The Michigan Trauma Quality Improvement Program

Ypsilanti, MI
February 11, 2020

Disclosures

- Salary Support for MTQIP from BCBSM/BCN and MDHHS
  - Mark Hemmila
  - Judy Mikhail
  - Jill Jakubus
  - Anne Cain-Nielsen

Disclosures

- Mark Hemmila Grants
  - Blue Cross Blue Shield of Michigan
  - Michigan Department of Health and Human Services
  - Ford Motor Company
  - Department of Defense
  - National Institutes of Health - NIGMS

No Photos Please

Evaluations

- Link will be emailed to you following meeting
- You have up to 7 days to submit
- Please answer the evaluation questions
- Physicians/Nurses/Advanced Practitioners:
  - E-mail certificate for 3.5 Category 1 CME

MTQIP Advisory Committee

- New member
  - Sujal Patel, Covenant
- Existing members
  - Gabi Iskander
  - Kristin Sihler
  - James Wagner
  - Wayne Vander Kolk
  - Wendy Wahl

Data Submission

- Data submitted December 6, 2019
  - This report
  - 2 week turnaround
- Data submitted February 7, 2020
  - Pending
- Next data submission
  - April 3, 2020

Future Meetings

- Spring (MCOT)
  - Wednesday May 13, 2020
  - Boyne Mountain, Boyne Falls
  - Morning (9-12)?
- Spring (Registrars and MCR's)
  - Tuesday June 2, 2020
  - Ypsilanti, EMU Marriott
  - Level 3's

State of Michigan

- FY 2019
  - 13 Level 3 Hospitals
  - Data Validation - 3 Hospitals completed
- FY 2020
  - State and region reporting (Level 1,2,3)
  - Level 3's reporting
  - Data validation - 12 Hospitals
- FY 2021
  - Proposal pending

Emergency General Surgery

- 2019
  - 7/1/2019
  - 4 Hospitals
- 2020
  - Approval for 2 additional hospitals
  - Recruitment
  - Acute Care Surgery Model
- Support
  - Abstractor

UMTRI Pedestrian vs. Vehicle

Patrick Bowman, MS

M·TQIP

Ford Alliance Pedestrian Project

"Understanding the Pedestrian Injury Distribution and Mechanism"

Patrick Bowman, Carol Flannagan, & Jingwen Hu

University of Michigan Transportation Research Institute

MTQIP Collaborative Meeting

February 11, 2020

Context

- Pedestrians make up 16% of all traffic fatalities[1]
- The number of pedestrian deaths rose 3% while all traffic fatalities declined by 2.4% in 2018[1]
- In Michigan, 14.9% of crash fatalities were pedestrians (145 total) in 2018[2]
- Vehicle technology (e.g., automatic braking, airbags, etc) to prevent injuries crashes has advanced for many crash types but less has been directed at preventing pedestrian injuries and deaths

[1] NHTSA "Pedestrian Safety" [https://www.nhtsa.gov/road-safety/pedestrian-safety]
[2] Michigan Traffic Crash Facts [www.MichiganTrafficCrashFacts.org]

Context

Two hopeful technologies for the future are:

1. Vehicle hood design to reduce injury
   - This is mandated in Europe, but not in the U.S.
   - More space between hood and engine plus even front-grille airbags have been developed
2. Pedestrian Automatic Emergency Braking
   - Beginning to be deployed in US and Europe
   - Only prevents some frontal pedestrian crashes and works best in daylight

Context

Technology development and benefits estimation requires data

- But, pedestrians are not included in current in-depth crash datasets that code injury and crash mechanisms
- The last pedestrian in-depth study was done in 1994 and vehicle designs have changed

Objective

The objective of this proposed study is to develop an improved method of understanding the pedestrian injury distribution and mechanism by collecting recent pedestrian injury cases and linking the police-reported crash data to the trauma data

- Linked cases will be reconstructed and used to impute vehicle speed and injury mechanism
- Linked cases will also be used to identify injury patterns

Overall Goal

Help Ford determine ways that pedestrian safety can be improved through vehicle design and technology

Crash Data

- Michigan State Police (MSP) crash records
  - Census of all police-reported crashes occurring on public roadways
  - 2013 – 2018 data years
- Inclusion Criteria
  - Pedestrian crashes on public roadways only
  - Included those crashes involving personal injury or property damage (> $1000)
- Exclusion Criteria
  - Passenger vehicles only
  - Single-vehicle crashes

Trauma Data

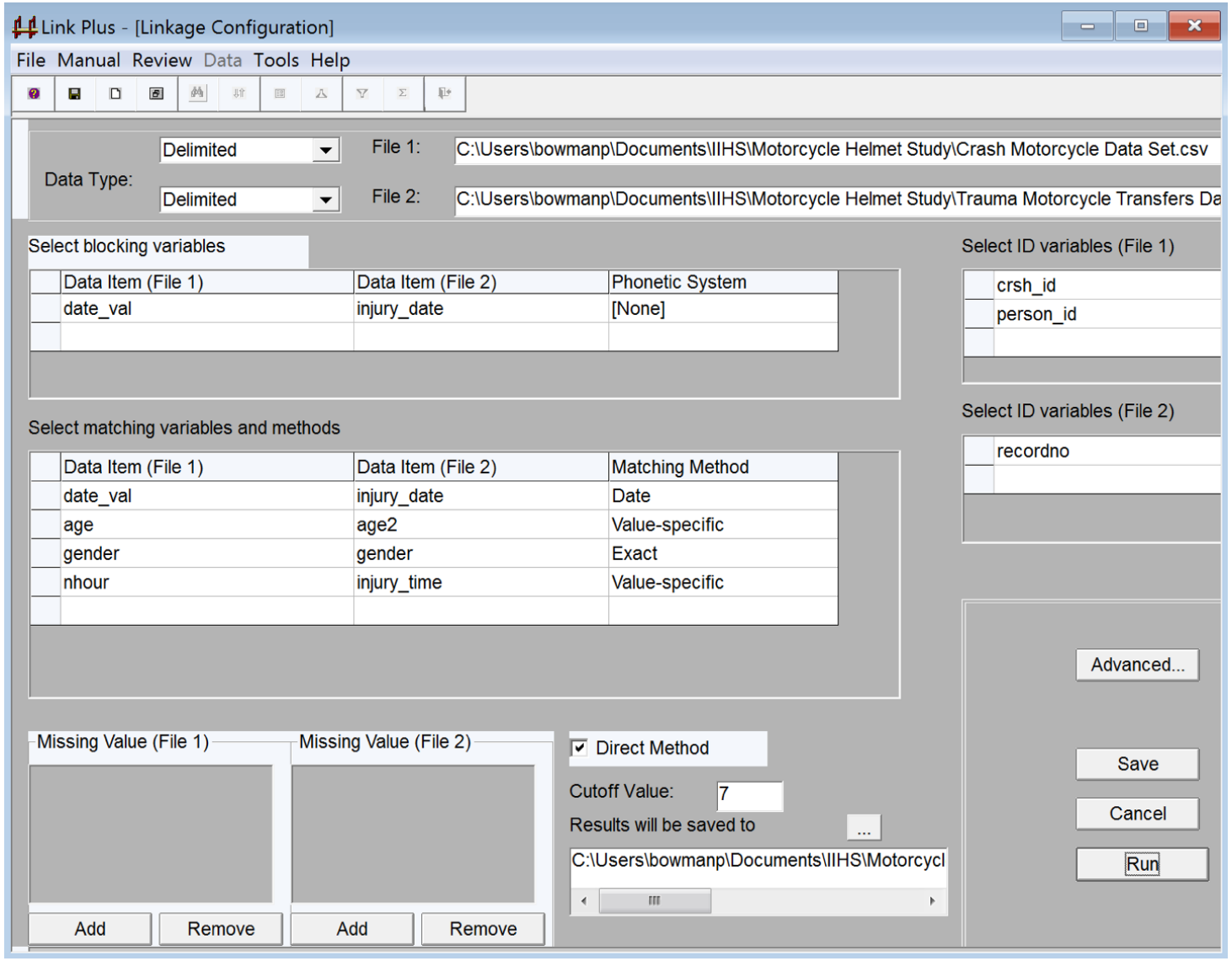
- Trauma data were linked to police-report data from Michigan
  - 822 linked total, 423 pedestrians used
  - 61.9% linkage rate
- Note that all cases in the sample have some serious injuries (because they are in the trauma dataset)
- Graphs show which injuries, *given that they are injured*
  - i.e., this isn't showing probability of injury given crash characteristics

Trauma data linkage

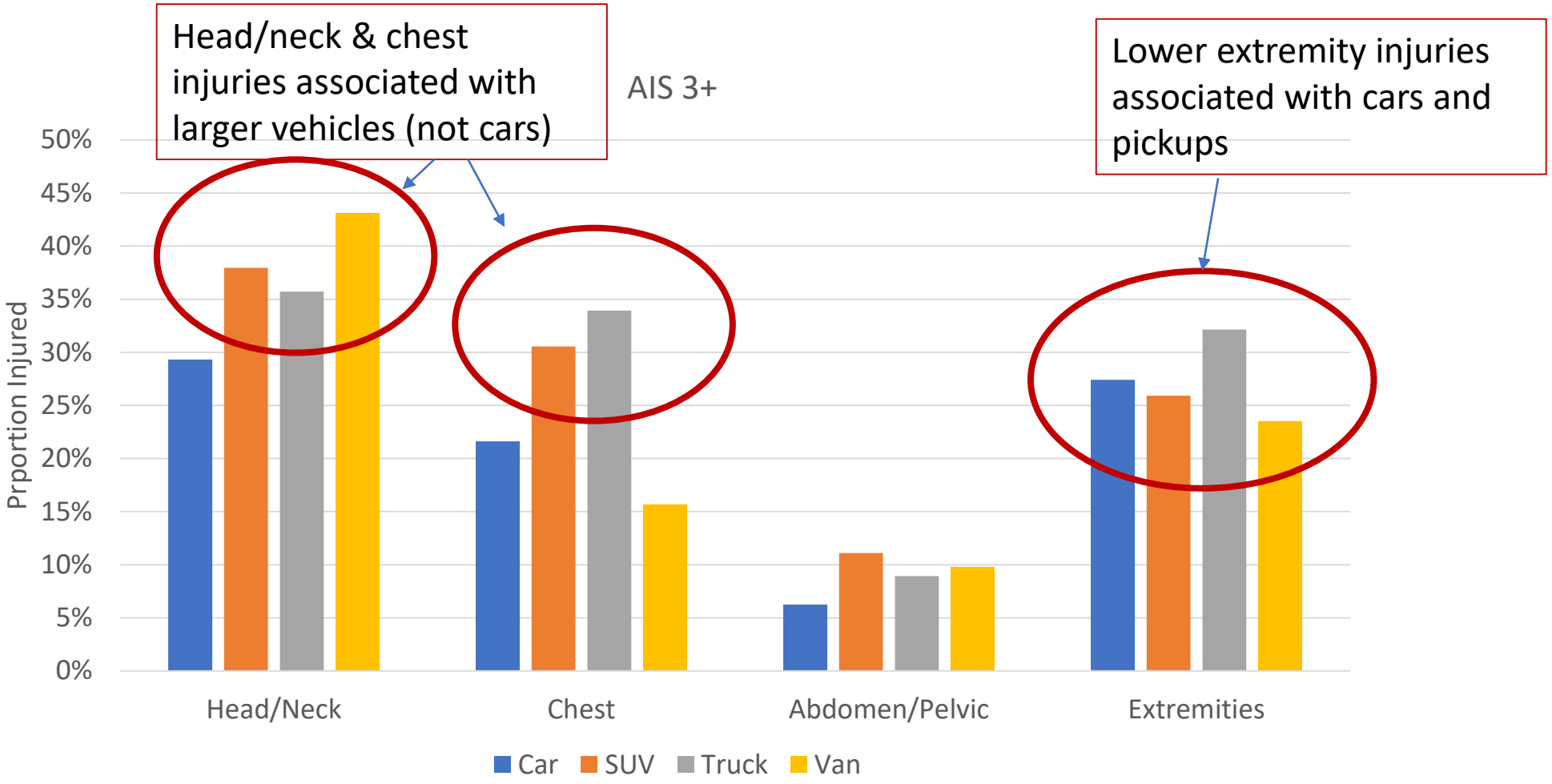
- Trauma data contain detailed breakdown of injuries for a large set of pedestrian crash events
- Linkage to crash data is done probabilistically based on date/time of event (or hospital admission), gender, and age
- Match score assesses the likelihood of a match being correct
  - $m = \frac{p(variables\ match | match\ is\ true)}{p(variables\ match | match\ is\ false)}$

Data Linkage

- Link Plus software
  - Free
  - Specify data formats
  - Matching method of date, value, or phonetically
  - Cutoff value
- Linkage variables
  - Gender
  - Age
  - Crash date [block]



Vehicle Type



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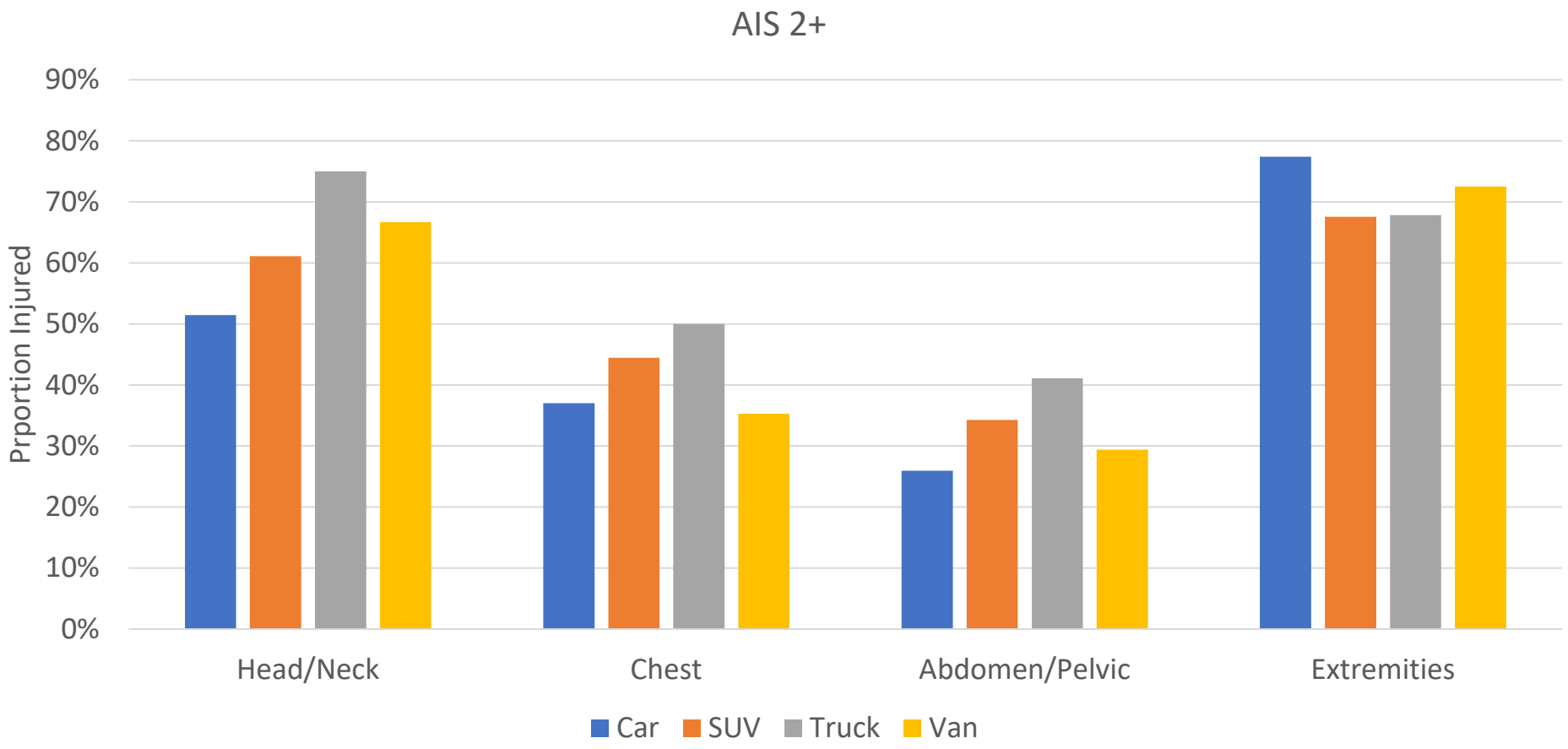
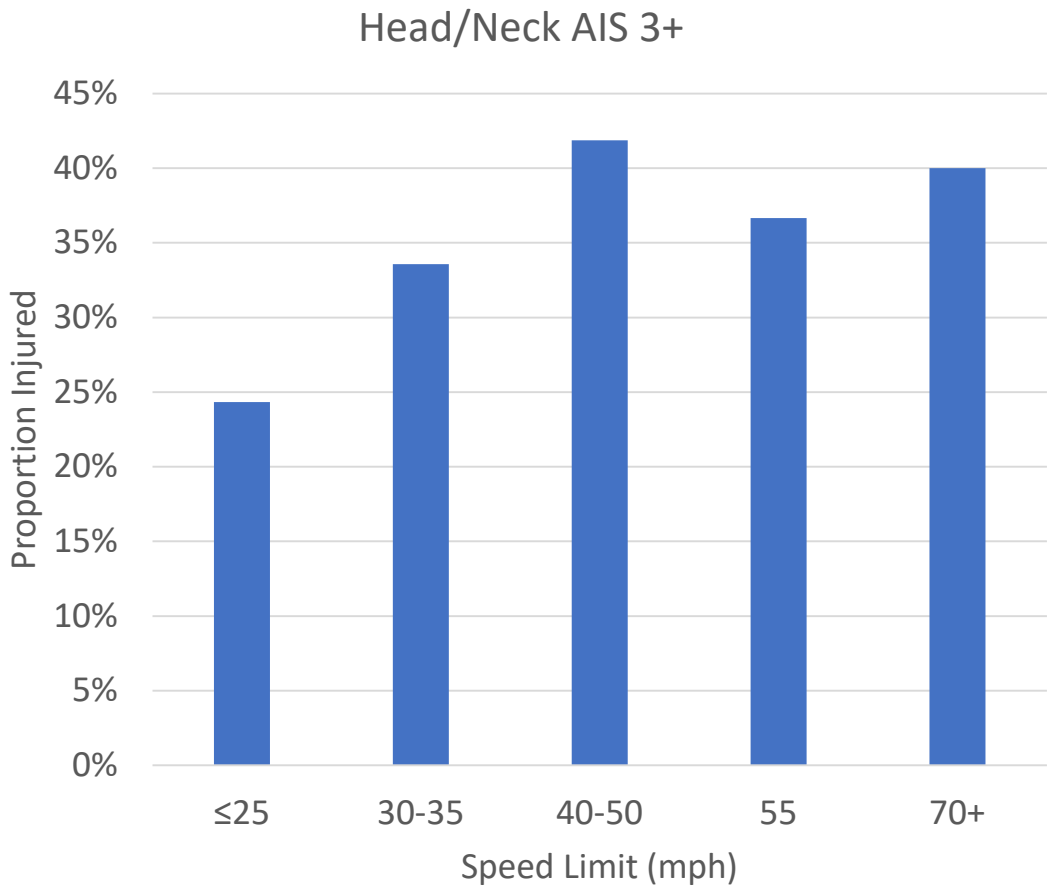
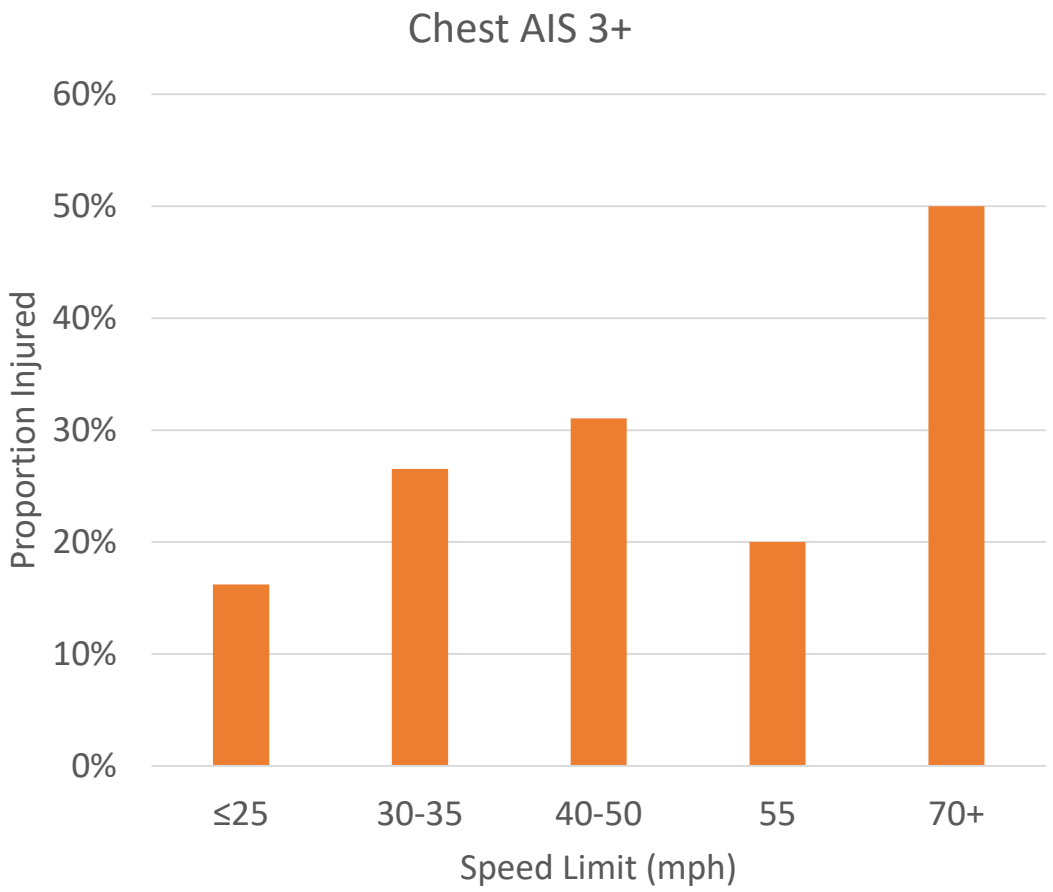


Speed Limit

- 64% of all pedestrian crashes in Michigan were on roads with speed limits ≤35 mph
- 38% of all fatal pedestrian crashes in Michigan were on roads with speed limits ≤35 mph
- 52% in our dataset were on roads with speed limits ≤35 mph
  - Our dataset falls in between all ped crashes and fatal ped crashes
  - Higher speed limits result in greater injury risk

Speed Limit


Head/Neck AIS 3+
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
Proportion Injured
≤25
30-35
40-50
55
70+
Speed Limit (mph)


Chest AIS 3+
60%
50%
40%
30%
20%
10%
0%
Proportion Injured
≤25
30-35
40-50
55
70+
Speed Limit (mph)

Case selection for reconstructions

- We select cases from linked dataset with high match scores and good police-report narratives and diagrams for reconstruction
- Cases will be selected from a variety of scenarios and vehicle types (car, pickup, SUV/van)
- Ten cases selected to develop reconstruction process so far

Police Report data

Trauma data

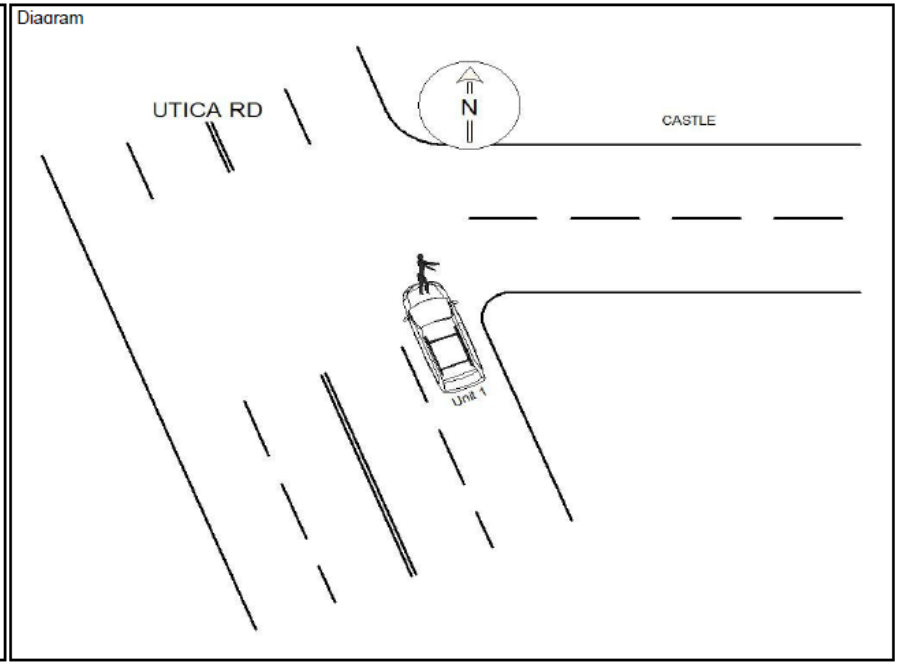
AIS Code	AIS Description
140629.3	cerebrum hematoma NFS
161011.5	diffuse axonal injury w LOC GT 24 hrs NFS
440604.2	diaphragm lac NFS
442205.3	hemopneumothorax NFS
510402.1	abdomen skin/subcutaneous/muscle contusion; hematoma
541826.4	liver lac - major; disruption LEQ 75% lobe; multiple; burst
542810.2	pancreas contusion; hematoma NFS
544226.4	spleen lac - major; disrpution; no hillar injury; devasculared GT 25%
710202.1	UE skin/subcutaneous/muscle abrasion
810202.1	LE skin/subcutaneous/muscle abrasion
854172.3	proximal tibia fx - complete articular; plateau; bicondylar - open
854272.3	tibia shaft fx - complex; comminuted; segmental - open
856151.2	pelvic ring fx - posterior arch intact; isolated fx
856161.3	pelvic ring fx - incomplete disruption of posterior arch NFS

Case Reconstructions – Case Selection

Record Number	Sex	Age	Height	Weight	AIS	AIS Description	Comments on accident	Pedestrian action	Vehicle Action	Posted Speed Limit	Vehicle	Similar Vehicle Model Available
9856					150202.3	Basilar fracture without CSF leak	Simple. Travelling at 25 MPH in their lane. Impact from right/center of vehicle	Crossing not at intersection	Going straight ahead	35		
19863					510202.1 772410.1 810202.1 853271.3	abdomen skin/subcutaneous/muscle abrasion carpal joint sprain LE skin/subcutaneous/muscle abrasion femur shaft fx - complex; comminuted; segmental	Running across street. Gets hit on the right side of body. Speed - 35	Crossing not at intersection	Going straight ahead	35		

Narrative

Diagram



Case Reconstructions – Preliminary Simulations

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Need to try a number of simulations to find one that fits injuries best

Case Reconstructions – Preliminary Simulations

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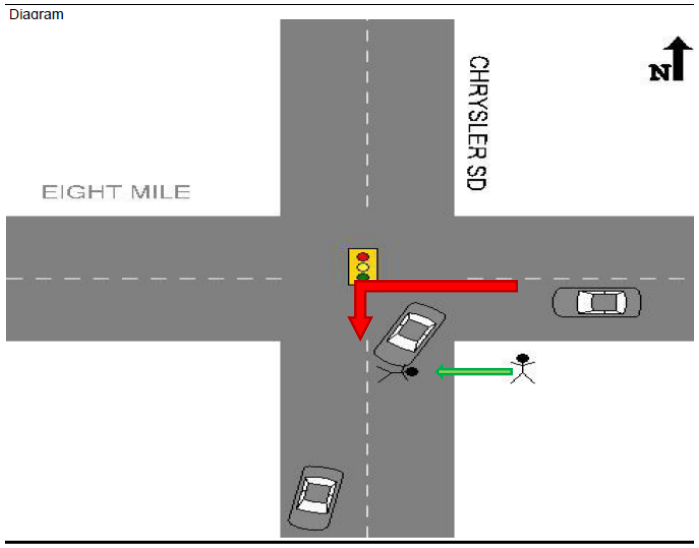
Select best match

	Vehicle Speed	Pedestrian Posture	Impact Location
Case 1	32kmph	Standing	Middle
Case 2	32kmph	Standing	Corner
Case 3	32kmph	Walking/Running (5mph)	Middle
Case 4	32kmph	Walking/Running (5mph)	Corner
Case 5	40 kmph	Standing	Middle
Case 6	40 kmph	Standing	Corner
Case 7	40 kmph	Walking/Running (5mph)	Middle
Case 8	40 kmph	Walking/Running (5mph)	Corner

	Tolerance	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
HIC15	700	715	1344	468	17	1419	1304	782	28
Sternum Res.Acc (g)	85g	25	17	20	20	27	17	21	20
Upper Torso Res. Acc (g)		38	20	22	16	42	22	21	17
Lower Torso Res. Acc (g)		23	24	24	22	36	34	34	23
Right Upper Leg Res. Acc (g)		65	89	141	119	77	97	160	204
Right Lower Leg Res. Acc (g)		188	169	163	185	278	290	328	220
Lower Torso Res. Force (N)	10 kN	1807	2369	3417	2215	3046	3172	1807	9576
Right Upper Leg Res. Force (N)	3-10 kN	4215	3101	3886	5706	7842	4970	5142	6178
Right Lower Leg Res. Force (N)	3-6 kN	2697	2378	2066	2049	4109	3593	3069	2884
Right Upper Leg Lateral Shear (N) (Y-axis)	3.9 kN	1244	1151	3214	5685	1308	1092	4056	6101
Right Lower Leg Lateral Shear (N) (Y-axis)	3.4 kN	1419	1489	1288	1935	1788	1686	1520	2303
Right Upper Leg Lateral Bending (Nm) X-axis	320 Nm	199	198	177	288	262	220	238	216
Right Lower Leg Lateral Bending (Nm) X-axis	200-400 Nm	63	75	58	29	61	24	63	42

Case 6 - Crash ID: 9601770



- Vehicle
  - Action– Turning left (Posted Speed Limit – 25MPH)
  - Vehicle Involved
- Pedestrian
  - Action - Crossing the road without a crosswalk
  - Pedestrian

140650.3	cerebrum hematoma - subdural NFS
140682.3	cerebrum pneumocephalus
140693.2	cerebrum subarachnoid hemorrhage NFS
150200.3	base skull fx NFS
441412.4	lung contusion - bilateral - major; 1+ lobes; increased A-a gradient
441450.4	lung lac - bilateral NFS
442202.2	pneumothorax NFS
442209.2	pneumomediastinum
510402.1	abdomen skin/subcutaneous/muscle contusion; hematoma
750621.2	clavicle shaft fx
750900.2	scapula fx NFS

Crash Conditions & Injury Measures – Crash ID: 9601770

Iteration	V Speed kph	Ped Speed mph	Impact location m	Ped orientation deg(radian)	Vehicle turning (deg/s)
1	40	-3	0 (center)	-90 (-1.57) - lateral	85
2	40	-3	0.8 (left corner)	-90 (-1.57) - lateral	85
3	40	-3	0.8 (left corner)	-63 (-1.1) - facing away from vehicle	85

HIC15	Sternum_acc g	Left Low Leg Bending Nm	Left Low Leg Force N	Left Low Leg Shear N	Left Up Leg Bending Nm	Left Up Leg Force N	Left Up Leg Shear N	Right Low Leg Bending Nm	Right Low Leg Force N	Right Low Leg Shear N	Right Up Leg Bending Nm	Right Up Leg Force N	Right Up Leg Shear N
700	**85 g**	**200-400 Nm**	**3-6 KN**	**3.4 KN**	**320 Nm**	**3-10 KN**	**3.9 KN**	**200-400 Nm**	**3-6 KN**	**3.4 KN**	**320 Nm**	**3-10 KN**	**3.9 KN**
862	97	119	3407	1030	53	5811	1667	127	3493	935	113	5573	3138
845	91	50	1708	938	48	4839	1560	112	4382	844	90	9427	8809
880	111	121	1807	964	99	3544	2311	123	3284	1053	121	5101	2313

Torso Low Lumbar Low Res Force N	Torso Low Lumbar Low Shear N
4862	4312
3629	3582
5872	5084

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750621.2	clavicle shaft fx
750900.2	scapula fx NFS

Crash Kinematics – Crash ID: 9601770

HIC15	Sternum_acc g	Left Low Leg Bending Nm	Left Low Leg Force N	Left Low Leg Shear N	Left Up Leg Bending Nm	Left Up Leg Force N	Left Up Leg Shear N	Right Low Leg Bending Nm	Right Low Leg Force N	Right Low Leg Shear N	Right Up Leg Bending Nm	Right Up Leg Force N	Right Up Leg Shear N
700	**85 g**	**200-400 Nm**	**3-6 KN**	**3.4 KN**	**320 Nm**	**3-10 KN**	**3.9 KN**	**200-400 Nm**	**3-6 KN**	**3.4 KN**	**320 Nm**	**3-10 KN**	**3.9 KN**
880	111	121	1807	964	99	3544	2311	123	3284	1053	121	5101	2313

Torso Low Lumbar Low Res Force N	Torso Low Lumbar Low Shear N
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Reconstructed Crashes with Reduced Speed

S.No	Case	Description	Injury	Original Delta v	-20% Delta v		-40% Delta v		-60% Delta v	
1	1486041	Vehicle driving straight and pedestrian crossing street 2004 Ford Taurus Delta V=60kph	Head **(HIC)**	1373	1235	-10.04%	207	-84.91%	454	-66.93%
			Chest (Sternum Acc) **g**	63	49	-22.13%	139	121.21%	46	-26.06%
			Lumbar Low Force **N**	3887	5040	29.66%	2106	-45.83%	2106	-45.83%
			Lower Ex Bending **Nm**	75	93	24.14%	34	-54.80%	27	-64.29%
2	1496455	Vehicle driving straight and pedestrian standing in center lane (Lateral Impact) 2005 Ford Taurus Delta V=45kph	Head **(HIC)**	688	454	-34.04%	341	-50.37%	94	-86.30%
			Chest (Sternum Acc) **g**	38	70	82.41%	53	38.53%	18	-54.18%
			Lumbar Low Force **N**	9059	4255	-86.03%	2598	-71.33%	1265	-86.03%
			Lower Ex Bending **Nm**	399	338	-15.44%	263	-34.19%	239	-40.13%
3	9891219	Vehicle driving straight and pedestrian running across street 2005 Dodge Grand Caravan Delta V=40kph	Head **(HIC)**	856	383	-55.30%	52	-93.93%	9	-99.00%
			Chest (Sternum Acc) **g**	44	86	95.50%	29	-33.61%	29	-33.31%
			Lumbar Low Force **N**	8223	5772	-29.80%	4539	-44.80%	3185	-61.26%
			Lower Ex Bending **Nm**	109	92	-15.46%	114	4.00%	56	-48.86%
4	9989979	Vehicle driving straight and pedestrian crossing street (Fatal) 1998 Ford Explorer Delta V=56kph	Head **(HIC)**	1629	1694	4.04%	1008	-38.11%	437	-73.15%
			Chest (Sternum Acc) **g**	60	55	-7.43%	39	-34.60%	27	-55.42%
			Lumbar Low Force **N**	10056	9271	-7.81%	8646	-14.02%	4371	-56.54%
			Lower Ex Bending **Nm**	74	61	-17.86%	40	-46.13%	13	-82.97%
5	9739478	Vehicle driving straight and pedestrian crossing street (Lateral Impact) 2000 DODGE Grand Caravan Delta V=32kph	Head **(HIC)**	542	475	-12.37%	325	-39.93%	317	-41.46%
			Chest (Sternum Acc) **g**	61	74	20.98%	26	-57.11%	26	-57.48%
			Lumbar Low Force **N**	1728	2911	68.42%	1944	12.50%	1298	-24.91%
			Lower Ex Bending **Nm**	204	184	-10.06%	144	-29.42%	106	-47.89%
6	9601770	Vehicle driving straight and pedestrian crossing street 2009 DODGE Grand Caravan Delta V=40kph	Head **(HIC)**	880	674	-23.43%	448	-49.11%	100	-88.62%
			Chest (Sternum Acc) **g**	111	101	-8.87%	31	-72.39%	28	-75.05%
			Lumbar Low Force **N**	5872	4683	-20.25%	2526	-56.98%	986	-83.20%
			Lower Ex Bending **Nm**	121	87	-28.32%	97	-20.36%	85	-29.96%

How Do We Use This Information?

- Once models with injury mechanisms are created, we can simulate the benefit of better hood design and other vehicle countermeasures
- These simulations are not possible without accurate injury data (MTQIP)
- Project finalized at the end of May, with results to Ford

Thank You for Providing Us with Data!

