanto M. Torres, MD, MPH; Alistair Kent, MD, MPH; Dane Scantling, DO, MPH; Bellal Joseph, MD; Elliott R. Haut, MD, PhD; Joseph V. Sakran, MD, MPH, MPA

Invited Commentary
page 540

Multimedia

Supplemental content

IMPORTANCE Whole-blood (WB) resuscitation has gained renewed interest among civilian trauma centers. However, there remains insufficient evidence that WB as an adjunct to component therapy–based massive transfusion protocol (WB-MTP) is associated with a survival advantage over MTP alone in adult civilian trauma patients presenting with severe hemorrhage.

OBJECTIVE To assess whether WB-MTP compared with MTP alone is associated with improved survival at 24 hours and 30 days among adult trauma patients presenting with severe hemorrhage.

DESIGN, SETTING, AND PARTICIPANTS This retrospective cohort study using the American College of Surgeons Trauma Quality Improvement Program databank from January 1, 2017, and December 31, 2018, included adult trauma patients with a systolic blood pressure less than 90 mm Hg and a shock index greater than 1 who received at least 4 units of red blood cells within the first hour of emergency department (ED) arrival at level I and level II US and Canadian adult civilian trauma centers. Patients with burns, death within 1 hour of ED arrival, and interfacility transfers were excluded. Data were analyzed from February 2022 to September 2022.

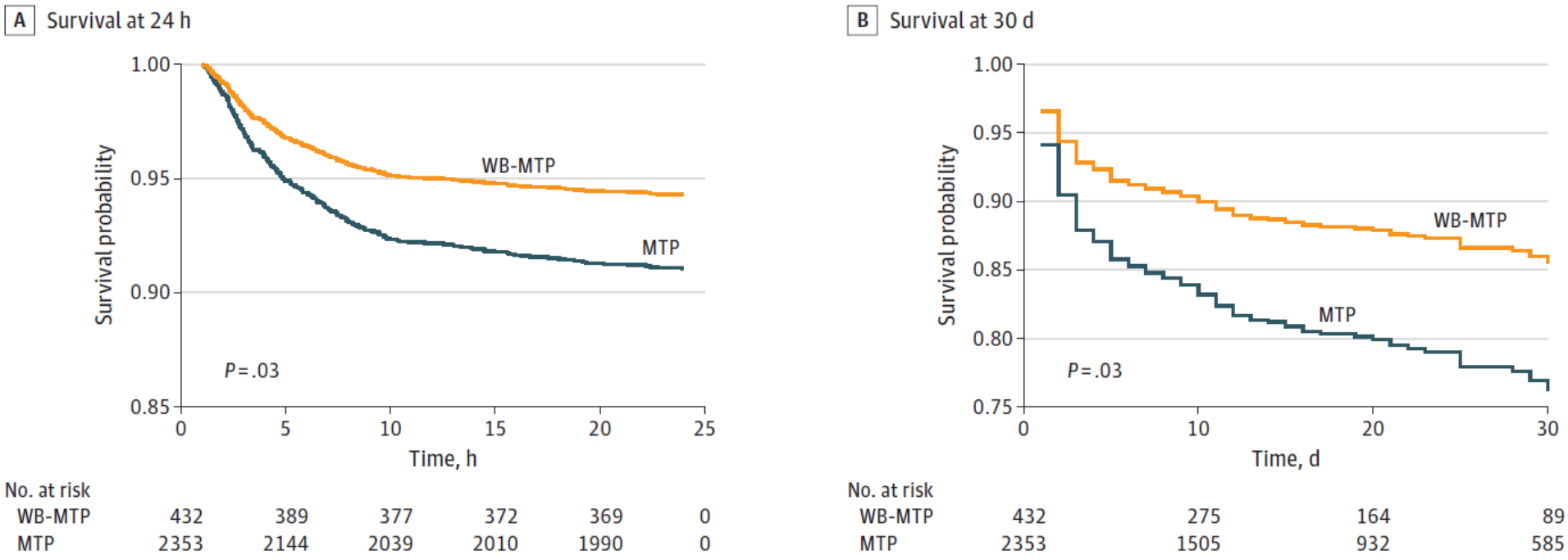
EXPOSURES Resuscitation with WB-MTP compared with MTP alone within 24 hours of ED presentation.

MAIN OUTCOMES AND MEASURES Primary outcomes were survival at 24 hours and 30 days. Secondary outcomes selected a priori included major complications, hospital length of stay, and intensive care unit length of stay.

RESULTS A total of 2785 patients met inclusion criteria: 432 (15.5%) in the WB-MTP group (335 male [78%]; median age, 38 years [IQR, 27-57 years]) and 2353 (84.5%) in the MTP-only group (1822 male [77%]; median age, 38 years [IQR, 27-56 years]). Both groups included severely injured patients (median injury severity score, 28 [IQR, 17-34]; median difference, 1.29 [95% CI, −0.05 to 2.64]). A survival curve demonstrated separation within 5 hours of ED presentation. WB-MTP was associated with improved survival at 24 hours, demonstrating a 37% lower risk of mortality (hazard ratio, 0.63; 95% CI, 0.41-0.96; $P = .03$). Similarly, the survival benefit associated with WB-MTP remained consistent at 30 days (HR, 0.53; 95% CI, 0.31-0.93; $P = .02$).

CONCLUSIONS AND RELEVANCE In this cohort study, receipt of WB-MTP was associated with improved survival in trauma patients presenting with severe hemorrhage, with a survival benefit found early after transfusion. The findings from this study are clinically important as this is an essential first step in prioritizing the selection of WB-MTP for trauma patients presenting with severe hemorrhage.

Figure 2. Adjusted Kaplan-Meier Survival Estimates by Transfusion Group

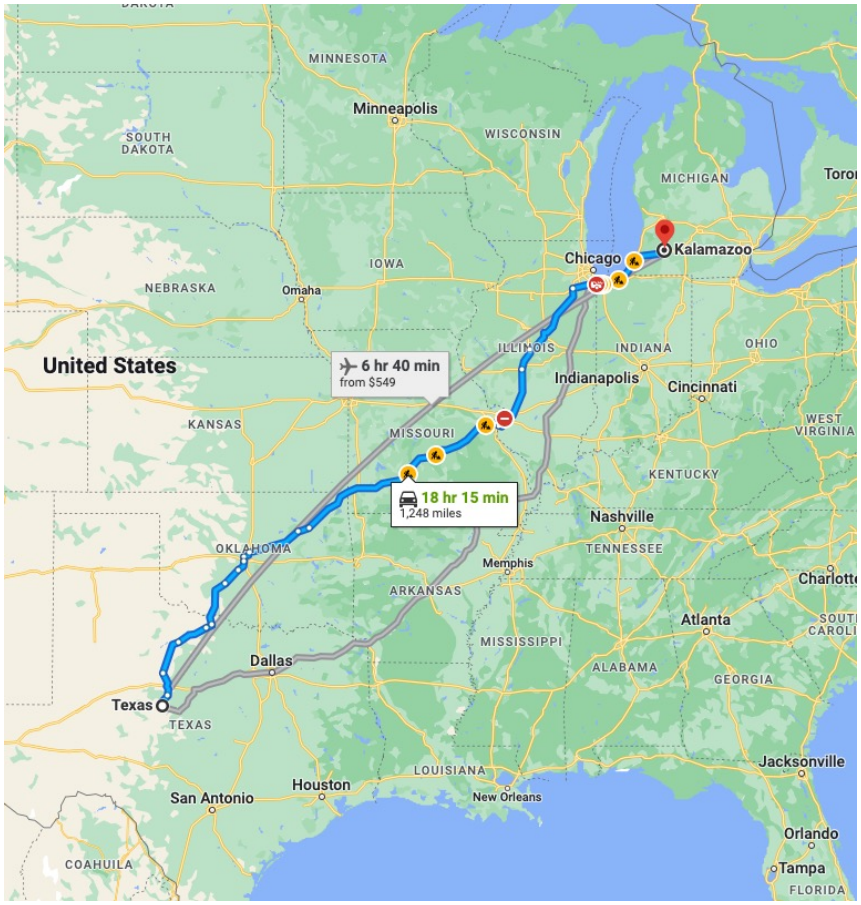


MTP indicates massive transfusion protocol and WB-MTP, whole blood as an adjunct to component therapy–based MTP.

