Examining racial disparities in the time to withdrawal of life-sustaining treatment in trauma

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Author Disclosures

The authors have nothing to disclose.

Reviewer Disclosures

The reviewers have nothing to disclose.

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Submitted: September 2, 2017, Revised: November 22, 2017, Accepted: November 24, 2017, Published online: December 20, 2017.
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Meeting Presentation Information: 76th Annual Meeting of American Association for the Surgery of Trauma, September 13 to 16, 2017, in Baltimore, Maryland.
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DOI: 10.1097/TA.0000000000001775

BACKGROUND: Racial disparities in medical treatment for seriously injured patients across the spectrum of care are well established, but racial disparities in end of life decision making practices have not been well described. When time from admission to time to withdrawal of life-sustaining treatment (WLST) increases, so does the potential for ineffective care, health care resource loss, and patient and family suffering. We sought to determine the existence and extent of racial disparities in late WLST after severe injury.

METHODS: We queried the American College of Surgeons' Trauma Quality Improvement Program (2013–2016) for all severely injured patients (Injury Severity Score, > 15; age, > 16 years) with a WLST order longer than 24 hours after admission. We defined late WLST as care withdrawn at a time interval beyond the 75th percentile for the entire cohort. Univariate and multivariate analyses were performed using descriptive statistics, and *t* tests and χ^2 tests where appropriate. Multivariable regression analysis was performed with random effects to account for institutional-level clustering using late WLST as the primary outcome and race as the primary predictor of interest.

RESULTS: A total of 13,054 patients from 393 centers were included in the analysis. Median time to WLST was 5.4 days (interquartile range, 2.6–10.3). In our unadjusted analysis, African-American patients (10.1% vs. 7.1%, $p < 0.001$) and Hispanic patients (7.8% vs. 6.8%, $p < 0.001$) were more likely to have late WLST as compared to early WLST. After adjustment for patient, injury, and institutional characteristics, African-American (odds ratio, 1.42; 95% confidence interval, 1.21–1.67) and Hispanic (odds ratio, 1.23; 95% confidence interval, 1.04–1.46) race were significant predictors of late WLST.

CONCLUSION: African-American and Hispanic race are both significant predictors of late WLST. These findings might be due to patient preference or medical decision making, but speak to the value in assuring a high standard related to identifying goals of care in a culturally sensitive manner. (*J Trauma Acute Care Surg.* 2018;84: 590–597. Copyright © 2017 Wolters Kluwer Health, Inc. All rights reserved.)

LEVEL OF EVIDENCE: Prognostic and epidemiologic study, level III.

KEY WORDS: Withdrawal of life-sustaining treatment; end-of-life care; trauma; racial disparities.

Trauma is the leading cause of death in persons aged 1 year to 44 years in the United States, with approximately 200,000 deaths per year, or one person every 3 minutes.[1] Racial disparities in trauma outcomes in the United States are well established, and trauma is estimated to be the third largest contributor to disproportionately high mortality rates for African Americans.[2–6] While overall survival for trauma patients has improved due to advances in trauma care,[7] mortality after the initial resuscitative phase has increased.[8] Up to 20% of trauma patients admitted to an intensive care unit (ICU) will eventually succumb to their injuries,[9] and, due to advances in life-supporting technology, upwards of 90% of trauma deaths beyond the first 24 hours occur after life-sustaining therapy is withdrawn.[10–13]

Significant variation exists in how life-sustaining treatment is withdrawn at the end of life among physicians, hospitals, and regions.[14,15] Recent trends in health care quality have brought the concept of end-of-life care in the ICU to the forefront,[16] and futile and potentially inappropriate interventions in the ICU setting are a common target for quality improvement.[17–19] Frequent and early communication with the ICU patient's family decreases nonbeneficial care and lessens post-mortem depressive symptoms for the patient's family.[18–22]

While racial/ethnic disparities in health care access and delivery are well established,[23] Medicare data in nontrauma patients have shown that minorities use more health care resources in the last 6 months of life than whites.[24,25] In trauma, African-American patients have been found to undergo a disproportionate share of highly invasive procedures at the end of life, and Hispanic patients receive fewer withdrawal of life-sustaining treatment (WLST) orders and have higher daily hospital costs at the end of life.[12,26] Longer length of time to WLST defined as length of time from admission to initiation of a WLST order likely increases the potential for ineffective care and patient and family suffering at the end of life. The objective of this study was to explore racial disparities in time to WLST in the trauma population.