Patrick Bowman

Statistician

bowmanp@umich.edu

MTQIP Hospital Scoring Index Results

Mark Hemmila, MD

Metrics for MTQIP

- Hospital = CQI Scoring Index
  - 10 Measures
  - End result: Hospital P4P
- Surgeon = VBR
  - 3 Measures (VTE Timing, VTE Type, PRBC to Plasma ratio)
  - Scoring as a group practice
  - End result: Surgeon VBR in 2020 (March)
  - BCBSM will notify

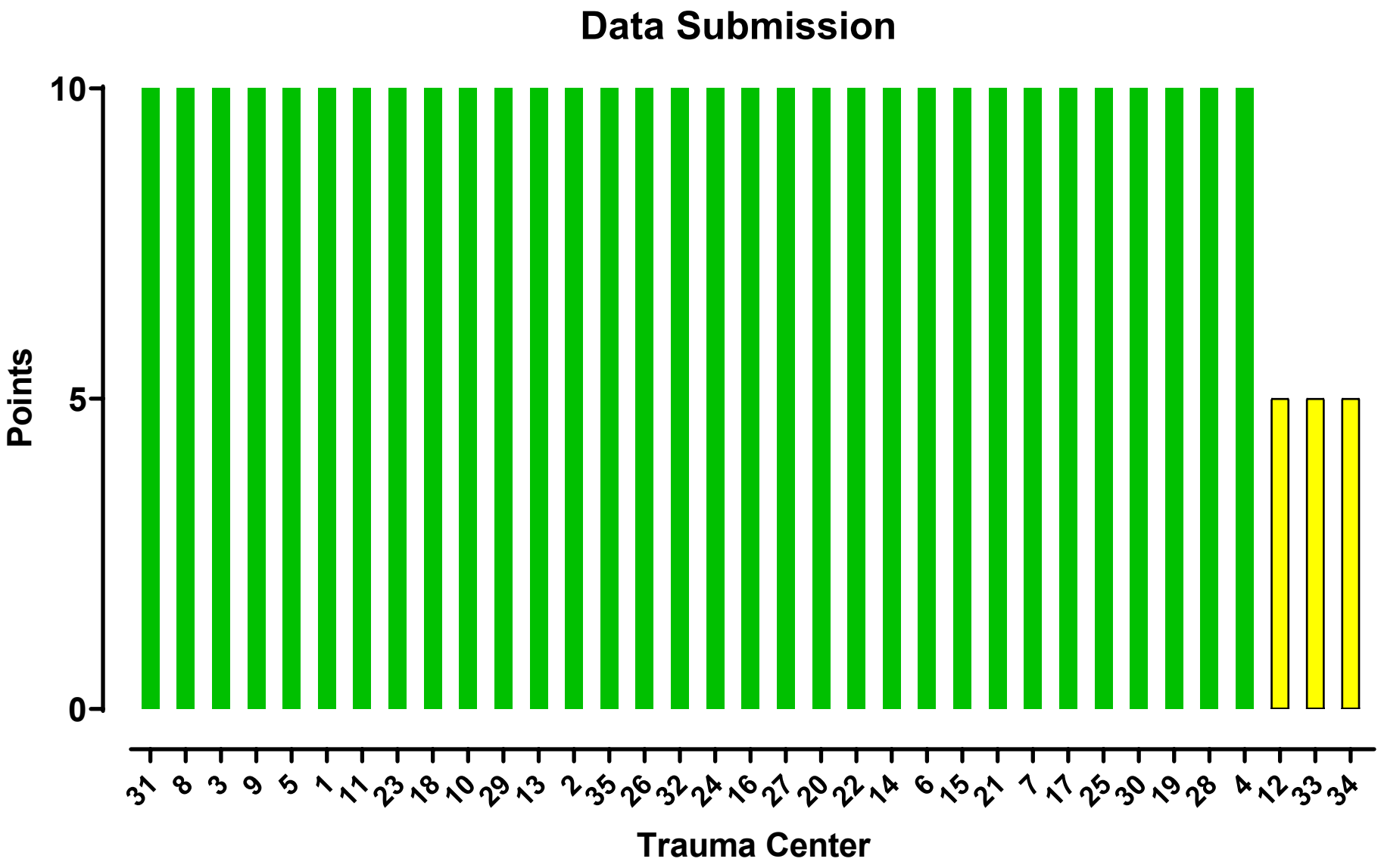
- Hospital Result
- Points
- Possible Points

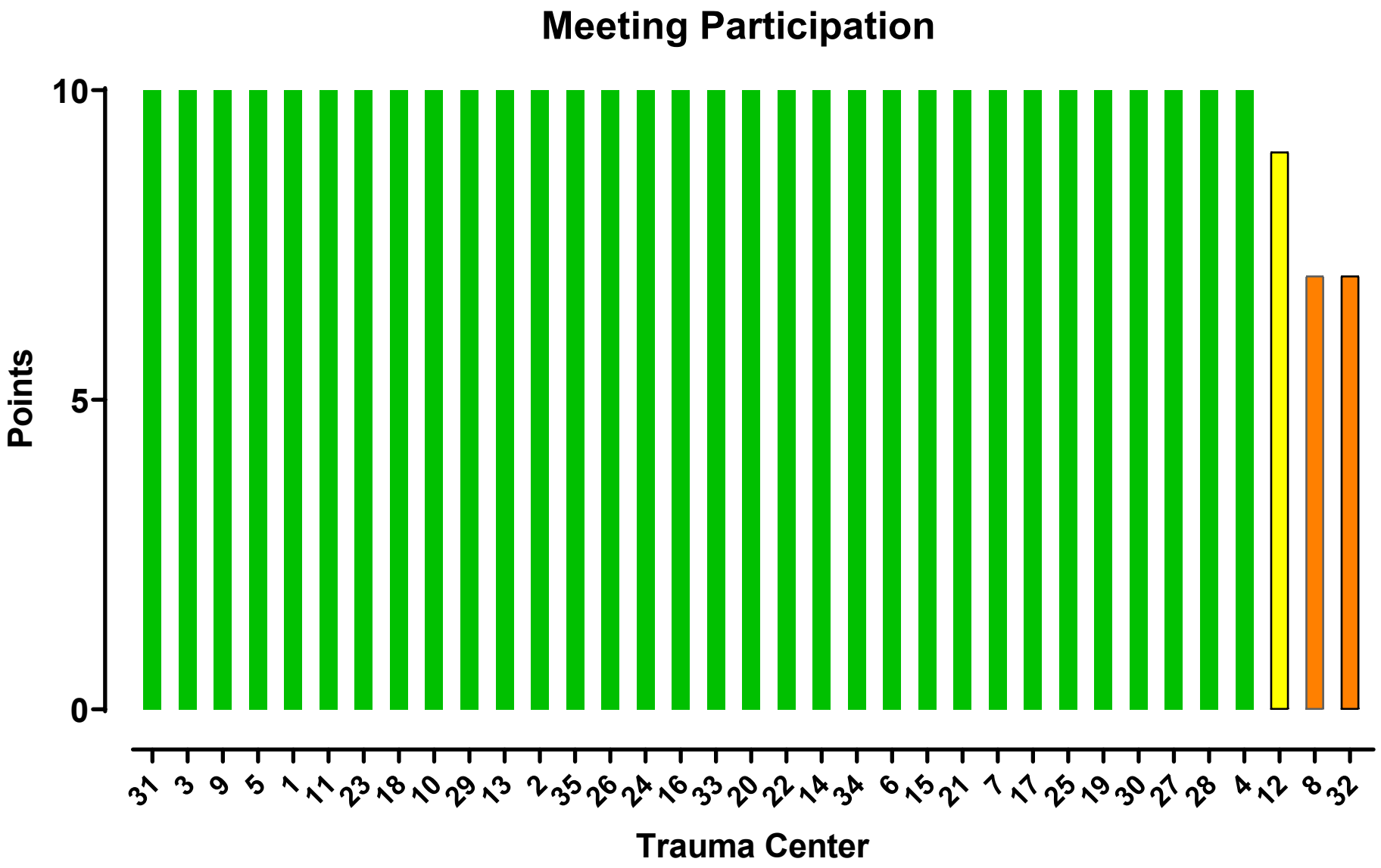
- Score =

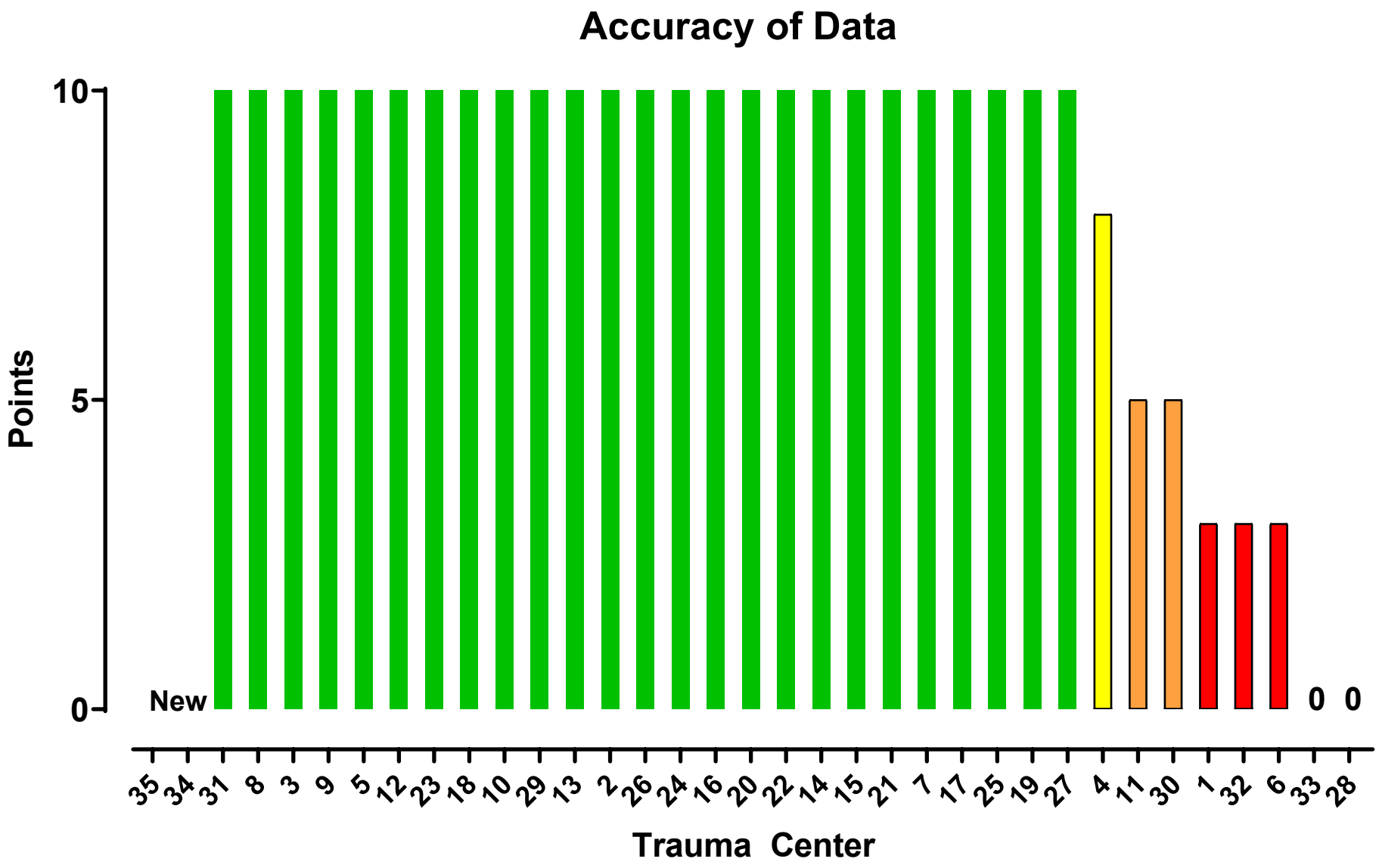
Points/Possible Points x 100

St. Elsewhere
Michigan Trauma Quality Improvement Program (MTQIP)
2018 Performance Index January 1, 2018 to December 31, 2018

Measure	Weight	Measure Description		Result	Points	Possible	
#1	10	**Data Submission (Partial/Incomplete Submissions No Points)**					PARTICIPATION (30%)
		On time and complete 3 of 3 times		3	10	10	
		On time and complete 2 of 3 times				5	
		On time and complete 1 of 3 times				0	
#2	10	**Meeting Participation All Disciplines *Surgeon represents 1 hospital only**					
		Surgeon, and (TPM or MCR) Participate in 3 of 3 Collaborative meetins (9 pts)		3	9	9	
		Surgeon, and (TPM or MCR) Participate in 2 of 3 Collaborative meetins (6 pts)				6	
		Surgeon, and (TPM or MCR) Participate in 1 of 3 Collaborative meetins (3 pts)				3	
		Surgeon, and (TPM or MCR) Participate in 0 of 3 Collaborative meetins (0 pts)				0	
		Registrar, and/or MCR Participate in the Data Abstractor Meeting (1 pt)		1	1	1	
#3	10	**Data Accuracy**	**Error Rate**				
		5 Star Validation	0-4.0%	6.5	3	10	
		4 Star Validation	4.1-5.0%			8	
		3 Star Validation	5.1-6.0%			5	
		2 Star Validation	6.1-7.0%			3	
		1 Star Validation	>7.0%			0	
#4	10	**Venous Thromboembolism (VTE) Prophylaxis Initiated Within 48 Hours of Arrival in Trauma Service Admits with ≥ 2 Day Length of Stay (18 Mo's: 1/1/17-6/30/18)**					PERFORMANCE (70%)
		≥ 55%		70	10	10	
		≥ 50%				8	
		≥ 40%				5	
		< 40%				0	
#5	10	**Low Molecular Weight Heparin (LMWH) Venous Thromboembolism (VTE) Prophylaxis Use in Trauma Service Admits (18 Mo's: 1/1/17-6/30/18)**					
		≥ 50%		23	3	10	
		37-49%				7	
		25-36%				5	
		20-24%				3	
		< 20%				0	
#6	10	**Red Blood Cell to Plasma Ratio (Weighted Mean Points) of Patients Transfused ≥5 Units in 1st 4 Hours (18 Mo's: 1/1/17-6/30/18)**					
		10 pts: Tier 1: ≤ 1.5		3.2	3.8	10	
		10 pts: Tier 2: 1.6-2.0				10	
		5 pts: Tier 3: 2.1-2.5				5	
		0 pts: Tier 4: > 2.5				0	
#7	10	**Serious Complication Rate-Trauma Service Admits (3 years: 7/1/15-6/30/18)**					
		Z-score: < -1 (major improvement)		4.64	5	10	
		Z-score: -1 to 1 or serious complications low-outlier (average or better rate)				7	
		Z-score > 1 (rates of serious complications increased)				5	
#8	10	**Mortality Rate-Trauma Service Admits (3 years: 7/1/15-6/30/18)**					
		Z-score: < -1 (major improvement)		-0.39	7	10	
		Z-score: -1 to 1 or mortality low-outlier (average or better rate)				7	
		Z-score: > 1 (rates of mortality increased)				5	
#9	10	**Open Fracture Antibiotic Usage (12 Mo's: 7/1/17-6/30/18)**					
		≥ 90% patients (Antibiotic type, date, time recorded)		94	10	10	
		≥ 80% patients (Antibiotic type, date, time recorded)				7	
		≥ 70% patients (Antibiotic type, date, time recorded)				5	
		< 70% patients (Antibiotic type, date, time recorded)				0	
#10	10	**Head CT Scan performed in ED on patient taking anticoagulation medication with head injury (12 Mo's: 7/1/17-6/30/18)**					
		≥ 90% patients (Head CT scan in ED with date and time recorded)		100	10	10	
		≥ 80% patients (Head CT scan in ED with date and time recorded)				7	
		≥ 70% patients (Head CT scan in ED with date and time recorded)				5	
		< 70% patients (Head CT scan in ED with date and time recorded)				0	
			Total Points		71.8	100	


Data Submission
Points
10
5
0
31 8 3 9 5 1 11 23 18 10 29 13 2 35 26 32 24 16 27 20 22 14 6 15 21 7 17 25 30 19 28 4 12 33 34
Trauma Center

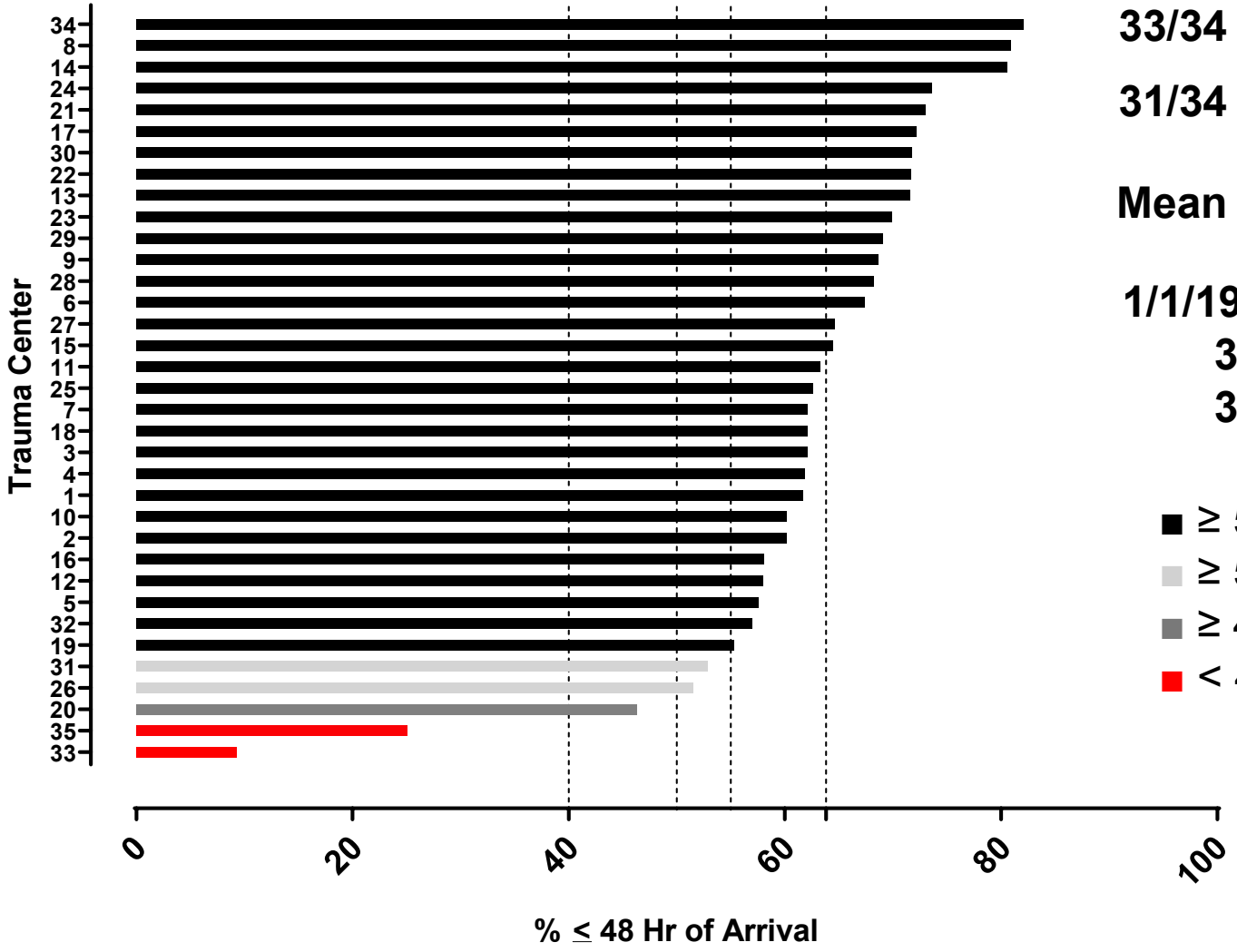

Meeting Participation
Points
10
5
0
31 3 9 5 1 11 23 18 10 29 13 2 35 26 24 16 33 20 22 14 34 6 15 21 7 17 25 19 30 27 28 4 12 8 32
Trauma Center


Accuracy of Data
Points
10
5
0
New
0
0
35 34 31 8 3 9 5 12 23 18 10 29 13 2 26 24 16 20 22 14 15 21 7 17 25 19 27 4 11 30 1 32 6 33 28
Trauma Center

#4 VTE Prophylaxis Initiated ≤ 48 hrs

- Venous Thromboembolism (VTE) Prophylaxis Initiated Within 48 Hours of Arrival in Trauma Service Admits with > 2 Day Length of Stay (18 Mo's: 1/1/19-6/30/19)

Metric #4 - VTE Prophylaxis Timeliness
Cohort 2 - Admit to Trauma
1/1/18 - 6/30/19



33/34 Centers ≥ 50% (+2)

31/34 Centers ≥ 55% (+3)

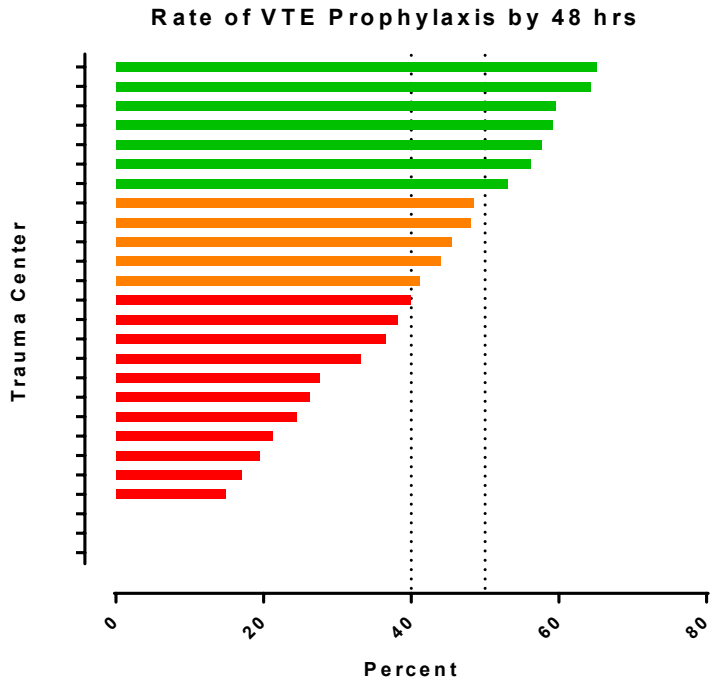
Mean 63.8%

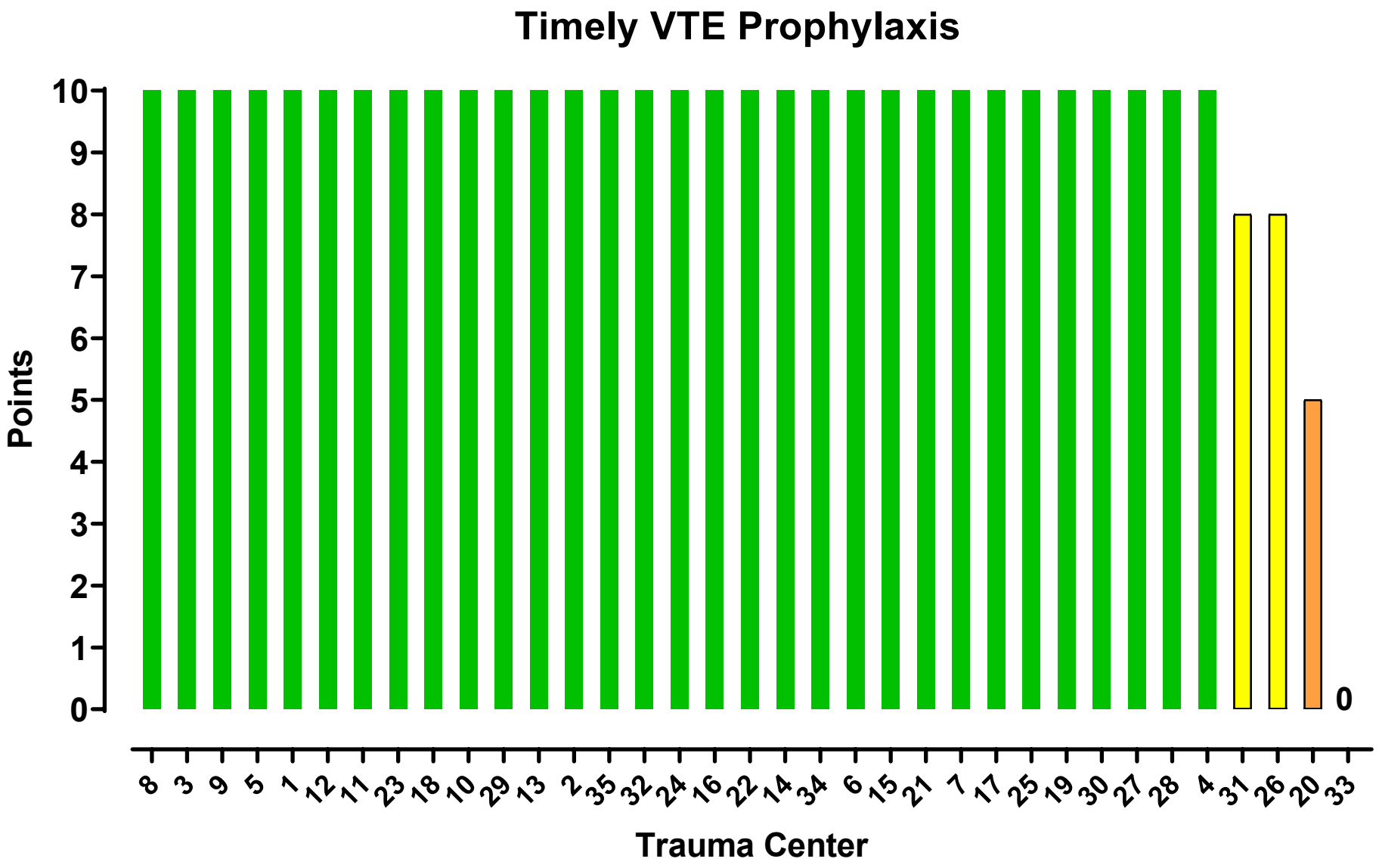
1/1/19 to 6/30/19
35 75%
34 84%

- ≥ 55%
- ≥ 50%
- ≥ 40%
- < 40%

#4 VTE Prophylaxis Initiated ≤ 48 hrs

- Hospital Target ≥ 55% = 10 points
- CQI Target 75% of hospitals ≥ 55%
  - 31/34 hospitals
  - May 2014: 7 > 50%
  - Feb 2020: 33 > 50%

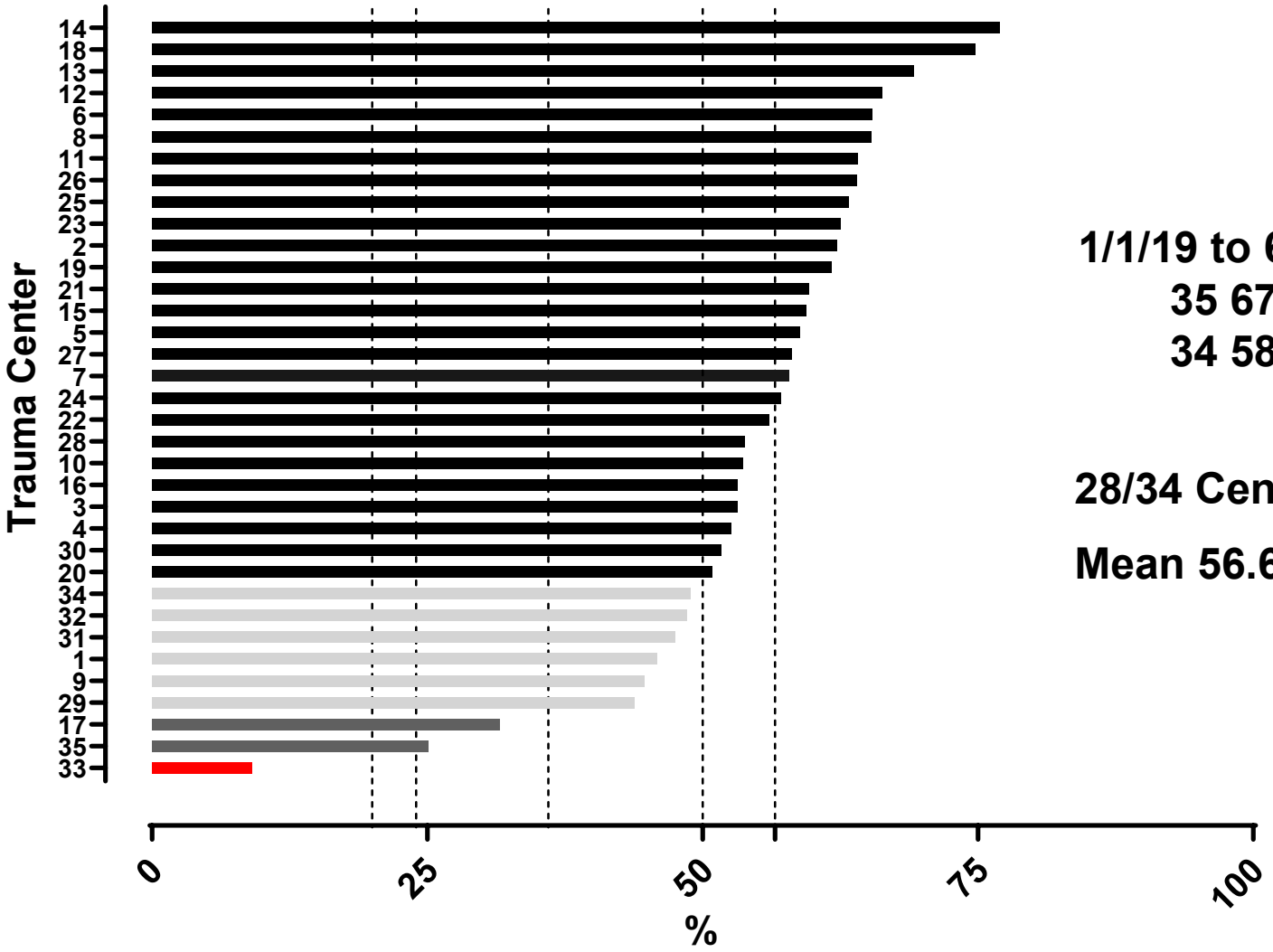



Timely VTE Prophylaxis
Points
10
9
8
7
6
5
4
3
2
1
0
0
8 3 9 5 1 12 11 23 18 10 29 13 2 35 32 24 16 22 14 34 6 15 21 7 17 25 19 30 27 28 4 31 26 20 33
Trauma Center

#5 VTE Prophylaxis with LMWH

- Low Molecular Weight Heparin (LMWH) Venous Thromboembolism (VTE) Prophylaxis Use in Trauma Service Admits (18 Mo's: 1/1/18-6/30/19)

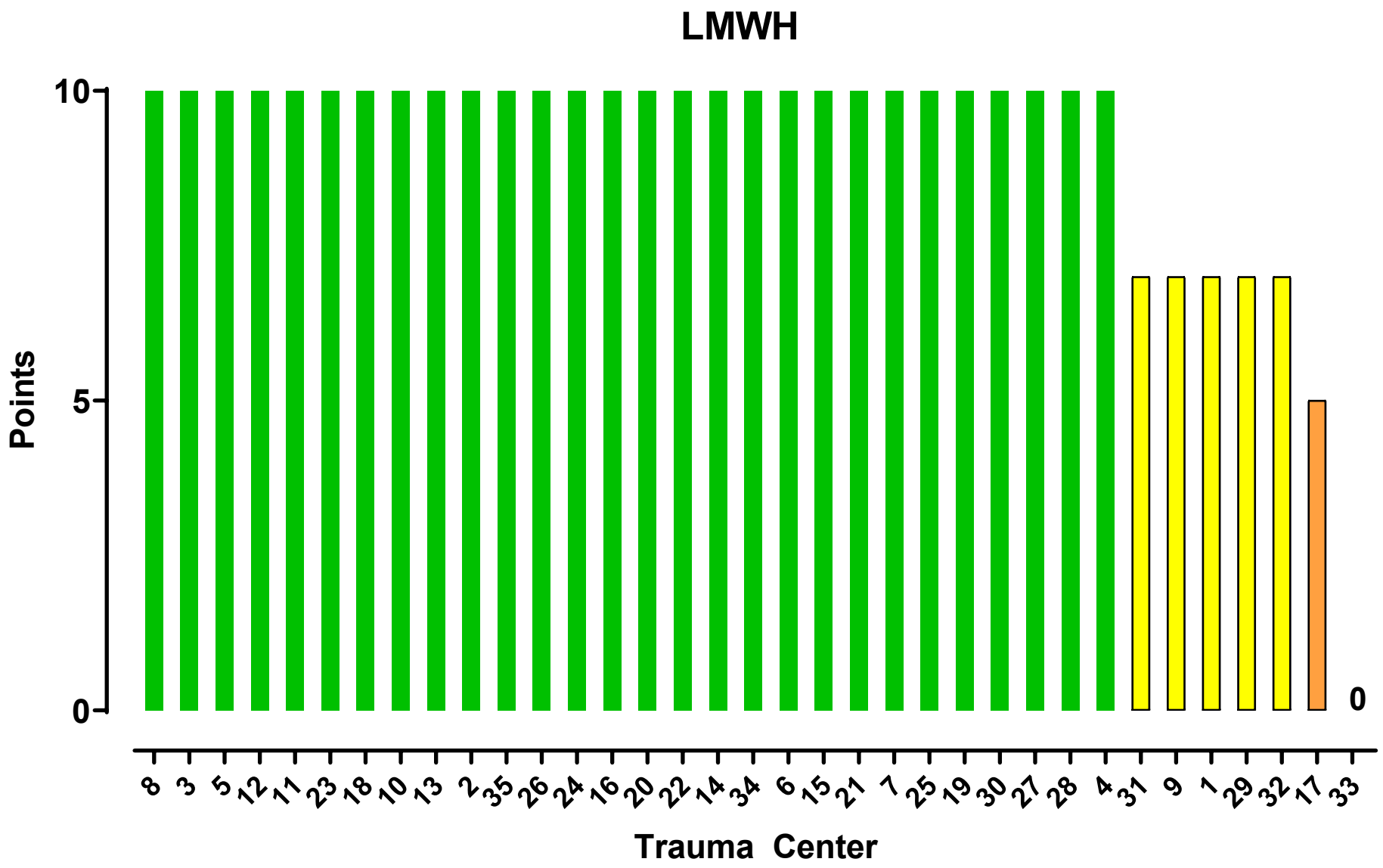
Metric #5 - VTE Prophylaxis LMWH Type
Cohort 2 - Admit to Trauma
1/1/18 - 6/30/19

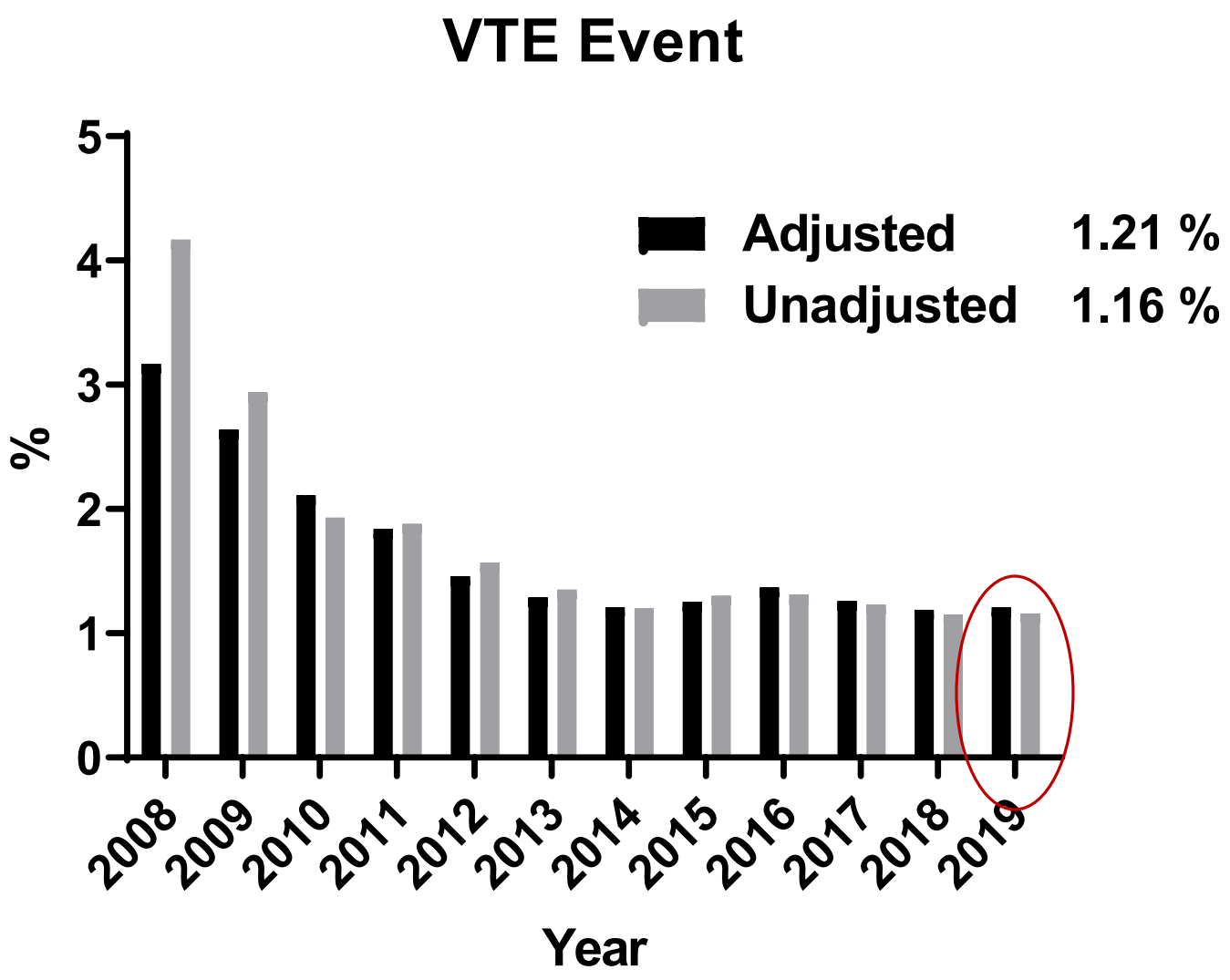


1/1/19 to 6/30/19
35 67%
34 58%

28/34 Centers ≥ 50% (+11)