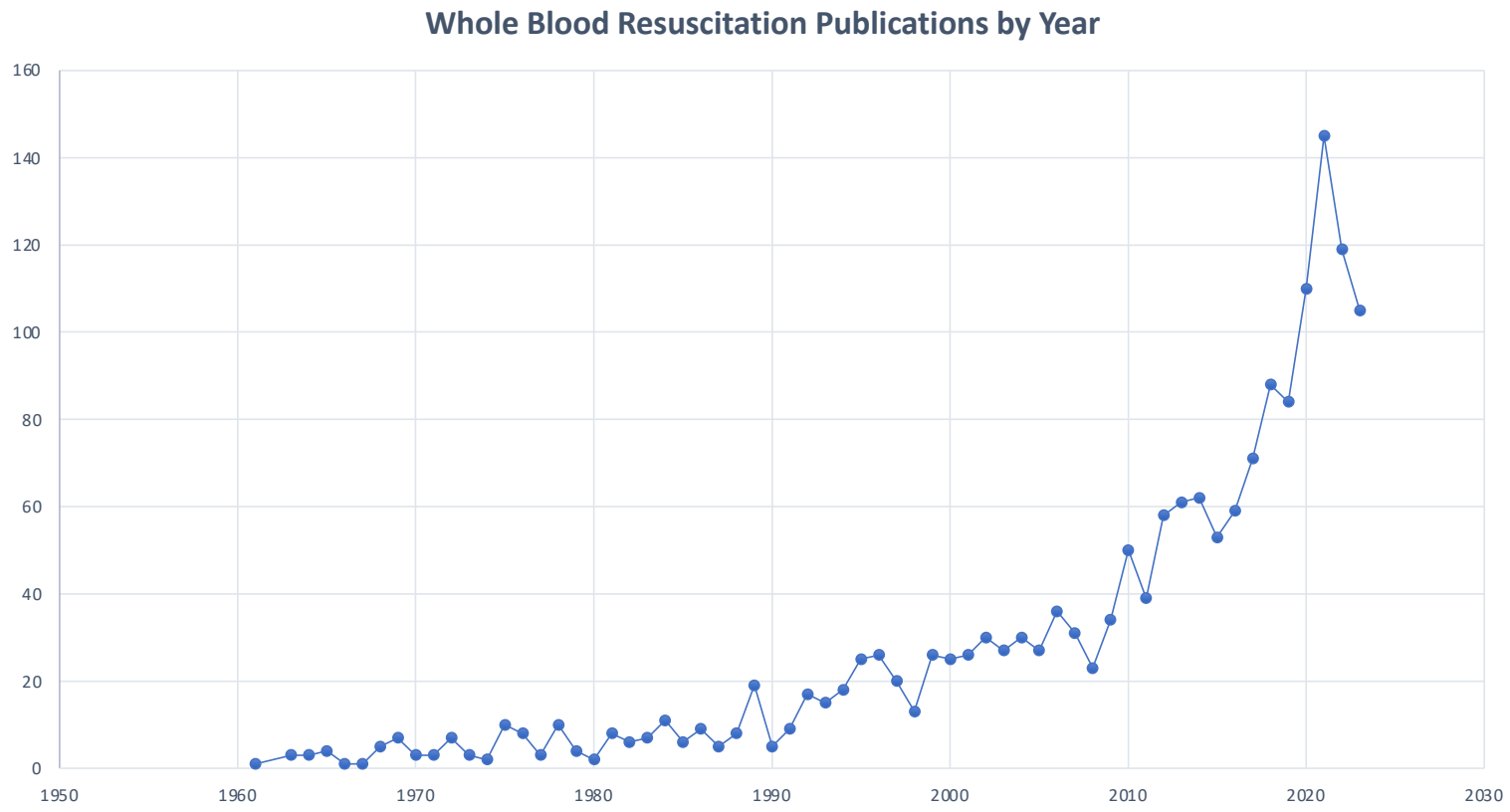
Whole Blood Resuscitation in Trauma

John Donkersloot MD
Hurley Medical Center
MTQIP Fall Meeting
10/10/2023

Michigan ACS Meeting, May 2022



Whole Blood Resuscitation - Publications



The Use of Fresh Whole Blood Transfusions by the SOF Medic for Hemostatic Resuscitation in the Austere Environment

SGM F Bowling, 18Z; COL Andre Pennardt, MD

The recommendations in this manuscript are only guidelines and are not a substitute for good clinical judgment.

The views and opinions expressed in this manuscript are those of the authors and do not reflect the official policy or position of the Army Medical Department, Department of the Army, the Department of Defense, or the U.S. government.

The leading cause of death on the battlefield is uncontrolled hemorrhage.[1,2] Non-compressible (truncal) hemorrhage is the cause over two thirds of these deaths.[3] This makes truncal hemorrhage the leading cause of potentially survivable death on the battlefield.[4] Over one third of the casualties who arrive at the Emergency Department (ED) or Combat Surgical Hospital (CSH) in need of a blood transfusion are already suffering from acute traumatic coagulopathy which is associated with an 80% mortality.[5-11] Early aggressive treatment and prevention of this coagulopathy through hemostatic resuscitation has been shown to increase survival.[5,6,8,12] Hemostatic resuscitation involves the very early use of blood and blood products as primary resuscitation fluids to both treat intrinsic acute traumatic coagulopathy and prevent the development of dilutional coagulopathy. Few, if any, of the products used in hemostatic resuscitation are currently available to the Special Operations Forces (SOF) medic. Warm Fresh Whole Blood (WFWB) transfusions could be a powerful tool for the SOF medic to use in order to begin hemostatic resuscitation in the field.

Part of the current standard of care for hemostatic resuscitation is the use of component therapy (CT).[13] CT involves targeted use of the various parts of blood, including red blood cells (RBCs), plasma, and platelets, that have been separated from a donated unit. A donated unit of blood is considered "whole blood" before it is separated into its components. The components are combined with anticoagulants and stored frozen or refrigerated prior to use in order to prolong their storage life. CT products need to be thawed and warmed in order to avoid causing or worsening hypothermia, which in turn inhibits clotting and has been shown to increase mortality.[14-26] The storage and administration considerations associated with the use of CT make it too logistically burdensome for the SOF medic and therefore not practical for the SOF operational environment.

Massive transfusion (MT) is generally defined as 10 or more units of blood in the first 24 hours after admission.[27] The most critically injured patients are the most likely to need a MT of blood.[28] The use of CT in MT has been shown to cause a myriad of complications that worsen the lethal triad of [29-36]

NARRATIVE REVIEW ARTICLE

CME

Whole Blood for Resuscitation in Adult Civilian Trauma in 2017: A Narrative Review

Evan G. Pivalizza, MD,* Christopher T. Stephens, MD,* Srikanth Sridhar, MD,* Sam D. Gumbert, MD,* Susan Rossmann, MD,† Marsha F. Bertholf, MD,† Yu Bai, MD,‡ and Bryan A. Cotton, MD§

After a hiatus of several decades, the concept of cold whole blood (WB) is being reintroduced into acute clinical trauma care in the United States. Initial implementation experience and data grew from military medical applications, followed by more recent development and data acquisition in civilian institutions. Anesthesiologists, especially those who work in acute trauma facilities, are likely to be presented with patients either receiving WB from the emergency department or may have WB as a therapeutic option in massive transfusion situations. In this focused review, we briefly discuss the historical concept of WB and describe the characteristics of WB, including storage, blood group compatibility, and theoretical hemolytic risks. We summarize relevant recent retrospective military and preliminary civilian efficacy as well as safety data related to WB transfusion, and describe our experience with the initial implementation of WB transfusion at our level 1 trauma hospital. Suggestions and collective published experience from other centers as well as ours may be useful to those investigating such a program. The role of WB as a significant therapeutic option in civilian trauma awaits further prospective validation. (Anesth Analg 2018;127:157–62)

In 2012, an expert review of fresh whole blood (WB) transfusion for hemorrhagic shock in *Anesthesia & Analgesia* discussed primary applications at that time that were in critically injured patients in the military arena and the pediatric surgical population.[1] Spinella et al[1] recommended future research on appropriate risk–benefit profiles and suggested strategies to reduce theoretical risks. In the interim period, despite limited attention in the anesthesiology literature,[2–4] there have been continued developments in WB storage and processing at the blood collection agency level. This has coincided with a steady increase in published reports of the clinical application, potential benefit or equivalency of WB used in combination with component therapy in both civilian and military populations.[5–8] Given the significant military experience of fresh WB transfusion in forward-deployed areas and initial supportive data in the civilian trauma population in the United States, our institution has recently implemented a limited WB transfusion protocol.

Herein, a multidisciplinary collection of anesthesiologists, a trauma surgeon, and pathologists with experience in WB use review WB for emergency resuscitation in civilian adult patients. This will be useful for acute care anesthesiologists who may not yet have experience with or availability of WB at their institutions. We briefly explore the concept and historical perspective of WB, the WB product itself, and potential risks and benefits; review the currently available clinical data in military and civilian cohorts; and provide advice on practical development and implementation of a local or regional WB program.

CONCEPT AND HISTORICAL PERSPECTIVE

The use of WB began with the origin of blood banking during World War I but not in earnest until World War II.[9] WB became the preferred product for the treatment of bleeding patients, and remained the primary resuscitation fluid in military settings through the start of the Vietnam War and in the civilian arena.[10] However, after dramatic advances in blood component separation, blood centers were able to supply hospitals with individual components, and WB decreased as a readily available product. While some studies suggested noninferiority in elective surgical cases, no studies of efficacy or hemostatic potential for patients in hemorrhagic shock were performed before these changes.[11] The response of the medical community was to implement resuscitation of bleeding patients with red blood cells (RBCs) and crystalloids solutions,[12] partly driven by a misinterpretation of landmark studies that noted that plasma and platelets were unnecessary in bleeding trauma patients, and that crystalloids were safe.[13,14] Carrico et al[13] noted that

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BACK TO THE FUTURE: WHOLE BLOOD RESUSCITATION OF THE SEVERELY INJURED TRAUMA PATIENT

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ABSTRACT—Following advances in blood typing and storage, whole blood transfusion became available for the treatment of casualties during World War I. While substantially utilized during World War II and the Korean War, whole blood transfusion declined during the Vietnam War as civilian centers transitioned to blood component therapies. Little evidence supported this shift, and recent conflicts in Iraq and Afghanistan have renewed interest in military and civilian applications of whole blood transfusion. Within the past two decades, civilian trauma centers have begun to study transfusion protocols based upon cold-stored, low anti-A/B titer type O whole blood for the treatment of severely injured civilian trauma patients. Early data suggests equivalent or improved resuscitation and hemostatic markers with whole blood transfusion when compared to balanced blood component therapy. Additional studies are taking place to define the optimal way to utilize low-titer type O whole blood in both prehospital and trauma center resuscitation of bleeding patients.

