Unexpected Survivors in Trauma: Where Do Brightspots Occur?

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Background

- Trauma Quality Improvement Program (TQIP)
- External benchmarking
- Outcomes classically reported in aggregate
- Needs of specific populations are not detectable
- Critically injured:
  - Tests of a facility's resources and processes of care?
  - Outcomes independent of hospital performance?

Objectives

- To determine if unexpected survivors of the most severe injuries cluster at specific TCs
- To evaluate whether performance remains constant across all levels of injury severity

Methods: Database

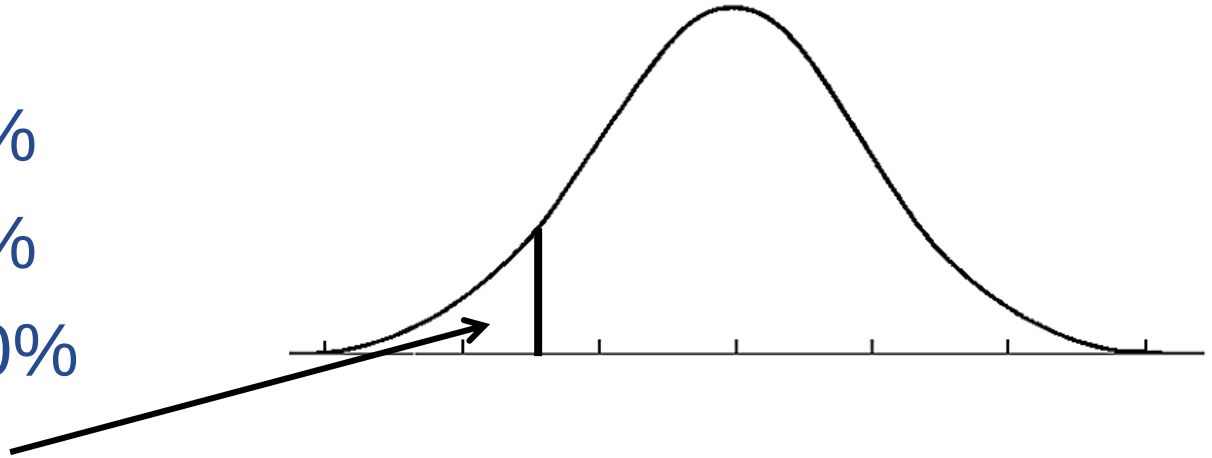
- National Trauma Data Bank (NTDB) 2007-2011
- Managed by the American College of Surgeons (ACS)

Methods: Inclusion/Exclusion Criteria

- Inclusion:
  - Patient: Adult (≥16 years) with blunt/penetrating injury and Injury Severity Score (ISS) ≥9
  - Hospital: Level 1
- Exclusion:
  - Patient: No signs of life (NSOL) or unknown disposition
  - Hospital: >20% missing data or <200 eligible patients