Mean 56.6%

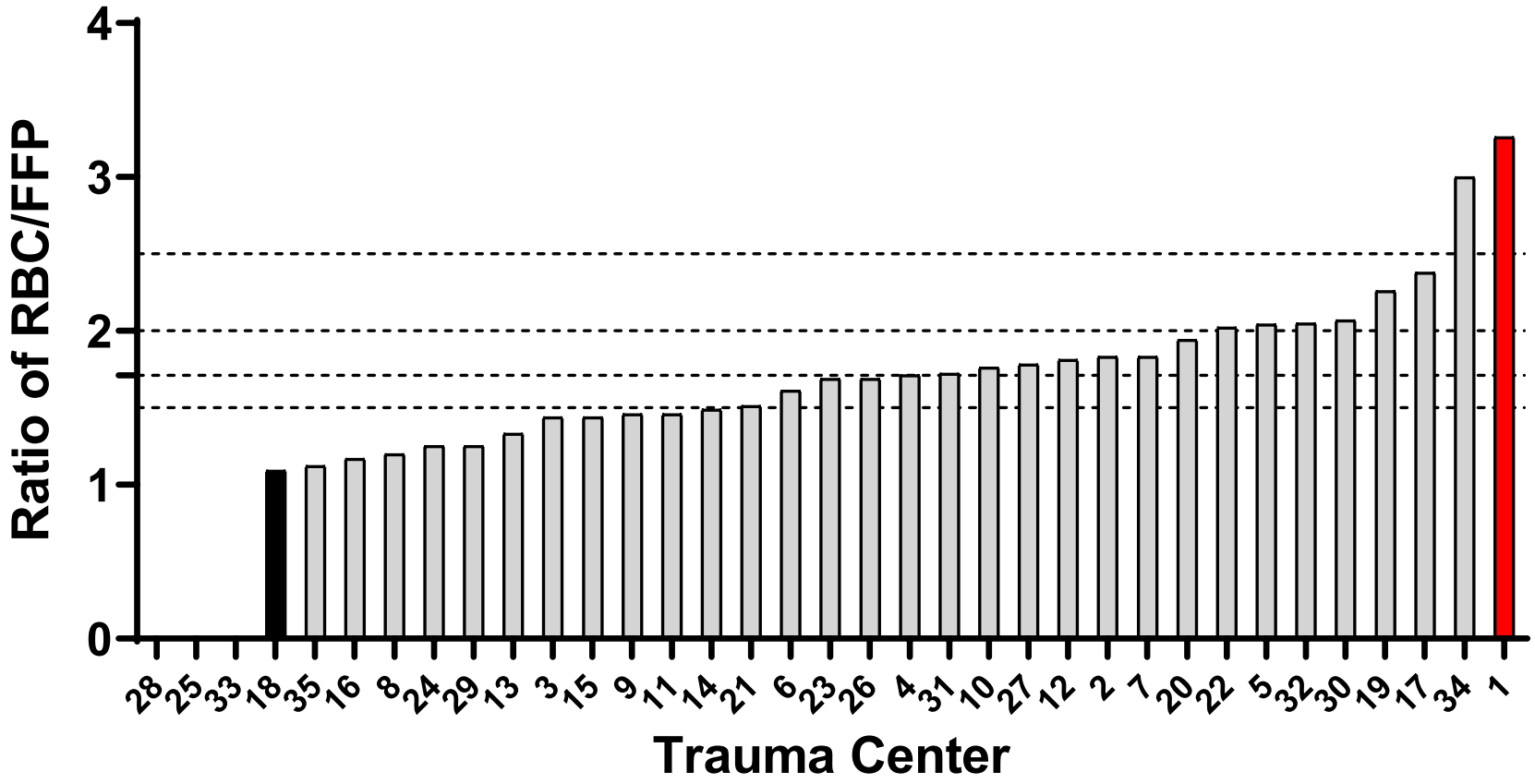

LMWH
Points
10
5
0
0
8 3 5 12 11 23 18 10 13 2 35 26 24 16 20 22 14 34 6 15 21 7 25 19 30 27 28 4 31 9 1 29 32 17 33
Trauma Center


VTE Event
Adjusted 1.21 %
Unadjusted 1.16 %
%
0
1
2
3
4
5
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year

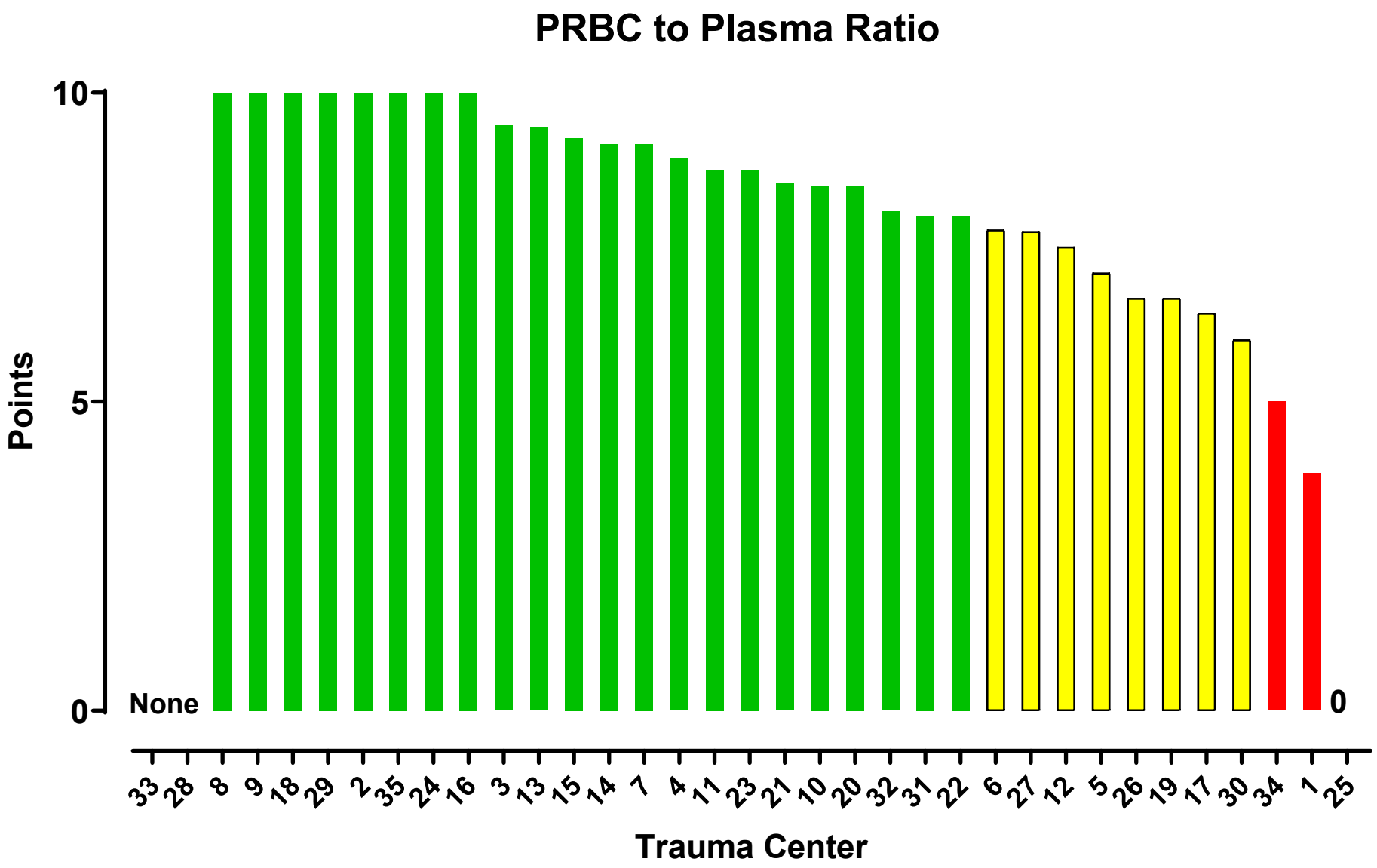
#6 Red Blood Cell to Plasma Ratio

- Red blood cell to plasma ratio (weighted mean points) of patients transfused ≥5 units in first 4 hours (18 Mo's: 1/1/18-6/30/19)

Metric #6 - RBC to FFP Ratio - Mean
Cohort 1 - MTQIP All
1/1/18 - 6/30/19



Mean 1.71


PRBC to Plasma Ratio
Points
10
5
0
None
0
33 28 8 9 18 29 2 35 24 16 3 13 15 14 7 4 11 23 21 10 20 32 31 22 6 27 12 5 26 19 17 30 34 1 25
Trauma Center

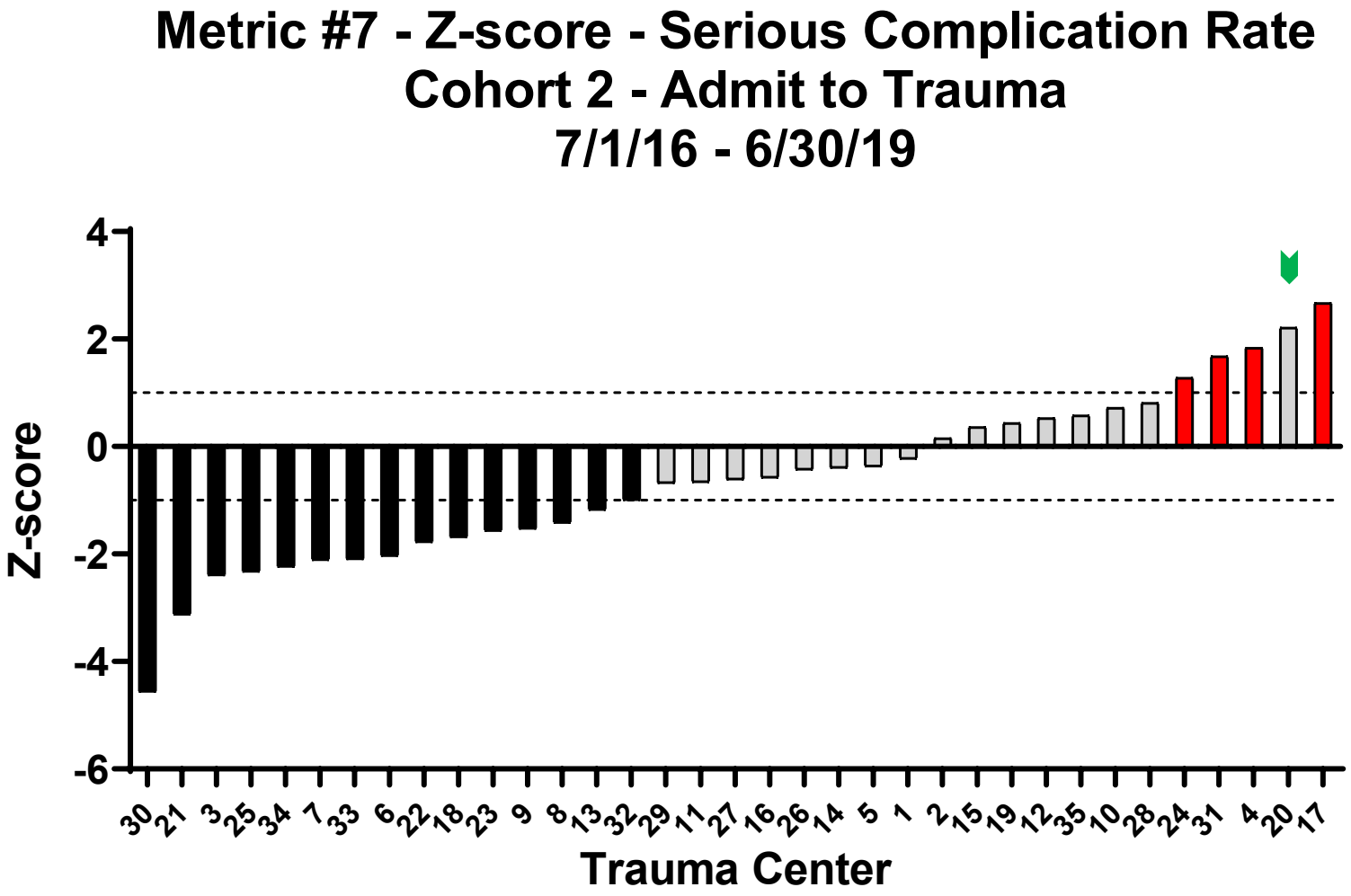
#7 Serious Complications

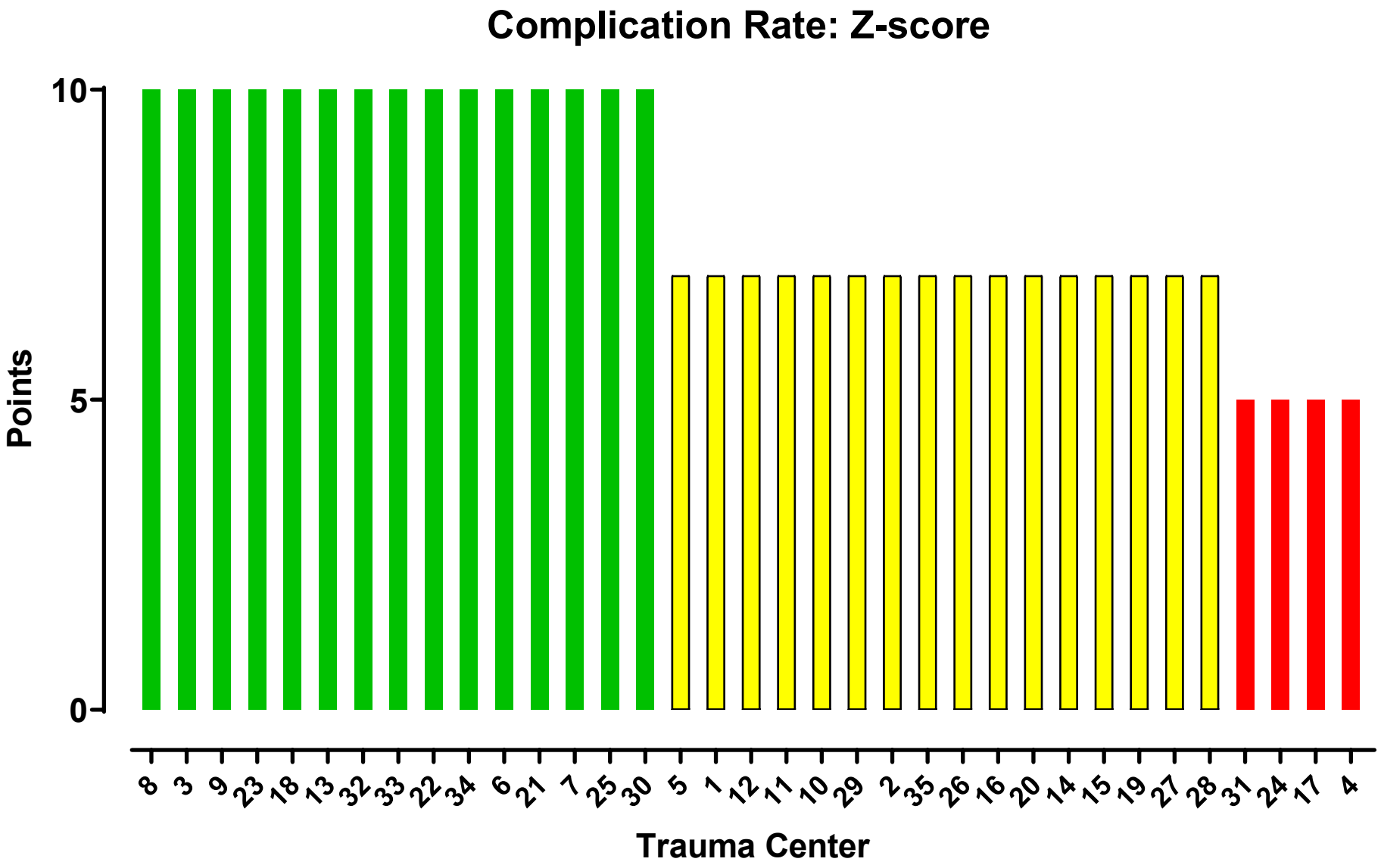
- Serious Complication Rate-Trauma Service Admits (3 years: 7/1/16-6/30/19)

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

#7 Serious Complication Rate (Z-score)

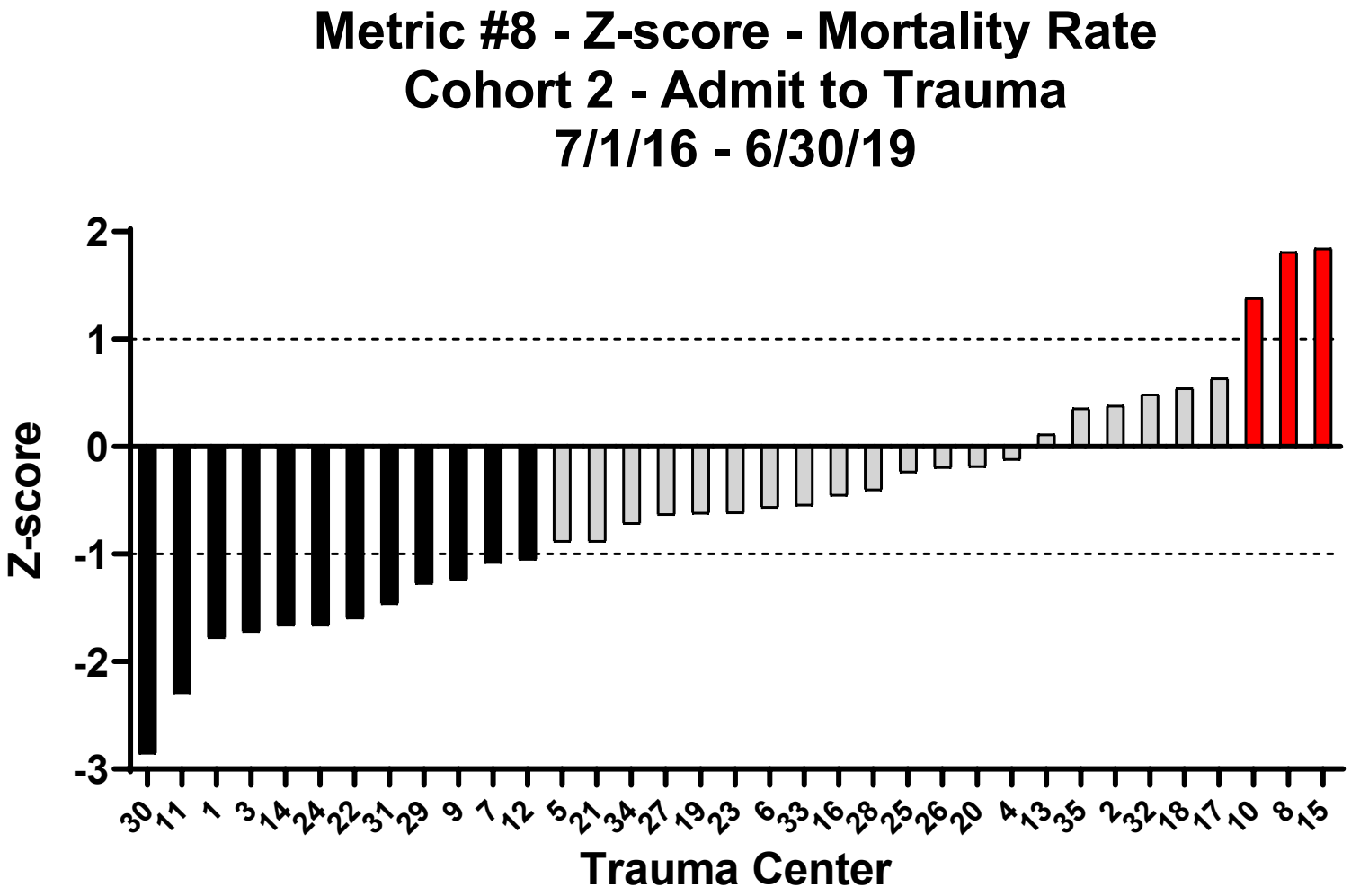


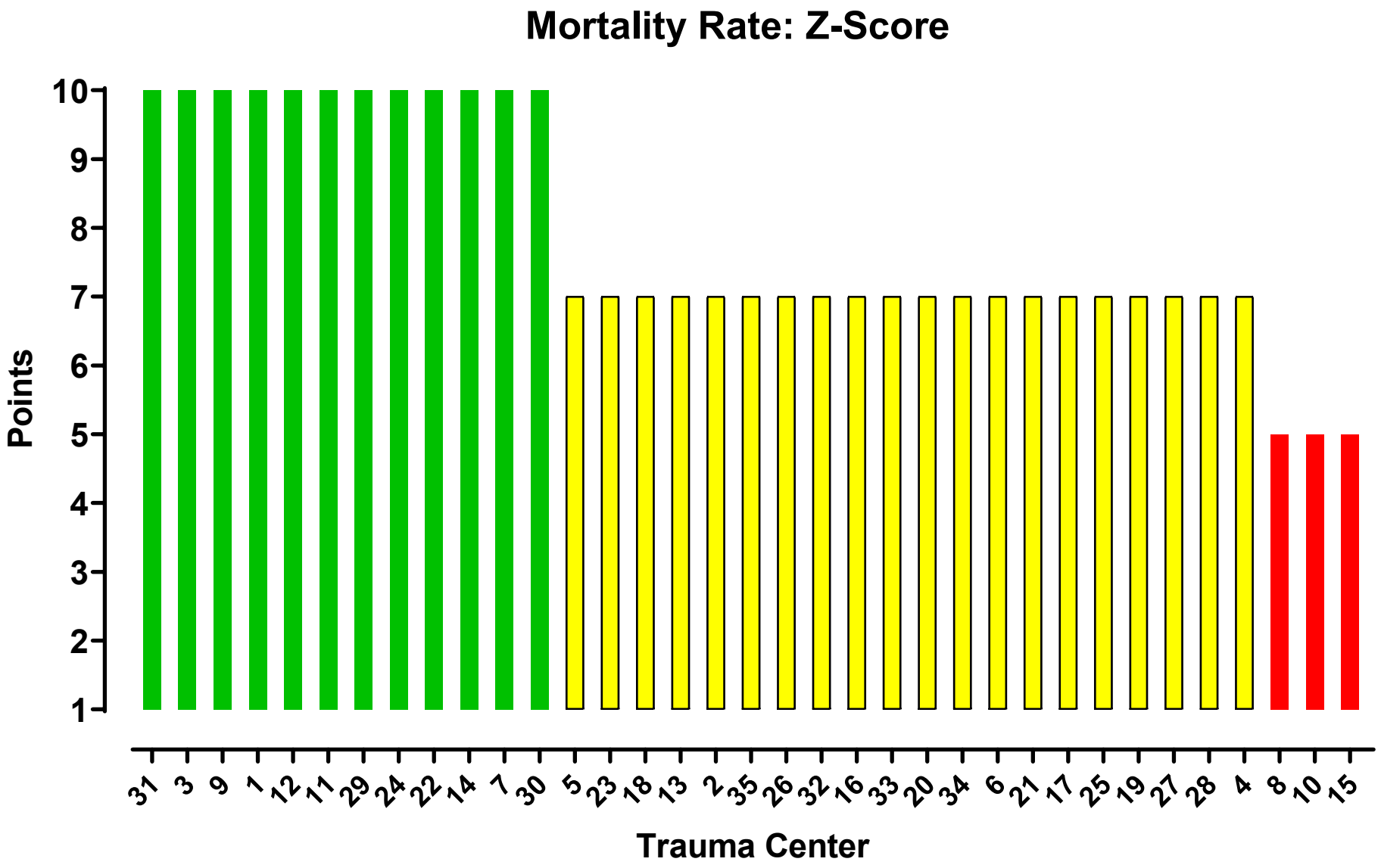

Complication Rate: Z-score
Points
10
5
0
8 3 9 23 18 13 32 33 22 34 6 21 7 25 30 5 1 12 11 10 29 2 35 26 16 20 14 15 19 27 28 31 24 17 4
Trauma Center

#8 Mortality

- Mortality Rate-Trauma Service Admits (3 years: 7/1/16-6/30/19)

#8 Mortality Rate (Z-score)




Mortality Rate: Z-Score
Points
10
9
8
7
6
5
4
3
2
1
31 3 9 1 12 11 29 24 22 14 7 30 5 23 18 13 2 35 26 32 16 33 20 34 6 21 17 25 19 27 28 4 8 10 15
Trauma Center

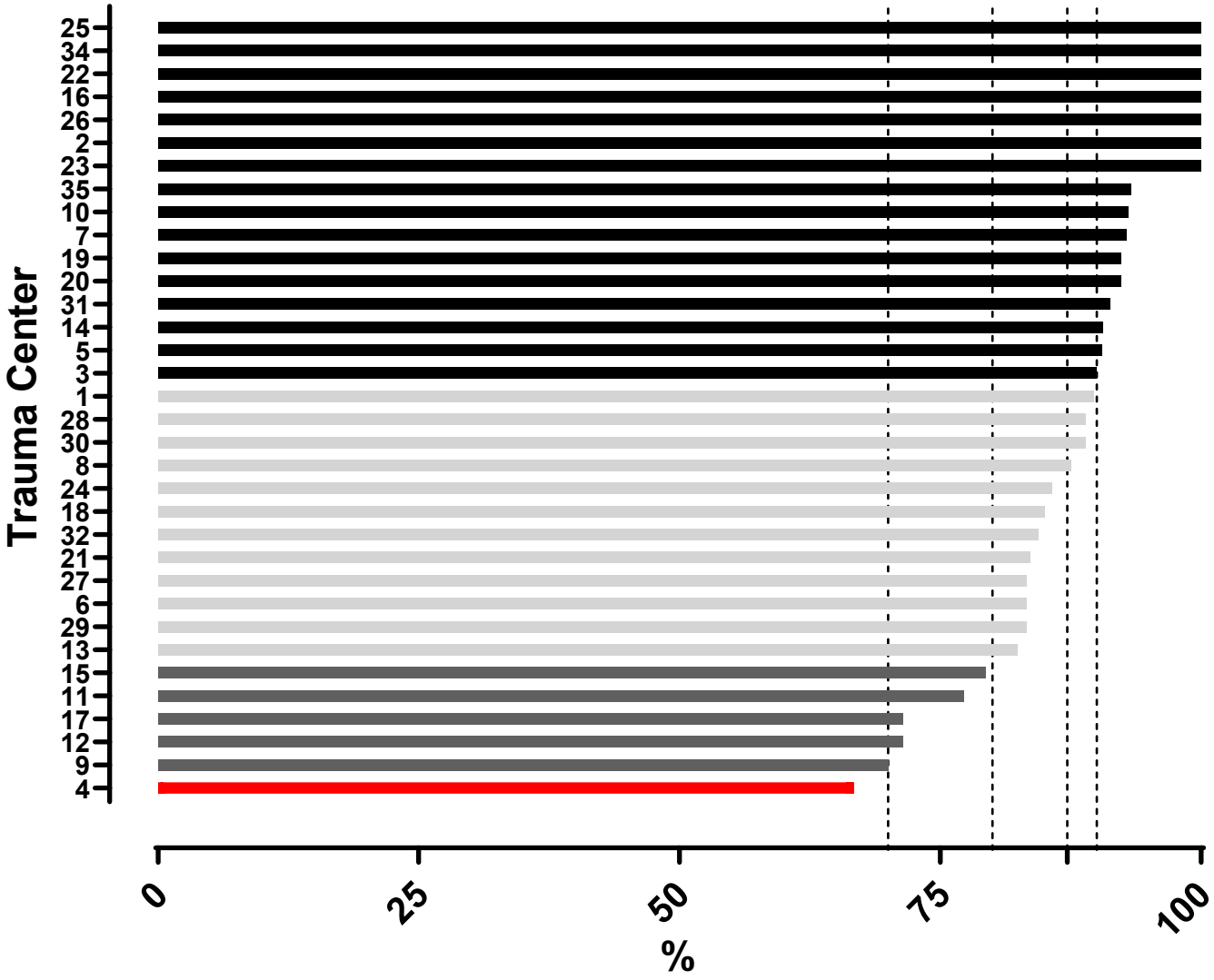
#9 Open Fracture Antibiotic Usage

- 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 = 7/1/18 to 6/30/19

#9 Open Fracture Antibiotic Usage

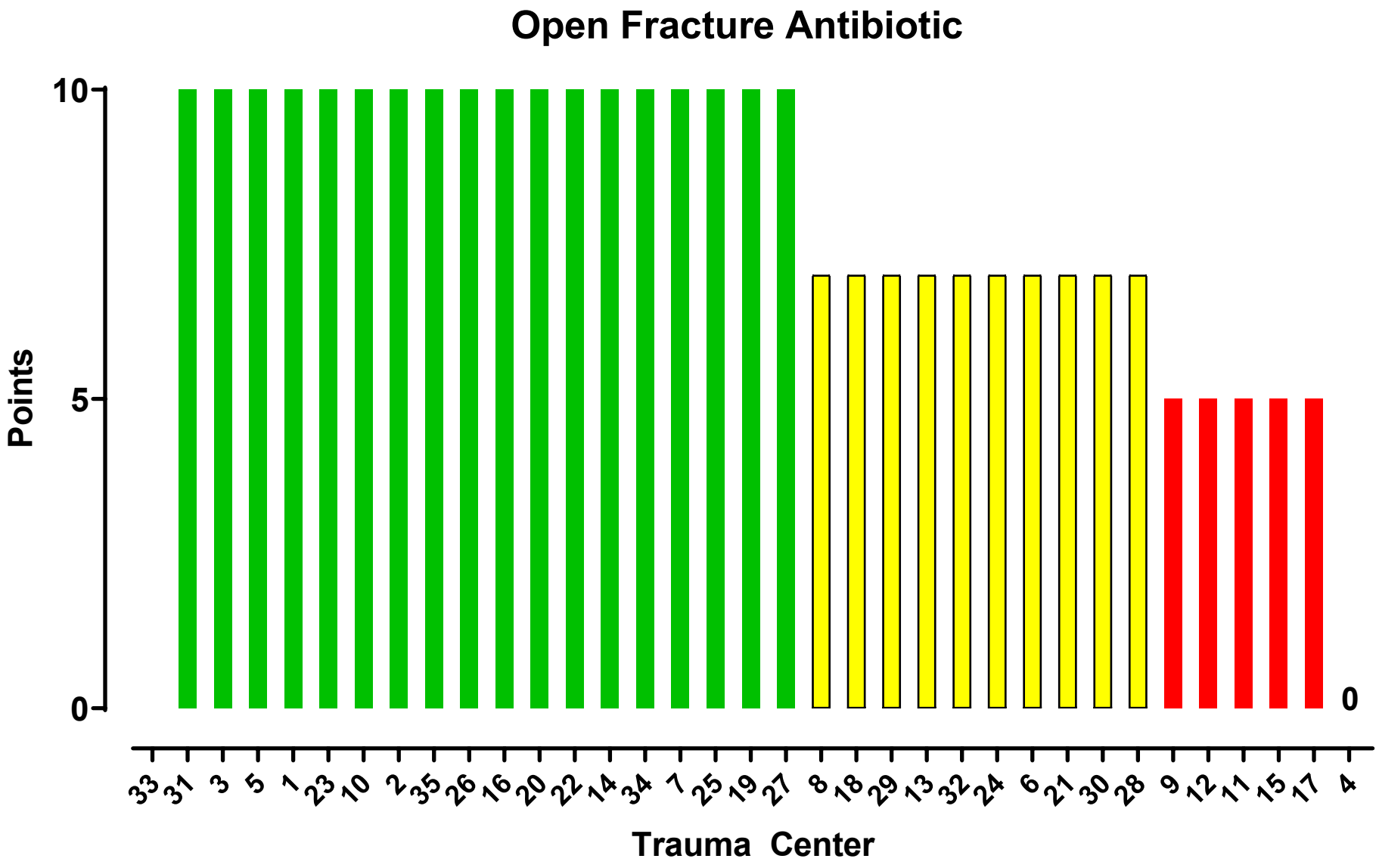
- Measure = % of patients with antibiotic type, date, time recorded ≤ 120 minutes
- ACS-COT Orange Book – VRC resources
  - Administration within 60 minutes
    - ACS OTA Ortho Update
    - ACS TQIP Best Practices Orthopedics

Metric #9 - Open Fracture - Time to Abx ≤ 120 min
Cohort 1 - MTQIP All
7/1/18 - 6/30/19

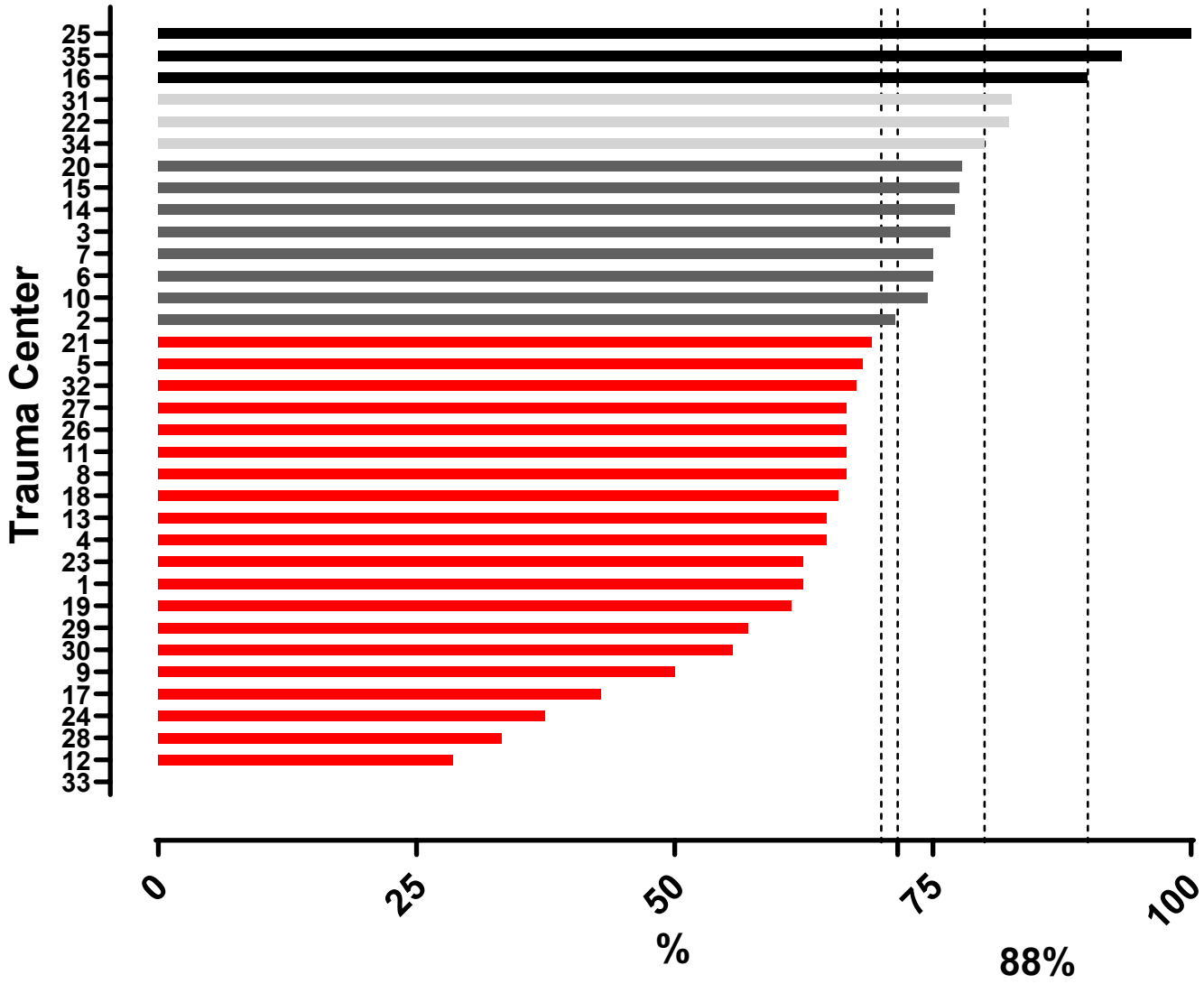


17/34 Centers ≥ 90% (+9)