KEYWORDS—Hemorrhagic shock, transfusion, trauma, whole blood

INTRODUCTION

Current trauma resuscitation protocols, as outlined by Advance Trauma Life Support guidelines, recommend initial resuscitation of the bleeding trauma patient with a crystalloid bolus followed by balanced blood component transfusion (1). One hundred years ago, injured Allied casualties during World War I had limited resuscitation options including experimental colloid solutions comprised of gutta percha or gum acacia and access to a newly introduced therapy: citrated whole blood (2). These current and historical strategies share a common goal, the resuscitation of the bleeding trauma patient with fluids that closely mimic the patient's lost blood. Although whole blood transfusion was phased out in favor of component transfusion, recent military experience has refocused clinical inquiry into the efficacy of whole blood. Here, we review the history of military and civilian whole blood transfusion and current research into its utility to resuscitate severely injured civilian trauma patients.

THE HISTORY OF WHOLE BLOOD TRANSFUSION

Following the development of blood storage solutions such as citrate and ABO typing in the early twentieth century, whole blood transfusion became a part of combat casualty care in select Allied hospitals during World War I (Fig. 1) (3). At the start of World War II, the British Royal Army Medical Corp utilized stored whole blood for casualty resuscitation; the American military instead chose to focus upon freeze dried plasma and albumin (4). By 1942, however, clinical observations of improved outcomes with whole blood transfusion lead to the adoption of whole blood programs within the US military,

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The authors report no conflicts of interest.

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Taylor & Francis
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The rebirth of the cool: a narrative review of the clinical outcomes of cold stored low titer group O whole blood recipients compared to conventional component recipients in trauma

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ABSTRACT

There has been renewed interest in the use of low titer group O whole blood (LTOWB) for the resuscitation of civilian casualties. LTOWB offers several advantages over conventional components such as providing balanced resuscitation in one bag that contains less additive/preservative solution than an equivalent volume of conventional components, is easier and faster to transfuse than multiple components, avoids blood product ratio confusion, contains cold stored platelets, and reduces donor exposures. The resurgence in its use in the resuscitation of civilian trauma patients has led to the publication of an increasing number of studies on its use, primarily amongst adult recipients but also in pediatric patients. These studies have indicated that hemolysis does not occur amongst adult and pediatric non-group O recipients of a modest quantity of LTOWB. The published studies to date on mortality have shown conflicting results with some demonstrating a reduction following LTOWB transfusion while most others have not shown a reduction; there have not been any studies to date that have found significantly increased overall mortality amongst LTOWB recipients. Similarly, when other clinical outcomes, such as venous thromboembolism, sepsis, hospital or intensive care unit lengths of stay are evaluated, LTOWB recipients have not demonstrated worse outcomes compared to conventional component recipients. While definitive proof of the trends in these morbidity and mortality outcomes awaits confirmation in randomized controlled trials, the evidence to date indicates the safety of transfusing LTOWB to injured civilians.

KEYWORDS

Low titer group O whole blood; trauma; transfusion; safety; hemolysis; outcomes; mortality; adverse

Introduction

Although conventional blood components are manufactured from whole blood (WB), the whole is both greater and lesser than the sum of its parts. WB is 'greater' than components in that it has many advantages over using an equivalent quantity of conventional components. Perhaps most importantly, the use of WB will greatly simplify the logistics of the resuscitation by providing leukoreduced at all. Cold stored PLTs have demonstrated superior *in vitro* hemostatic properties compared to room temperature PLTs [3–5], suggesting that they might be primed to promote coagulation once transfused. In addition, the use of WB effectively permits the storage of PLTs for the entire shelf life of the WB unit. This is very convenient as remote emergency facilities, such as at ski or diving resorts, that

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Whole Blood Resuscitation and Association with Survival in Injured Patients with an Elevated Probability of Mortality

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BACKGROUND: Low-titer group O whole blood (LTOWB) resuscitation is becoming common in both military and civilian settings and may represent the ideal resuscitation intervention. We sought to characterize the safety and efficacy of LTOWB resuscitation relative to blood component resuscitation.

STUDY DESIGN: A prospective, multicenter, observational cohort study was performed using 7 trauma centers. Injured patients at risk of massive transfusion who required both blood transfusion and hemorrhage control procedures were enrolled. The primary outcome was 4-hour mortality. Secondary outcomes included 24-hour and 28-day mortality, achievement of hemostasis, death from exsanguination, and the incidence of unexpected survivors.

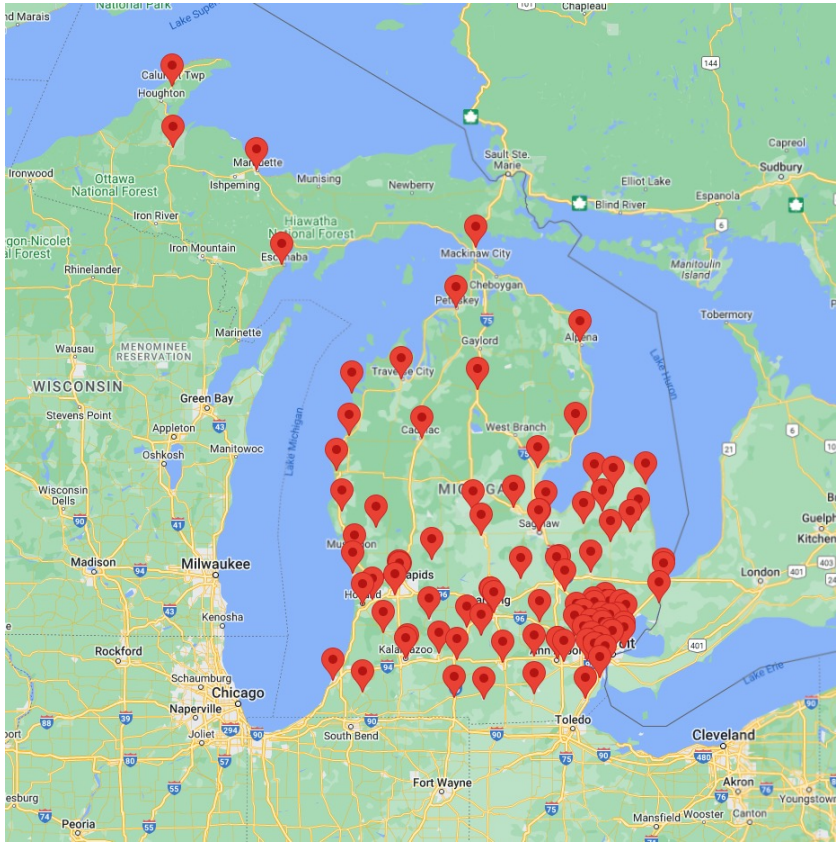
RESULTS: A total of 1,051 patients in hemorrhagic shock met all enrollment criteria. The cohort was severely injured with >70% of patients requiring massive transfusion. After propensity adjustment, no significant 4-hour mortality difference across LTOWB and component patients was found (relative risk [RR] 0.90, 95% CI 0.59 to 1.39, p = 0.64). Similarly, no adjusted mortality differences were demonstrated at 24 hours or 28 days for the enrolled cohort. When patients with an elevated prehospital probability of mortality were analyzed, LTOWB resuscitation was independently associated with a 48% lower risk of 4-hour mortality (relative risk [RR] 0.52, 95% CI 0.32 to 0.87, p = 0.01) and a 30% lower risk of 28-day mortality (RR 0.70, 95% CI 0.51 to 0.96, p = 0.03).

CONCLUSIONS: Early LTOWB resuscitation is safe but not independently associated with survival for the overall enrolled population. When patients were selected with an elevated probability of mortality based on prehospital injury characteristics, LTOWB was independently associated with a lower risk of mortality starting at 4 hours after arrival through 28 days after injury. (J Am Coll Surg 2023;237:206–219.