METHODS

Study Design

This is a retrospective cohort analysis of data from the American College of Surgeons' Trauma Quality Improvement Program (TQIP) from January 1, 2013, to December 31, 2016.[27,28]

Data Source

The TQIP is a validated, standardized, outcomes-based program that was created to improve the quality of trauma care.[27,28] Over 100 trauma process and outcome variables are collected, including institutional variables, transport times, physiologic data, baseline patient demographics, injury mechanism and severity, in-hospital outcomes, and the timing and presence of a physician WLST order. Data abstractors are trained and audits are performed at participating sites to ensure reliability of data.

Study Cohort

We included trauma patients admitted from January 1, 2013, to December 31, 2016, to a trauma center participating in TQIP. Selected patients were aged older than 16 years, had an Injury Severity Score greater than 15,[29] and had a physician WLST order documented at any point during the admission. Patients with advance directives limiting care in place upon admission are excluded from TQIP. Additionally, patients dying within 24 hours of arrival to the emergency department were excluded from this analysis, as these deaths are often related to high injury severity and less influenced through deliberate decision making related to goals of care. Patients were considered to have a WLST order if documentation in the medical record confirmed that treatment was withdrawn based on a decision to either remove or withhold further life supporting intervention, as defined in the data dictionary for the National Trauma Data Standard.[30]

Outcome Measure

The primary outcome in this study was late WLST. The time to WLST was measured in days from arrival at hospital. Late WLST was defined as withdrawal occurring later than the 75th

percentile time to WLST for the entire cohort. The 75th percentile was chosen as an indicator of late WLST due to the extremely right-tailed distribution in time to WLST. This patient-level characteristic was then used as a binary outcome variable in the analysis.

Exposure

Self-reported patient race and ethnicity was the primary predictor in the model. Patients who reported their ethnicity as Latino or Hispanic were categorized as Hispanic, and non-Hispanic patients were categorized by their self-reported race as either white non-Hispanic, African American non-Hispanic, or other.

Potential Confounders

It is plausible that injury severity or other factors might confound the relationship between the timing of WLST orders and race/ethnicity. To address this potential confounding, we adjusted for the following patient-level predictors in our statistical model: age, sex, insurance status, comorbidities, mechanism and severity of injury, Glasgow Coma Scale (GCS) motor score on admission, and systolic blood pressure (SBP) on admission. Insurance status was categorically divided into Medicare, Medicaid, private/commercial, or uninsured based on previous research examining trends in trauma outcomes by payor status.[31] The GCS motor score was analyzed as a categorical variable: score of 6, 4 to 5, 2 to 3, 1 (not chemically paralyzed), and 1 (chemically paralyzed). An SBP less than 90 mm Hg was classified as shock on admission and analyzed as a binary variable. Preexisting comorbidities included in the analysis were history of stroke, diabetes, myocardial infarction, peripheral vascular disease, disseminated cancer, esophageal varices, chronic obstructive pulmonary disease, cirrhosis, chronic renal failure, hypertension, or alcohol use disorder. Comorbidities were defined as a categorical variable in the analysis as 0, 1, 2, or greater than or equal to three preinjury comorbid conditions.

Hospital-Level Predictors

Hospital-level characteristics described were trauma center designation level (I, II, or not applicable),[32] hospital size based on number of beds (quartiles), teaching status (community, nonteaching, or university), hospital type (nonprofit/profit), and US Census Bureau designated region (Northeast, South, West, or Midwest).[33]

Statistical Analysis

Univariable analyses were performed using the Student's *t* test and χ^2 test where appropriate. To identify factors associated with late WLST, we performed multivariable logistic regression analysis with robust standard errors to account for the differences in case mix across centers. All covariates that were statistically significant in univariable analyses were included in the multivariable model. Missing covariate values were estimated by a multiple-imputation technique.[34,35] This approach was preferable to case deletion because of the potential for bias associated with nonrandom missing data. Median time to WLST was calculated on a center-level basis only for centers with a sample size of 10 patients or greater to minimize bias caused by outliers.

Results were considered significant at a two-sided alpha level of p value less than 0.05 unless otherwise specified. All statistical analyses were performed using SAS software (version 9.4, SAS Institute Inc., Cary, NC). This study is a retrospective analysis of deidentified data, and thus was determined exempt from Institutional Review Board review through Northwestern University.