Methods: TRISS Categories

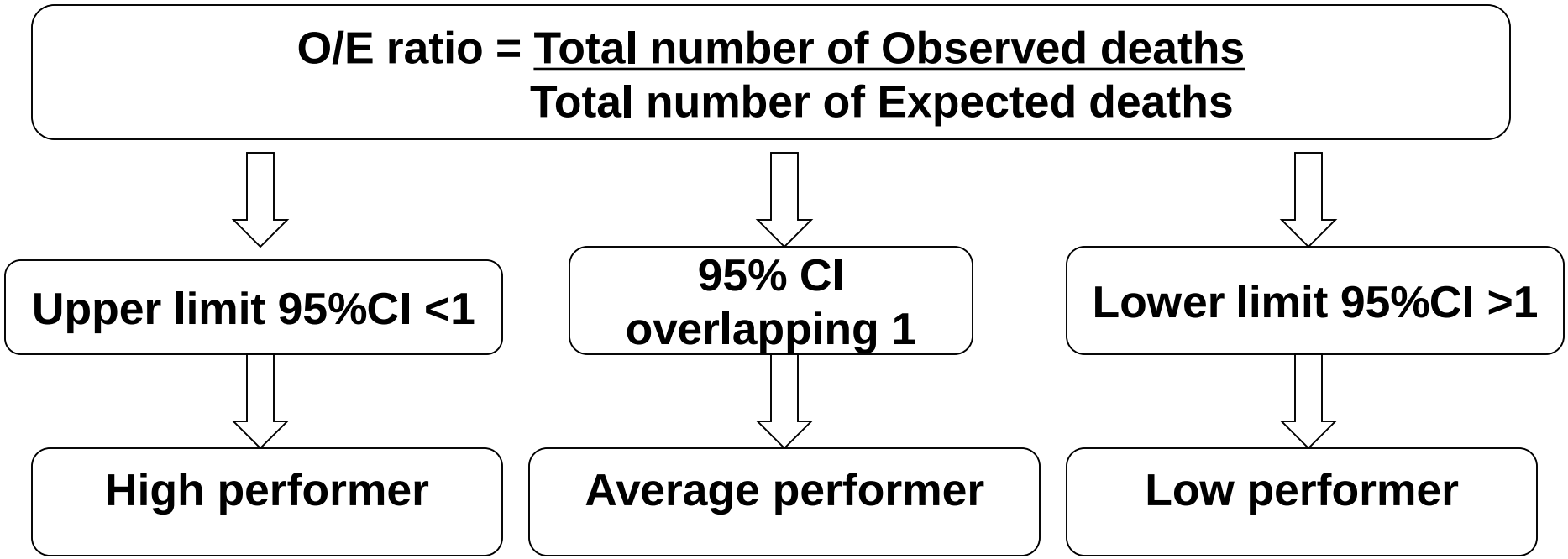
- Trauma and Injury Severity Score (TRISS) – 2009-2010 revisions
  - <25%
  - 25-50%
  - 50-75%
  - 75-100%
  - <10%



Methods: Benchmarking

- TQIP methodology
- Observed to expected in-hospital mortality (O/E) ratios
- Multivariate logistic regression
  - Age
  - Hypotension
  - Pulse
  - ISS
  - GCS
  - Ventilator use