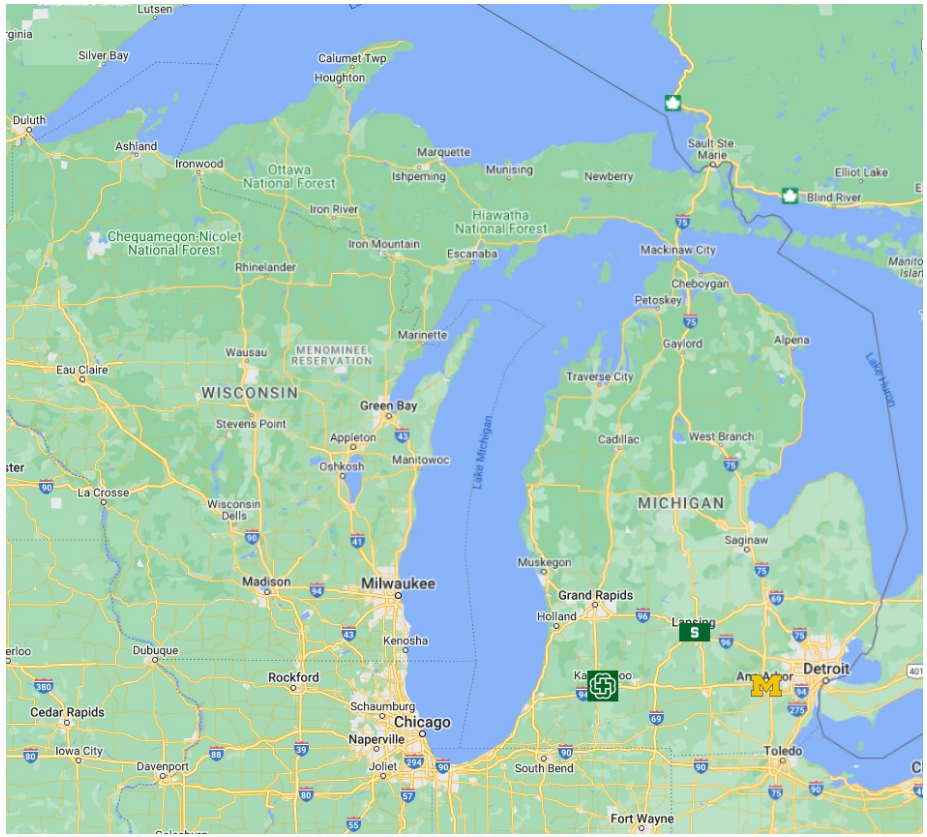
Conclusions as of 10/10/2023

- Whole blood for trauma resuscitation is equivalent to balanced component-based resuscitation
- Some studies are showing benefit to whole blood resuscitation versus balanced component-based resuscitation
- More and larger studies are needed to draw definite conclusions

Trauma Centers in Michigan



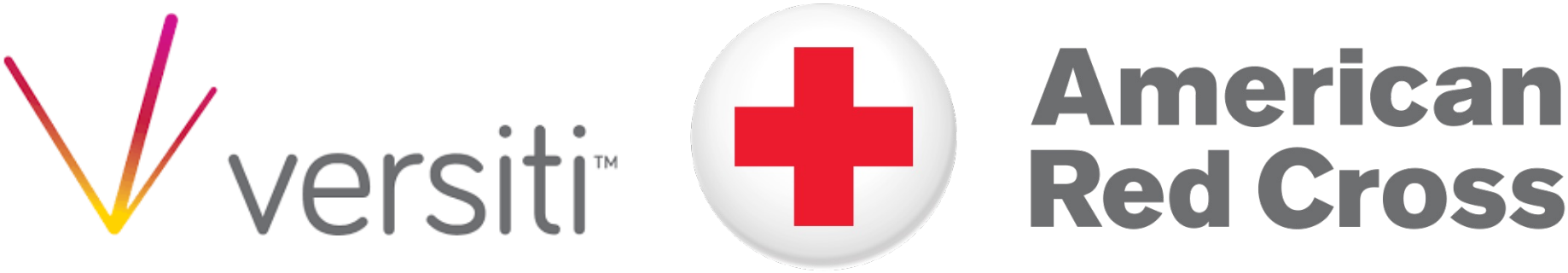
Trauma Centers in Michigan using Whole Blood (correct me if I am wrong!)

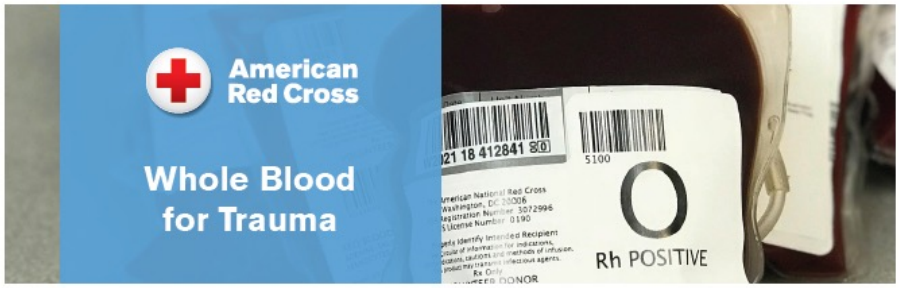


- University of Michigan (Ann Arbor)
- Sparrow Hospital (Lansing)
- Bronson Hospital (Kalamazoo)


Whole blood might/will likely help my bleeding patient – we should have it now!
Blood bank logistics
Existing protocols
Economics/Costs
Shelf life
Contracts

Major blood suppliers in the state of Michigan





The American Red Cross is pleased to make available whole blood for trauma. This product offers hospitals an important intervention in treating massively bleeding patients where every second counts. Studies have shown that early transfusion of blood can result in fewer deaths from traumatic injury or severe hemorrhage.* Red Cross understands that hospitals require flexibility when choosing a blood product to treat their patients. Whether using whole blood or traditional component therapy Red Cross provides the products that best meet your patient needs. And when time matters, choose whole blood for trauma to save lives.

Product Description (Product Code: E0033V00):

- 500 ml
- Cold-stored, group O (O-pos/O-neg)
- Low-titered (1:200)
- Leuko-reduced
- Platelet-sparing filter
- Anticoagulant CPD
- TRALI mitigated from aspirin-free donor
- 5 days fresh
- Shelf-life is 21 days

Ordering Requirements:

- Scheduled order only
- No returns

Visit the American Red Cross education portal SUCCESS at success.redcross.org to learn more about whole blood for trauma and massive transfusion.

*Citation list available upon request.

Early Experience: University of Michigan Data

- 16 total patients
- 2/15 survivors progressed to requiring MTP
- Average age 50.6 years old
- 11 male
- 5 female

Early Experience: Anecdotal

- Decreased conversions to MTP from previous
- It takes a village
  - Blood bank champion
  - ER champions
  - Trauma program staff champions
- Overall benefit to the institution

Next steps/Timeline → where do we go from here?

- Fall 2023: Surveys sent out to Michigan Trauma Centers
  - Trauma Program Manager
  - Trauma Medical Director
  - Blood Bank Director
- Winter 2023: Data compiled
- February 2023: Data presented at February MTQIP Virtual Meeting

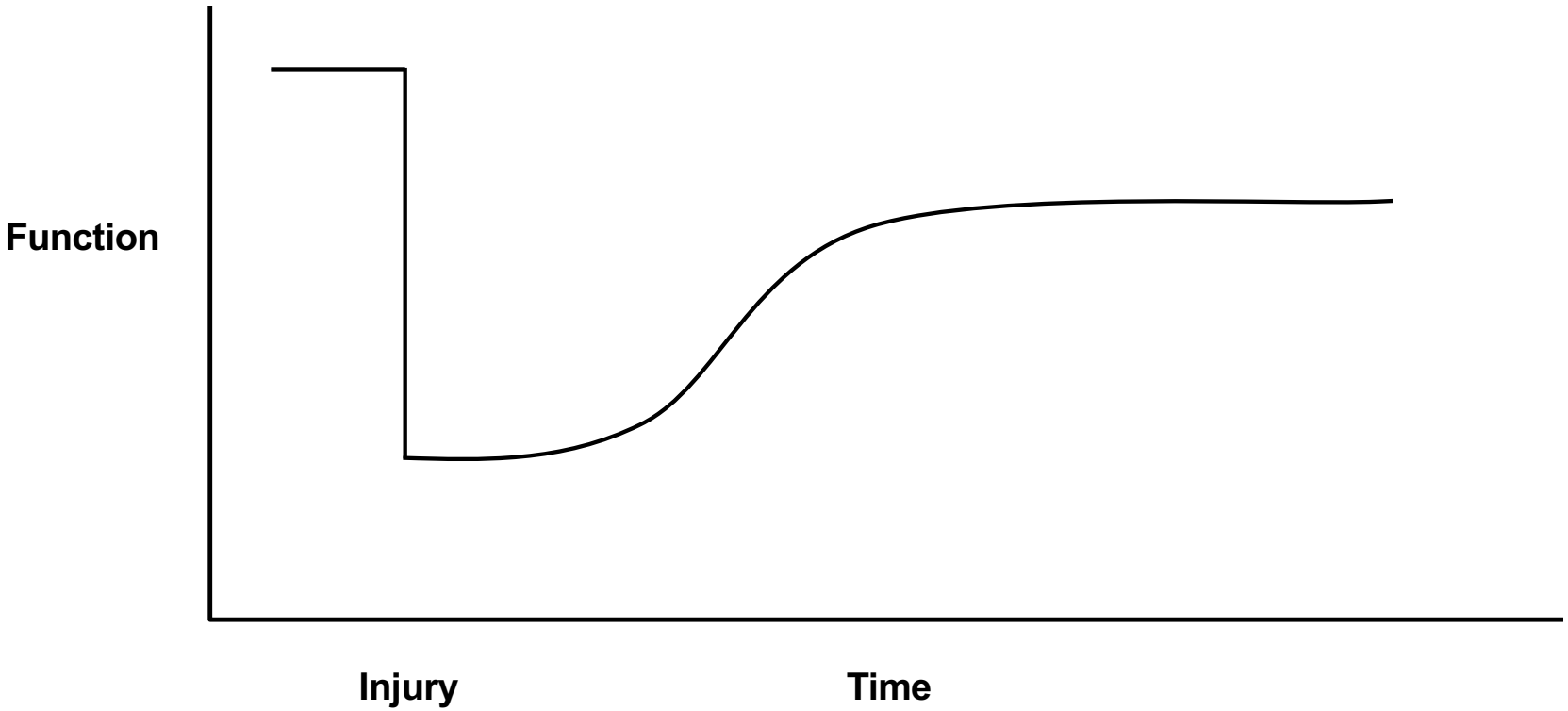
Questions?