RESULTS

We identified 13,054 patients from 393 centers meeting our inclusion criteria in the analysis. The cohort was 69% male (n = 9,003) and the median age was 67 (interquartile range [IQR], 51–81 years). The median ICU length of stay was 6 days (IQR, 3–10). The in-hospital mortality rate for the entire cohort was 97.3%, consistent with a population defined by the documentation of a WLST order. The median length of time until WLST for the cohort was 5 days (IQR, 3–10 days) and the 75th percentile was 10 days. There was no significant difference in the mortality rate between the early (n = 9789) and late (n = 3265) withdrawal groups (97.4% vs. 96.9%, respectively, $p = 0.113$). The ICU length of stay was significantly longer in the late withdrawal group, (15 days vs. 4 days, $p < 0.001$), as was the number of days spent on ventilator support (13 days vs. 4 days, $p < 0.001$). There was considerable variation in unadjusted median time to WLST by center, ranging from 2 days to 11.5 days (Fig. 1).

Patient Characteristics

Patient characteristics differed across the early versus late WLST groups (Table 1). In our unadjusted analysis, African American patients and Hispanic patients were significantly overrepresented in the late WLST group. Male patients, patients with fewer co-morbidities, younger patients, and patients on Medicaid or private/commercial insurance were all more likely to receive late WLST.

Injury Characteristics

Patients with injuries from a motor vehicle collision, severe chest injuries, and high GCS motor score upon admission were more likely to receive late WLST (Table 2). Conversely, patients with a severe head injury and a low GCS motor score upon admission were significantly less likely to have late WLST. The presence of shock on admission to the emergency department was comparable between the groups.

Institutional Characteristics

Patients were more likely to experience late WLST when treated at institutions located in the South or Northeast, university teaching hospitals, and centers with Level I trauma center designation, compared with their counterparts cared for at other centers (Table 3). There was no association between WLST and hospital for-profit status.

Patient, Injury, and Hospital Predictors of Late Time to WLST

In adjusted analyses (Table 4), predictors of late time to WLST included African American race (odds ratio [OR], 1.42; 95% confidence interval [CI], 1.21–1.67), Hispanic race (OR, 1.23; 95% CI, 1.04–1.46), age <55 years (OR, 2.11; 95% CI, 1.75–2.54), male sex (OR, 1.26; 95% CI, 1.15–1.39) and Medicaid coverage (OR, 1.21; 95% CI, 1.01–1.44). Conversely, severe head injury (OR, 0.78; 95% CI, 0.69–0.88), uninsured status (OR, 0.86; 95% CI, 0.74–0.99), firearm injury (OR, 0.64;

95% CI, 0.52–0.80), and low GCS motor score on admission (1 without chemical paralysis: OR, 0.84; 95% CI, 0.72–0.98) were associated with early WLST. Northeast region (OR, 1.18; 95% CI, 1.00–1.39) was the only institutional factor found to be significantly associated with late WLST after adjustment for patient and injury factors.

DISCUSSION

Previous research has shown that WLST is common in the trauma population,[36] there is high variation among centers,[12] minorities are less likely to have WLST before death,[12] and minority trauma patients receive a disproportionate share of high intensity treatment at the end of life.[26] The interaction of race and the timing of WLST, however, is unclear from the available literature. We examined the interaction between race and late WLST in trauma patients and found that African Americans and Hispanics were significantly more likely to receive late WLST, even when controlling for patient, injury, and institutional characteristics. This is consistent with previous research indicating that members of minority races are less likely to consent for removal of life-sustaining treatment, and are more likely to have the desire to be kept alive by any means necessary.[37,38] Some postulate that this trend may be due to minorities' deep seated mistrust in the medical system, or an effort to compensate for inadequate access to medical care earlier in life.[39] However, these findings may not be wholly attributable to patient or family preference, as the quality of the discussion between the provider and caregivers is vital to a desirable end result. Previous research has shown that when discussing end-of-life care, providers offer less prognostic information to African American patients,[40] patients of lower socioeconomic status,[41] and those with lower educational attainment,[42] perhaps perpetuating patient and/or family passivity in end-of-life care decisions.