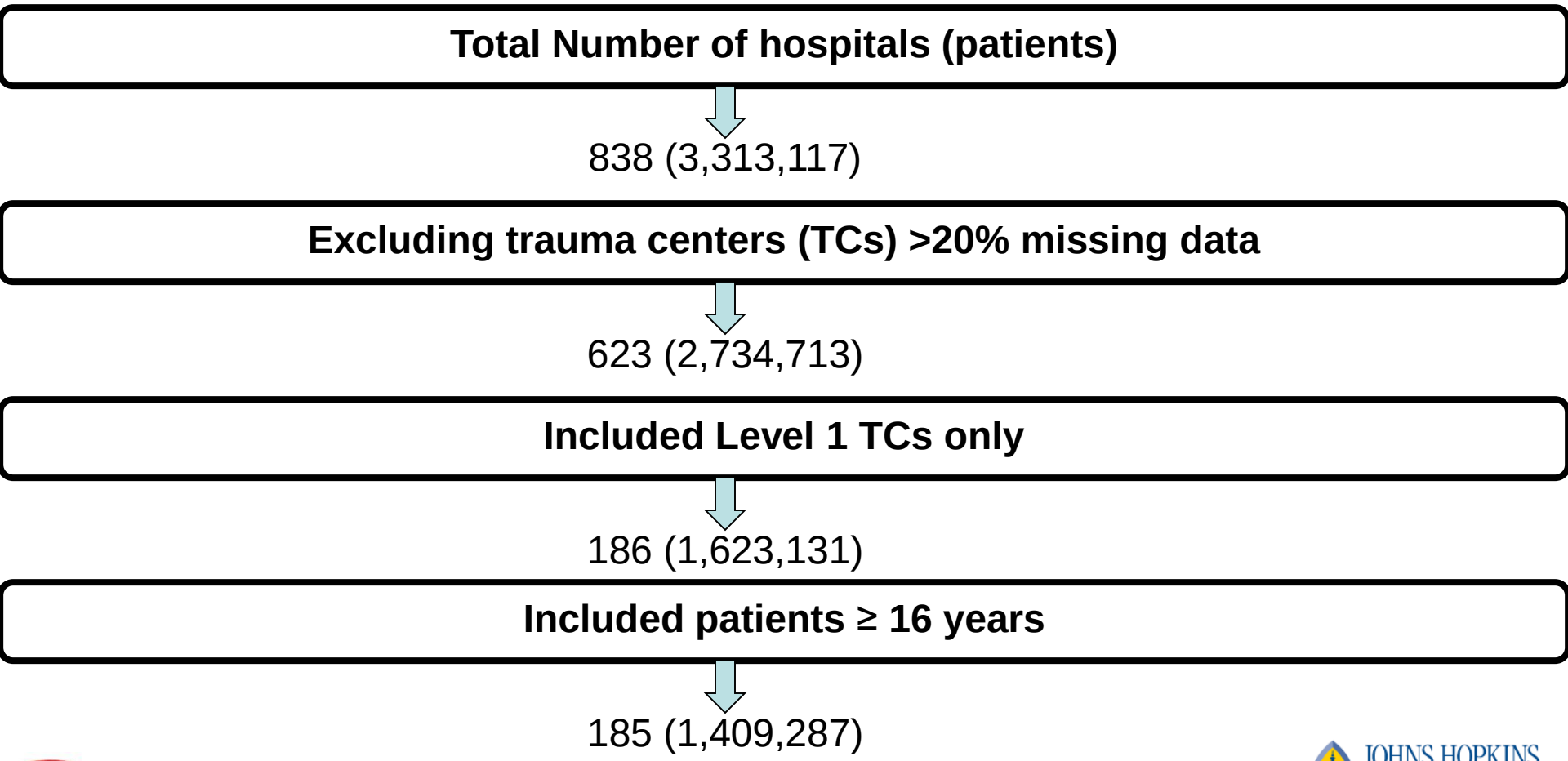
Methods: Benchmarking



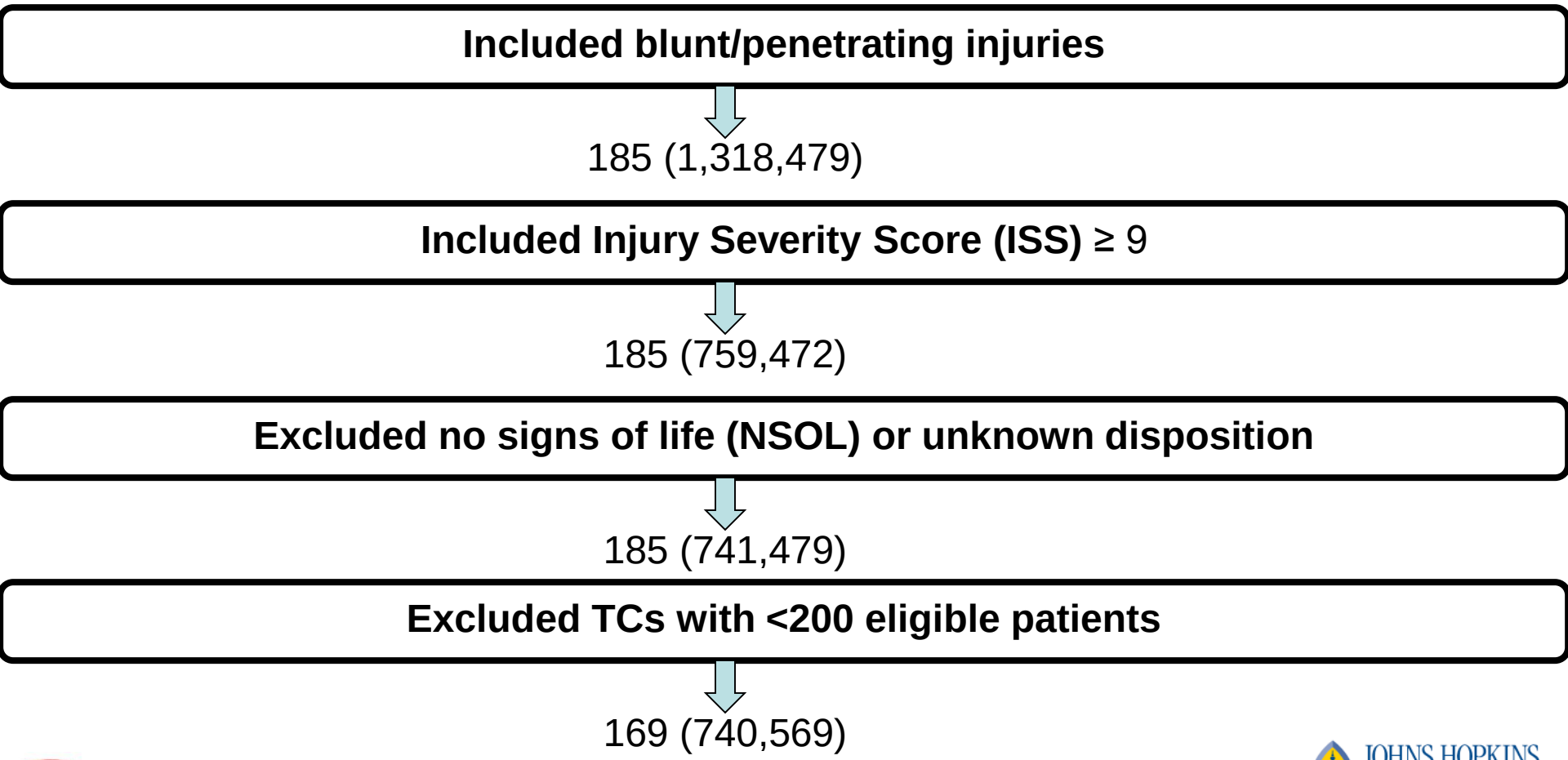
Methods: Statistical Considerations

- 95% Confidence Interval: Poisson approximation
- Missing data: Multiple imputation
- Correlated outcomes: Cluster analysis
