

The State Trauma Registry and how to use the data

Gill Cryer M.D.
University of California, Los Angeles

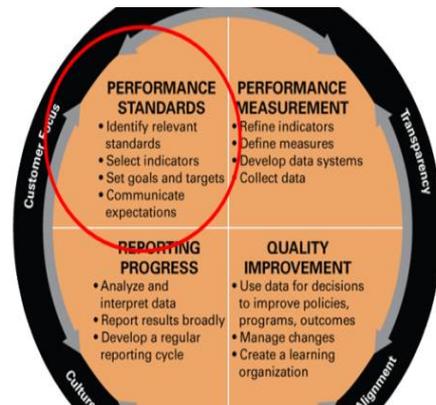
Disclosures

- ▶ Nothing to disclose

▶ 20

STATE TRAUMA SYSTEM PERFORMANCE IMPROVEMENT & PATIENT SAFETY SUBCOMMITTEE: Mission and Vision

- ▶ Mission is to provide an accountable, equitable, and quality state trauma system of care that is driven by evidence based practice and performance improvement reviews which are facilitated by data analysis.
- ▶ Vision is that through our State Trauma System, all the people of California have reduced incidence of injury, the best chance for survival, and maximal potential for recovery.



STAC PIPS PROCESS MEASURES

- ▶ Pre hospital efficiency
 - ▶ Does patient go to a trauma center?
 - ▶ Does patient get there within an hour?
- ▶ Efficient transfer
 - ▶ Is need for transfer recognized quickly?
 - ▶ Does transfer occur quickly?
- ▶ Trauma center outcomes
 - ▶ Do all patients in all trauma centers have equally good outcomes?
 - ▶ Do transferred patients have equally good outcomes?

▶ 23

STAC PIPS Deliverables

- ▶ Provide risk adjusted outcomes comparisons
 - ▶ Pre hospital care
 - ▶ Trauma center care
 - ▶ LEMSAs
 - ▶ Urban and rural
 - ▶ Retriage and transfer
- ▶ Identify barriers to good outcomes
- ▶ Develop consortiums to improve processes and outcomes

▶ 24



What do we need to do this?

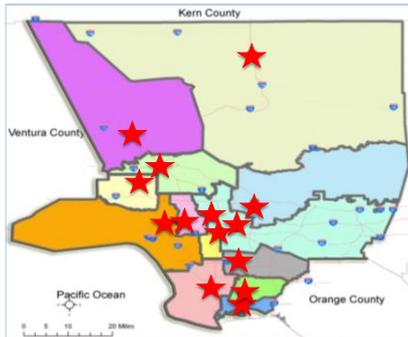
- ▶ Accurate verified data
 - ▶ Prehospital providers
 - ▶ Trauma centers
 - ▶ Follow up
- ▶ Statistical evaluation of the data
- ▶ Feedback to all stakeholders
- ▶ Consortiums to identify problem areas to fix and best practices to disseminate
- ▶ Follow up reports to confirm progress

25

Los Angeles County EMS Trauma System



Los Angeles County Trauma System



LA Trauma System Severe TBI Project

- ▶ Traumatic Brain Injury (TBI) prevalent and increasing
 - ▶ 1.4m ED visits, 53,000 deaths annually
- ▶ Most common reason for ambulance transport to a trauma center in Los Angeles (LA) County
- ▶ National studies show large variation in care processes and risk-adjusted outcomes
- ▶ We decided to make severe TBI the focus of our annual system wide PIPS effort

▶ 28

Specific Aims

1. To calculate the risk-adjusted performance of each County-designated trauma center at caring for patients with severe TBI
2. To explore associations between hospital-level care practices and risk-adjusted performance

▶ 29



30

Cohort

- ▶ All patients presenting to any of the 14 trauma centers with severe TBI during a two-year period (2009-2010)
 - ▶ Blunt injury
 - ▶ Glasgow Coma Scale (GCS) < 9
 - ▶ Abnormal intracranial findings on head CT
- ▶ Prospective identification and data collection
- ▶ Excluded patients <18 years old
- ▶ A single Neurosurgeon participated in designing the study

▶ 31

Outcomes

- ▶ Patient level: inpatient mortality
 - ▶ Based on discharge destination field (“morgue”)
 - ▶ Available for all patients
- ▶ Hospital level: observed-to-expected mortality ratio (O/E)
 - ▶ >1 = more observed deaths than expected after controlling for hospital’s patient mix; lower performance
 - ▶ <1 = less observed than expected; higher performance

▶ 32

Patient-level variables used in national trauma registry

- ▶ Demographics
- ▶ Vital signs (heart rate, systolic blood pressure)
- ▶ Mechanism of injury
- ▶ Injury Severity Score (ISS)
- ▶ Glasgow Coma Scale (GCS)
- ▶ 14 medical comorbidities