Collaborative Mean = 87.2%


Open Fracture Antibiotic
Points
10
5
0
0
33 31 3 5 1 23 10 2 35 26 16 20 22 14 34 7 25 19 27 8 18 29 13 32 24 6 21 30 28 9 12 11 15 17 4
Trauma Center

Open Fracture - Time to Abx ≤ 60 min
Cohort 1 - MTQIP All
7/1/18 - 6/30/19



3/34 Centers ≥ 90%

Collaborative Mean = 71.6%

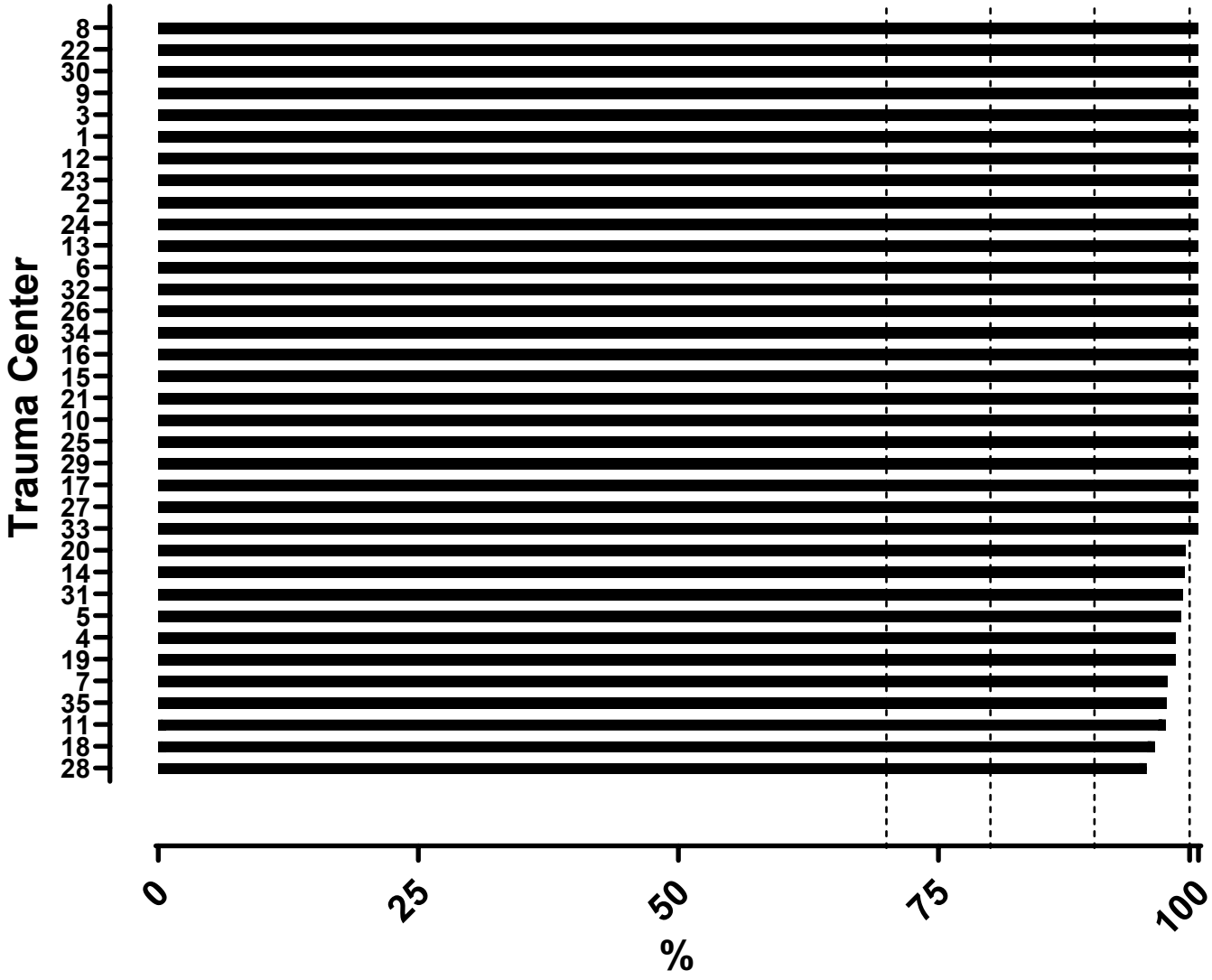
#10 Head CT Scan in ED on patient taking anticoagulation medication with TBI

- Head CT date and time from procedures
- Presence of prehospital anticoagulation or anti-platelet use
- TBI (AIS Head, excluding NFS, scalp, neck, hypoxia)
- Cohort1, Blunt mechanism
- Exclude direct admissions and transfer in
- No Signs of Life = Exclude DOAs
- Transfers Out = Include Transfers Out
- Time Period = 7/1/18 to 6/30/19

#10 Head CT

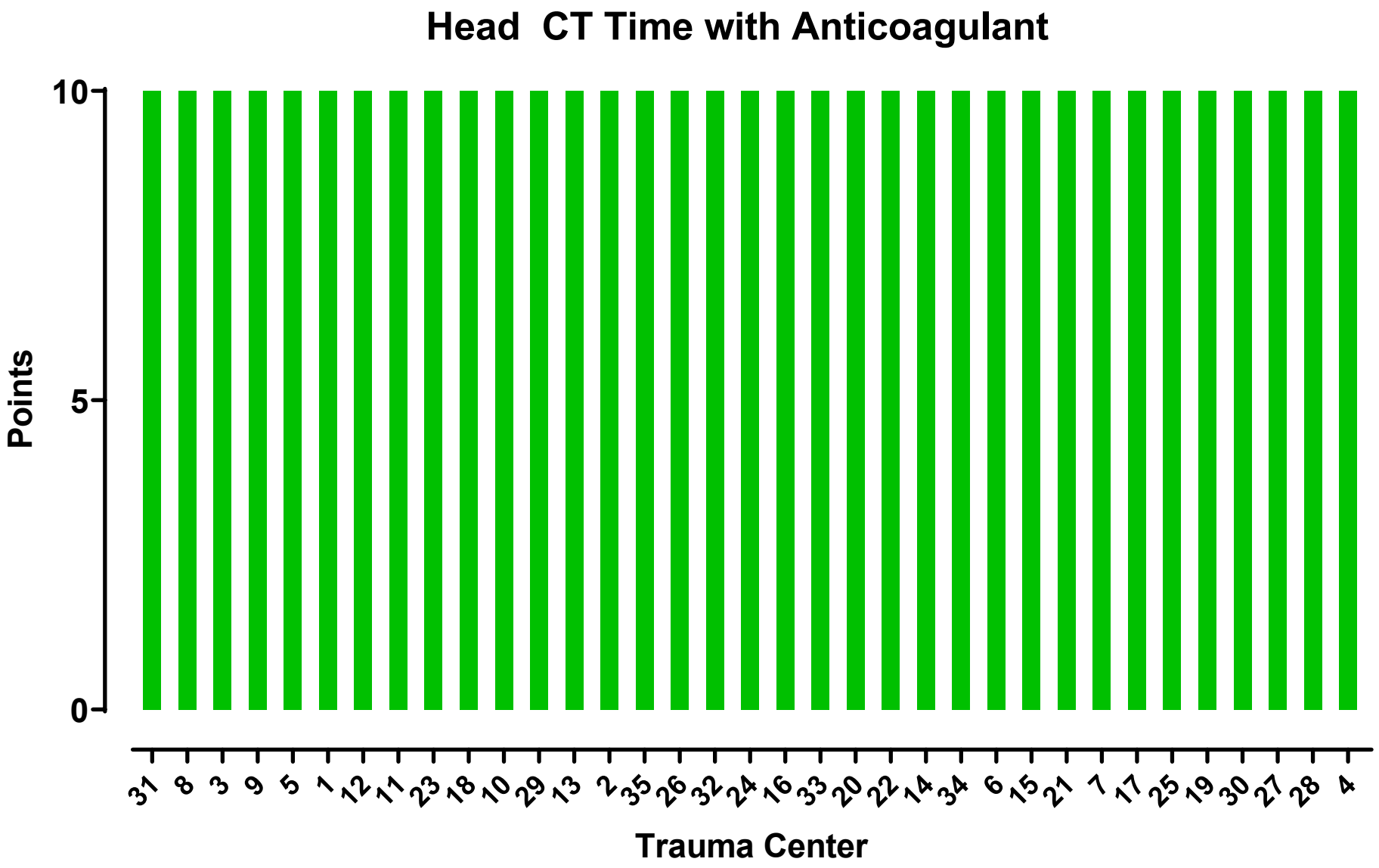
- Measure = % of patients with Head CT, date, and time
- Timing
- Treatment
  - Later in program

Metric #10 - ED Head CT - Code, Date and Time
Cohort 1 - MTQIP All, TBI on Anticoagulant
7/1/18 - 6/30/19

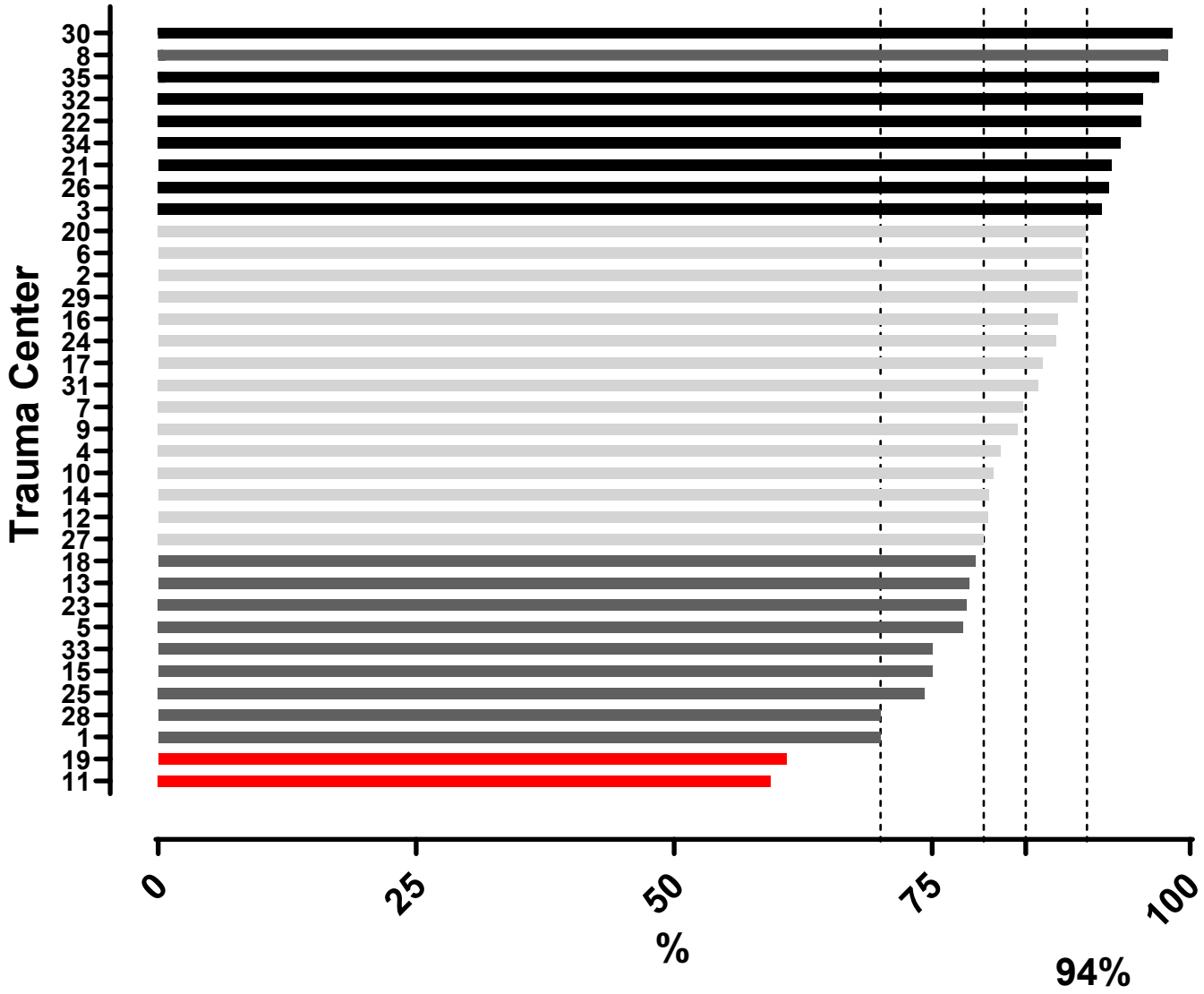


Mean 99.2%

34/34 Centers ≥ 90% (+4)


Head CT Time with Anticoagulant
Points
10
5
0
31 8 3 9 5 1 12 11 23 18 10 29 13 2 35 26 32 24 16 33 20 22 14 34 6 15 21 7 17 25 19 30 27 28 4
Trauma Center

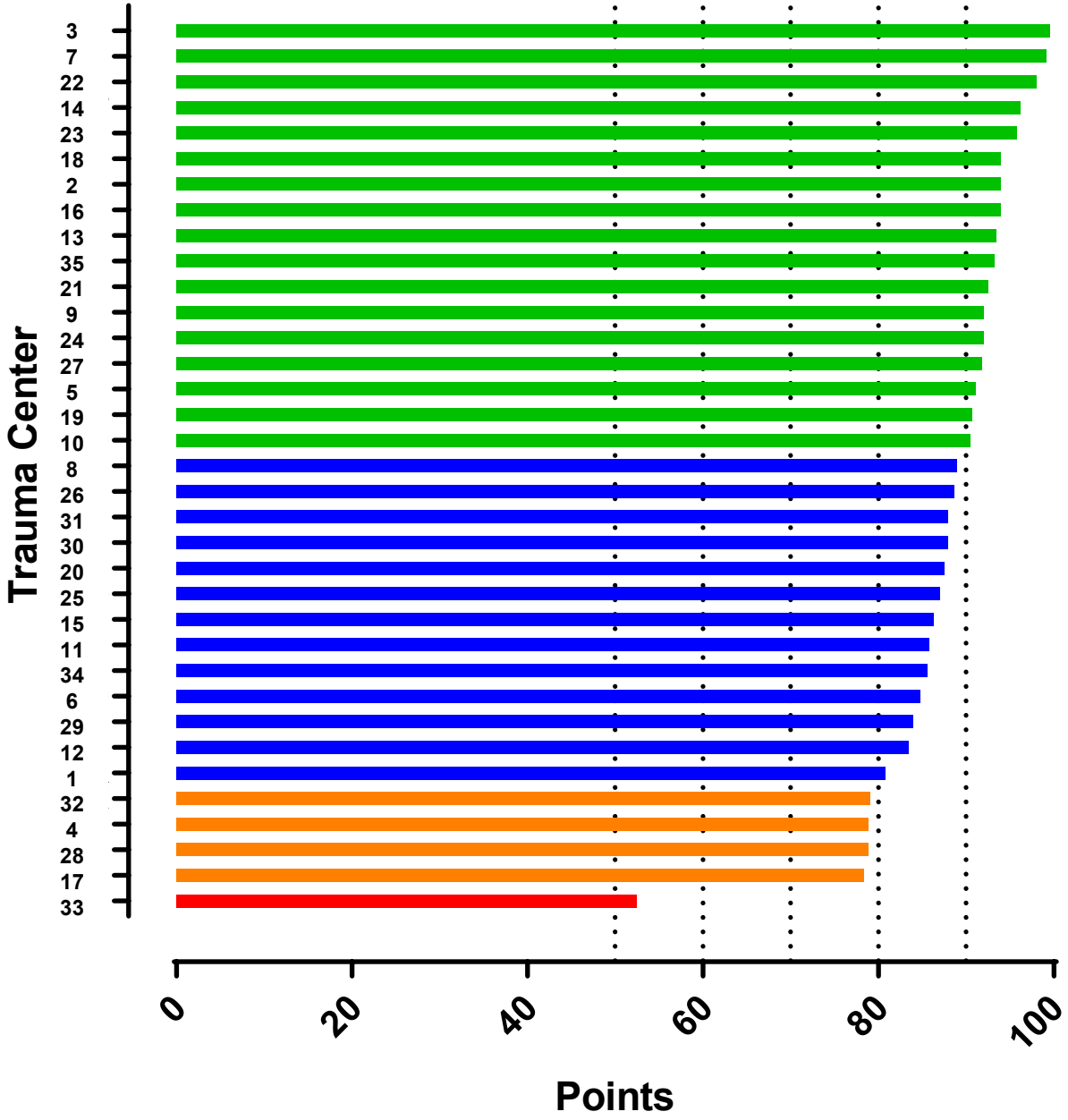
2020 Metric #10 - ED Head CT ≤ 120 min
Cohort 1 - MTQIP All, TBI on Anticoagulant (Excluding ASA)
7/1/18 - 6/30/19



9/34 Centers ≥ 90%

Mean 84.1%

2018 CQI Score



2019

89.2%

99 – 78%

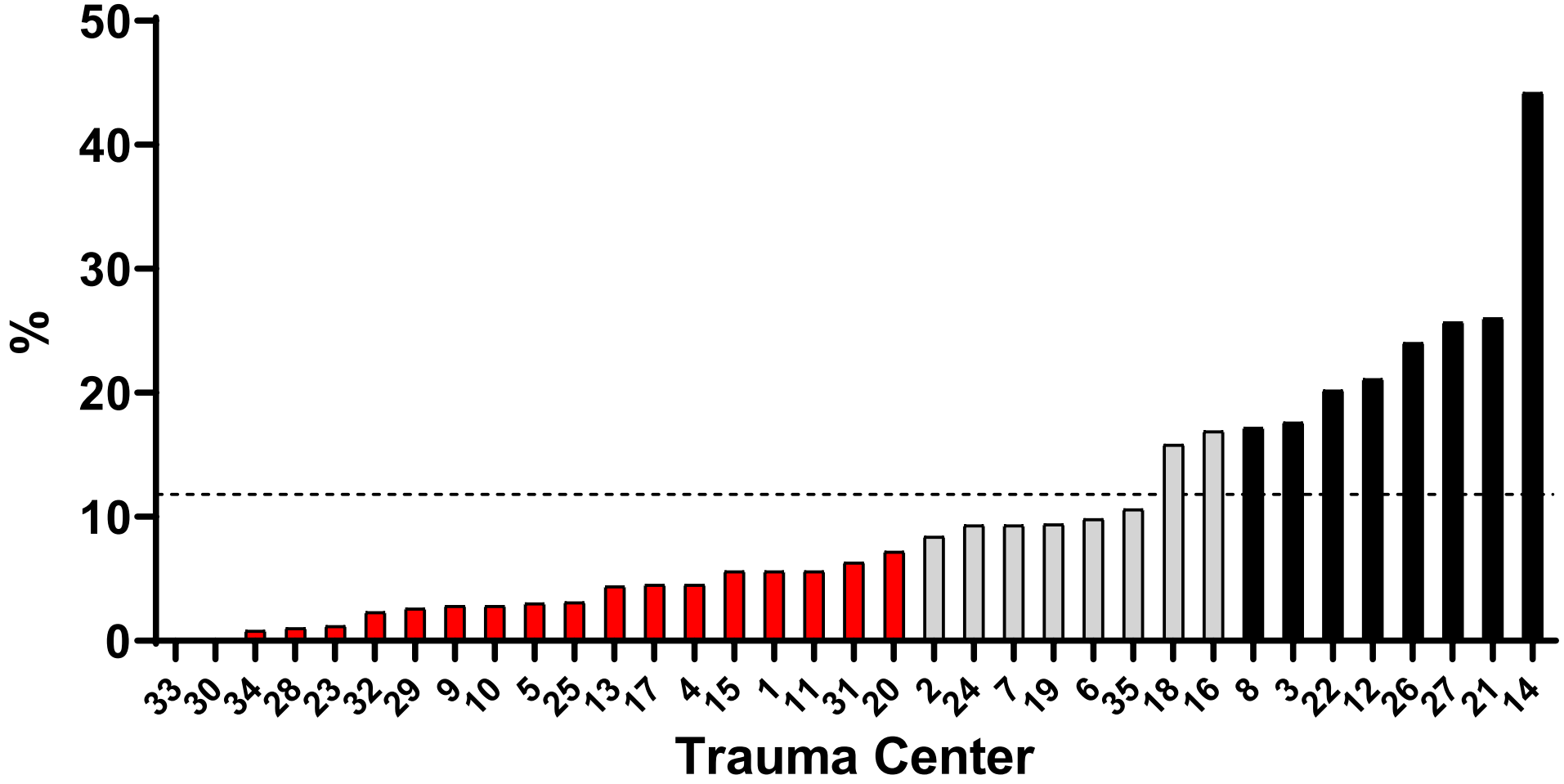
2018

87.9%

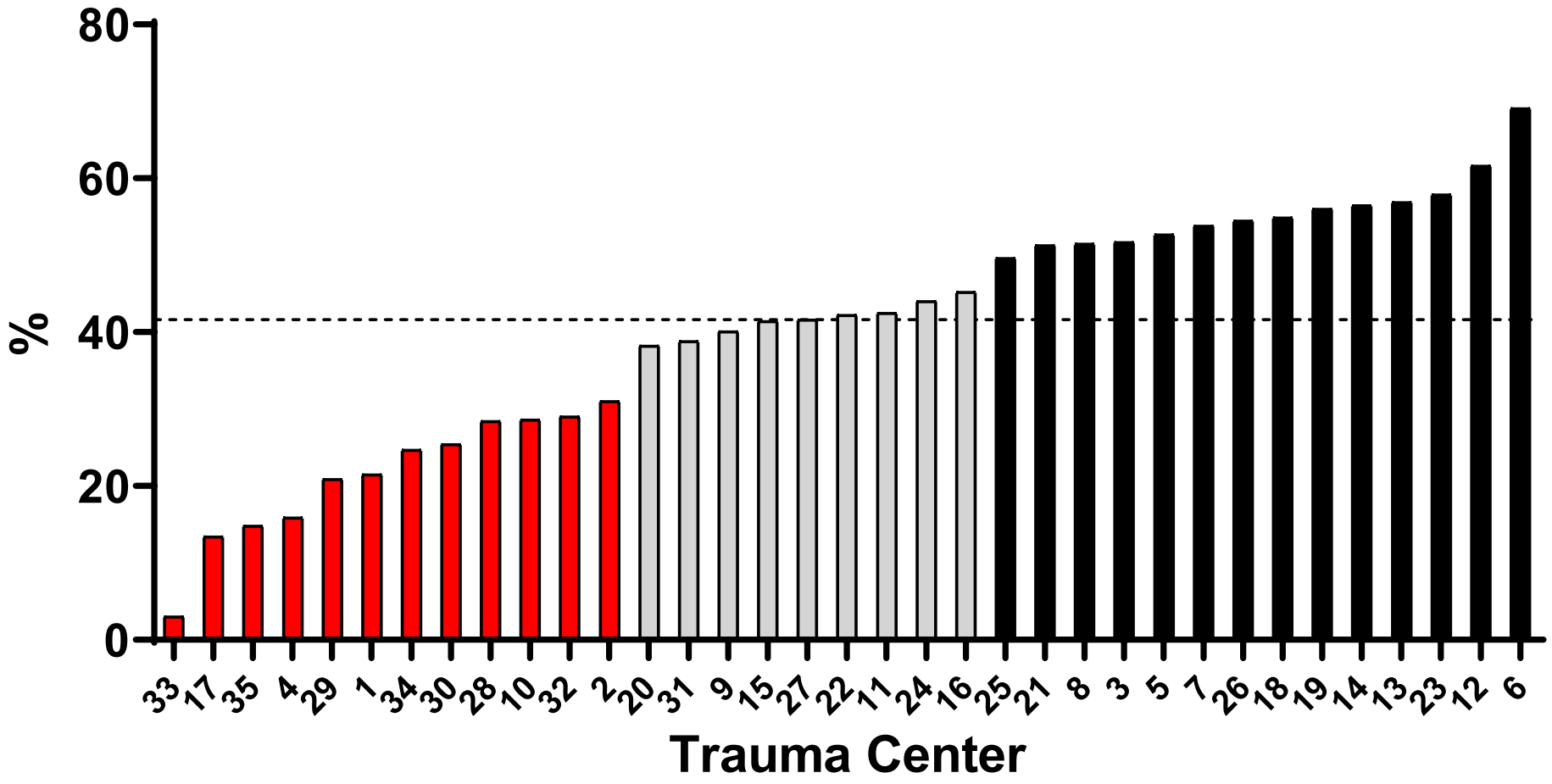
99 – 69%

2014	86%
2015	86%
2016	92%
2017	85%
2018	86%
2019	89%

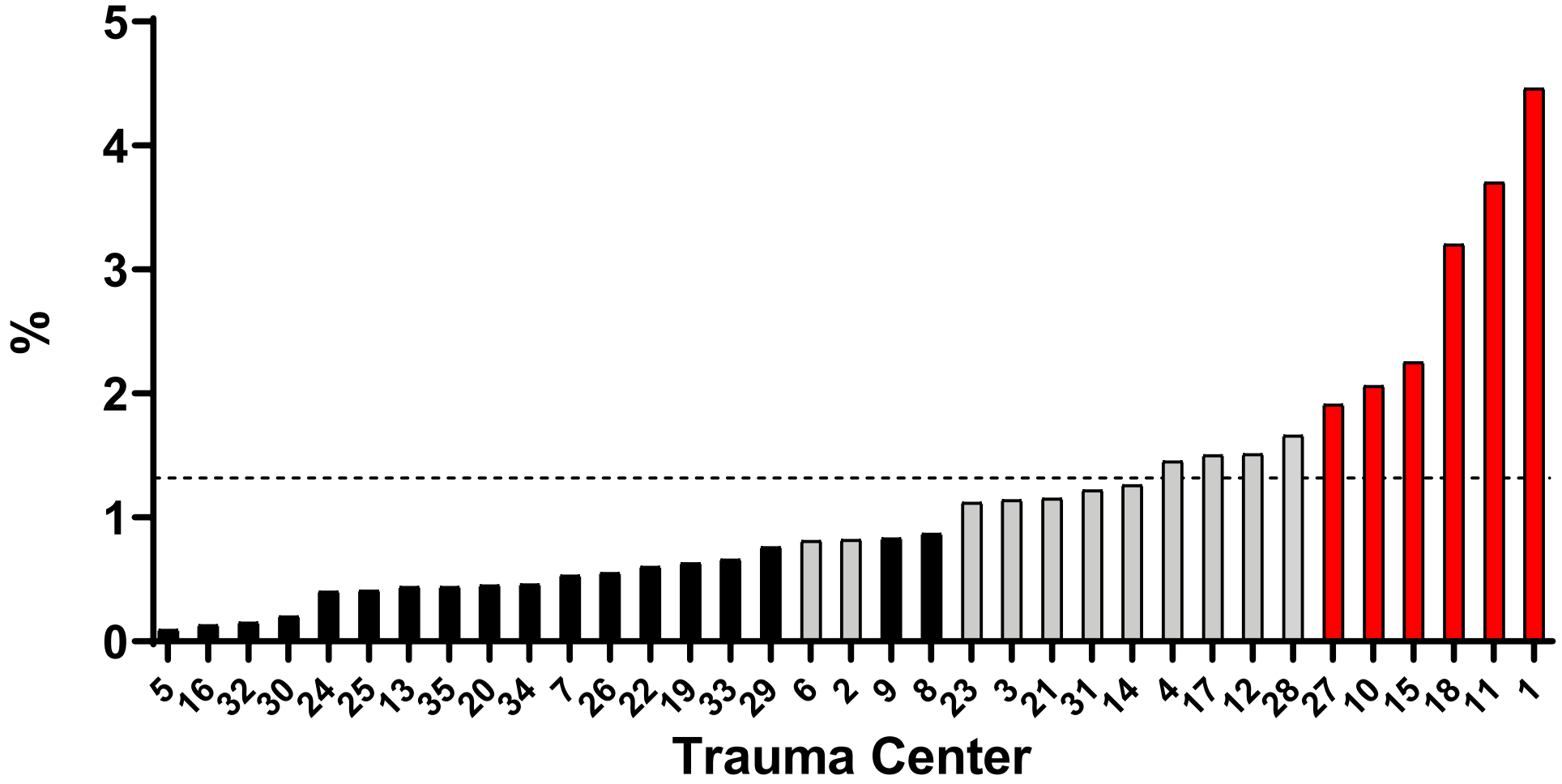
VTE LMWH ≤ 48 hours
Cohort - TBI

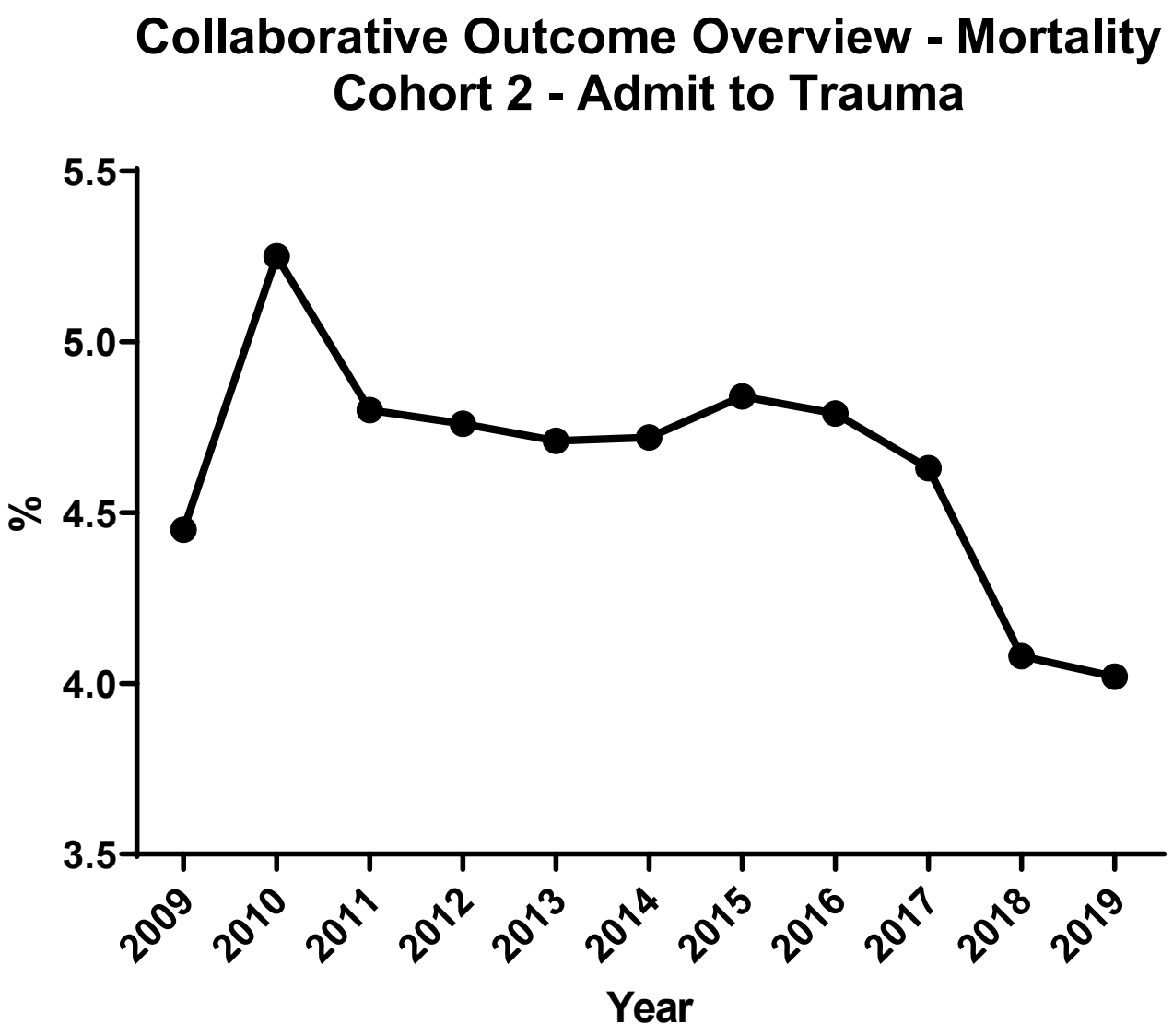


VTE LMWH ≤ 48 hours
Cohort - Spine Injury

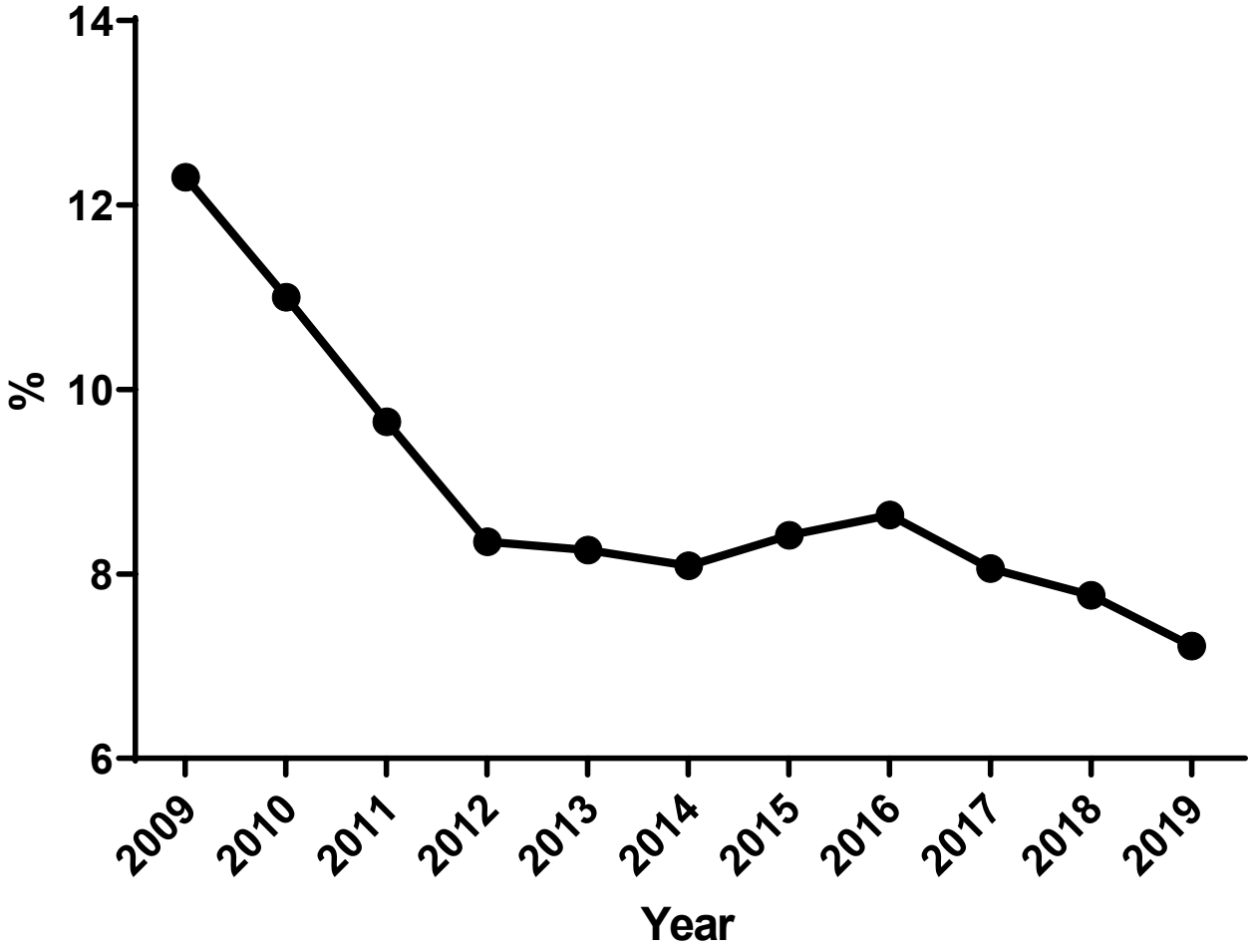


VAP
Cohort 2 - Admit to Trauma




Collaborative Outcome Overview - Mortality
Cohort 2 - Admit to Trauma
5.5
5.0
4.5
4.0
3.5
%
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year

Collaborative Outcome Overview - Serious Cx
Cohort 2 - Admit to Trauma



MTQIP Program Manager Data Update

Jill Jakubus, PA-C

Topics

- Validation Paper (EAST)
  2019 Validation Results
  Hospital LOS
  GCS 40
  Research in Progress

PULL BACK THE CURTAIN: EXTERNAL DATA VALIDATION IS AN ESSENTIAL ELEMENT OF QUALITY IMPROVEMENT BENCHMARK REPORTING

Jill L. Jakubus, PA-C

Disclosures

- Jill L. Jakubus, Shauna L. Di Pasquo, Judy N. Mikhail, Anne H. Cain-Nielsen, and Mark R. Hemmila receive salary support from Blue Cross Blue Shield of Michigan and Blue Care Network (a nonprofit mutual company) through their support of the Michigan Trauma Quality Improvement Program.
- Peter C. Jenkins is supported by the National Heart, Lung, and Blood Institute Career Development Program in Emergency Care Research K12-KC068853.