- Model discrimination and calibration: AUROC and calibration curves
- Concordance and correlation
  - Spearman's coefficient
  - Weighted kappa statistic
  - Quintile differences
- Sensitivity analyses

Results: Flow Diagram (1)



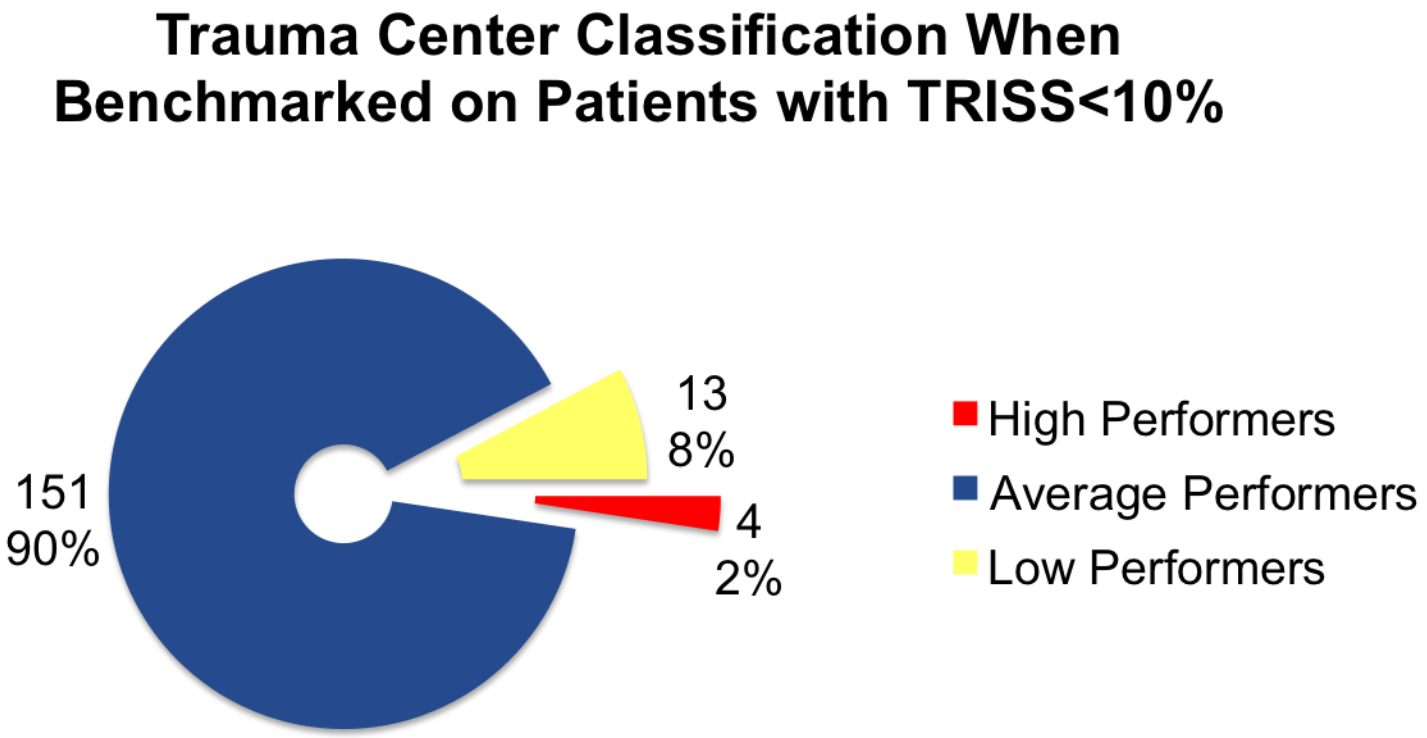
Results: Flow Diagram (2)