- John Donkersloot

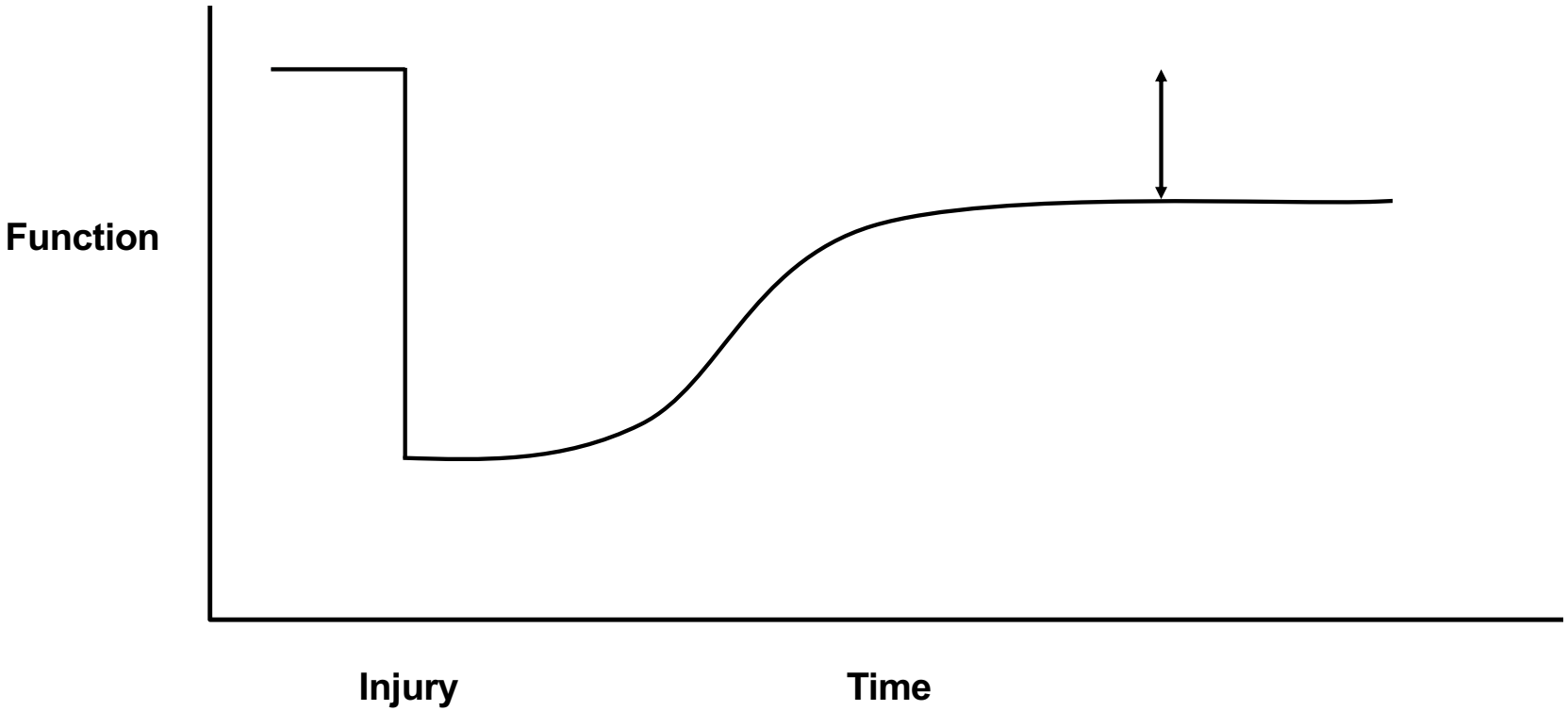
MTQIP Patient Recorded Outcome Measures

Mark Hemmila, MD
Bryant Oliphant, MD

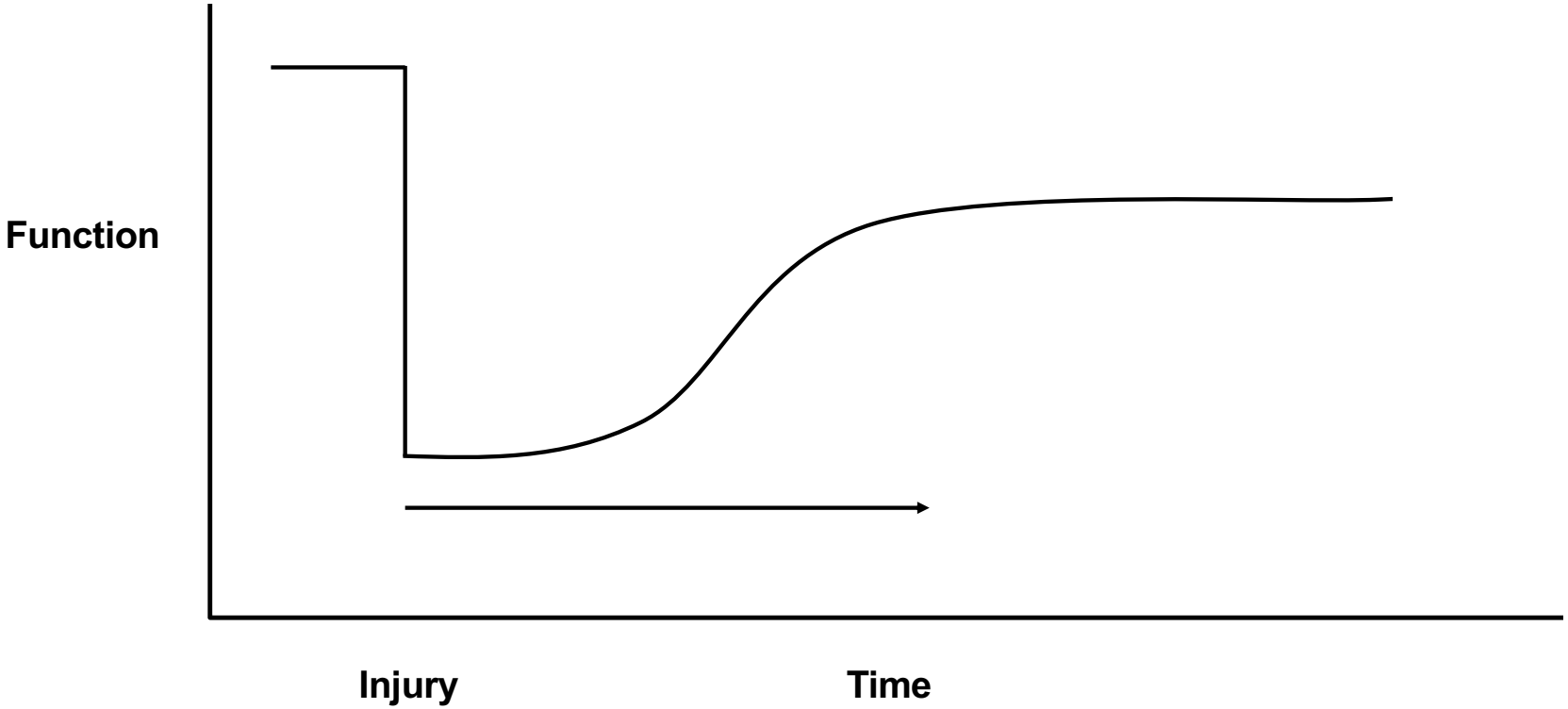
Trauma - Return to Health



Trauma - Return to Health



Trauma - Return to Health



Patient Reported Outcome Measures

- EuroQol 5D-5L
- Caregiver burden
- Economic impact
  - Bills
  - Job
  - Housing
  - Food
- Opioid use

Summary

- Participant Trauma Centers
  - 16 Total
- Surveys
  - 711 Total, >75% complete
  - 547 Unique patients
- Contact
  - Text, E-mail > Phone
  - Patient preference after first contact

EuroQol

- EQ-5D-5L
  - EQ-5D is a standardized measure of health status developed by the EuroQol Group to provide a simple, generic measure of health for clinical and economic appraisal.
- Descriptive system questionnaire
  - 5 Dimensions
  - 5 Response Levels
- Visual Analogue Scale
  - EQ-VAS 0-100

Trauma Center	Surveys
14	1
8	3
4	12
30	19
5	21
1	6
18	11
13	5
7	110
16	32
29	46
32	48
25	41
19	50
35	32
27	274
Total	711