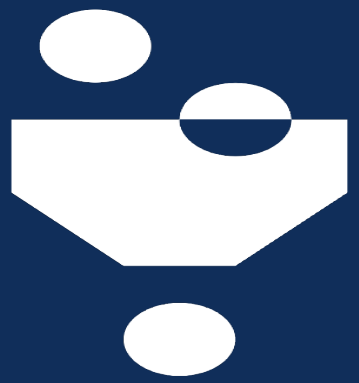
Background

MTQIP Centers

Collaborative Meetings
Benchmark Reports

Annual Validation

Methods



ED Profile	Validator	Error Type	Center
Activation Level	Full		Full
Initial ED/Hospital Temperature	96.3	1	NK/NR
Initial ED/Hospital HR	203		203
Initial ED/Hospital SBP	54	2	60
Intubation Location	ED		ED
Initial ED/Hospital GCS - Eye	1		1
Initial ED/Hospital GCS - Verbal	1		1
Initial ED/Hospital GCS - Motor	1		1
Initial ED/Hospital GCS Total	3		3

Selection Criteria | **Case Re-Abstraction** | **Appeal/Report**

Case List | **Data Validation** | **Feedback**

Impact of external data validation on data validity and reliability for benchmarking variables

29 Centers
166 Center Visits

1,243 Cases
127,238 Variables

↑ Data Accuracy

↑ Data Reliability

6.2% Error Rate: Visit 1

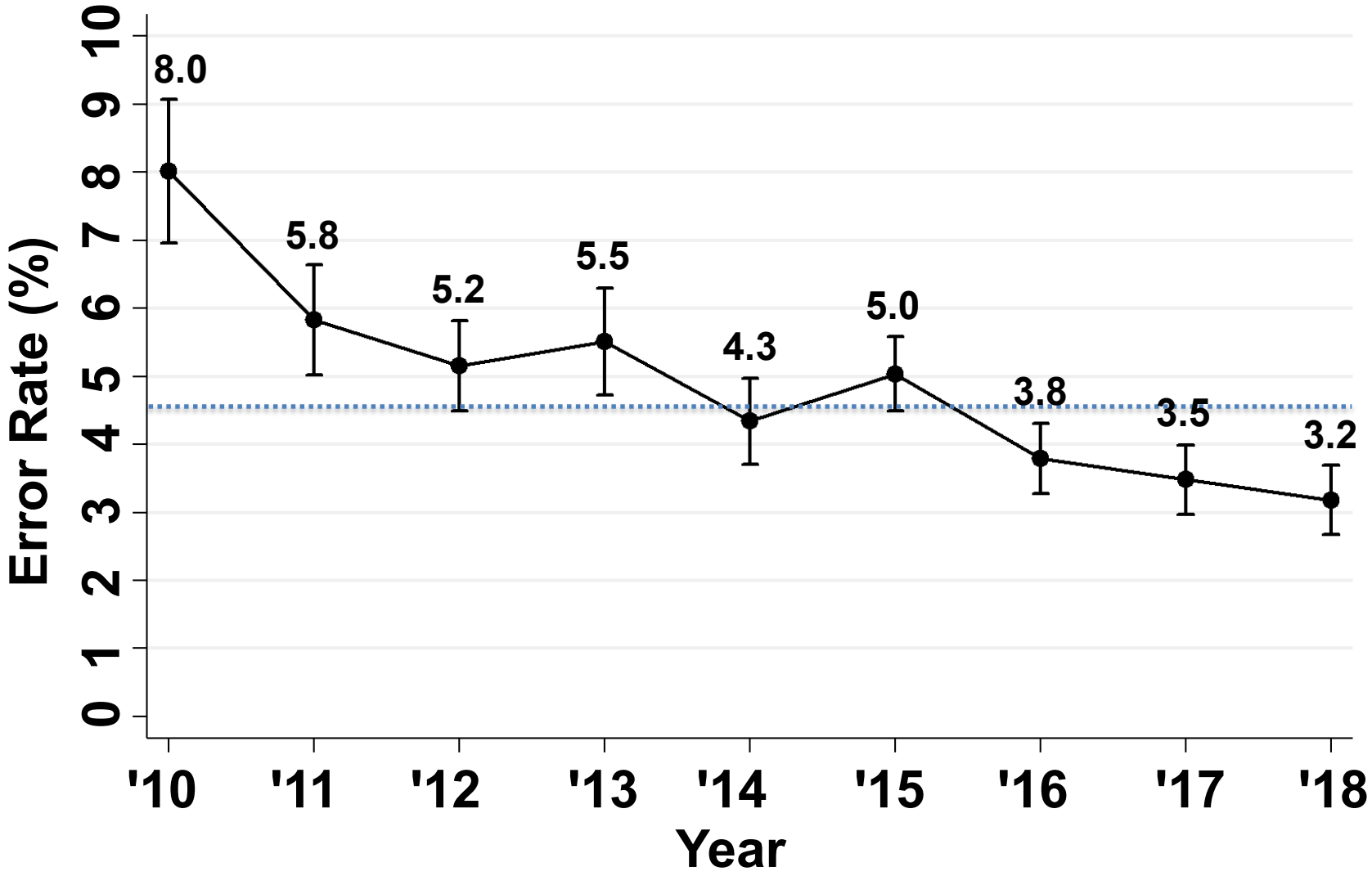
↓ Error Rate : Visits 2-8

90% Kappa > 0.61
Comorbids (n=20)

39% Error rate ↓
Comorbids (n=18)

Data Validation Error Rate by Year

Linear Adjusted Prediction (95% CI)



Topics

- ✓ Validation Paper (EAST)
- 2019 Validation Results
  Hospital LOS
  GCS 40
  Research in Progress

Scheduling

All centers not validated the previous year
8 centers with the highest error rates
Random sampling until a total of 25 reached

2019 Validation Centers

www.mtqip.org* > *Calendar* > *Data Validation

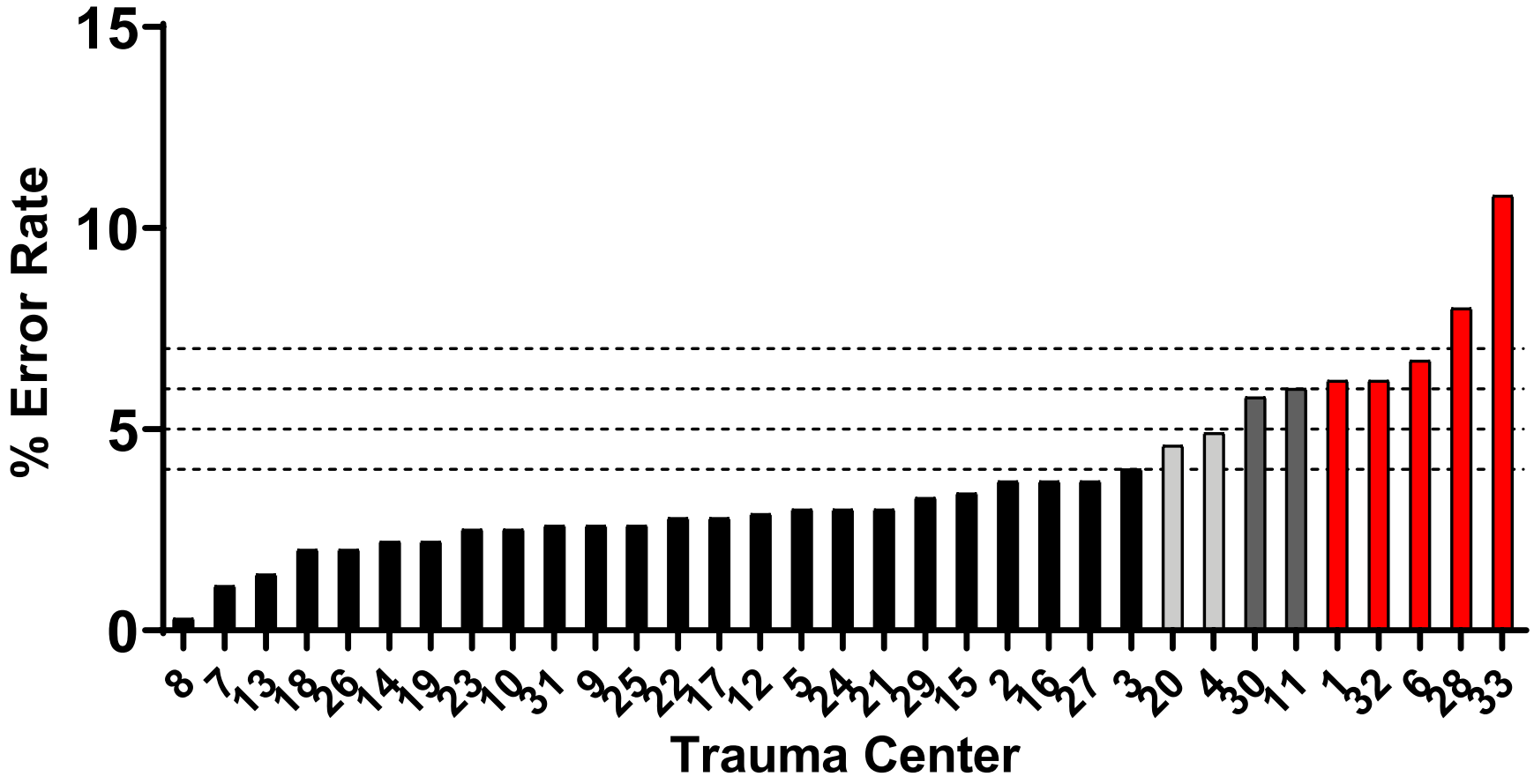
1. Ascension St. Mary's Hospital
2. Beaumont Hospital - Dearborn
3. Beaumont Hospital - Farmington Hills
4. Beaumont Hospital - Royal Oak
5. Beaumont Hospital - Troy
6. Bronson Methodist Hospital
7. Covenant HealthCare
8. Detroit Receiving Hospital
9. Genesys Health System
10. Henry Ford Allegiance
11. Henry Ford Hospital
12. Hurley Medical Center
13. McLaren Lapeer
14. McLaren Oakland
15. Mercy Health Muskegon
16. Michigan Medicine
17. MidMichigan Medical Center
18. Providence Hospital - Southfield
19. Sinai-Grace Hospital
20. Sparrow Hospital
21. St. Joseph Mercy Hospital Ann Arbor
22. St. Joseph Mercy Oakland
23. St. Mary Mercy Livonia Hospital
24. University of Minnesota
25. UP Health System Marquette

Centers Deferred to 2020 Validation

www.mtqip.org* > *Calendar* > *Data Validation

1. **Ascension St. John Hospital**
2. **Beaumont Hospital - Trenton**
3. **Borgess Health**
4. **Henry Ford Macomb Hospital**
5. **McLaren Macomb**
6. **Mercy Health Saint Mary's**
7. **Munson Medical Center**
8. **Spectrum Health**

Metric #3 - Data Validation Accuracy
Last Processed Report



Data quality questions?

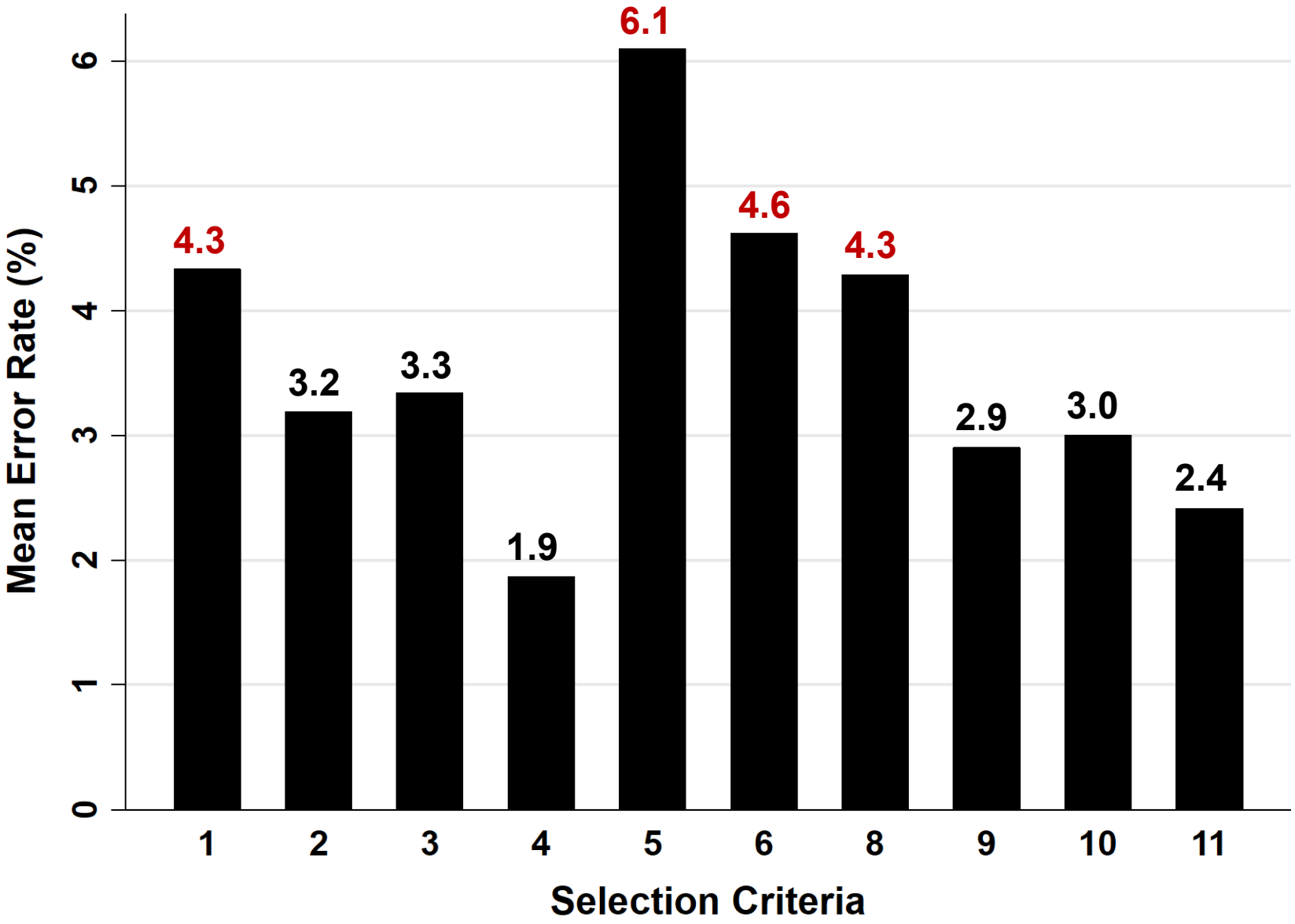
Highest error selection criteria?

Case Selection Criteria

1) ISS < 16 and mortality
2) ISS > 24 and no complications and hospital days > 1
3) Length of stay > 14 days and no complication or mortality
4) Age > 64 and no co-morbidities
5) Mechanical ventilator days > 7 and no pneumonia
6) Motor GCS = 1 and no complications and hospital days > 1
7) ~~Hematocrit < 22.0 and no PRBC within 4 hours or IV fluid captured~~
8) ISS > 24 and no complications and ICU days > 7
9) ISS > 9 and no injury in the AIS head and no VTE prophylaxis and length of stay > 2 days
10) ED BP < 90 and lowest SBP < 90 and PRBC within 4 hours = 0
11) Antibiotic days > 6 and no complications

Data Validation Mean Error Rate by Selection Criteria

2018 – 2019 Validation Cases

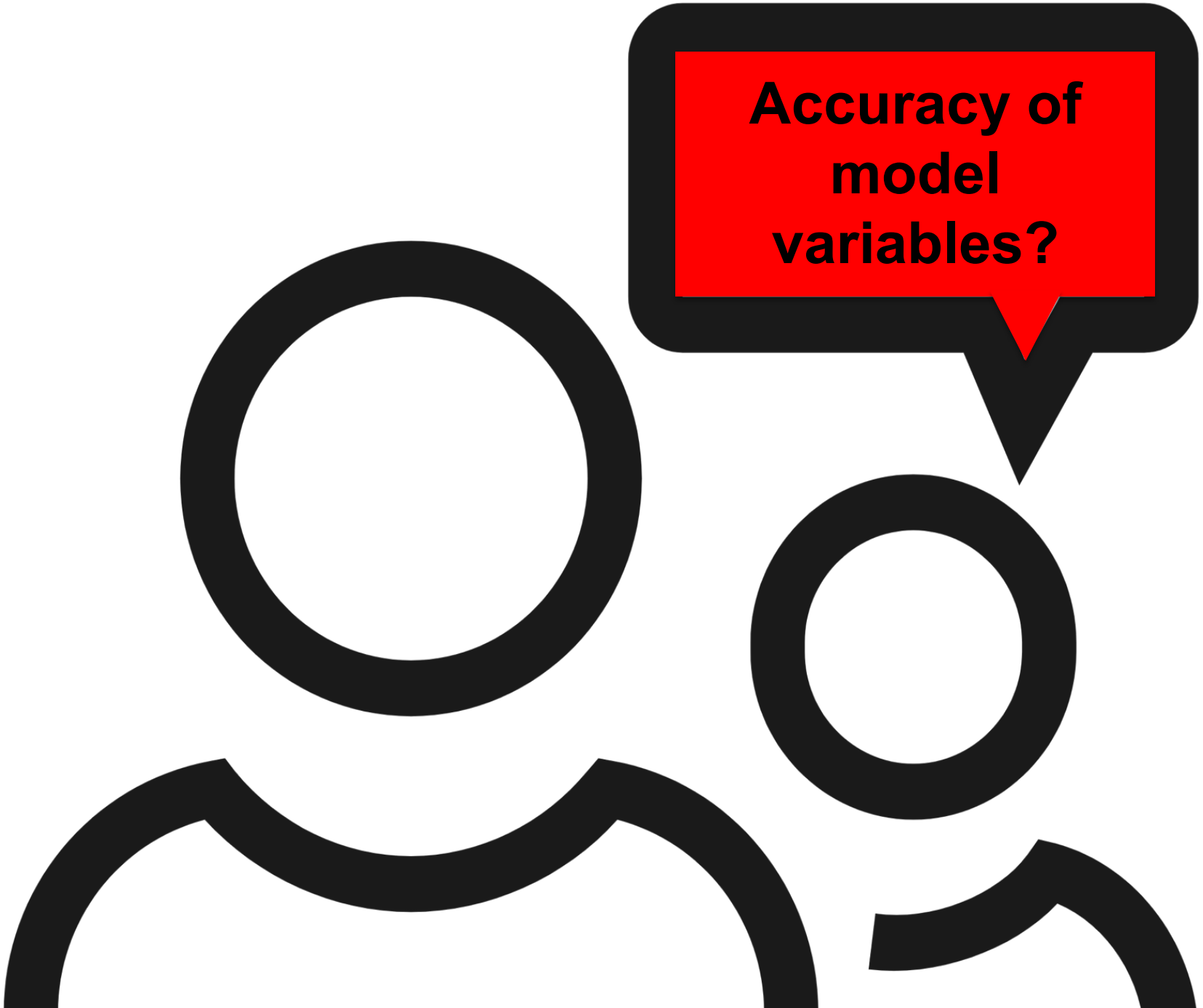


Case Selection Criteria

1) ISS < 16 and mortality

5) Mechanical ventilator days > 7 and no pneumonia
6) Motor GCS = 1 and no complications and hospital days > 1

8) ISS > 24 and no complications and ICU days > 7


Accuracy of model variables?

Validated Model Variables

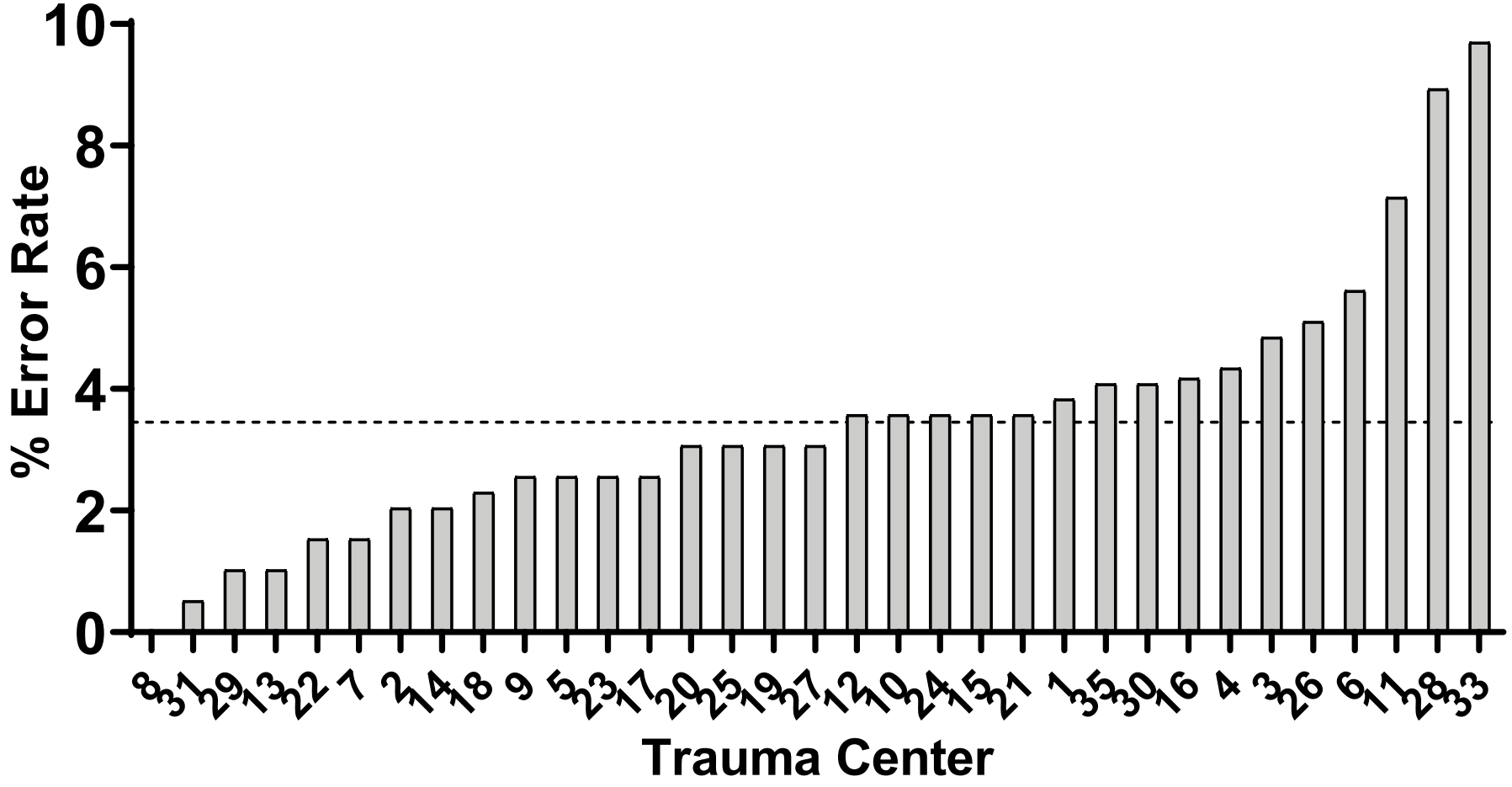
ED pulse
ED systolic blood pressure
ED GCS – motor

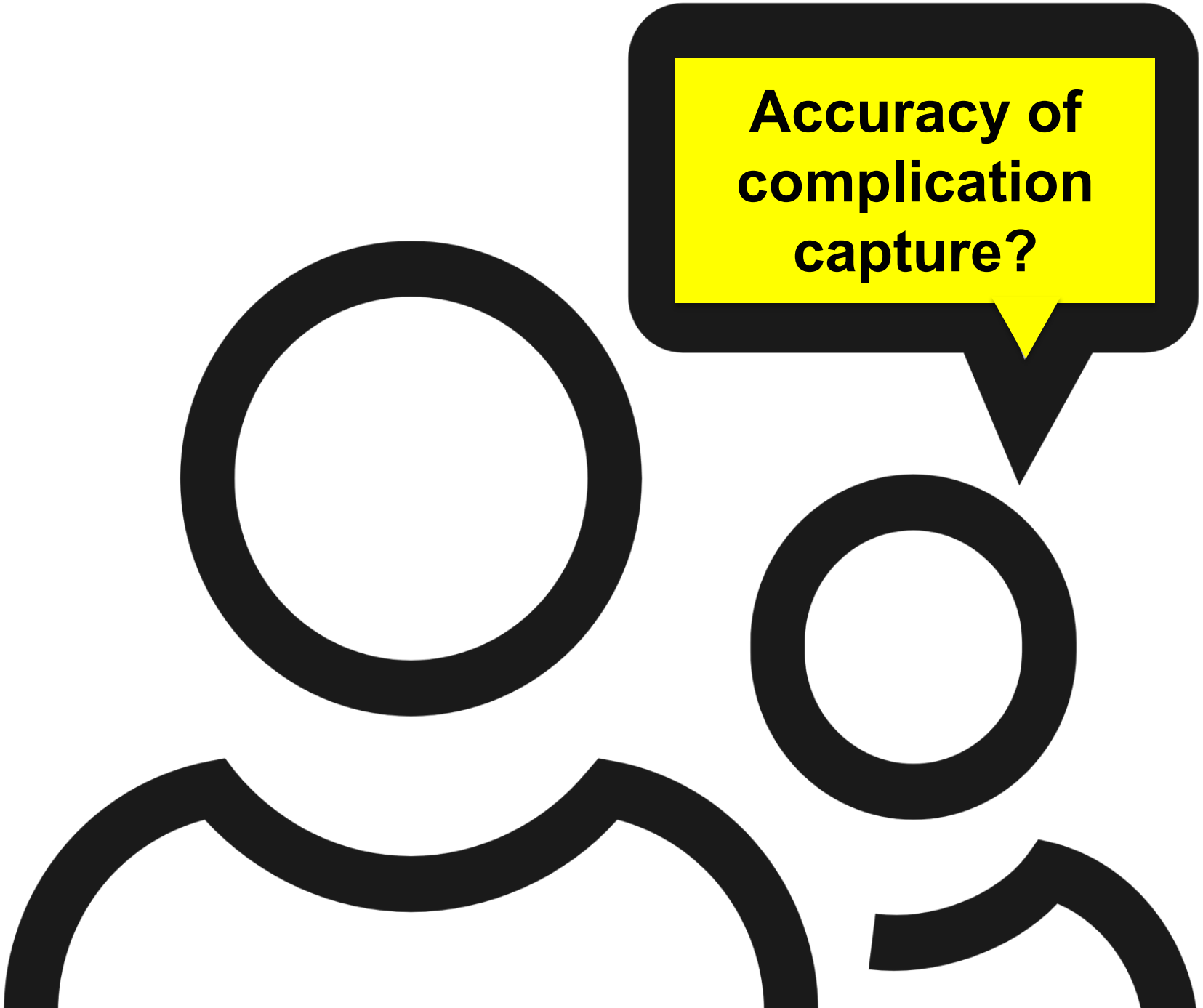
AIS max severity head/neck
AIS max severity face
AIS max severity chest
AIS max severity abdomen
AIS max severity extremity

Alcohol use disorder
Current smoker
Substance abuse disorder
Functionally dependent health status
COPD

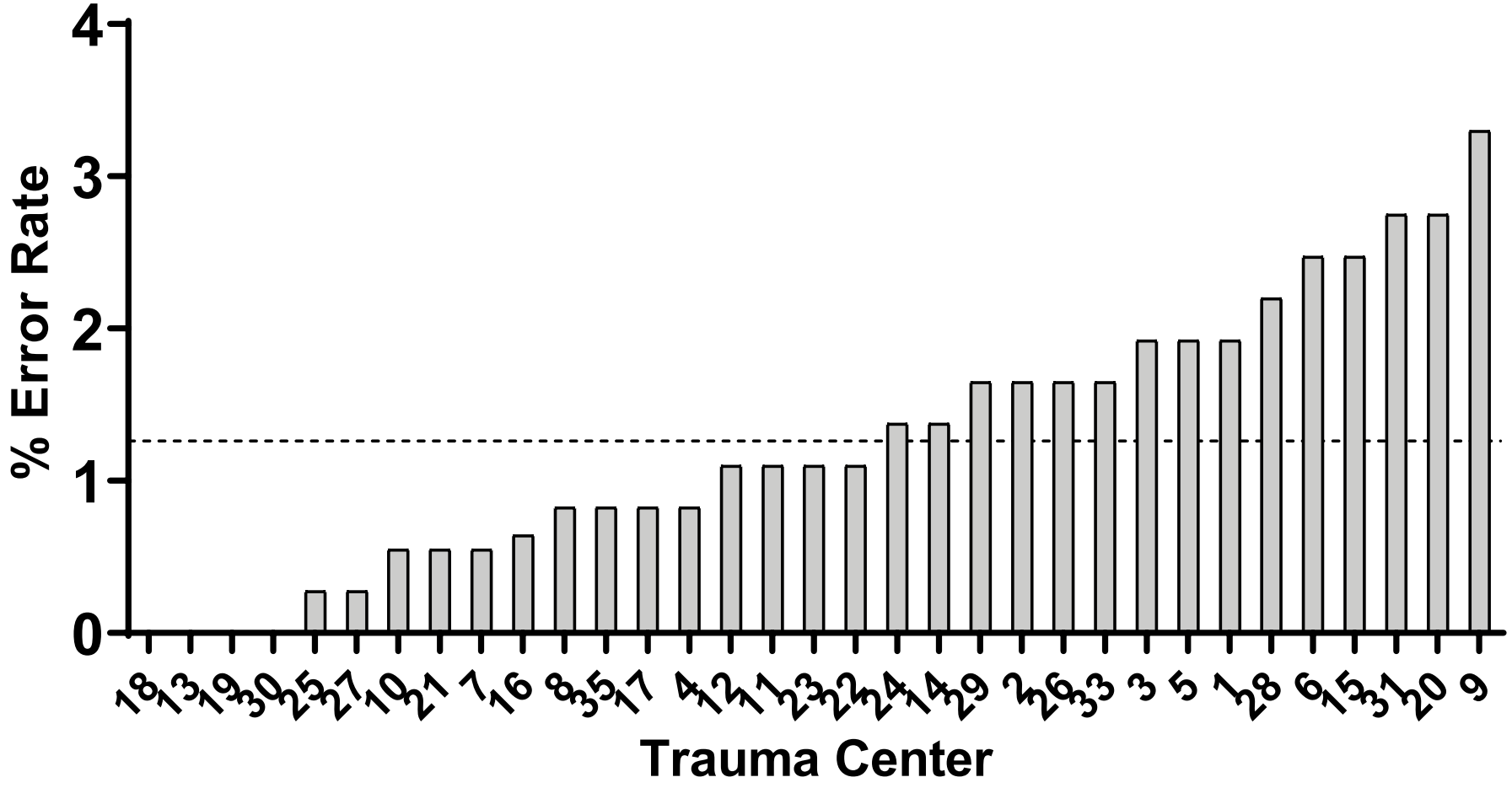
Cirrhosis
CHF
Angina
MI
PAD
HTN
Chronic renal failure
CVA
Dementia
Mental/personality disorder
Disseminated cancer
Steroid use
Bleeding Disorder
Current chemotherapy
Diabetes mellitus

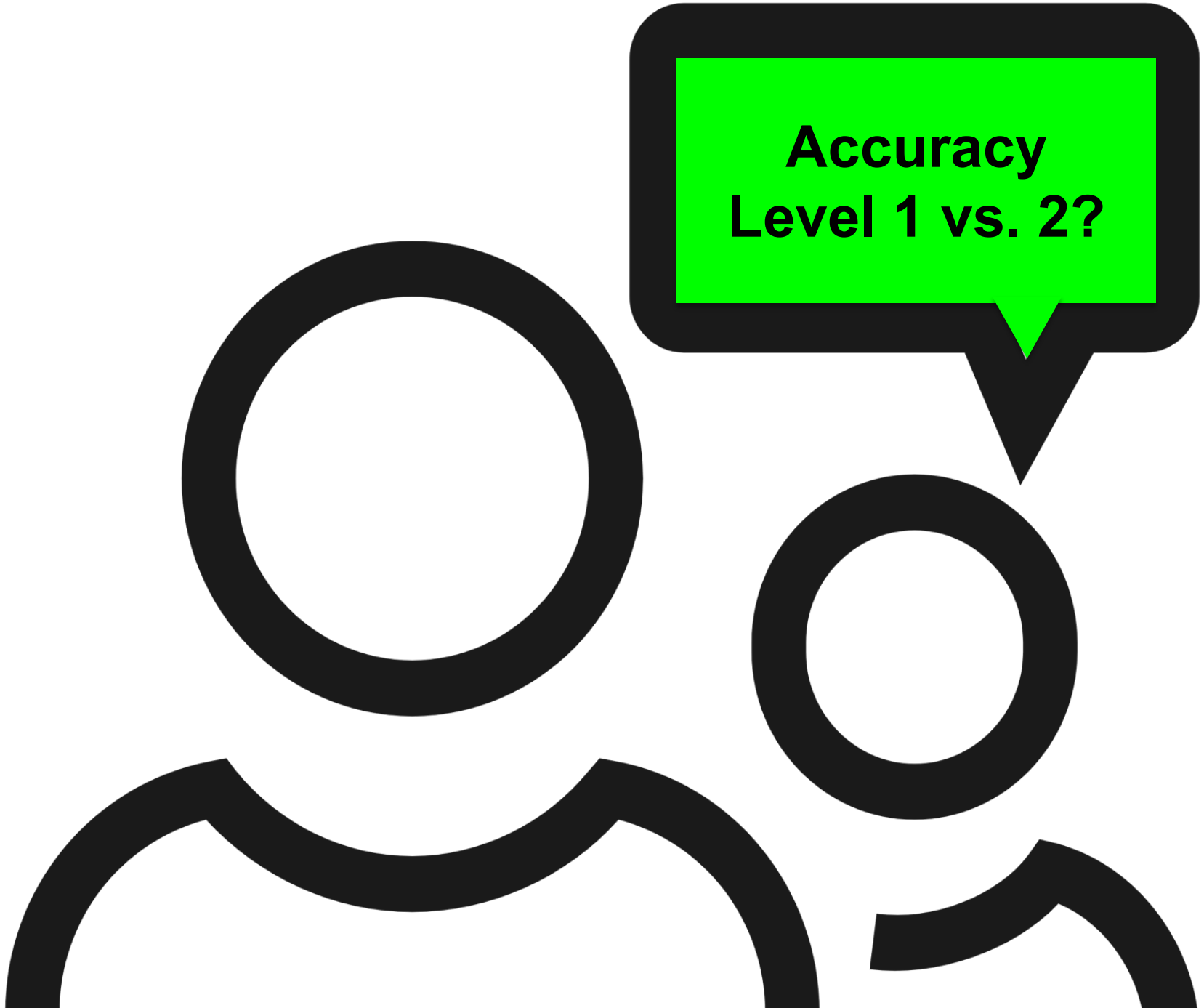
Data Validation - Model Variables
2018 - 2019 Validations




Accuracy of complication capture?