▶ 33

Variables added by the Consortium

- ▶ Pupil reactivity (present vs. absent)
- ▶ International Normalized Ratio (≤ 1.4 vs. > 1.4)
- ▶ Nine separate intracranial findings on head CT:
 - ▶ *Type of injury*: epidural hematoma, subdural hematoma, subarachnoid hemorrhage, intracranial hemorrhage, intraparenchymal contusion
 - ▶ *Sequelae*: cerebral edema, mass effect, loss of basal cisterns, loss of grey/white differential



▶ 34

Hospital Characteristics

- ▶ Demographics
 - ▶ Ownership, teaching status, size, trauma designation (Level I or Level II)
- ▶ Neuro-specialty care
 - ▶ NeuroICU, neurosurgeon “in house”, protocol for severe TBI
- ▶ Volume
 - ▶ TBI patients per neurosurgeon per year, TBI patients per trauma surgeon per year, TBI as a percentage of total admissions
- ▶ Patient-level aggregates
 - ▶ Age, ISS, GCS, pupil reactivity

▶ 35

LA County TBI Consortium

- ▶ Established 2013
- ▶ Members
 - ▶ Trauma directors and program managers from all 14 County-designated trauma centers
 - ▶ Administrators from LA County EMS
 - ▶ *Neurosurgeons, neurologists, critical care specialists*
 - ▶ *Health services researchers*
- ▶ Goal: cooperative, multi-institutional quality improvement

▶ 36



Results

Characteristics of 840 Severe TBI patients in Los Angeles County, 2009-2010

Variable	Overall (n=840)	Range at Hospital Level (n=13)
Inpatient mortality, %	40	25-52
Age, mean (SD)	43 (23)	31-52
Gender, % male	76	67-83
Race		
% Non-Hispanic White	33	2-59
% Non-Hispanic Black	13	2-33
% Hispanic	41	7-56

▶ 38

High injury severity, low levels of consciousness, most injured in fall

Variable	Overall (n=840)	Range at Hospital Level (n=13)
ISS, mean (SD)	29 (12)	25-34
GCS, mean (SD)	4.4 (1.8)	3.9-4.9
Mechanism		
% Fall	32	14-58
% Auto vs. Pedestrian	29	19-33
% Assault	13	2-22
% Motor Vehicle Crash	13	4-25

▶ 39

Most maintained brain stem function, but had significant intracranial hypertension

Variable	Overall (n=840)	Range at Hospital Level (n=13)
Reactive pupil, %	64	44-77
Elevated INR, %	14	6-30
Type of Injury		
SDH, %	66	54-78
SAH, %	60	40-75
Sequelae		
Edema, %	28	8-51
Mass effect, %	20	7-28

▶ 40

Determining hospital performance

- ▶ Not so easy!
- ▶ Statistical methods for risk adjustment not available centrally at EMS
- ▶ Eventual help from RAND fellow at UCLA
- ▶ Performed multilevel mixed effects logistic regression
- ▶ Calculated observed-to-expected ratios for each hospital
 - ▶ Sum actual mortality within hospital ("observed")
 - ▶ Sum predicted mortality within hospital ("expected")
- ▶ Used nested models to compare O/E ratios to hospital characteristics
- ▶ Then we had to understand and feed back the data also not so easy!

▶ 41

LA County TBI Consortium

- ▶ Established 2013
- ▶ Members
 - ▶ Trauma directors and program managers from all 14 County-designated trauma centers
 - ▶ Administrators from LA County EMS
 - ▶ *Neurosurgeons, neurologists, critical care specialists*
 - ▶ *Health services researchers*
- ▶ Goal: cooperative, multi-institutional quality improvement

▶ 42



LA County Trauma Consortium Meeting

October 2014



▶ 43

Risk-adjusted performance of hospitals

Rank	Observed	Expected	O/E Ratio
1	7	9.9	0.71
2	12	14.5	0.83
3	35	36.2	0.97
4	24	24.8	0.97
5	25	25.3	0.99
6	21	21.2	0.99
7	27	26.9	1.00
8	15	14.7	1.02
9	92	89.5	1.03
10	23	22.3	1.03
11	23	22.0	1.05
12	12	10.8	1.11
13	23	20.6	1.12

Three hospitals were statistical outliers



▶ 45

Who receives ICP monitoring?