Results: TRISS<10%

- 11,941 patients
  - Male (70.6%)
  - Caucasian (74.6%)
  - Blunt trauma (90.8%)
- Higher proportion
  - Hypotensive (43.8% vs. 3.8%)
  - GCS 3 (96.7% vs. 8.0%)
  - ISS 25-75 (94.3% vs. 16.2%)
  - Requiring vent support (86.6% vs. 34.6%)

Results: Benchmarking



Results: Comparison

Variable	High performers (1027 patients; 4 TCs)	Low performers (1377 patients; 13 TCs)	p-value
Total patients, %	8.6	11.5	
Patients per TC, Mean	256.8	105.9	0.001*
Age, Mean	49.7	45.6	<0.001*
Race, %			
White	91.5	63.0	<0.001*
Type of injury, % Penetrating	4.4	18.4	<0.001*
Mode of prehospital transport, %			
Helicopter	75.1	40.7	
Region			
Midwest	0.0	0.0	<0.001*
Northeast	17.0	0.0	
South	83.0	76.1	
West	0.0	23.9	
Bed Size			
<=200	0.0	6.3	<0.001*
201-400	0.0	4.6	
401-600	18.7	15.8	
>600	81.3	73.4	
Teaching Hospital, %	100.0	95.4	<0.001*