Data Validation - Complications
2018 - 2019 Validations




Accuracy
Level 1 vs. 2?

```
. ttest case_error_rate_val, by(level_val)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
1	500	.0487389	.0017441	.0389986	.0453123	.0521655
2	918	.0404633	.0012372	.0374851	.0380353	.0428914
combined	1,418	.0433814	.0010149	.0382171	.0413905	.0453722
diff		.0082756	.0021135		.0041296	.0124215

```
    diff = mean(1) - mean(2)                                      t =   3.9156
Ho: diff = 0                                     degrees of freedom =     1416

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0001          Pr(T > t) = 0.0000
```

. year 2018 - 2019

```
. ttest case_error_rate_val, by(level_val)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
1	126	.0353459	.0031248	.0350761	.0291615	.0415303
2	251	.0342359	.0021576	.0341821	.0299866	.0384852
combined	377	.0346069	.0017738	.0344408	.0311191	.0380947
diff		.00111	.0037649		-.0062929	.0085129

```
    diff = mean(1) - mean(2)                                      t =   0.2948
Ho: diff = 0                                     degrees of freedom =      375

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.6159         Pr(|T| > |t|) = 0.7683          Pr(T > t) = 0.3841
```

2020 Validation Centers

www.mtqip.org* > *Calendar* > *Data Validation

1. Ascension Borgess Hospital
2. Ascension Providence Hospital Novi
3. Ascension Providence Hospital Southfield
4. Ascension St. John Hospital
5. Ascension St. Mary's Hospital
6. Beaumont Hospital - Dearborn
7. Beaumont Hospital - Royal Oak
8. Beaumont Hospital - Trenton
9. Beaumont Hospital - Troy
10. Detroit Receiving Hospital
11. Henry Ford Hospital
12. Henry Ford Macomb Hospital
13. McLaren Lapeer
14. McLaren Macomb
15. McLaren Oakland
16. Mercy Health Muskegon
17. Mercy Health Saint Mary’s
18. Metro Health Hospital
19. Michigan Medicine
20. MidMichigan Medical Center
21. Munson Medical Center
22. Sinai-Grace Hospital
23. Spectrum Health
24. St. Joseph Mercy Hospital Ann Arbor
25. University of Minnesota

Centers Deferred to 2021 Validation

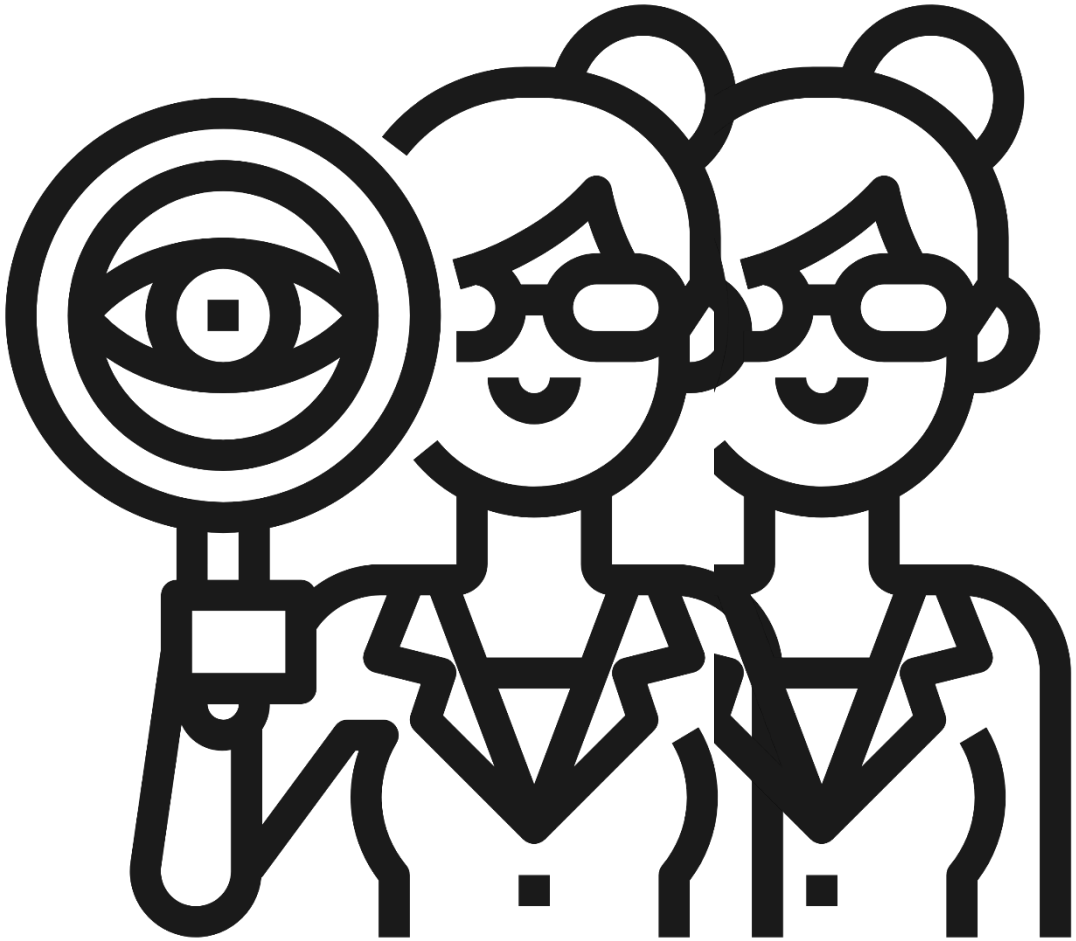
www.mtqip.org* > *Calendar* > *Data Validation

1. **Beaumont Hospital - Farmington Hills**
2. **Bronson Methodist Hospital**
3. **Covenant HealthCare**
4. **Genesys Health System**
5. **Henry Ford Allegiance**
6. **Hurley Medical Center**
7. **Sparrow Hospital**
8. **St. Joseph Mercy Oakland**
9. **St. Mary Mercy Livonia Hospital**
10. **UP Health System Marquette**

Topics

- ✓ Validation Paper (EAST)
- ✓ 2019 Validation Results
- ● Hospital LOS
  GCS 40
  Research in Progress

Hospital LOS



Hospital LOS

TOTAL DAYS IN HOSPITAL

Total number of days spent in hospital (calculate from admit and discharge date).

Def. Source:
Data Base Column Name: HOSPDAYS
Type of Element: Numeric
Length: 4
Validation Range: +/- 1 day
Report: #1

Calculation (days)	Registry Output (days)	Registry Round	Expected Round
10.63	10	down	up
5.83	5	down	up
6.83	6	down	up
8.93	9	up	up
3.93	4	up	up
5.69	6	up	up
4.84	5	up	up
2.04	2	down	down
3.79	4	up	up
5.75	6	up	up
4.65	4	down	up
4.06	4	down	down
14.63	14	up	up
4.92	5	up	up
6.78	7	up	up

Hospital LOS Plan

- Now is the time
- Opportunity for improvement
- Recalculation code to standardize across the collaborative
- Update validation

Topics

- ✓ Validation Paper (EAST)
- ✓ 2019 Validation Results
- ✓ Hospital LOS
- ● GCS 40

  Research in Progress

GCS 40

- Who?
- Why?
- Benefit?

GCS 40 Data Quandaries

- Mixed GCS across collaborative
- Mixed GCS within centers
- Unclear association for verbiage
- Model stability
- Nonsensical data

GCS 40

- Request continued use of historic GCS
- Migration as a group

Topics

- ✓ Validation Paper (EAST)
- ✓ 2019 Validation Results
- ✓ Hospital LOS
- ✓ GCS 40
- ● Research in Progress

Research in Progress

Center	PI	Topic	Phase
Detroit Receiving	Oliphant	The accuracy of orthopaedic data in a trauma registry. Traumatic injury and associated costs.	Analysis
Henry Ford	Johnson	EMS vs. private car effect on outcomes	Pending update reply
Michigan Medicine	Wang	Injury prevention in vunerable populations	Analysis
Michigan Medicine	Jakubus	Data validation in benchmark reporting and modeling	Presented at EAST Jan 2020. Accepted *J Trauma Acute Care Surg*.
Providence Hospital		TXA in trauma	Pending new PI assignment
Providence Hospital, Spectrum Health, St. Joseph Mercy, Michigan Medicine	Iskander, Lopez, Jakubus, Wahl	Optimal timing head CT's for geriatric falls	Analysis
Spectrum Health	Chapman	Outcomes in operative fixation of rib fractures	Analysis
University of Minnesota	Tignanelli	Redefining the Trauma Triage Matrix: the Role of Emergent Interventions	Accepted *Journal of Surgical Research*

Topics

- ✓ Validation Paper (EAST)
- ✓ 2019 Validation Results
- ✓ Hospital LOS
- ✓ GCS 40
- ✓ Research in Progress

Summary

- Validation is associated with improved data accuracy and reliability
- Hospital LOS will be standardized by calculation across the collaborative
- GCS 40 has data nuances that could threaten modeling (GCS preferred)

Lunch

Back at 1:00p

M·TQIP

MTQIP Program Manager Update

Judy Mikhail, PhD MBA RN

Future Meetings

Trauma
Center
Presentations

Highly Rated
On Evals

Trauma Bay
Resuscitations
What Works
What Doesn't

Highly
Successful

Trauma OR
What Works
What Doesn't

Future
Meeting

Trauma and or QI Related Topics
Multidisciplinary
Various Subspecialties

Regional Anesthesia
Practical Application
in Trauma

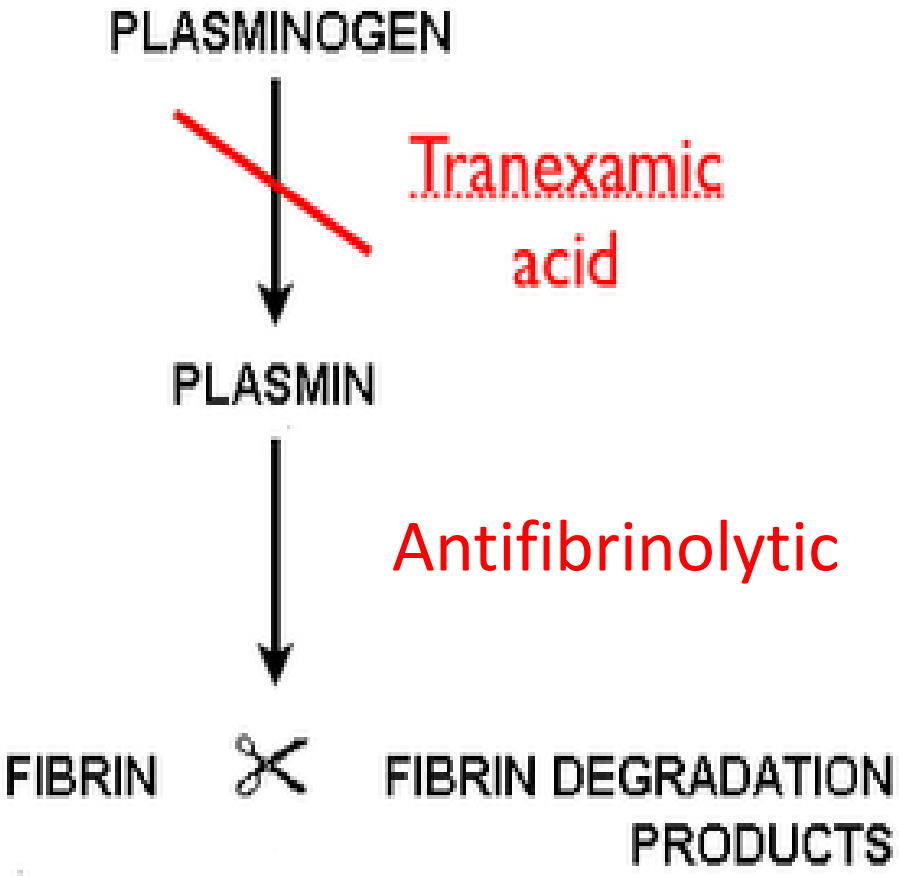
Emergency Med?
Anesthesiologist?

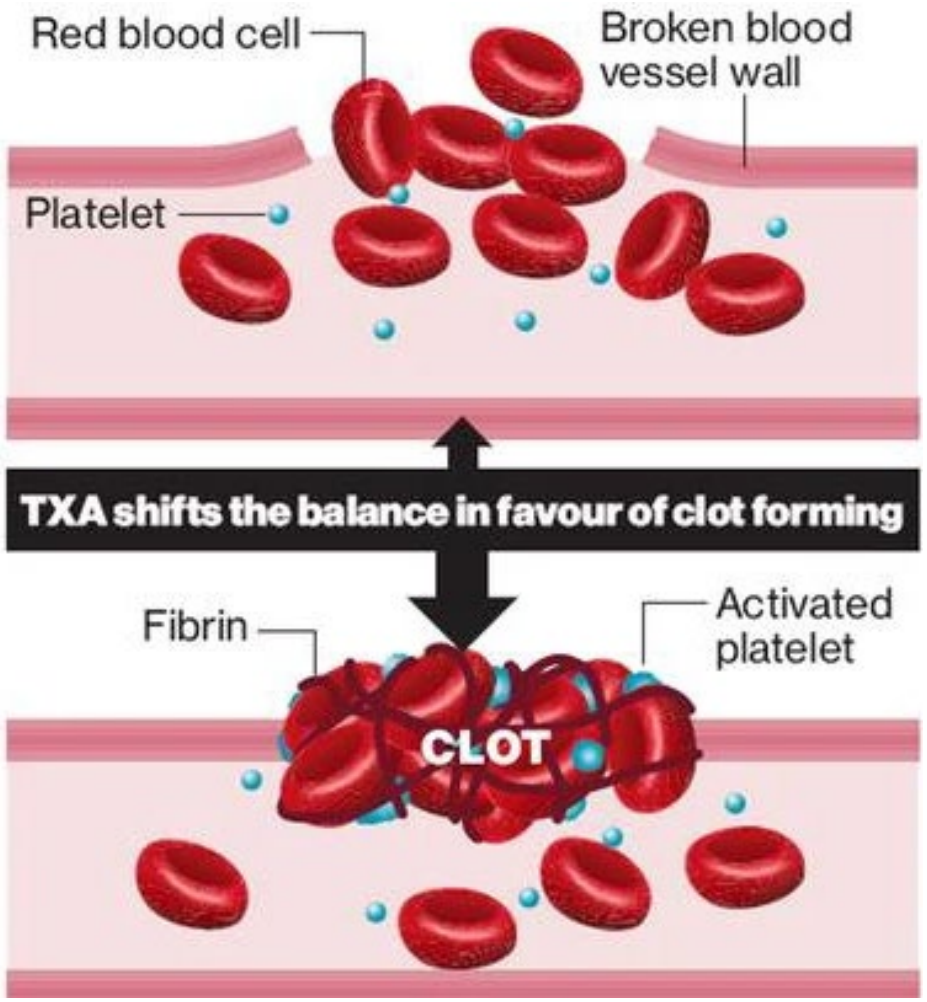
Future Topics

Latest Research

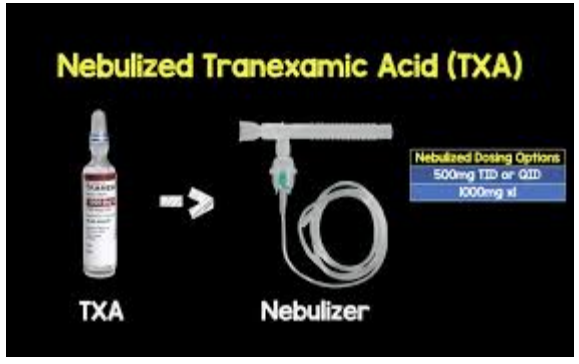
Old Drug New Tricks: Tranexamic Acid (TXA)

TXA


PLASMINOGEN
Tranexamic acid
PLASMIN
Antifibrinolytic
FIBRIN
FIBRIN DEGRADATION PRODUCTS


Red blood cell
Broken blood vessel wall
Platelet
TXA shifts the balance in favour of clot forming
Fibrin
Activated platelet
CLOT

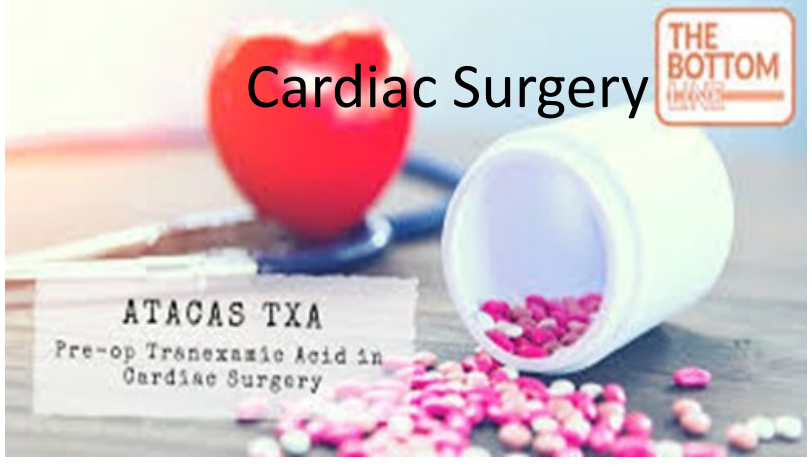
The WOMAN Trial: Early TXA in Post-Partum Hemorrhage
R.E.B.E.L.em


Nebulized Tranexamic Acid (TXA)
Nebulized Dosing Options
500mg TID or QID
1000mg x1
TXA
Nebulizer

MASSIVE
GI BLEED

Nebulized
TXA
Hemoptysis
(Wand 2018)

Topical TXA in Epistaxis
R.E.B.E.L.em


Cardiac Surgery
THE BOTTOM LINE
ATACAS TXA
Pre-op Tranexamic Acid in Cardiac Surgery

Super Drug?

Low Cost

Stops Bleeding

Trauma TXA Trials

CRASH-2 Trial

CRASH-3 Trial

CRASH-2
Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage

Effects of tranexamic acid on death, vascular occlusive events, and blood transfusion in trauma patients with significant haemorrhage (CRASH-2): a randomised, placebo-controlled trial

CRASH-2 trial collaborators*

Summary

Background Tranexamic acid can reduce bleeding in patients undergoing elective surgery. We assessed the effects of early administration of a short course of tranexamic acid on death, vascular occlusive events, and the receipt of blood transfusion in trauma patients.

Published Online June 15, 2010
DOI:10.1016/S0140-6736(10)60835-5

Lancet 2010; 376:23-32

CRASH-2 Trial

20211 trauma patients

274 hospitals in 40 countries

84% Men
Mean age ~35
Mean time to injury ~ 2.5h
33% penetrating trauma

Randomized

TXA	Placebo
10,060 patients	10,067 Patients

Primary Outcome: Death in hospital within 4 weeks

Secondary Outcomes: vascular occlusive events, surgical intervention, blood transfusion, units transfused, dependency

Inclusion Criteria

1. Risk of significant hemorrhage
2. <90 mmHg systolic bp and/or >110 HR
3. Within 8h of injury
4. Uncertainty principle

A priori analysis plan:

1. Hours since injury
2. Systolic BP
3. GCS
4. Penetrating only vs Blunt/Penetrating injury

CRASH-2

Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage

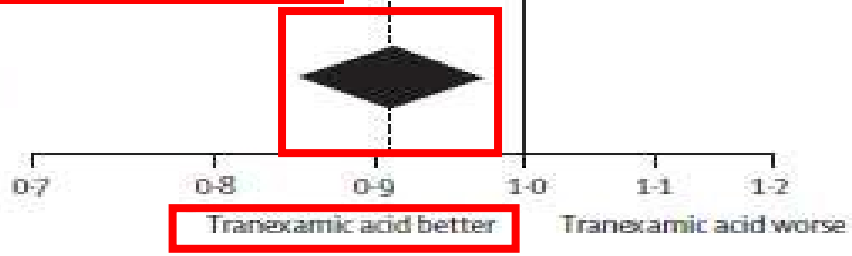
- TXA significantly reduced all-cause mortality (14.5% TXA vs 16.0% placebo: p=0.0035)

- TXA reduced risk of death due to bleeding (4.9% TXA vs 5.7% placebo: p=0.0077)

CRASH2

Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage

	Tranexamic acid allocated	Placebo allocated	Risk ratio (99% CI)
Time from injury (h)			
≤1	509/3747 (13·6%)	581/3704 (15·7%)	0·87 (0·75–1·00)
>1–≤3	463/3037 (15·2%)	528/2996 (17·6%)	0·87 (0·75–1·00)
>3	491/3272 (15·0%)	502/3362 (14·9%)	1·00 (0·86–1·17)
χ^2_1=4·411; p=0·11			
Systolic blood pressure (mm Hg)			
≥90	702/6878 (10·2%)	736/6761 (10·9%)	0·94 (0·82–1·07)
76–89	286/1689 (17·5%)	313/1689 (18·5%)	0·94 (0·78–1·14)
≤75	478/1562 (30·6%)	562/1599 (35·1%)	0·87 (0·76–0·99)
χ^2_1=1·343; p=0·51			
GCS			
Severe (3–8)	706/1780 (44·5%)	860/1830 (47·0%)	0·95 (0·86–1·04)
Moderate (9–12)	219/1349 (16·2%)	249/1344 (18·5%)	0·88 (0·70–1·09)
Mild (13–15)	447/6915 (6·5%)	502/6877 (7·3%)	0·88 (0·75–1·04)
χ^2_1=1·387; p=0·50			
Injury type			
Blunt	1134/6788 (16·7%)	1233/6817 (18·1%)	0·92 (0·83–1·02)
Penetrating	329/3272 (10·1%)	380/3250 (11·7%)	0·86 (0·72–1·03)
χ^2_1=0·791; p=0·37			
All patients	**1463/10·060 (14·5%)**	**1613/10·067 (16·0%)**	**0·91 (0·85–0·97)***
Two-sided p=0·0035			



CRASH2
Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage

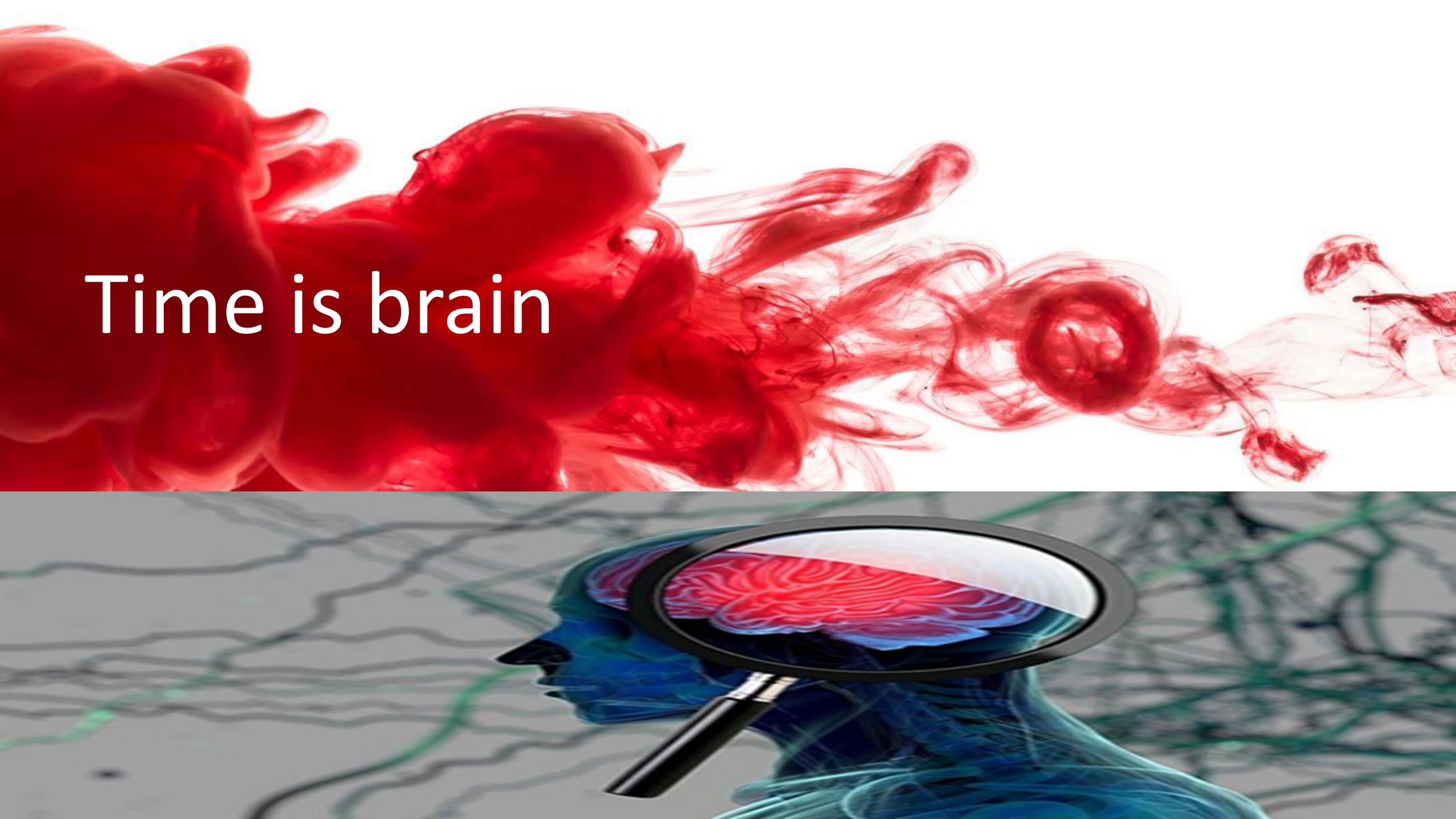
Skeptics

BUT

- 98% of patients in CRASH-2 were treated in "developing" countries (India 4768, Columbia 2940, Egypt 2234, Georgia 1783, Ecuador 1198, Indonesia 706, Cuba 575, Malaysia 216) compared with UK 135, Australia 17, Canada 2

- Inclusion was SBP<90 or HR>110 or "at risk of significant hemorrhage" and only 50% received a blood transfusion with median 3 units

Time is brain



CRASH 3 Trial

Published online
Oct 14, 2019

CRASH

Clinical Randomisation of an Antifibrinolytic in Significant Head Injury

Effects of tranexamic acid on death, disability, vascular occlusive events and other morbidities in patients with acute traumatic brain injury (CRASH-3): a randomised, placebo-controlled trial

*The CRASH-3 trial collaborators**

Summary

Background Tranexamic acid reduces surgical bleeding and decreases mortality in patients with traumatic extracranial bleeding. Intracranial bleeding is common after traumatic brain injury (TBI) and can cause brain herniation and death. We aimed to assess the effects of tranexamic acid in patients with TBI.

Methods This randomised, placebo-controlled trial was done in 175 hospitals in 29 countries. Adults with TBI who were within 3 h of injury, had a Glasgow Coma Scale (GCS) score of 12 or lower or any intracranial bleeding on CT scan, and no major extracranial bleeding were eligible. The time window for eligibility was originally 8 h but in 2016 the protocol was changed to limit recruitment to patients within 3 h of injury. This change was made blind to the trial data, in response to external evidence suggesting that delayed treatment is unlikely to be effective. We randomly assigned (1:1) patients to receive tranexamic acid (loading dose 1 g over 10 min then infusion of 1 g over 8 h) or matching placebo. Patients were assigned by selecting a numbered treatment pack from a box containing eight packs that were identical apart from the pack number. Patients, caregivers, and those assessing outcomes were masked to allocation. The primary outcome was head injury-related death in hospital within 28 days of injury in patients treated within 3 h of injury. We prespecified a sensitivity analysis that excluded patients with a GCS score of 3 and those with bilateral unreactive pupils at baseline. All analyses were done by intention to treat. This trial was registered with ISRCTN (ISRCTN15088122), ClinicalTrials.gov (NCT01402882), EudraCT (2011-003669-14), and the Pan African Clinical Trial Registry (PACTR20121000441277).

Results Between July 20, 2012, and Jan 31, 2019, we randomly allocated 12 737 patients with TBI to receive tranexamic acid (6406 [50·3%] or placebo [6331 [49·7%], of whom 9202 (72·2%) patients were treated within 3 h of injury. Among patients treated within 3 h of injury, the risk of head injury-related death was 18·5% in the tranexamic acid group versus 19·8% in the placebo group (855 *vs* 892 events; risk ratio [RR] 0·94 [95% CI 0·86–1·02]). In the prespecified sensitivity analysis that excluded patients with a GCS score of 3 or bilateral unreactive pupils at baseline, the risk of head injury-related death was 12·5% in the tranexamic acid group versus 14·0% in the placebo group (485 *vs* 525 events; RR 0·89 [95% CI 0·80–1·00]). The risk of head injury-related death reduced with tranexamic acid in patients with mild-to-moderate head injury (RR 0·78 [95% CI 0·64–0·95]) but not in patients with severe head injury (0·99 [95% CI 0·91–1·07]; p value for heterogeneity 0·030). Early treatment was more effective than was later treatment in patients with mild and moderate head injury (p=0·005) but time to treatment had no obvious effect in patients with severe head injury (p=0·73). The risk of vascular occlusive events was similar in the tranexamic acid and placebo groups (RR 0·98 (0·74–1·28). The risk of seizures was also similar between groups (1·09 [95% CI 0·90–1·33]).

Interpretation Our results show that tranexamic acid is safe in patients with TBI and that treatment within 3 h of injury reduces head injury-related death. Patients should be treated as soon as possible after injury.

Funding National Institute for Health Research Health Technology Assessment, JP Moulton Charitable Trust, Department of Health and Social Care, Department for International Development, Global Challenges Research Fund, Medical Research Council, and Wellcome Trust (Joint Global Health Trials scheme).

Published Online
October 14, 2019
https://doi.org/10.1016/S0140-6736(19)32233-0

See Online/Comment
https://doi.org/10.1016/S0140-6736(19)32312-8

*Members listed at end of paper

For the Arabic translation of the abstract see Online for appendix 1

For the Chinese translation of the abstract see Online for appendix 2

For the French translation of the abstract see Online for appendix 3

For the Hindi translation of the abstract see Online for appendix 4

For the Japanese translation of the abstract see Online for appendix 5

For the Spanish translation of the abstract see Online for appendix 6

For the Urdu translation of the abstract see Online for appendix 7

Correspondence to:
Clinical Trials Unit, London School of Hygiene & Tropical Medicine, London WC1 E7HT, UK
crash@lshtm.ac.uk

ELIGIBILITY (data collected on entry form)

- adult with traumatic brain injury
- within 8 hours of injury
- any intracranial bleeding on CT scan **OR** GCS ≤12 if no scan available
- no significant extra cranial bleeding (needing immediate blood transfusion)
- where the responsible clinician is substantially uncertain as to the appropriateness of antifibrinolytic agents in a patient

↓

Appropriate **CONSENT PROCESS**
eg relative agreement or waiver

↓

RANDOMISE (tranexamic acid or placebo)
Entry form completed

↓

Give **loading dose** over 10 minutes

↓

Give **maintenance dose** over 8 hours

↓

Complete **outcome form** at discharge, death or day 28 (whichever is earlier)

All clinically indicated treatment is given in addition to trial enrolment.
Report adverse events as per protocol (up to day 28)

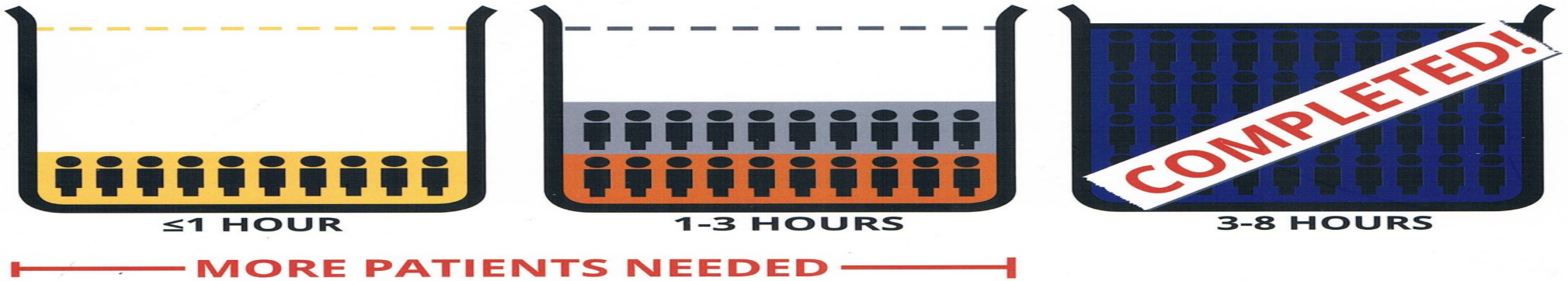
CLINICAL TRIALS UNIT
London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT
020 7299 4684
ctu@Lshtm.ac.uk
crash3.Lshtm.ac.uk

CRASH3

Clinical Randomisation of an Antifibrinolytic in Significant Head Injury

RANDOMISE AS SOON AS POSSIBLE WITHIN 3 HOURS OF INJURY

WE WANT 1/3 OF PATIENTS RANDOMISED INTO EACH CATEGORY



We want to:

- **REDUCE** time to treatment
- **PREVENT** intracranial haemorrhage
- **PREVENT** small bleeds getting larger

We must treat urgently.

Mr Antonio Belli
Professor of Trauma Neurosurgery,
University of Birmingham UK

TIME IS BRAIN

CRASH-3

Effects of tranexamic acid in patients with acute traumatic brain injury

The CRASH-3 Trial Collaborators. Effects of Tranexamic Acid on Death, Disability, Vascular Occlusive Events and Other Morbidities in Patients with Acute Traumatic Brain Injury (CRASH-3): A Randomized, Placebo-Controlled Trial. Lancet 2019.

Methods

- 175 hospitals, 29 countries
- Randomized, Double-blind, Placebo-controlled
- 9,202 patients treated within 3h
- Intention to treat, pre-specified subgroup analysis

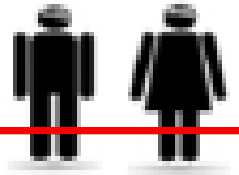
Intervention

- 1g TXA over 10 min followed by 1g TXA over 8h **OR** placebo

RESULTS

No significant difference in head-injury related death within 28 days for TXA vs placebo.

Effect of TXA on head-injury related death	TXA	Placebo	RR (95% CI)
All	18.5%	19.8%	0.94 (0.86 – 1.02)
Excluding GCS 3 & bilateral unreactive pupils	12.5%	14%	0.89 (0.80 – 1.00)
Mild-to-moderate head injury (GCS 9-15)	5.8%	7.5%	0.78 (0.64 – 0.95)
Risk of vascular occlusive events	1.5%	1.3%	1.08 (0.71 – 1.64)



NNT = 59*

*GCS 9-15

THE BOTTOM LINE

When given within 3h of injury, TXA was shown to have a mortality benefit in head-injury related death in patients with acute traumatic TBI and a GCS of 9-15 with no significant increase in vascular occlusive events.

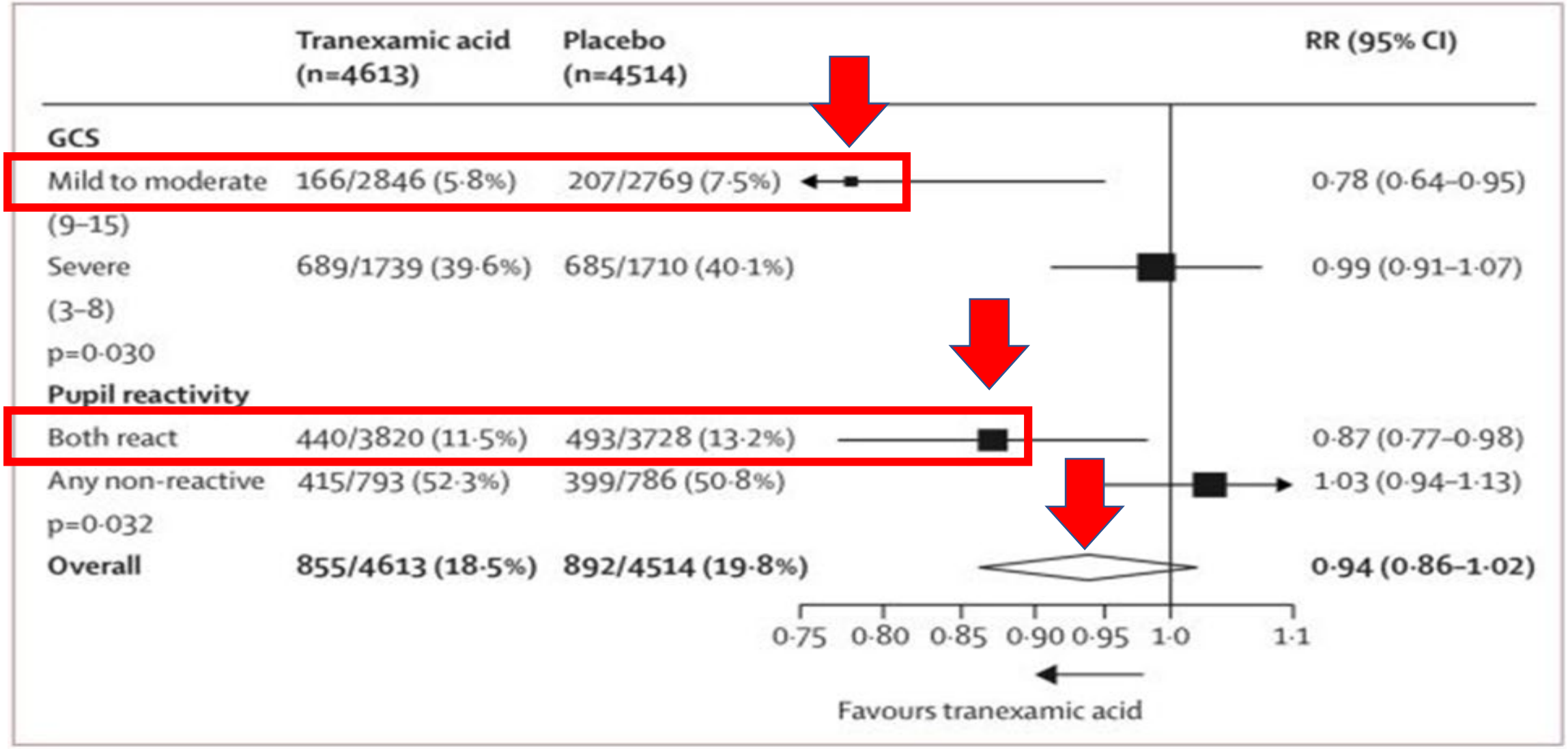


Figure 3: **Effect of tranexamic acid on head injury-related death stratified by baseline severity in patients randomised within 3 h of injury**

RR=risk ratio. GCS=Glasgow Coma Scale.