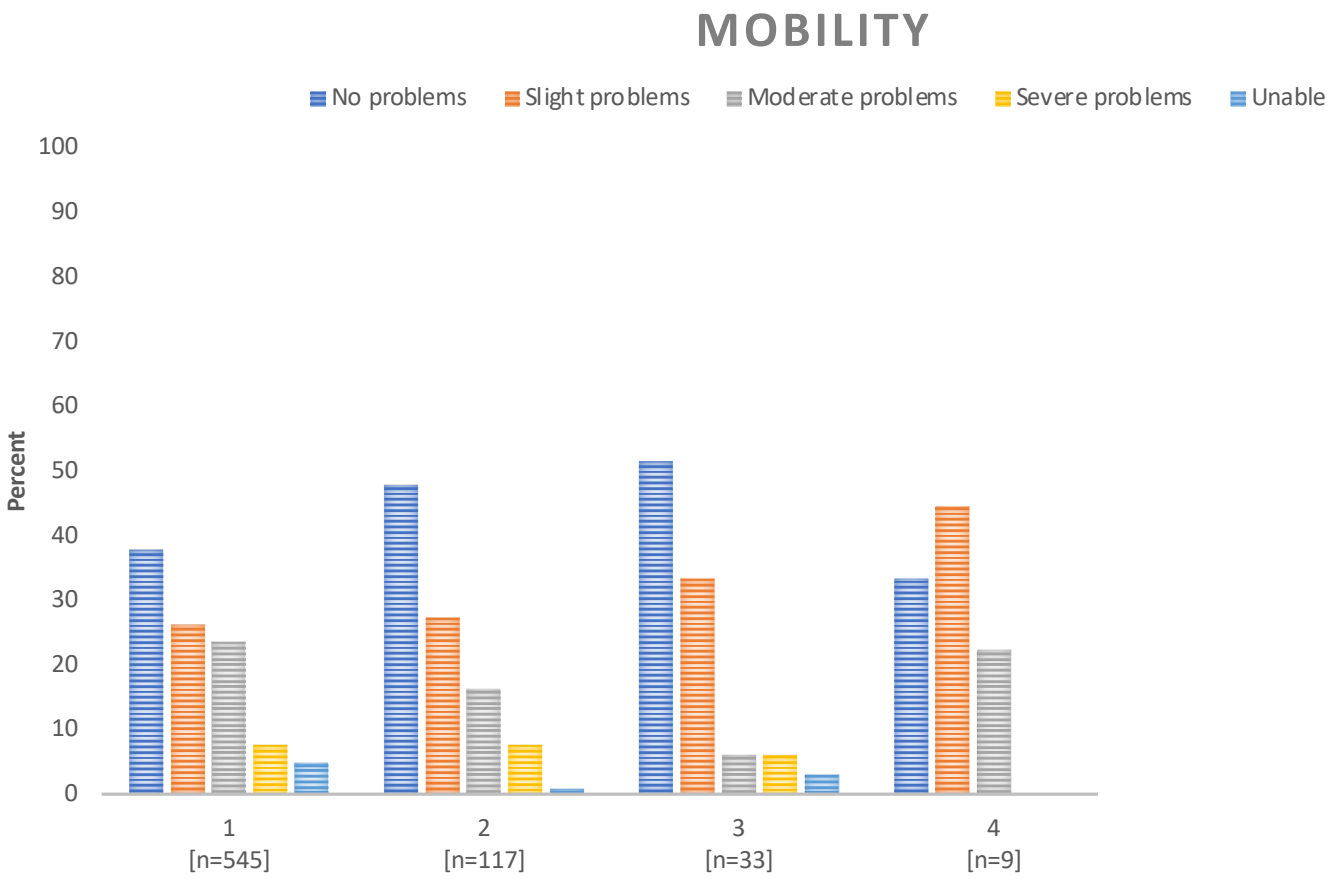
Characteristic	Value
Age	60.8 ± 19.3
Female	51.6%
Race White	92.1%
Race Black	4.1%
Race Other	3.8%
ISS	11.8 ± 6.8
Hospital LOS	5.5 ± 5.2
Operation	56%
Discharge Home (Self-care)	40%
Discharge Rehab	22.3%
Discharge SNF	18.2%
Discharge Home (Home health)	17.1%

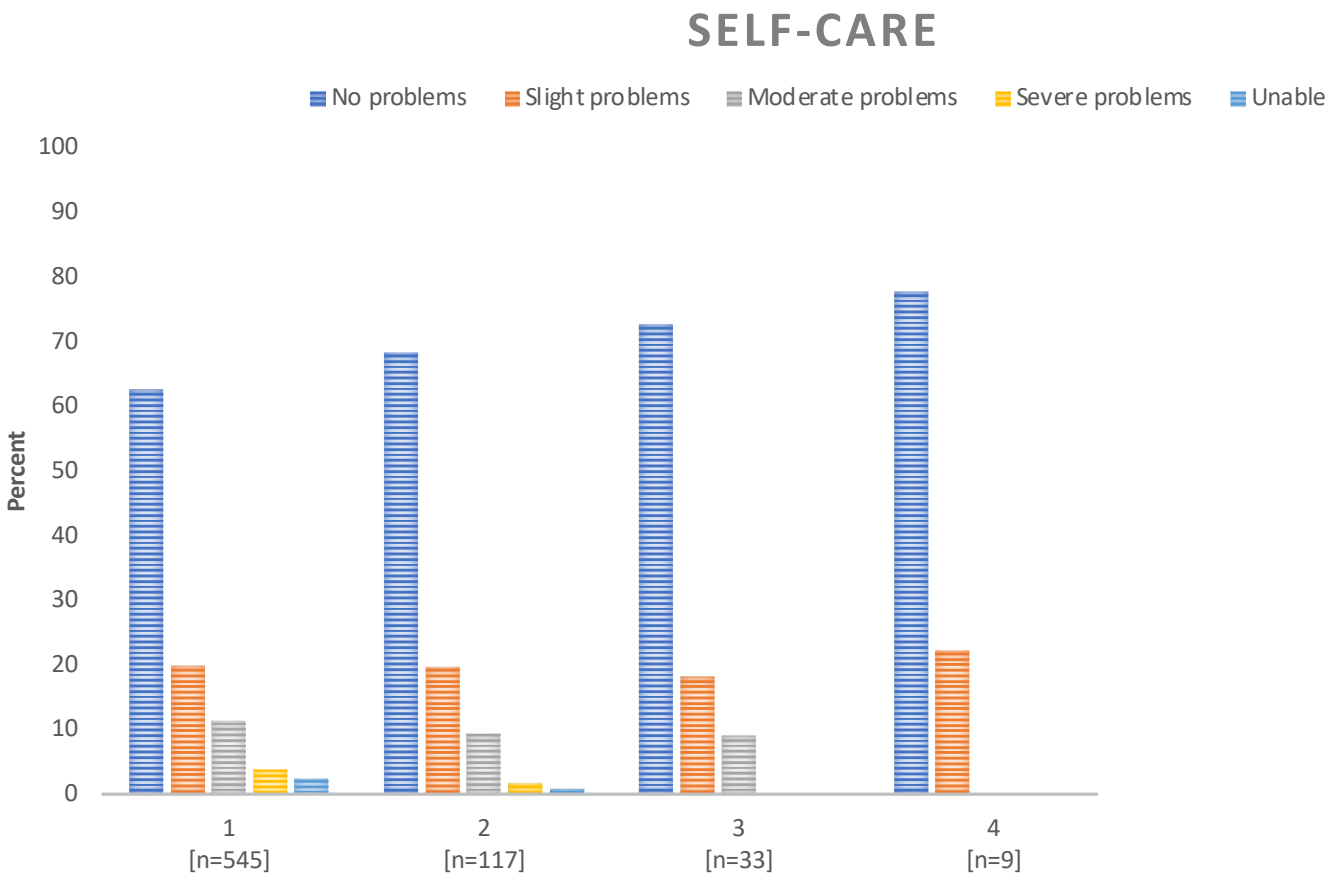
First Survey (Mean 5.8 mo, 32% 2-4 mo, 53% 5-7 mo)