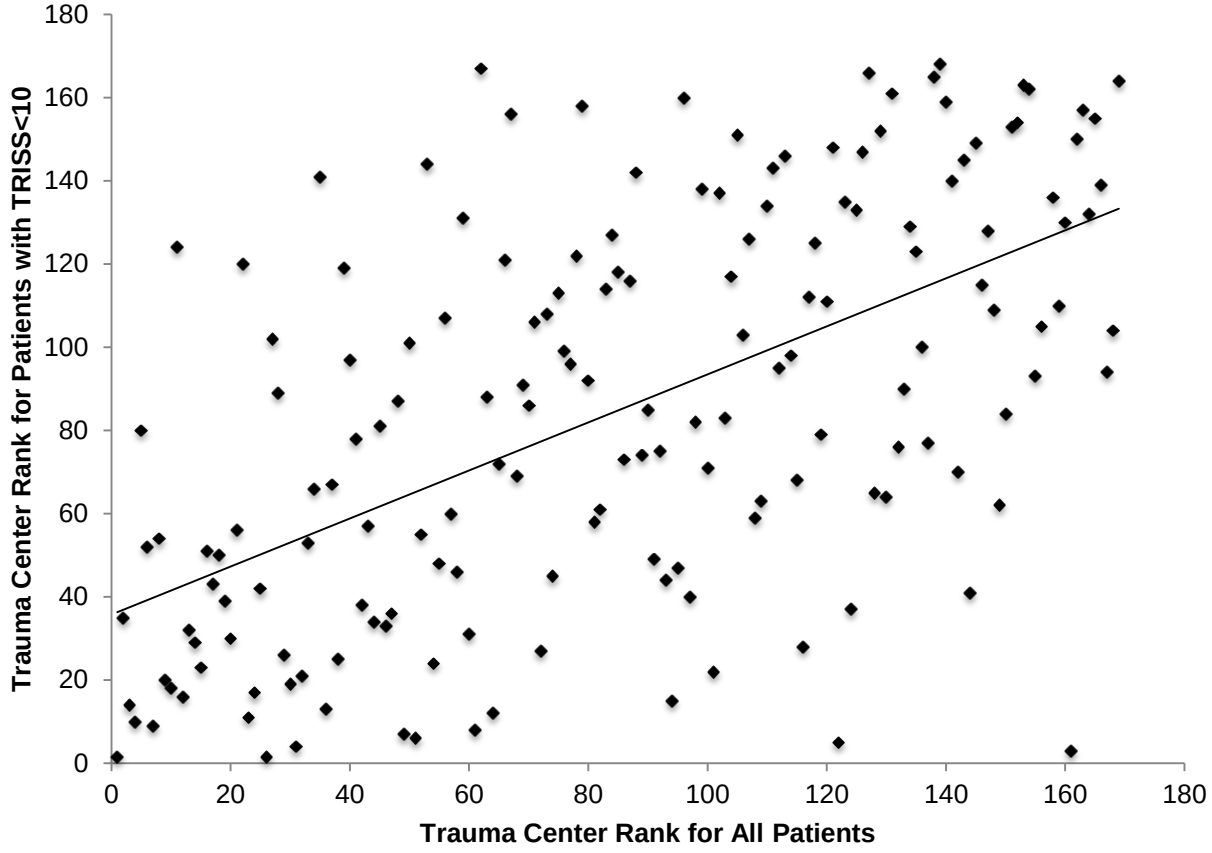
Results: Concordance

		Trauma center performance classification for patients with TRISS<10%			
Trauma center performance classification for all trauma patients		High	Average	Low	Total
	High	4	42	1	47
	Average	0	74	4	78
	Low	0	35	8	43
	Total	4	151	13	168*

*One TC did include any patients with a TRISS<10% and was therefore excluded from this comparison.

- Weighted kappa = 0.15

Results: Correlation



- Spearman's rho = 0.58

Results: Rank Quintiles

	All patients		
	Spearman rho*	Weighted kappa¶	Percentage unchanged§
TRISS<10%	0.58	0.15	38.1
TRISS<25%	0.71	0.39	44.1
TRISS 25-50%	0.72	0.37	45.6
TRISS 50-75%	0.74	0.35	49.7
TRISS 75-100%	0.79	0.54	46.8

*Comparing rank of O/E mortality ratios
¶Comparing categorization as high, average or low performer
§ Comparing rank quintiles of O/E mortality ratios

Implications

- Some TCs consistently perform better in the care of the severely injured
  - Outcomes not independent of hospital processes
  - Could serve as models for QI initiatives
- Performance status is not homogeneous across strata of severity of illness
  - Aggregate data does not reflect performance in subgroups
  - Composite measures of quality

Limitations

- NTDB: inconsistent and missing data
  - NTDB >2007, Level 1, multiple imputation
- Small sample size of TRISS<10%
  - Excluded TCs with <200 eligible patients
- TQIP methodology
  - Sensitivity analysis
- Hospital characteristics

Conclusions

- Certain TCs are high performers when benchmarked on mortality in the most severely injured
- TC performance demonstrates low to moderate concordance across strata of severity of illness
- High performers may be further studied to model QI initiatives

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