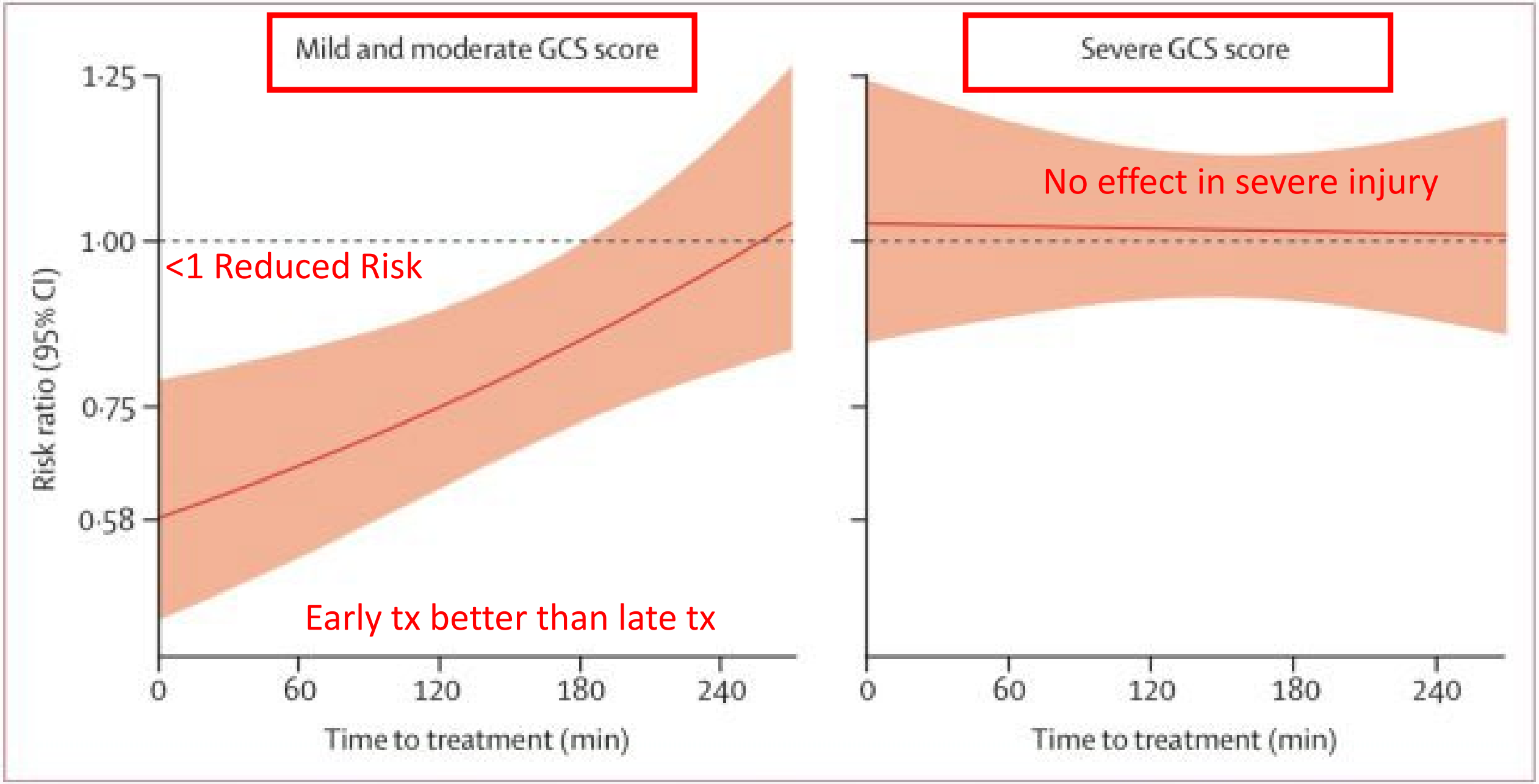


Figure 4: Effect of tranexamic acid on head injury-related death by severity and time to treatment in all patients

MTQIP Currently Collects TXA Administration, Date & Time

Don't forget :

Biannual (q2-Yr) *Indepth* BCBSM Evaluation of MTQIP

- Disciplines
  - Surgeons
  - TPM, MCR, REG
- Sections/ # Questions
  - CQI Coordinating Center
  - Collaborative Meetings (8)
  - Data Registry, Reports, Audits (11)
  - Support, Resources, Value (8)

Feb 2020

Please Respond

THISWEEK

Final Performance Index Results

- Administrative lists from BCBSM
- Appropriate administrators confirmed by trauma program
- Final results go out to centers end of this week

CME

Email to Follow Meeting

Michigan Medicine | U-M Medical School | UofMHealth.org

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The Office of Continuing Medical Education and Lifelong Learning
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titution, clinical
nts within and
excellence.

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Office of Continuing Medical Education and Lifelong Learning

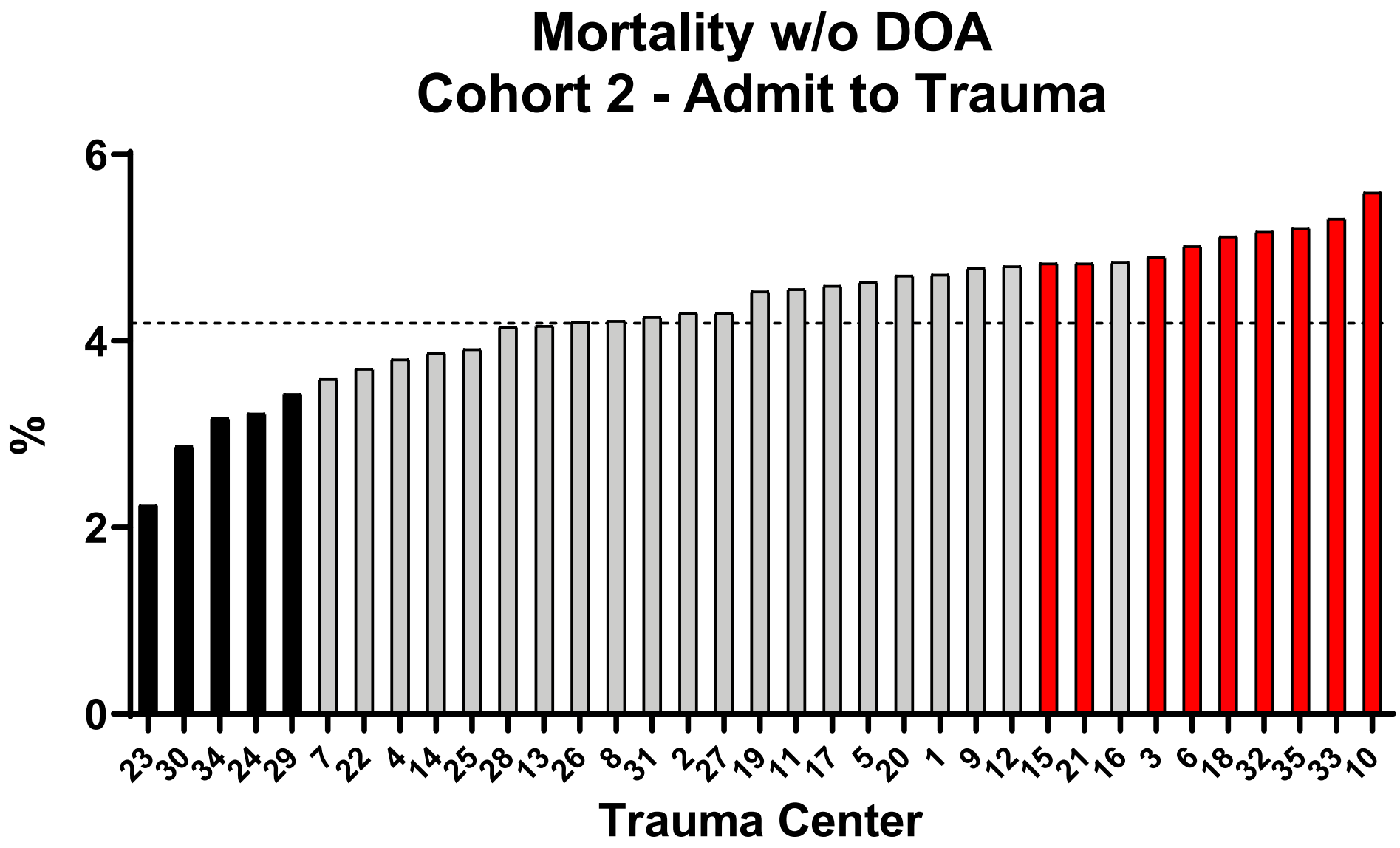
?

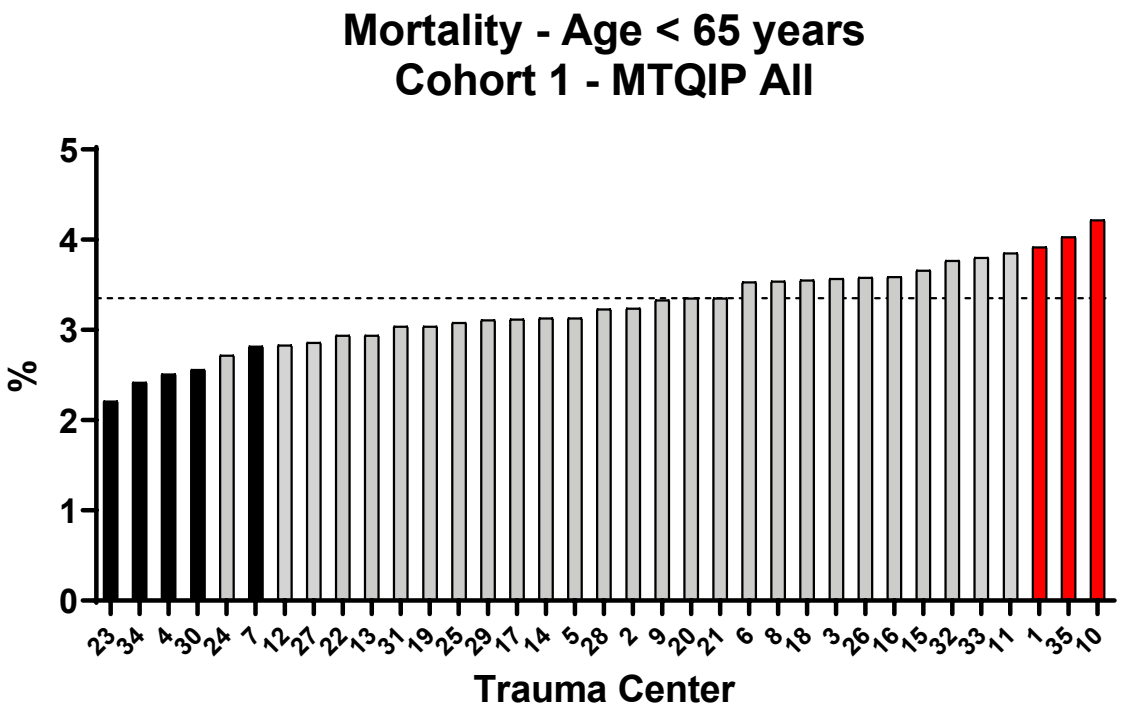
MTQIP Data
Query's, Thoughts, Feedback

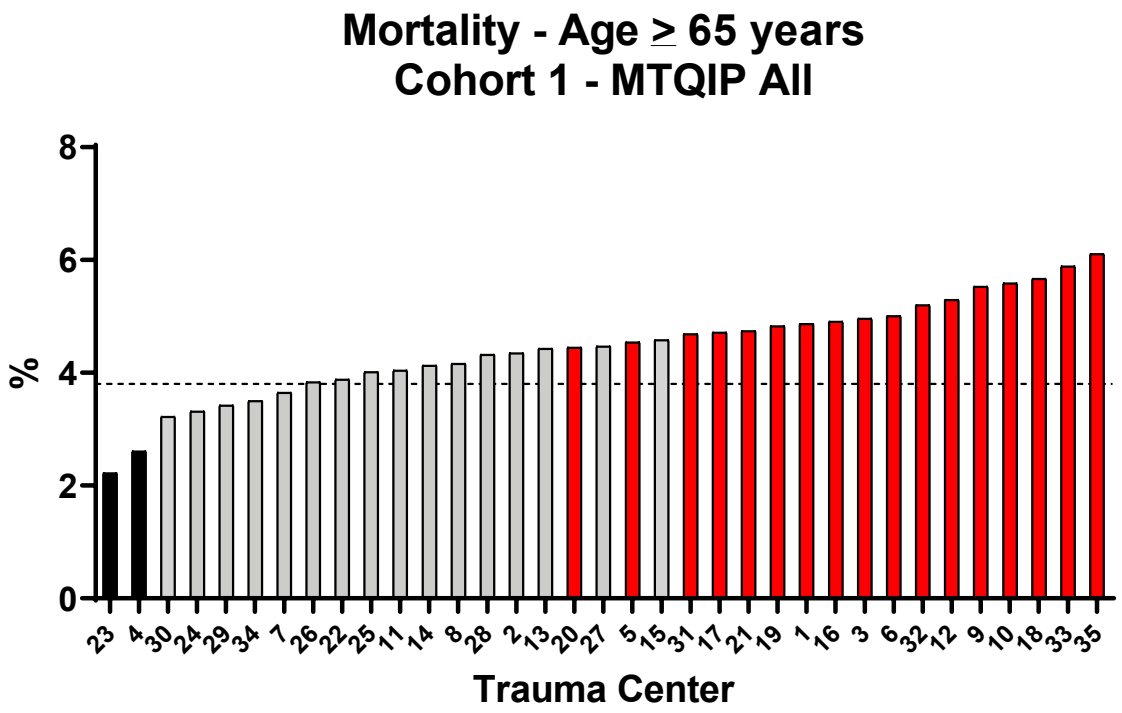
Mark Hemmila, MD

Unexpected Outcome

- Exercise - Mortality
- How to drill in and find out what is going on
- Exploration and Discussion
- No right or wrong here


Mortality w/o DOA
Cohort 2 - Admit to Trauma
%
0
2
4
6
23 30 34 24 29 7 22 4 14 25 28 13 26 8 31 2 27 19 11 17 5 20 1 9 12 15 21 16 3 6 18 32 35 33 10
Trauma Center


Mortality - Age < 65 years
Cohort 1 - MTQIP All
%
0
1
2
3
4
5
23 34 4 30 24 7 12 27 22 13 31 19 25 29 17 14 5 28 2 9 20 21 6 8 18 3 26 16 15 32 33 11 1 35 10
Trauma Center


Mortality - Age ≥ 65 years
Cohort 1 - MTQIP All
%
0
2
4
6
8
23 4 30 24 29 34 7 26 22 25 11 14 8 28 2 13 20 27 5 15 31 17 21 19 1 16 3 6 32 12 9 10 18 33 35
Trauma Center

- Cohort 2
- Exclude no signs of life
- Exclude alive
- AM expected mortality
- Include if expected mortality <5%
- Sum
  - Dead
  - Expected mortality

ID	n	dead	expected_mortality	o/e ratio
23	1356	5	21	0.24
34	929	4	14	0.28
7	1702	5	16	0.31
22	809	4	9	0.45
31	1177	5	11	0.46
25	501	3	6	0.51
26	1113	6	11	0.53
30	1716	14	25	0.57
13	1573	10	17	0.57
16	523	3	5	0.61
8	1259	9	14	0.62
14	1771	12	19	0.64
24	656	5	8	0.66
6	622	3	4	0.71
4	825	7	10	0.71
35	522	4	5	0.80
29	1419	17	21	0.82
19	3503	27	33	0.83
1	1686	10	12	0.83
28	497	6	7	0.89
18	1227	8	9	0.94
10	1692	12	13	0.94
21	2394	21	22	0.94
20	1854	16	17	0.96
5	1237	11	11	0.98
3	1407	11	11	1.00
27	1211	11	11	1.00
11	1296	13	12	1.06
9	892	12	11	1.08
15	1898	14	13	1.09
17	663	7	6	1.11
32	497	5	4	1.25
12	764	10	8	1.26
2	287	4	2	1.89
33	628	13	6	2.26

	recordno	age	expected_m~y	dead	death
1115	1.000e+08	84.0	.03	0	No
1116	14763	22.0	0	0	No
1117	1.000e+08	58.0	0	0	No
1118	32095	18.5	0	0	No
1119	14671	21.0	1	1	Yes
1120	42275	20.0	.01	0	No
1121	3112	91.5	.03	0	No
1122	20190790	64.0	0	0	No
1123	9827	16.0	0	0	No
1124	5689	85.0	.01	0	No
1125	25781	20.5	0	0	No
1126	42578	64.0	.01	0	No
1127	4933	83.5	.01	0	No
1128	32962	36.9	.28	0	No
1129	25098	63.2	0	0	No
1130	42932	78.0	.08	0	No
1131	14116	93.0	.01	0	No

- Cohort 2
- Exclude no signs of life
- Exclude alive
- AM expected mortality
- Include if expected mortality <5%
- Sum
  - Dead
  - Expected mortality

ID	n	dead	expected_mortality	o/e ratio
23	1356	5	21	0.24
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31	1177	5	11	0.46
25	501	3	6	0.51
26	1113	6	11	0.53
30	1716	14	25	0.57
13	1573	10	17	0.57
16	523	3	5	0.61
8	1259	9	14	0.62
14	1771	12	19	0.64
24	656	5	8	0.66
6	622	3	4	0.71
4	825	7	10	0.71
35	522	4	5	0.80
29	1419	17	21	0.82
19	3503	27	33	0.83
1	1686	10	12	0.83
28	497	6	7	0.89
18	1227	8	9	0.94
10	1692	12	13	0.94
21	2394	21	22	0.94
20	1854	16	17	0.96
5	1237	11	11	0.98
3	1407	11	11	1.00
27	1211	11	11	1.00
11	1296	13	12	1.06
9	892	12	11	1.08
15	1898	14	13	1.09
17	663	7	6	1.11
32	497	5	4	1.25
12	764	10	8	1.26
2	287	4	2	1.89
33	628	13	6	2.26

- Cohort 2
- Exclude no signs of life
- Exclude alive
- AM expected mortality
- Include if expected mortality >5%
- Sum
  - Dead
  - Expected mortality

ID	n	dead	expected_mortality	o/e ratio
23	355	20	57	0.35
30	293	25	55	0.45
24	96	11	20	0.55
34	156	14	24	0.58
29	274	36	50	0.72
22	154	29	39	0.74
25	139	22	29	0.77
28	88	15	19	0.77
4	268	48	62	0.78
7	212	43	53	0.82
14	357	73	86	0.84
8	185	36	42	0.87
17	167	45	51	0.88
26	203	47	53	0.89
13	286	59	65	0.90
11	238	63	67	0.93
9	178	34	36	0.94
2	55	17	18	0.95
27	260	79	81	0.98
19	562	131	133	0.99
12	119	28	28	1.01
33	53	12	12	1.02
5	178	47	46	1.02
3	277	93	88	1.05
20	242	61	58	1.06
31	167	58	55	1.06
21	459	137	128	1.07
15	250	78	73	1.07
16	99	29	27	1.09
18	221	79	69	1.14
1	215	72	63	1.14
6	92	31	27	1.17
35	67	23	20	1.18
10	293	97	82	1.18
32	80	41	34	1.19

- Cohort 2
- Exclude no signs of life
- Exclude alive
- AM expected mortality
- Include if expected mortality >40%
- Sum
  - Dead
  - Expected mortality

ID	n	dead	expected_mortality	o/e ratio
33	9	3	6	0.50
24	15	6	10	0.60
30	37	17	25	0.69
23	25	12	17	0.70
26	44	22	28	0.78
22	34	19	23	0.82
4	46	26	31	0.83
11	62	37	43	0.86
29	31	19	22	0.87
7	40	25	28	0.89
19	95	60	67	0.90
14	71	46	50	0.92
3	79	49	53	0.93
8	32	20	22	0.93
31	50	36	38	0.95
10	67	45	47	0.95
17	50	32	33	0.96
9	25	16	17	0.97
5	33	23	24	0.97
28	14	9	9	0.97
12	22	14	14	0.98
27	73	50	51	0.99
18	67	45	44	1.01
20	42	29	28	1.02
13	54	38	36	1.04
15	62	46	44	1.05
1	57	42	40	1.06
34	13	9	8	1.07
6	23	18	17	1.07
25	17	14	13	1.08
16	20	16	15	1.08
21	112	84	77	1.09
2	15	13	12	1.13
32	35	31	27	1.16
35	16	15	12	1.24

- All tables combined
- Highlight if o/e > 1 and high outlier

ID	<5% o/e ratio	>5% o/e ratio	>40% o/e ratio
31	0.46	1.06	0.95
8	0.62	0.87	0.93
3	1.00	1.05	0.93
9	1.08	0.94	0.97
5	0.98	1.02	0.97
1	0.83	1.14	1.06
12	1.26	1.01	0.98
11	1.06	0.93	0.86
23	0.24	0.35	0.70
18	0.94	1.14	1.01
10	0.94	1.18	0.95
29	0.82	0.72	0.87
13	0.57	0.90	1.04
2	1.89	0.95	1.13
35	0.80	1.18	1.24
26	0.53	0.89	0.78
32	1.25	1.19	1.16
24	0.66	0.55	0.60
16	0.61	1.09	1.08
33	2.26	1.02	0.50
20	0.96	1.06	1.02
22	0.45	0.74	0.82
14	0.64	0.84	0.92
34	0.28	0.58	1.07
6	0.71	1.17	1.07
15	1.09	1.07	1.05
21	0.94	1.07	1.09
7	0.31	0.82	0.89
17	1.11	0.88	0.96
25	0.51	0.77	1.08
19	0.83	0.99	0.90
30	0.57	0.45	0.69
27	1.00	0.98	0.99
28	0.89	0.77	0.97
4	0.71	0.78	0.83

PI

- All deaths are reviewed
- Unanticipated
- Anticipated with opportunity for improvement
- Anticipated without opportunity for improvement

ected_mort	dead	death	review results			
0.380	1	Yes	2	1= Unanticipated		
0.120	1	Yes	3	2= Anticipated with opportunity		
0.680	1	Yes	3	3= Anticipated no opportunity		
0.060	1	Yes	3			
0.610	1	Yes	3			
0.690	1	Yes	3			
0.060	1	Yes	3			
0.800	1	Yes	3			
0.040	1	Yes	1			
0.310	1	Yes	3			
0.780	1	Yes	2			
0.320	1	Yes	3			
0.240	1	Yes	2			
0.210	1	Yes	3			
0.360	1	Yes	3			
0.570	1	Yes	3			
0.880	1	Yes	3			
0.040	1	Yes	3			
0.590	1	Yes	2			
0.020	1	Yes	3			
0.440	1	Yes	3			
0.780	1	Yes	2			

Discussion

- Helpful or not?
- Lists of patients
- PI findings?

TBI in Patients on Anticoagulation

- Anticoagulant
- Antiplatelet
- New data collection (1/1/2018)
  - Level of anticoagulation
  - First therapy (type, date, time)

TBI in Patients on Anticoagulation

- 1/1/2018
- Head CT criteria (AIS head 2-5)
- On Coumadin or DOAC
- Exclude
  - No signs of life
  - Missing ED date/time
  - AIS head = 6

(max)		
max_hn_ais	Freq.	Percent
2	244	21.31
3	391	34.15
4	247	21.57
5	263	22.97
Total	1,145	100

year	Freq.	Percent
2018	606	52.93
2019	539	47.07
Total	1,145	100

Therapy	Freq.	Percent
Coumadin	582	50.83
Direct Thrombin	20	1.75
Factor Xa	551	48.12
Aspirin/Plavix /etc.	498	43.49
Total	1,145	100

	min_to_first_revers	
Percentiles		Smallest
1%	14	5
5%	34	10
10%	51	11
25%	80.5	12
50%	133.5	
		Largest
75%	208.5	1388
90%	348	1403
95%	608	1411
99%	1281	1426

Percent reversal, total, and by agent		
	Freq.	Percent
any_reversal	699	61.05
FFP	168	20.41
PBRC	50	6.31
PLT	98	12.25
Vitamin K	336	38.84
4F PCC	414	47.1
3F PCC	6	0.78
Antifibrinolytic (TXA)	52	6.39
Desmopressin	29	3.74
Protamine	1	0.13
Dialysis	1	0.13
Charcoal	0	0
Monoclonal ab (Praxbind)	3	0.39
Modified recombinant factor Xa (Andexanet)	19	2.47
Other	36	4.56
Total	1,145	100

Time to reversal, by agent, in minutes

Any minutes to reversal outside of 0-1440 minutes (0-24 hours) were recoded as missing

Entire sample:

	ffp	prbc	plt	vitk	4fpcc	3fpcc	antifb	desmo	prot	monab	fxa	other	Any agent
N	152	33	90	315	400	5	50	27	1	2	19	35	668
mean	294.4	399.0	280.8	238.6	172.3	108.8	137.3	223.4	69.0	147.5	171.7	206.4	190.9
sd	274.3	429.5	274.2	253.4	177.1	50.8	180.4	191.7	.	75.7	109.7	246.2	215.6
min	5	10	26	12	12	58	11	12	69	94	65	15	5
p25	119.5	50	101	98	83.5	66	46	111	69	94	98	93	80.5
p50	198	229	214	152	126	103	82	193	69	147.5	136	137	133.5
p75	355	608	318	257	193.5	137	163	290	69	201	211	230	208.5
max	1426	1411	1362	1403	1417	180	1167	1043	69	201	514	1357	1426

For patients on warfarin:

stats	ffp	prbc	plt	vitk	4fpcc	3fpcc	antifb	desmo	prot	monab	fxa	other	Any agent
N	122	17	46	295	223	5	16	12	1	0	0	8	387
mean	284.5	412.6	288.5	236.3	178.7	108.8	92.8	209.5	69.0	.	.	341.8	197.1
sd	264.1	475.2	290.1	249.6	191.4	50.8	78.3	123.9	.	.	.	429.3	228.9
min	5	12	26	12	12	58	16	12	69	.	.	15	5
p25	122	61	99	98	81	66	38	90	69	.	.	106	78
p50	193	182	215	150	130	103	58.5	210	69	.	.	231	137
p75	337	757	325	257	204	137	137.5	306.5	69	.	.	344	213
max	1426	1411	1362	1403	1417	180	256	414	69	.	.	1357	1426

For patients on DOACs:													
stats	ffp	prbc	plt	vitk	4fpcc	3fpcc	antifb	desmo	prot	monab	fxa	other	Any agent
N	31	16	46	23	182	0	35	16	0	2	19	30	288
mean	335.0	384.6	267.6	256.7	164.3	.	161.1	224.3	.	147.5	171.7	168.4	181.9
sd	308.7	390.2	255.1	295.0	155.9	.	207.6	232.1	.	75.7	109.7	144.0	194.0
min	25	10	29	33	14	.	11	70	.	94	65	51	10
p25	118	45.5	107	94	86	.	54	111.5	.	94	98	93	86.5
p50	241	279	186	169	125	.	112	162.5	.	147.5	136	132.5	126.5
p75	508	589.5	294	273	183	.	181	217	.	201	211	199	201
max	1333	1388	1215	1209	1180	.	1167	1043	.	201	514	836	1388

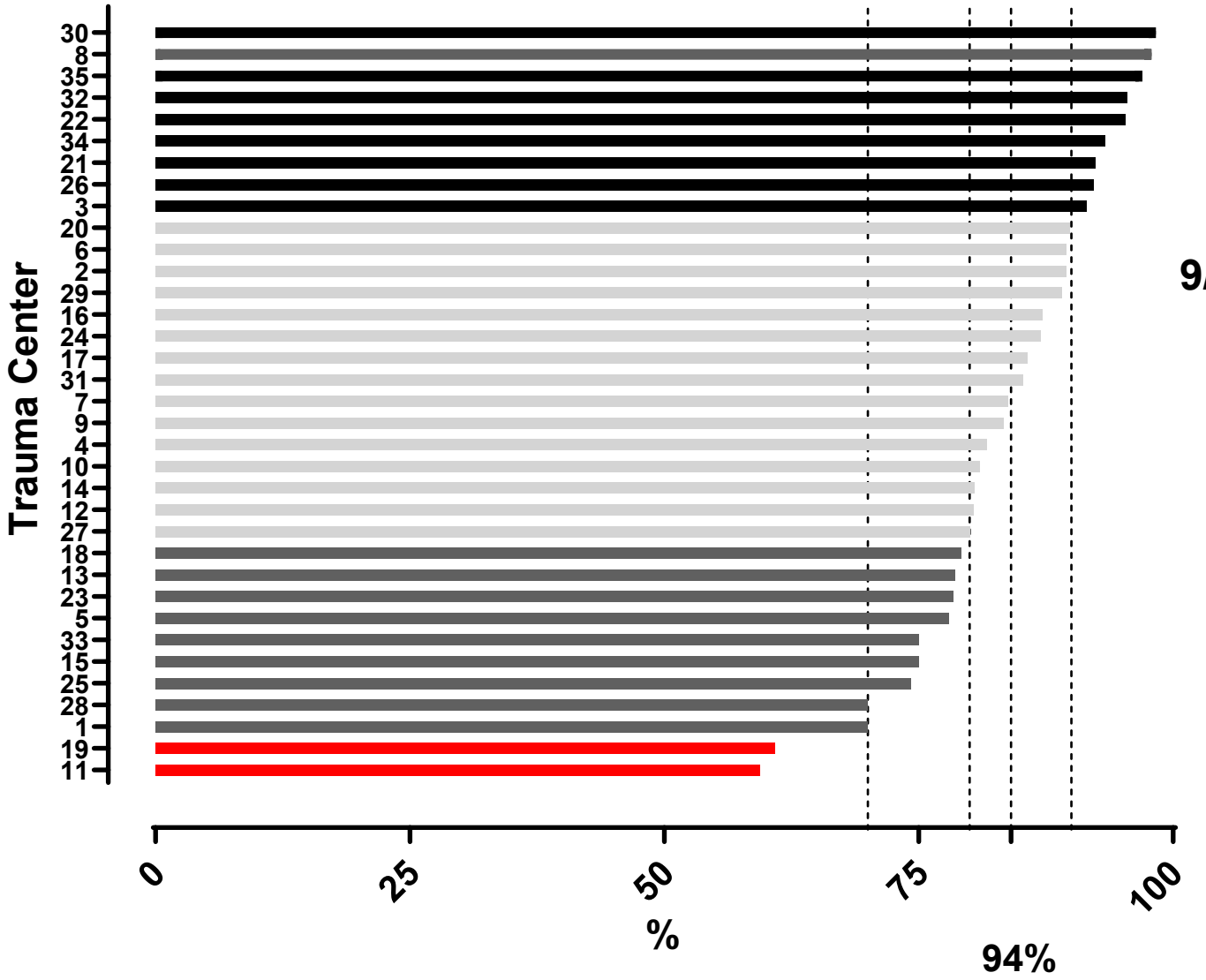
For patients on warfarin with INR 2+:

	ffp	prbc	plt	vitk	4fpcc	3fpcc	antifb	desmo	prot	other	Any agent
N	77	9	29	210	163	3	7	6	0	3	248
mean	269.1	332.2	291.1	231.5	188.8	116.3	129.7	260.8	.	601.0	195.7
sd	264.4	428.4	276.2	232.5	194.6	58.2	97.0	141.4	.	687.0	210.1
min	5	16	70	12	12	66	20	12	.	15	5
p25	116	61	99	105	87	66	40	193	.	15	81.5
p50	185	142	215	154.5	141	103	100	306.5	.	431	140
p75	317	311	349	257	212	180	229	333	.	1357	213.5
max	1426	1132	1332	1403	1417	180	256	414	.	1357	1426

For patients on warfarin with INR <2:

	ffp	prbc	plt	vitk	4fpcc	3fpcc	antifb	desmo	prot	other	Any agent
N	39	6	14	71	45	2	9	4	1	4	120
mean	315.2	611.3	213.4	252.1	145.6	97.5	64.1	169.0	69.0	214.0	207.9
sd	279.9	589.9	176.5	306.8	200.8	55.9	48.2	94.8	.	52.8	276.5
min	39	12	26	32	28	58	16	84	69	137	12
p25	134	30	97	87	57	58	37	90	69	183.5	69.5
p50	199	532.5	202.5	145	91	97.5	50	156.5	69	231	135.5
p75	435	1150	257	243	177	137	87	248	69	244.5	210.5
max	1142	1411	725	1306	1332	137	162	279	69	257	1411