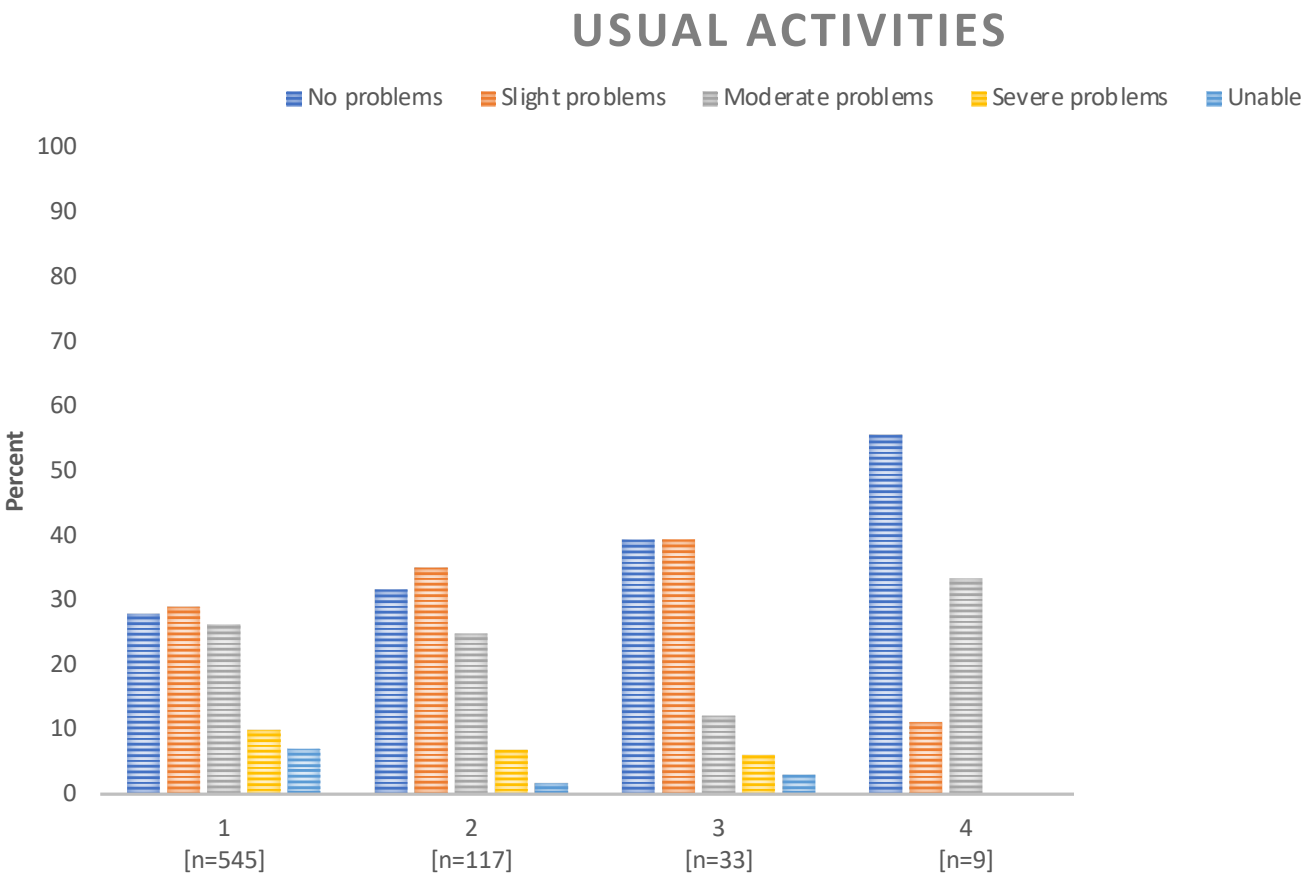
N=547	Mobility %	Self-Care %	Usual Activities %	Pain/ Discomfort %	Anxiety/ Depression N (%)
Level 1 No problems	37.7	62.5	27.8	22.3	55.4
Level 2 Slight problems	26.3	19.7	29.1	40.2	23.4
Level 3 Moderate problems	23.4	11.3	26.1	31.1	14.1
Level 4 Severe problems	7.7	4.0	10.1	4.9	4.2
Level 5 Extreme problems/ unable to do	4.9	2.4	7.0	1.5	2.9

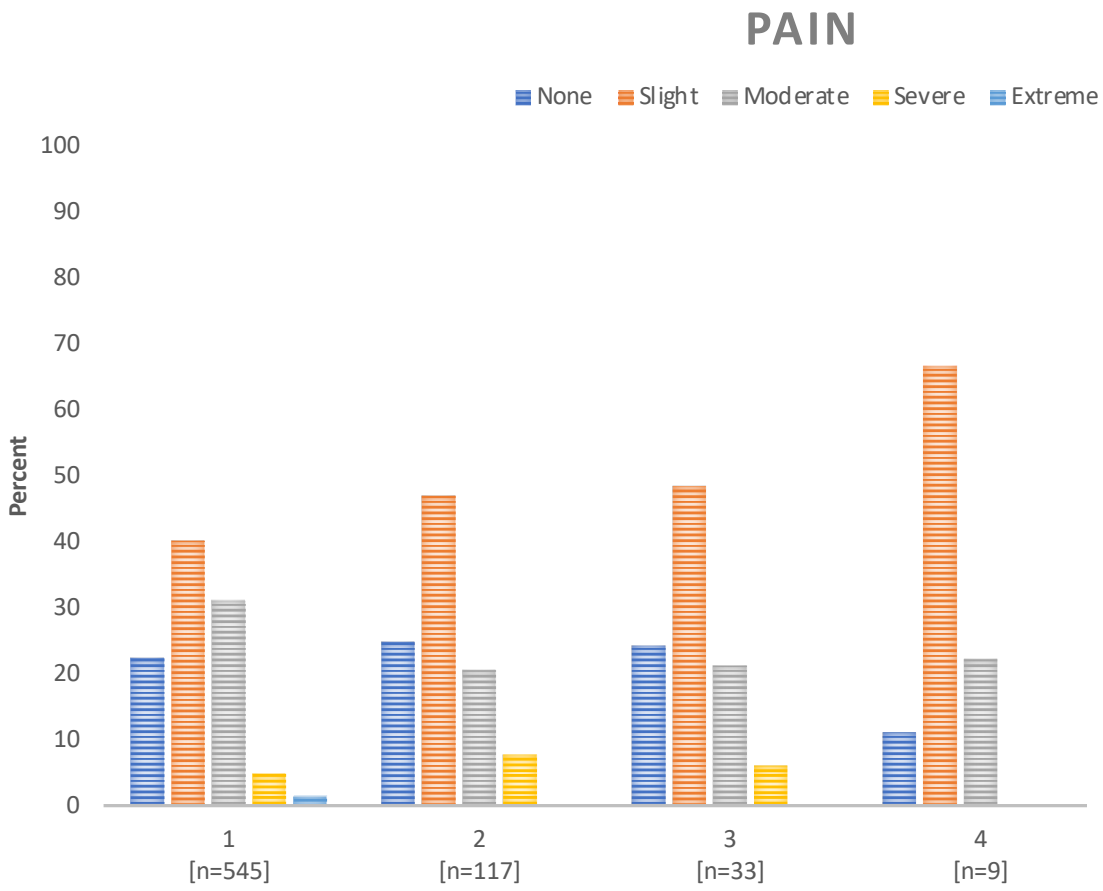
2nd Survey (Mean 10.0 mo, 45% 8-12 mo, 24% 13-24 mo)

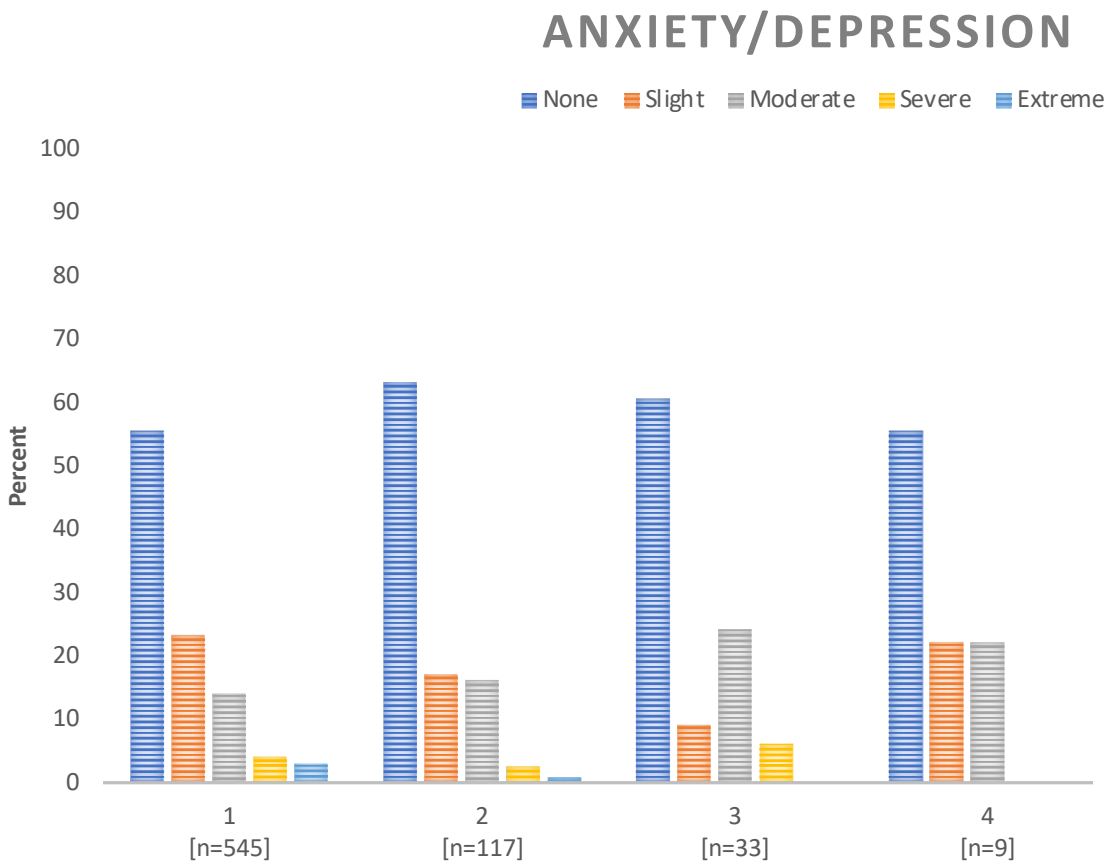
N=117	Mobility N (%)	Self-Care N (%)	Usual Activities N (%)	Pain/ Discomfort N (%)	Anxiety/ Depression N (%)
Level 1 No problems	47.9	68.4	31.6	24.8	63.3
Level 2 Slight problems	27.4	19.7	35.0	47.0	17.1
Level 3 Moderate problems	16.2	9.4	24.8	20.5	16.2
Level 4 Severe problems	7.7	1.7	6.8	7.7	2.6
Level 5 Extreme problems/ unable to do	0.9	0.9	1.7	0	0.9