- ▶ 378 of 822 patients (46%)
- ▶ **More likely to have:** at least 1 reactive pupil, intraparenchymal contusion on head CT
- ▶ **Less likely to be:** older, female, presenting in cardiac arrest, injured in a fall, diagnosed with hypertension or alcoholism, elevated INR
- ▶ **Unadjusted mortality:** 31% of monitored patients vs. 46% in non-monitored ($p < 0.001$)

▶

Multivariate regression models

- ▶ ICP monitor placement (6 variables significant)
 - ▶ **Increased odds:** subdural hematoma, intraparenchymal contusion, mass effect
 - ▶ **Decreased odds:** age, alcoholism, elevated INR
- ▶ Inpatient mortality (12 variables significant)
 - ▶ **Increased odds:** age, ISS, SBP > 200 mm Hg, elevated INR, cerebral edema, mass effect, loss of basal cisterns, loss of grey/white differential
 - ▶ **Decreased odds:** GCS, mechanism of injury other than fall, at least 1 reactive pupil, epidural hematoma

▶

PSM model for difference in mortality associated with ICP monitoring

	Mortality difference (% points)	95% CI	p-value
Full sample	-8.3	-0.9 to -15.7	0.029
High ISS (>25)	-16.0	-8.8 to -23.2	<0.001
Low GCS (3)	-13.3	-6.0 to -20.5	<0.001
High ISS, Low GCS	-32.9	-20.3 to -45.4	<0.001

▶



Limitations

- ▶ Unable to control for potential confounding due to medical treatment of TBI
- ▶ Mortality only; no information on functional recovery
- ▶ Severe TBI only

▶

Conclusions

- ▶ ICP monitoring associated with reduced inpatient mortality after controlling for injury profile and propensity to undergo monitor placement
- ▶ Older patients less likely to undergo monitoring
- ▶ More severely-injured patients and those with lower levels of consciousness on admission receive larger benefit from invasive monitoring

▶

Discussion

51

Conclusions

- ▶ Variation in performance
 - ▶ Unadjusted mortality rates: 25-52%
 - ▶ O/E ratios: 0.71-1.12
 - ▶ Three hospitals identified as statistical outliers
- ▶ Few clear relationships between hospital characteristics and risk-adjusted performance
- ▶ 3 potential care processes that can potentially explain the variability in outcome between centers
 - ▶ ICP monitoring
 - ▶ Craniotomy indications and use
 - ▶ Indications for withdrawal of care

▶ 52

Next steps

- ▶ Collect TBI data over two-year period starting now
- ▶ Produce and distribute quarterly performance reports for all centers
- ▶ Continue regular meetings with focus on discussing data
- ▶ Partnered quality improvement using Comprehensive Unit-based Safety Program (CUSP) techniques
- ▶ Continual analysis to document and demonstrate system-wide improvement

▶ 53

Need for Risk Adjusted Data Analysis

- ▶ Proposal for all LA Trauma Centers to join TQIP
- ▶ Alternative was to partner with academic center to have them run statistical reports on a regular basis as we did for TBI
- ▶ Initially there was push back because of cost and extra effort
- ▶ As we began moving through the TBI project it became clear that we needed regular risk adjusted reports to be able to accomplish anything
- ▶ We need these reports in all areas of care not just TBI
- ▶ We are now all in agreement that we need to join TQIP as a system

▶ 54



L.A. County Trauma Consortium

- ▶ Shared vision for trauma care in L.A. County
- ▶ Reduce the variability in care through shared practices and adoption of guidelines
- ▶ Pool data from all centers to better characterize outcomes and to determine effective practices
- ▶ Provide partnered evaluation and continual feedback to improve system-wide trauma care

▶ 55

LA County Trauma Consortium

Cynthia Marin, RN, MSN, and Pavel Petrik, MD (Antelope Valley Hospital);
Laura Schnieder, RN, and Gudata Hinika, MD (California Hospital);
Elizabeth Cheek, RN, and Jeffrey Upperman, MD (Children's Hospital Los Angeles);
Heidi Hotz, RN, and Daniel Margulies, MD (Cedars-Sinai Medical Center);
Kimberly Murphy, RN, and David Hanpeter, MD (Providence Holy Cross);
Robin Tyler, RN, and Brant Putnam, MD (Harbor/UCLA Medical Center);
Susan Thompson, RN, MSN, and Amal Obaid, MD (Huntington Memorial Hospital);
Gilda Cruz-Manglapus, RN, and Ranbir Singh, MD (Henry Mayo Newhall);
Desiree Thomas, RN, and Brian Acker, MD (Long Beach Memorial Medical Center);
Melanie Crowley, RN, MSN, and Shawk Saad, MD (Northridge Hospital);
Renee Smith, RN, and Tchaka Shepherd, MD (Saint Francis Medical Center);
Patricia Meier, RN, and James Murray, MD (Saint Mary Medical Center);
Marilyn Cohen, RN, and H. Gill Cryer, MD, PhD (UCLA Medical Center);
Sixta Navarrete, RN, and Demetrios Demetriades, MD (LAC+USC)

▶ 56

Thank you!



adawes@mednet.ucla.edu



@AaronDawesMD

- ▶ **Acknowledgements:**
 - ▶ Robert Wood Johnson Clinical Scholars Program
 - ▶ Veterans Affairs Office of Academic Affiliations
 - ▶ UCLA Department of Surgery
 - ▶ UCLA Department of Neurosurgery
 - ▶ USC Department of Neurosurgery
 - ▶ LA County Department of Health Services, Emergency Medical Services Agency

▶ 57