2020 Metric #10 - ED Head CT ≤ 120 min
Cohort 1 - MTQIP All, TBI on Anticoagulant (Excluding ASA)
7/1/18 - 6/30/19



9/34 Centers ≥ 90%

Mean 84.1%

Discussion

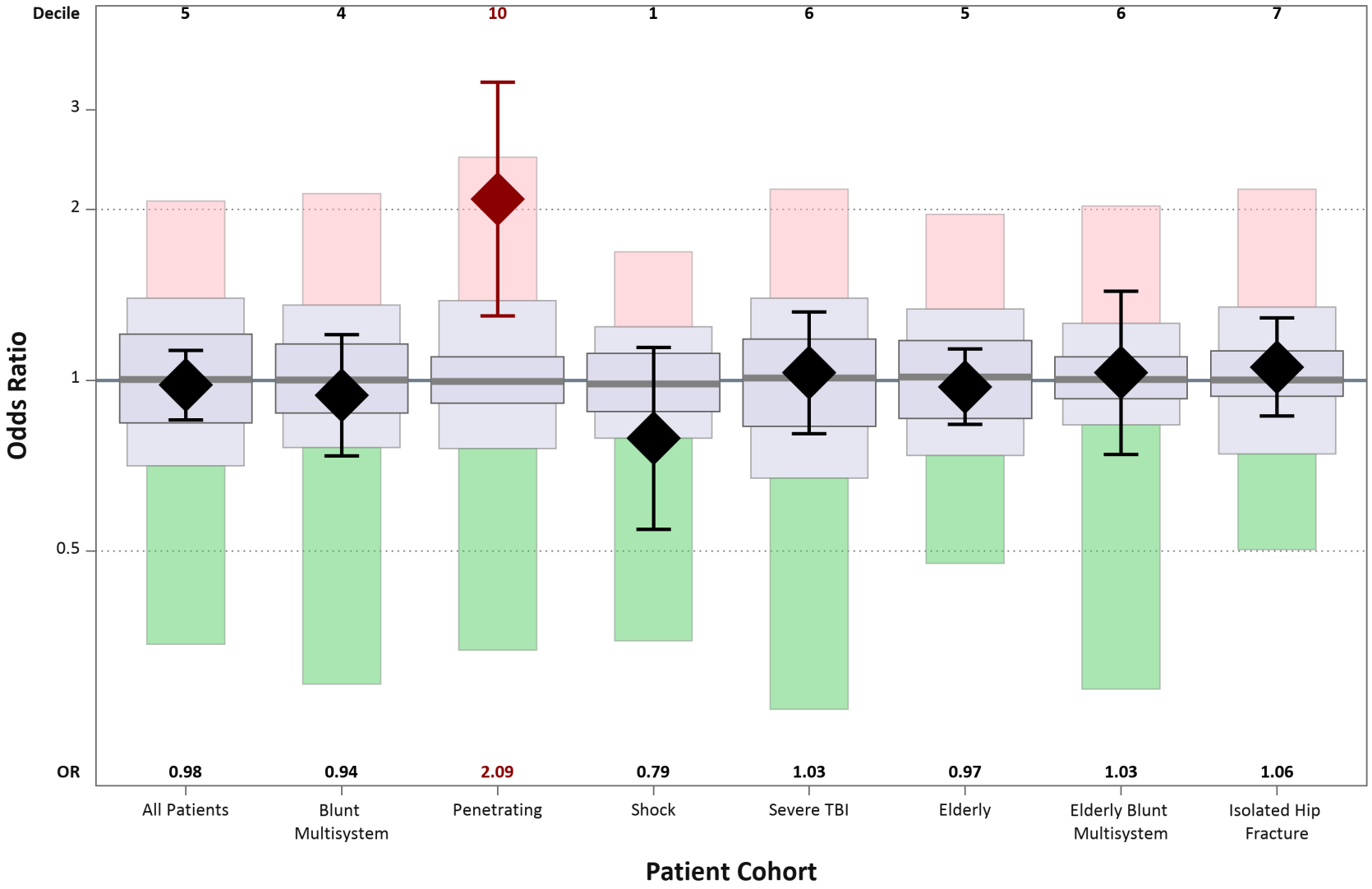
ACS TQIP Collaborative Report

Mark Hemmila, MD

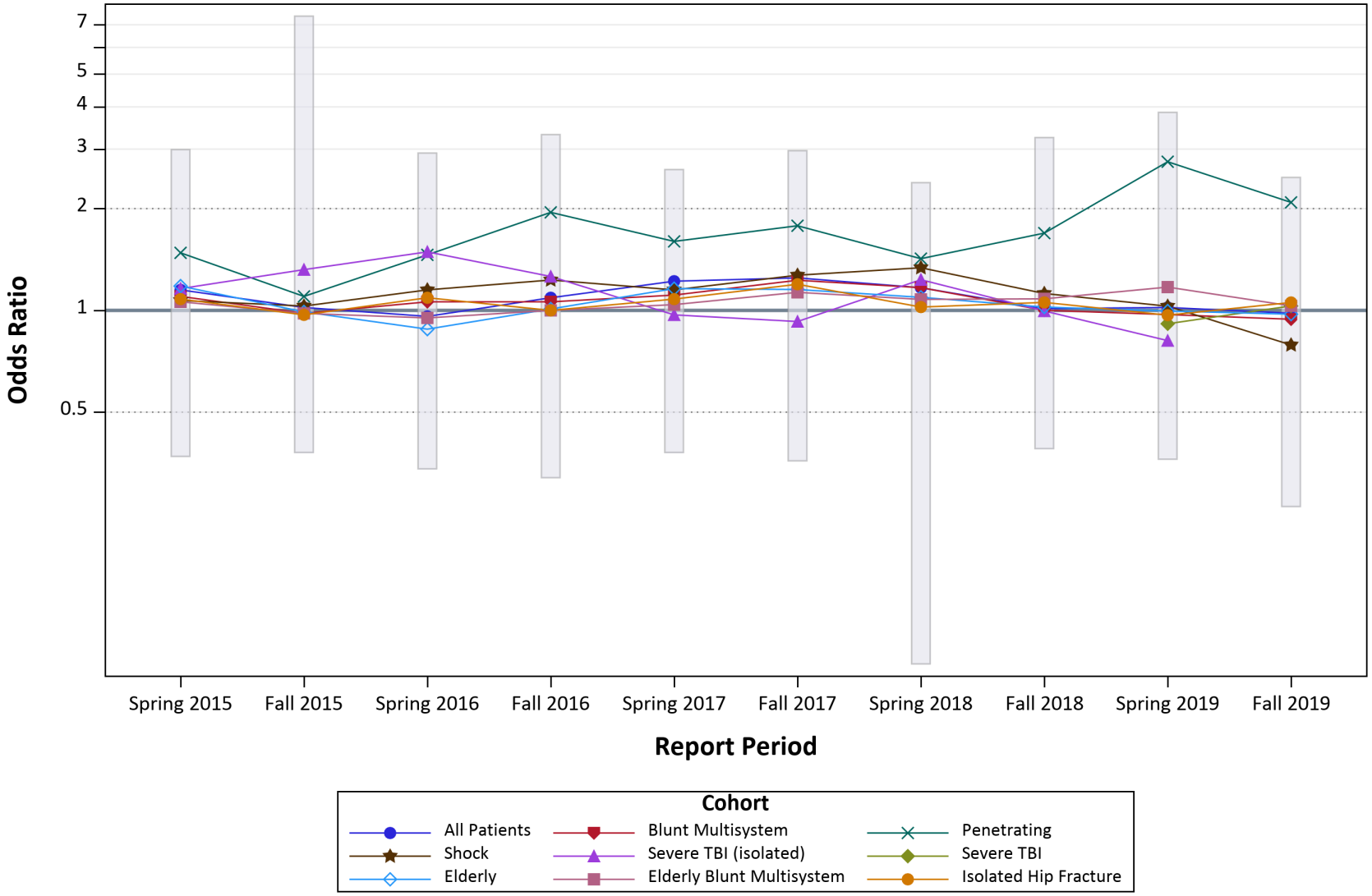
Inclusion/Exclusion

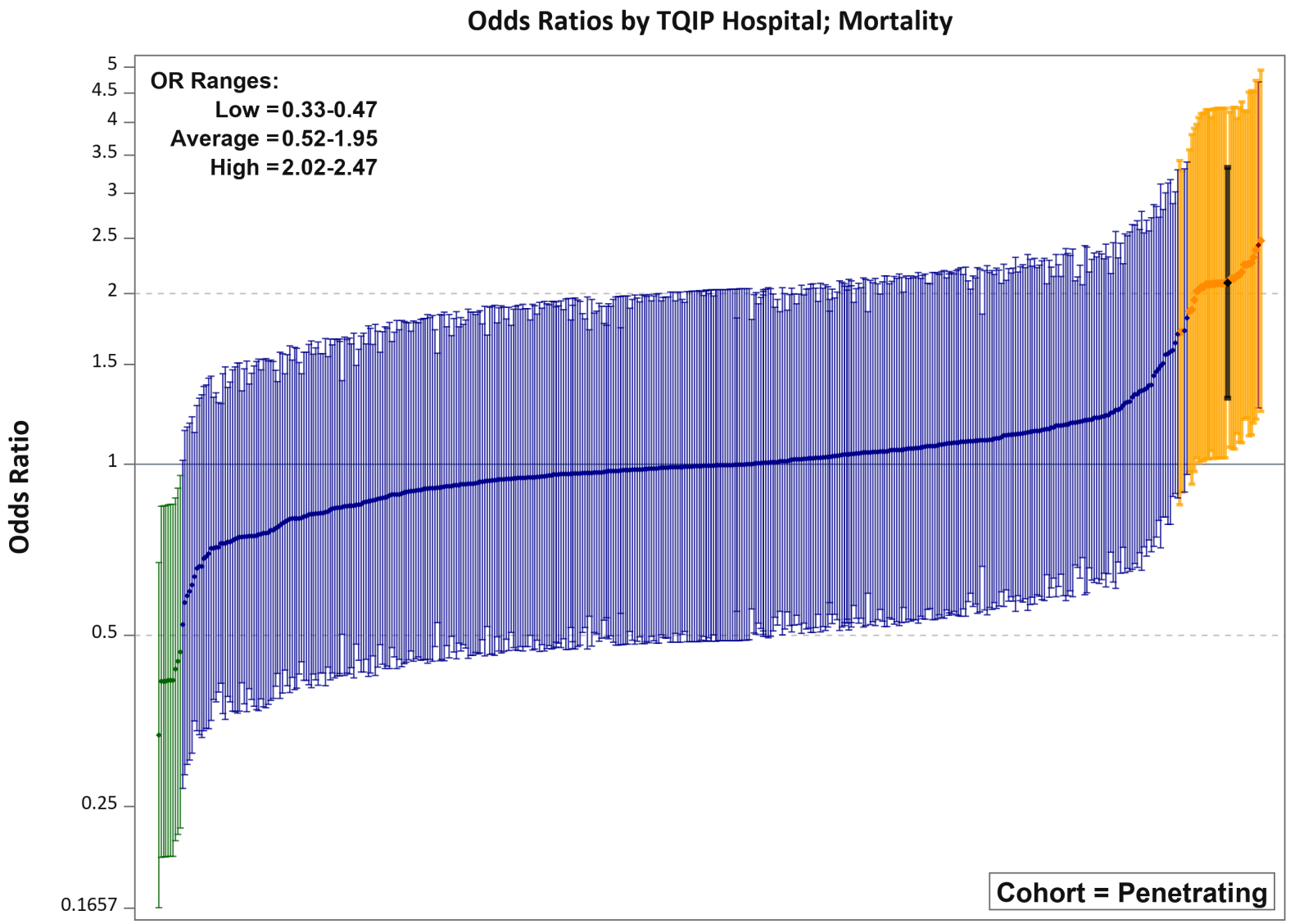
- AIS = 3 in at least one body region
- Exclude if pre-existing advanced directive
- Exclude if no signs-of-life
- Mortality includes discharge to hospice

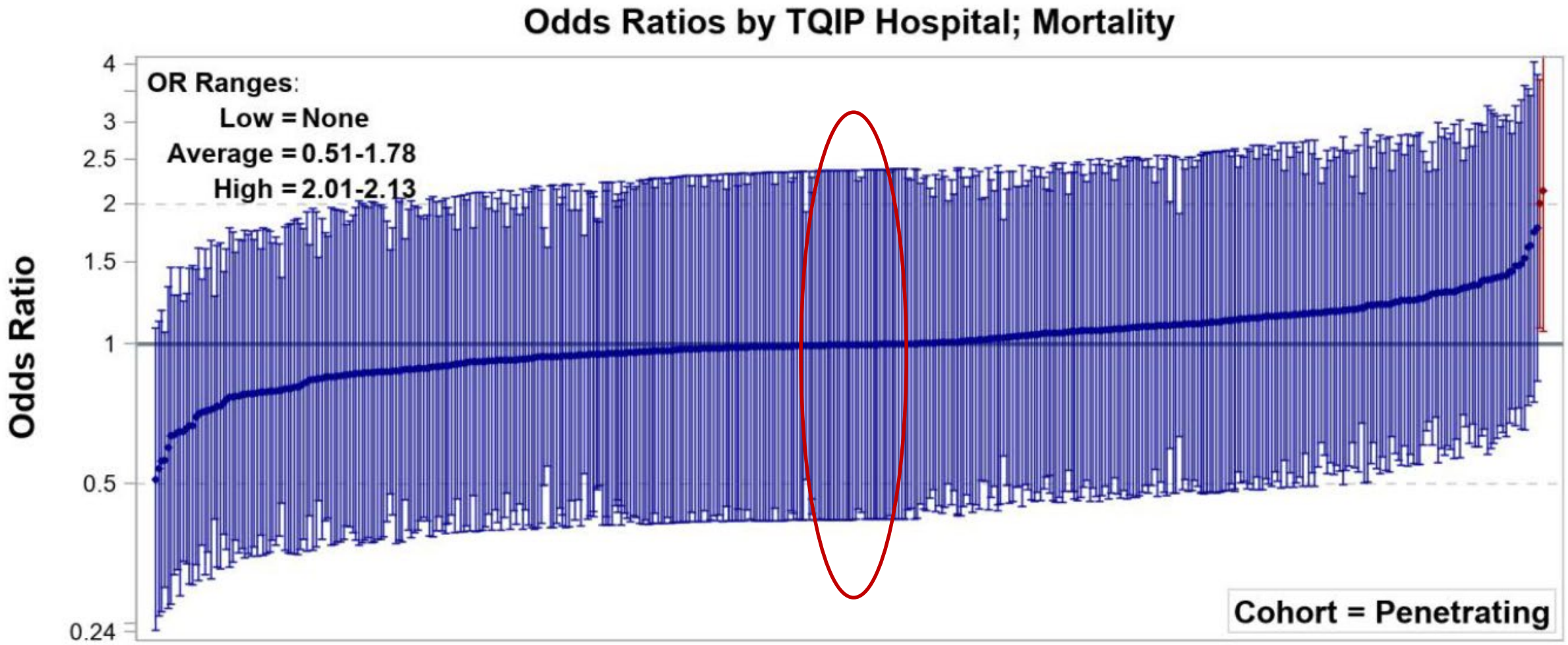
Risk-Adjusted Mortality by Cohort - Fall 2019
TQIP Report ID: Michigan



Risk-Adjusted Mortality by Cohort - Fall 2019
TQIP Report ID: Michigan




Odds Ratios by TQIP Hospital; Mortality
OR Ranges:
Low = 0.33-0.47
Average = 0.52-1.95
High = 2.02-2.47
Odds Ratio
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0.25
0.1657
Cohort = Penetrating



Center 27 OR = 1.05

VII. Patient Characteristics

Table 7: Patient Demographic Characteristics by Cohort

		Patients				Race						
Cohort	Group	N	Mean Age (years)	Male (%)	Transfer-In Patients (%)	White (%)	Black (%)	Asian (%)	Pacific Islander (%)	American Indian (%)	Other (%)	Unknown (%)
All Patients	All Others	296,297	55	64.4	31.6	75.4	13.8	2.3	0.3	1.0	7.3	3.5
	Collaborative	13,177	59	58.4	21.8	78.7	16.8	0.9	0.1	0.3	3.4	1.4
Blunt Multisystem	All Others	43,751	49	68.5	25.2	76.0	12.4	2.6	0.3	0.8	8.2	5.4
	Collaborative	1,381	50	64.5	23.5	80.0	13.3	1.0	0.2	0.3	5.4	2.8
Penetrating	All Others	14,192	34	87.8	17.0	38.3	49.0	1.1	0.3	1.6	10.0	5.4
	Collaborative	418	33	87.6	8.6	27.2	66.4	0.7	0.0	0.0	6.1	2.4
Shock	All Others	13,516	48	60.8	18.0	67.3	21.2	2.3	0.4	0.9	8.1	5.0

VII. Patient Characteristics

Table 8: Patient Injury Severity by Cohort

		Patients							Mean Risk Ratio		
Cohort	Group	N	Pre-Hospital Cardiac Arrest (%)	SBP≤ 90mmHg (%)	Median ISS	Mean SBP (mmHg)	Mean Pulse (bpm)	ED GCS Total 8 or less (%)	Survival	Major Complication	Complication Including Death
All Patients	All Others	296,297	1.3	4.3	14	138	88	12.4	0.712	0.717	0.551
	Collaborative	13,177	1.0	3.2	11	142	87	9.8	0.749	0.754	0.603
Blunt Multisystem	All Others	43,751	3.3	10.8	26	128	96	29.2	0.431	0.405	0.204
	Collaborative	1,381	3.7	9.3	25	131	95	28.9	0.434	0.419	0.212
Penetrating	All Others	14,192	3.4	15.4	16	121	99	17.4	0.620	0.556	0.385
	Collaborative	418	4.8	13.0	17	123	100	20.3	0.613	0.554	0.380

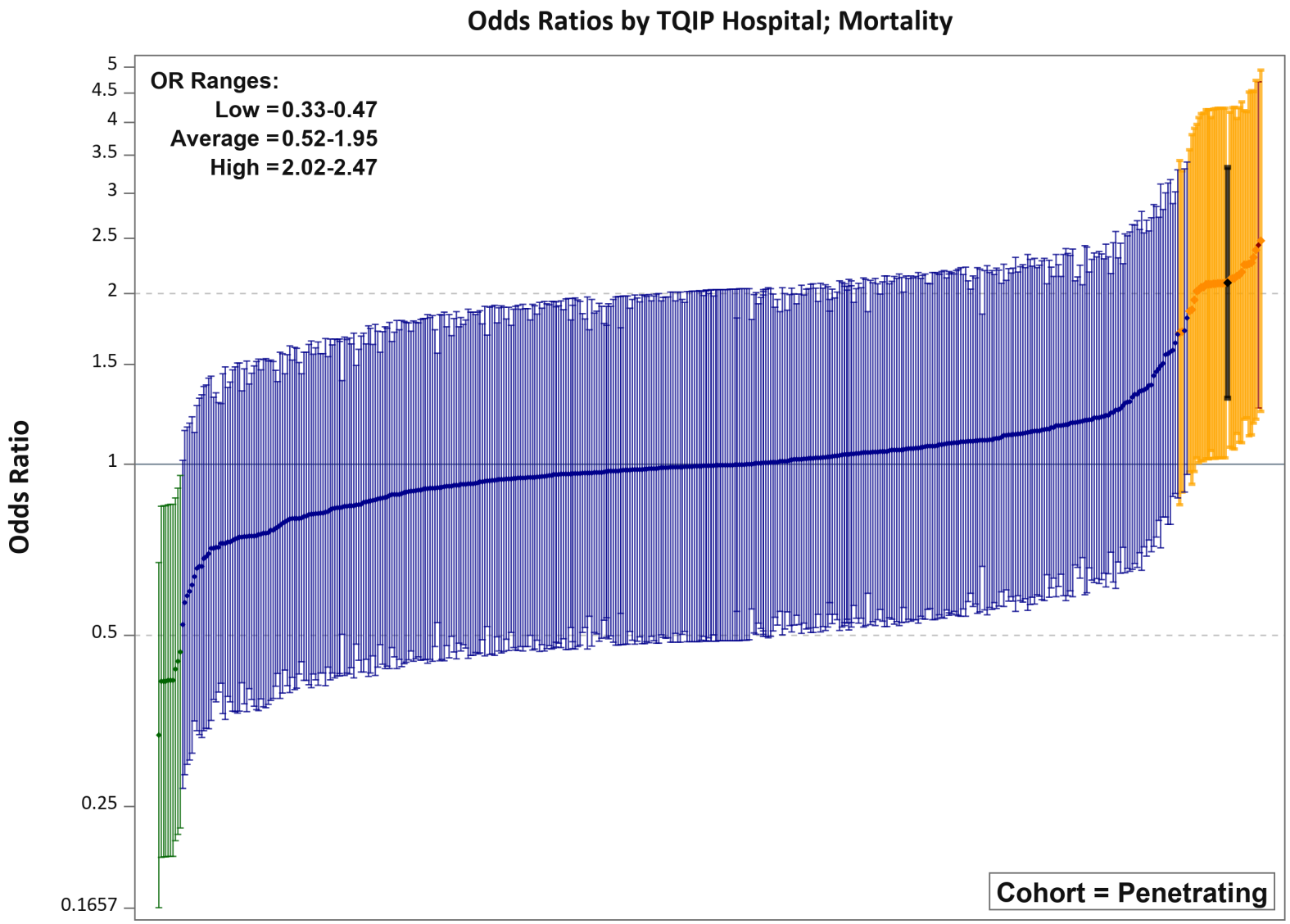
VII. Patient Characteristics

Table 9: Selected Mechanisms of Injury by Cohort

Cohort	Group	Patients (N)	Fall (%)	MVT Occupant and Other (%)	MVT Motorcyclist (%)	Pedestrian Pedal (%)	Struck by/ Against (%)	Firearm (%)	Cut/Pierce (%)	Other (%)
All Patients	All Others	296,297	45.1	23.2	5.9	7.4	5.0	6.2	2.7	4.4
	Collaborative	13,177	56.8	19.2	3.8	4.8	5.0	5.0	1.7	3.8
Blunt Multisystem	All Others	43,751	22.6	44.6	12.3	13.7	2.7	0.0	0.0	4.1
	Collaborative	1,381	26.6	45.4	12.3	9.3	2.8	0.0	0.0	3.6
Penetrating	All Others	14,192	0.0	0.0	0.0	0.0	0.0	59.4	40.6	0.0
	Collaborative	418	0.0	0.0	0.0	0.0	0.0	65.3	34.7	0.0

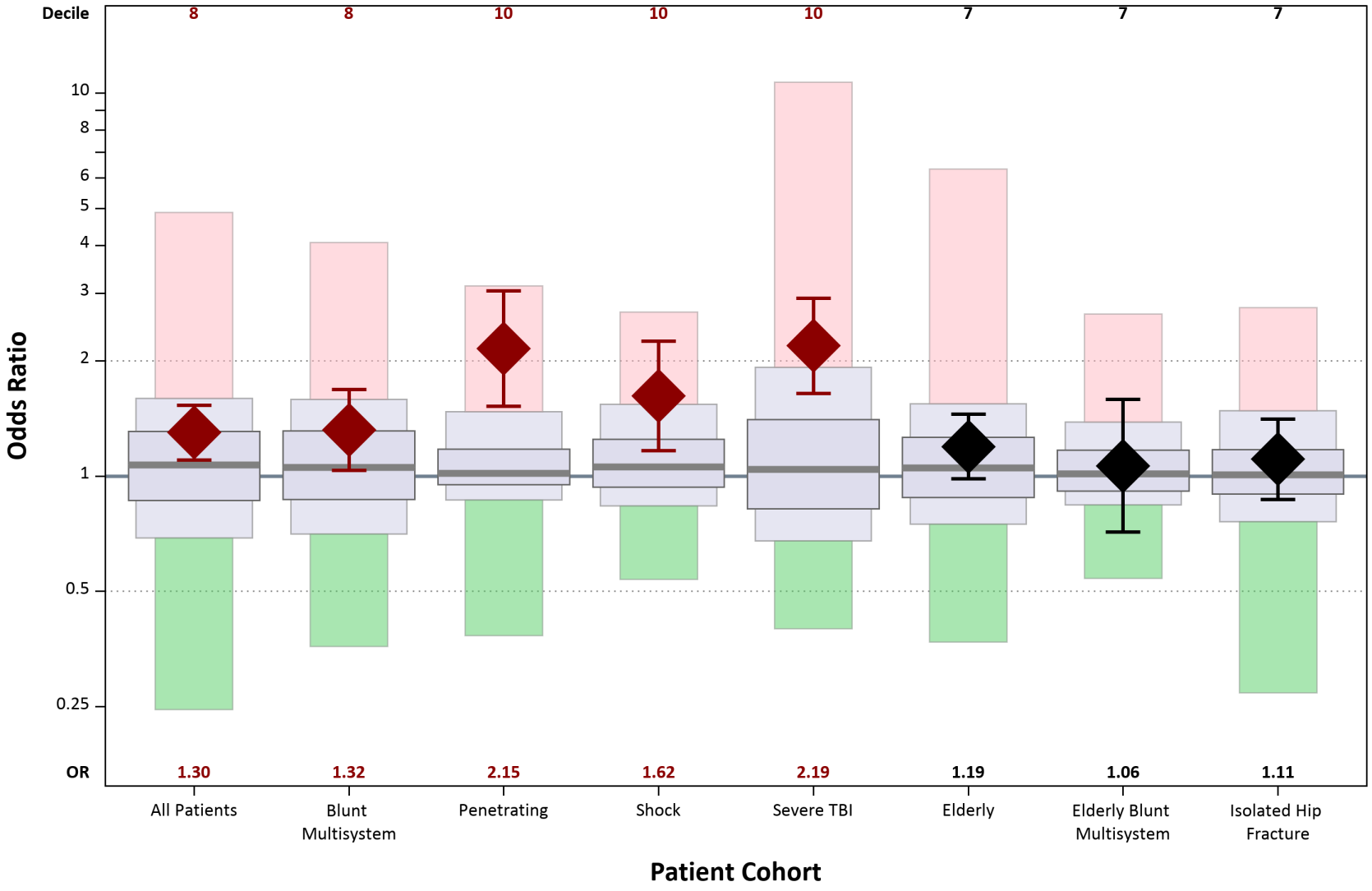
Table 2: Risk-Adjusted Mortality by Cohort

		Mortality				Odds Ratio and 95% Confidence Interval				
Cohort	N	Observed Events	Observed (%)	Expected (%)	TQIP Average (%)	Odds Ratio	Lower	Upper	Outlier	Decile
All Patients	13,177	865	6.6	6.6	7.5	0.98	0.85	1.13	Average	5
Blunt Multisystem	1,381	209	15.1	15.2	15.4	0.94	0.74	1.20	Average	4
Penetrating	418	63	15.1	15.0	10.3	2.09	1.30	3.35	High	10
Shock	399	87	21.8	21.6	27.6	0.79	0.55	1.14	Average	1
Severe TBI	779	358	46.0	46.9	45.0	1.03	0.80	1.32	Average	6
Elderly	5,788	511	8.8	8.9	10.2	0.97	0.84	1.14	Average	5
Elderly Blunt Multisystem	387	82	21.2	21.2	22.4	1.03	0.74	1.44	Average	6
Isolated Hip Fracture	3,897	140	3.6	3.4	3.1	1.06	0.87	1.29	Average	7


Odds Ratios by TQIP Hospital; Mortality
OR Ranges:
Low = 0.33-0.47
Average = 0.52-1.95
High = 2.02-2.47
Odds Ratio
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0.25
0.1657
Cohort = Penetrating

Note: The estimates of the odds ratios (ORs) in these figures reflect the results from the risk-adjusted TQIP Collaborative models which account for commonality among hospitals belonging to the same Collaborative. As such, they will not match the estimates provided to centers in their TQIP Benchmark Reports.

Risk-Adjusted Major Complications by Cohort - Fall 2019
TQIP Report ID: Michigan



Risk-Adjusted Major Complications by Cohort - Fall 2019
TQIP Report ID: Michigan

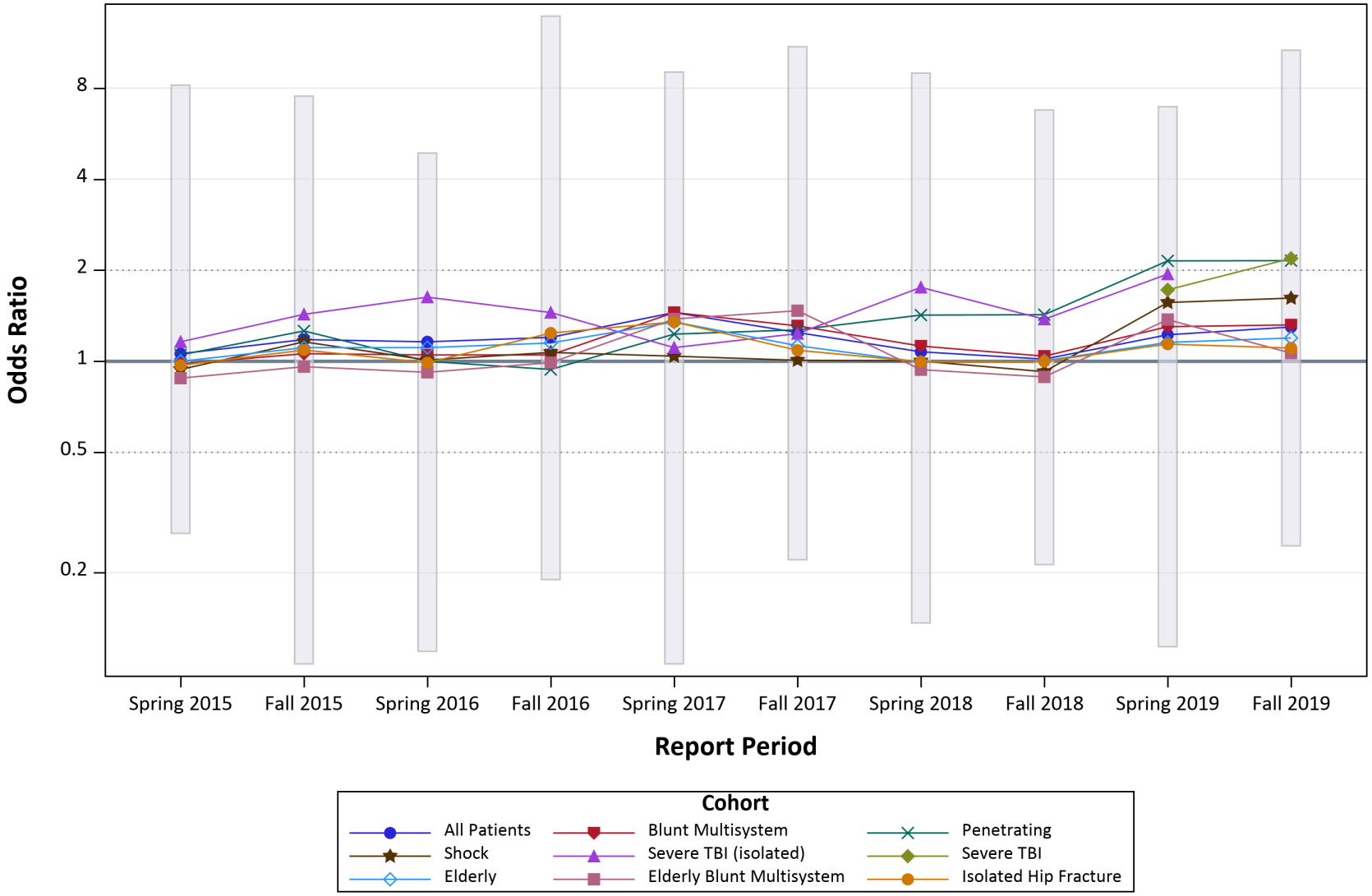


Table 12: Complications by Cohort*

		Patients	Null Values		Organ Dysfunction				
Cohort	Group	N	Unknown (%)	None (%)	Acute Kidney Injury (%)	Acute Respiratory Distress Syndrome (%)	Cardiac Arrest with CPR (%)	Stroke/CVA (%)	Myocardial Infarction (%)
All Patients	All Others	295,087	0.1	86.9	0.9	0.6	1.4	0.4	0.2
	Collaborative	13,177	0.3	87.5	0.4	0.5	1.4	0.3	0.4
Blunt Multisystem	All Others	43,617	0.2	74.5	2.4	1.8	3.9	1.3	0.4

Table 12: Complications by Cohort* (continued)

		Patients	Infection						
Cohort	Group	N	Catheter-Associated UTI (%)	Superficial Incisional Surgical Site Infection (%)	Deep Surgical Site Infection (%)	Organ/Space Surgical Site Infection (%)	Ventilator-Associated Pneumonia (%)	CLABSI (%)	Severe Sepsis (%)
All Patients	All Others	295,087	0.4	0.2	0.2	0.1	0.9	0.1	0.5
	Collaborative	13,177	0.4	0.1	0.1	0.2	1.7	0.0	0.4

Table 12: Complications by Cohort* (continued)

		Patients	Assorted							
Cohort	Group	N	Pressure Ulcer (%)	Alcohol Withdrawal Syndrome (%)	Deep Vein Thrombosis (%)	Pulmonary Embolism (%)	Extremity Compartment Syndrome (%)	Unplanned Intubation (%)	Unplanned Return to OR (%)	Unplanned Admission to ICU (%)
All Patients	All Others	295,087	0.7	1.0	1.2	0.6	0.1	0.4	1.0	2.6
	Collaborative	13,177	0.7	1.5	1.2	0.5	0.1	0.4	1.0	2.7
Blunt Multisystem	All Others	43,617	2.4	1.1	3.1	1.5	0.3	1.0	2.1	4.1

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IX. Processes of Care: Orthopedic Trauma Care

Table 15: First Operative Internal or External Fixation in Elderly Patients with Isolated Hip Fracture

	Isolated Hip Fracture	Operative Fixation		Time to Operative Fixation (hours)	Operative Fixation more than 48 Hours		Missing Time to Operative Fixation	
Group	N	N	%	Median (IQR)	N	%	N	%
All Others	36,397	32,535	89.4	21.68 (15.75-30)	2,890	8.9	125	0.4
Collaborative	3,897	3,559	91.3	22.48 (16.83-30.67)	324	9.1	6	0.2

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Table 21: Procedures for Patients with Blunt Splenic Injuries by Cohort

		Patients	Operative Management		Splenic Preservation		Angiography		Time to Operative Management (hours)	Missing Time to Operative Management	
Cohort	Group	N	N	%	N	%	N	%	Median (IQR)	N	%
Blunt Splenic Injury (BSI)	All Others	14,016	2,648	18.9	11,368	81.1	2,449	17.5	1.77 (0.95-3.93)	27	1.0
	Collaborative	460	58	12.6	402	87.4	63	13.7	2.62 (1.38-5.6)	1	1.7
Isolated BSI	All Others	1,243	239	19.2	1,004	80.8	349	28.1	2.24 (1.11-5.76)	3	1.3
	Collaborative	57	7	12.3	50	87.7	15	26.3	3.48 (2.87-21.32)	0	0.0

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Table 23: Pharmacologic VTE Prophylaxis by Cohort

		Patients[1]	VTE Prophylaxis				Time to VTE Prophylaxis (days)	Missing Time to VTE Prophylaxis	
Cohort	Group	N	N	%	No Prophylaxis (%)	Status Unknown (%)	Median (IQR)	N	%
All Patients	All Others	285,489	192,778	67.6	32.4	0.1	2 (1-3)	429	0.2
	Collaborative	12,759	9,667	75.8	24.2	0.1	2 (1-2)	15	0.2
Blunt Multisystem	All Others	40,438	32,666	80.9	19.1	0.1	2 (2-4)	67	0.2
	Collaborative	1,262	1,067	84.6	15.4	0.1	2 (1-3)	2	0.2
Penetrating	All Others	13,011	10,575	81.3	18.7	0.1	2 (1-2)	19	0.2
	Collaborative	362	327	90.3	9.7	0.0	1 (1-2)	0	0.0
Shock	All Others	10,205	8,150	79.9	20.1	0.1	2 (1-4)	16	0.2
	Collaborative	339	281	82.9	17.1	0.0	2 (1-3)	1	0.4
Severe TBI	All Others	17,483	11,396	65.3	34.7	0.2	3 (2-5)	20	0.2
	Collaborative	552	373	67.7	32.3	0.2	3 (2-5)	2	0.5
Elderly	All Others	103,878	64,766	62.4	37.6	0.1	2 (1-3)	164	0.3
	Collaborative	5,602	4,119	73.6	26.4	0.1	2 (1-2)	5	0.1
Elderly Blunt Multisystem	All Others	10,189	7,664	75.3	24.7	0.1	2 (2-4)	24	0.3
	Collaborative	347	276	79.5	20.5	0.0	2 (1-3)	0	0.0
Isolated Hip Fracture	All Others	36,075	30,695	85.1	14.9	0.0	2 (1-2)	72	0.2
	Collaborative	3,872	3,699	95.6	4.4	0.1	2 (1-2)	2	0.1

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Table 24: Pharmacologic VTE Prophylaxis Type by Cohort

		VTE Prophylaxis[1]	Unfractionated Heparin		Low Molecular Weight Heparin		Direct Thrombin or Xa Inhibitor		Other	
Cohort	Group	N	N	%	N	%	N	%	N	%
All Patients	All Others	192,778	42,035	21.8	143,356	74.4	2,408	1.2	4,026	2.1
	Collaborative	9,667	2,335	24.2	6,741	69.7	213	2.2	306	3.2
Blunt Multisystem	All Others	32,666	7,653	23.4	24,400	74.7	169	0.5	406	1.2
	Collaborative	1,067	245	23.0	800	75.0	7	0.7	13	1.2
Penetrating	All Others	10,575	1,564	14.8	8,897	84.1	24	0.2	87	0.8
	Collaborative	327	60	18.3	263	80.4	1	0.3	3	0.9
Shock	All Others	8,150	1,933	23.7	6,018	73.8	68	0.8	112	1.4
	Collaborative	281	71	25.3	196	69.8	4	1.4	9	3.2
Severe TBI	All Others	11,396	4,071	35.7	7,137	62.6	43	0.4	139	1.2
	Collaborative	373	163	43.7	206	55.2	1	0.3	3	0.8
Elderly	All Others	64,766	19,817	30.6	40,809	63.0	1,441	2.2	1,924	3.0
	Collaborative	4,119	1,247	30.3	2,516	61.1	161	3.9	135	3.3
Elderly Blunt Multisystem	All Others	7,664	2,542	33.2	4,881	63.7	71	0.9	144	1.9
	Collaborative	276	78	28.3	188	68.1	6	2.2	2	0.7
Isolated Hip Fracture	All Others	30,695	5,672	18.5	20,748	67.6	1,641	5.3	2,059	6.7
	Collaborative	3,699	850	23.0	2,294	62.0	196	5.3	289	7.8

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Table 34: Massive Transfusion Protocol: Plasma to Packed Red Blood Cells (PRBC) Ratios for Hemorrhagic Shock Patients

	Patients[1]	Plasma:PRBC Transfused Ratio between 1:1 and 1:2	
Group	N	N	%[2]
All Others	2,273	1,566	68.9
Collaborative	52	47	90.4

[1] Patients receiving more than 6 units of PRBCs within 4 hours from ED/Hospital arrival
[2] Patients with no plasma or unknown volume of plasma are included in the denominator

Conclusion

- Thank you for attending
- Evaluations
  - Fill out and turn in
- Questions?
- See you in May