Because of the sudden, unexpected nature of trauma, patient's next of kin are often unaware of the patient's goals and wishes and are therefore unable to provide physicians with adequate direction on goals of care. Additionally, physicians are sometimes unable to accurately predict a seriously injured patient's survival, let alone their likely long-term functional and cognitive outcome.[43] Surgical residency training largely overlooks the art of engaging patients and families in shared decision making at the end of life,[44] even though it has been recognized as a core surgical principle by the American College of Surgeons.[45] Although most if not all physicians aspire to achieve high-quality

TABLE 1. Patient Characteristics Associated With Late WLST

Patient Characteristics	Early Withdrawal (n = 9,789), n (%)	Late Withdrawal (n = 3,265), n (%)	*p*
Race			<0.001
African American	690 (7.1)	329 (10.1)	
White (non-Hispanic)	7,524 (76.9)	2,403 (73.6)	
Hispanic	661 (6.8)	256 (7.8)	
Other	914 (9.3)	277 (8.5)	
Sex			<0.001
Female	3,173 (32.4)	877 (26.9)	
Male	6,615 (67.6)	2,388 (73.1)	
Age, y			<0.001
<55	2,908 (29.7)	1,007 (30.8)	
55–64	1,416 (14.5)	587 (18.0)	
65–74	1,557 (15.9)	607 (18.6)	
75–84	2,162 (22.1)	684 (21.0)	
≥85	1,746 (17.8)	380 (11.6)	
Insurance type			<0.001
Private/commercial	2,716 (27.8)	1,020 (31.2)	
Medicare	4,499 (46.0)	1,345 (41.2)	
Medicaid	783 (8.0)	346 (10.6)	
Uninsured	934 (9.5)	276 (8.5)	
Other/unknown	857 (8.8)	278 (8.5)	
Comorbidities			<0.001
None	2,359 (24.2)	689 (21.1)	
1	2,563 (26.2)	830 (25.4)	
2	2,168 (22.2)	708 (21.7)	
>3	2,699 (36.9)	1,038 (31.8)	

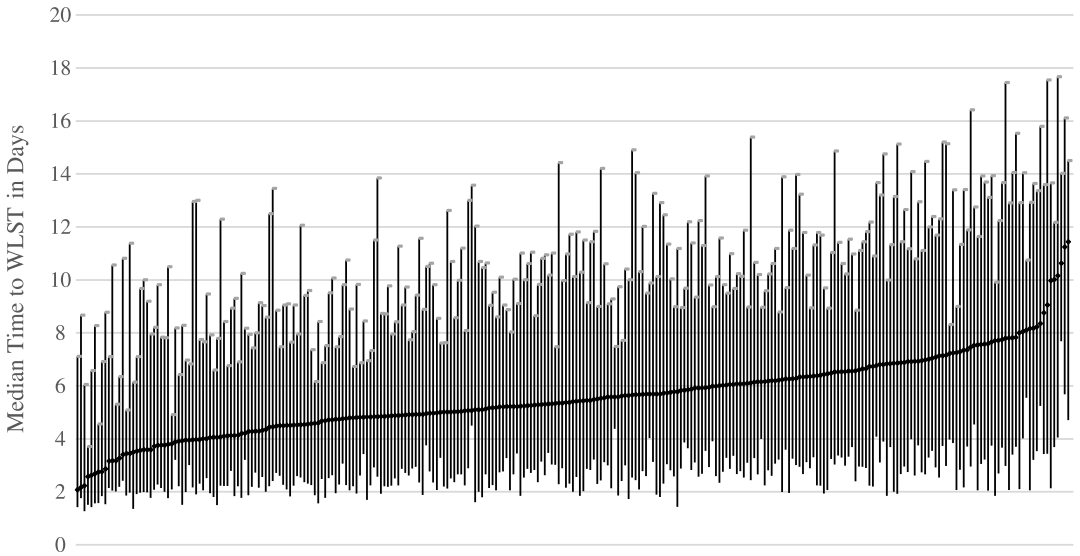

Figure 1. Median Time to WLST by center. Unadjusted time to WLST in days for each of the 285 centers with ≥ 10 patients included in the analysis. Each point represents median time to WLST for one center, and the vertical bar represents the center's IQR for time to WLST.