MOBILITY
No problems
Slight problems
Moderate problems
Severe problems
Unable
Percent
100
90
80
70
60
50
40
30
20
10
0
1
[n=545]
2
[n=117]
3
[n=33]
4
[n=9]


SELF-CARE
No problems
Slight problems
Moderate problems
Severe problems
Unable
Percent
100
90
80
70
60
50
40
30
20
10
0
1
[n=545]
2
[n=117]
3
[n=33]
4
[n=9]

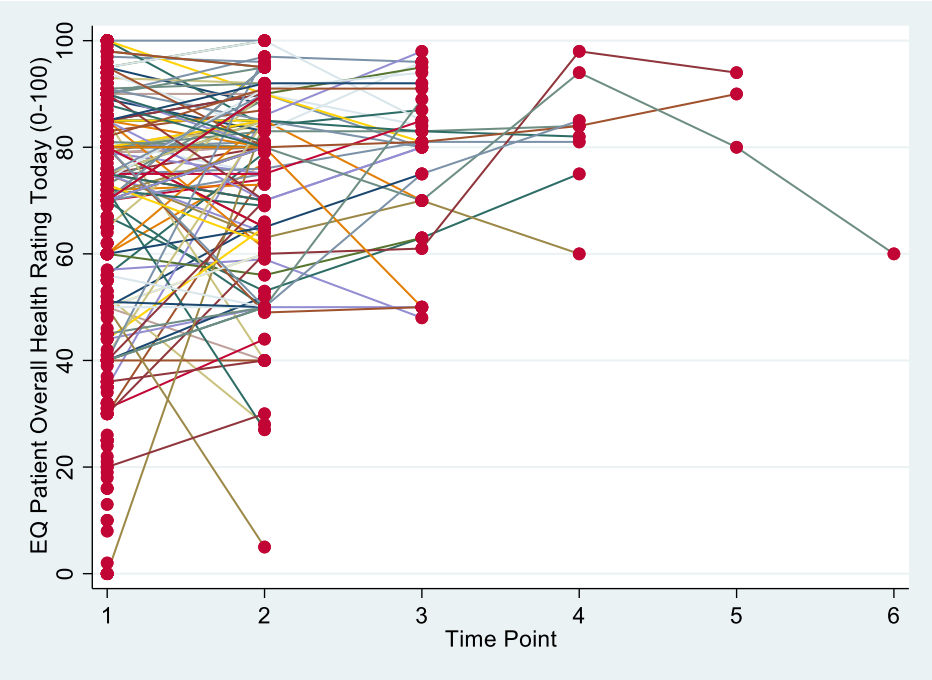

USUAL ACTIVITIES
No problems
Slight problems
Moderate problems
Severe problems
Unable
Percent
100
90
80
70
60
50
40
30
20
10
0
1
[n=545]
2
[n=117]
3
[n=33]
4
[n=9]


PAIN
None
Slight
Moderate
Severe
Extreme
Percent
100
90
80
70
60
50
40
30
20
10
0
1
[n=545]
2
[n=117]
3
[n=33]
4
[n=9]


ANXIETY/DEPRESSION
None
Slight
Moderate
Severe
Extreme
Percent
100
90
80
70
60
50
40
30
20
10
0
1
[n=545]
2
[n=117]
3
[n=33]
4
[n=9]

Overall Health – EQ Visual Analogue Scale

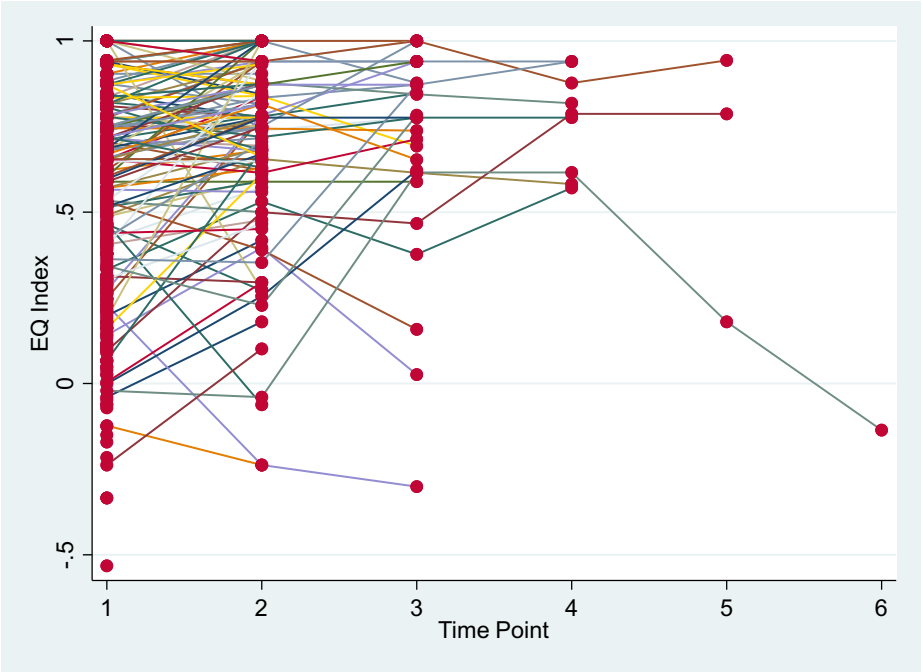
Survey	Mean EQ VAS
1st	69.8
2nd	74.0
3rd	77.8
4th	82.6
5th	88
6th	60



EQ-5D Index (Weighting of descriptive survey answers)

Survey	Mean EQ-5D Index
1st	0.650
2nd	0.716
3rd	0.726
4th	0.767
5th	0.637
6th	-0.136

Population Norm = 0.897



Potential of Orthopaedic PROMs

Tracking Recovery After Injury

- Huge blindspot in the care of these patients – NTRAP
- PROs are a patient-centered subjective measure
- Actual physical activity doesn’t necessarily correlate with PROs
- Actigraphy data offers lens into actual patient activity
- Combination of PROs + Actigraphy data is promising

Recovery Trajectory → Interventions

- Identify patients with delayed or incomplete recovery
- Characterize risk factors involved – Modifiable vs. Nonmodifiable
- Design interventions to help them recover

MTQIP Orthopaedic Update

October 10, 2023

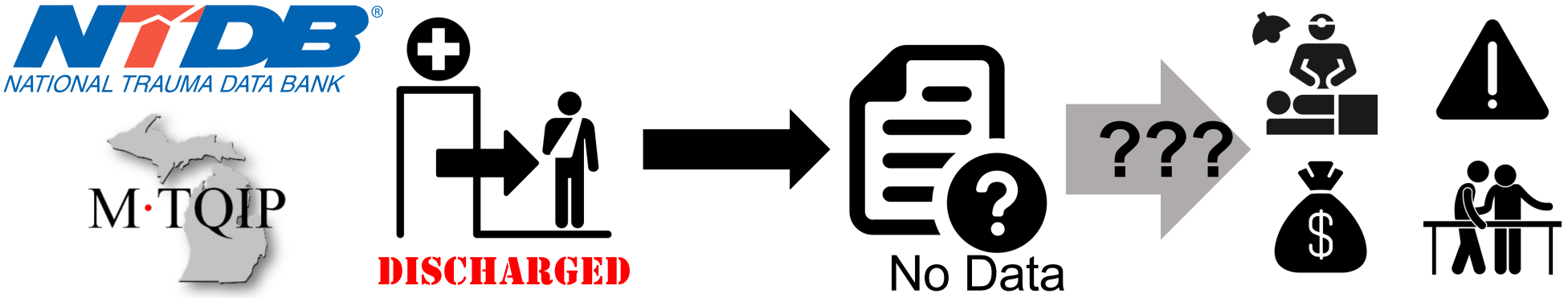
Bryant W. Oliphant, MD, MBA, MSc
Staff Physician Detroit Receiving Hospital
Assistant Professor – Wayne State University, Department of Orthopaedic Surgery
Research Assistant Professor – University of Michigan, Department of Orthopaedic Surgery
@BonezNQuality

Lower Extremity Infection Project

Lower Extremity Injury (LEI)

- Bad Problem
- $$$
- Heterogeneity of Injuries
- Multifactorial Treatment
  - Ortho
  - Plastics
  - Vascular
- Complications Post-Discharge (Hidden Burden)

Long-term Data is Essential in Trauma HSR



Too Sick to Operate?

Delays in Orthopaedic Process Measures

Trauma Quality Improvement Program Process Measures - Orthopaedic
Time to operative fixation in patients with mid-shaft femur fracture
Time to operative fixation in patients with open tibia shaft fracture
Time to irrigation and debridement in patients with open tibia shaft fracture
Time to flap coverage in patients with open tibia shaft fracture
Number of fasciotomies performed in patients with tibia shaft fractures
Time to operative fixation in elderly patients with hip fractures
Time to antibiotics in open femur or tibia fractures

Reason for Delay?

Questions

- Contact info:
- Bryant W. Oliphant, MD, MBA, MSc
- @BonezNQuality

M·TQIP

Wrap Up

Bryant Oliphant, MD

Conclusion

- Thank you for attending
- Evaluations
  - Judy will send out email
- Questions?
- See you in February