TABLE 2. Injury Characteristics Associated With Late WLST

Injury Characteristics	Early Withdrawal (n = 9,789), n (%)	Late Withdrawal (n = 3,265), n (%)	*p*
Severe injury (AIS score, ≥ 3)			
Head	8,456 (86.4)	2,489 (68.7)	<0.001
Chest	3,303 (33.7)	1,433 (39.5)	<0.001
Abdomen	1,308 (10.4)	95 (2.6)	<0.001
Spine	1,349 (13.8)	536 (14.8)	<0.001
Lower extremity	1,250 (12.8)	587 (16.2)	<0.001
Mechanism			<0.001
Fall	5,419 (55.4)	1,513 (46.3)	
Firearm	604 (6.2)	115 (3.5)	
MVC	1,766 (18.0)	807 (24.7)	
Motorcycle	589 (6.0)	250 (7.7)	
Other blunt	539 (5.5)	209 (6.4)	
Pedestrian	835 (8.5)	355 (10.9)	
Stab	37 (0.4)	16 (0.5)	
GCS motor score in ED			<0.001
6	3,057 (31.2)	1,473 (45.1)	
4–5	1,703 (17.4)	582 (17.8)	
2–3	546 (5.6)	128 (3.9)	
1, no paralysis	2,395 (24.5)	543 (16.6)	
1, with paralysis	2,088 (21.3)	539 (16.5)	
Shock in ED*	996 (10.2)	351 (10.8)	0.345

*SBP ≤ 90 mm Hg.
AIS, Abbreviated Injury Scale; MVC, motor vehicle crash; ED, emergency department.

shared decision making and a dignified, pain-free death for every patient, end-of-life discussions can be difficult for the physician to navigate. Better education around shared decision making and further investigation into long-term patient-centered outcomes will likely help trauma surgeons improve these conversations and the quality of care at the end of life.

Early and severe traumatic brain injury was associated with early WLST. This intuitively connects early (or easier) decision to withdraw care for a family member with the prospect

TABLE 3. Institutional Characteristics Associated With Late WLST

Institutional Characteristics	Early Withdrawal (n = 9,789), n (%)	Late Withdrawal (n = 3,265), n (%)	*p*
Region			0.048
Midwest	2,122 (22.0)	643 (20.0)	
Northeast	1,647 (17.1)	585 (18.2)	
South	3,872 (40.1)	1338 (41.6)	
West	2,013 (20.9)	652 (20.3)	
Hospital type			0.993
For profit	815 (8.3)	272 (8.3)	
Nonprofit	8,974 (91.7)	2,993 (91.7)	
Teaching status			<0.001
Community	3,556 (36.3)	1,063 (32.6)	
Nonteaching	800 (8.2)	216 (6.6)	
University	5,433 (55.5)	1,986 (60.8)	
Level designation			0.005
I	6,819 (69.8)	2,359 (72.3)	
II	2,750 (28.1)	824 (25.3)	
N/A	2,080 (2.1)	80 (2.5)	

TABLE 4. Predictors of Late Time to WLST*

Patient Characteristics	OR (95% CI)
Race	
African American	1.42 (1.21–1.67)
White (non-Hispanic)	1 (Reference)
Hispanic	1.23 (1.04–1.46)
Other race	0.96 (0.81–1.15)
Male sex	1.26 (1.15–1.39)
Age, y	
<55	2.11 (1.75–2.54)
55–64	2.09 (1.77–2.47)
65–74	1.91 (1.62–2.24)
75–84	1.50 (1.28–1.75)
≥85	1 (Reference)
Insurance type	
Private	1 (Reference)
Medicare	0.97 (0.86–1.09)
Medicaid	1.21 (1.01–1.44)
Uninsured	0.86 (0.75–1.00)
Other/unknown	0.89 (0.76–1.04)
Comorbidities	
0	1 (Reference)
1	1.14 (1.01–1.28)
2	1.17 (1.00–1.36)
3+	1.27 (1.11–1.45)
Injury characteristics	
Mechanism of injury	
Fall	1 (Reference)
MVC	1.42 (1.25–1.62)
Motorcycle	1.43 (1.17–1.74)
Other blunt	1.23 (1.00–1.50)
Pedestrian	1.40 (1.19–1.65)
Stab	1.11 (0.59–2.08)
Firearm	0.62 (0.50–0.78)
Severe injury AIS ≥ 3 by body region	
Head	0.78 (0.69–0.89)
Chest	1.16 (1.05–1.29)
Abdomen	1.26 (1.10–1.46)
Spine	1.02 (0.91–1.15)
Lower extremity	1.05 (0.92–1.20)
GCS motor score upon admission	
6	2.26 (1.94–2.62)
4–5	1.67 (1.43–1.95)
2–3	0.97 (0.75–1.24)
1 (not chemically paralyzed)	0.85 (0.73–1.00)
1 (chemically paralyzed)	1 (Reference)
Institutional Characteristics	
Region	
Midwest	1 (Reference)
Northeast	1.18 (1.00–1.39)
South	1.05 (0.91–1.21)
West	1.07 (0.89–1.28)
Level designation	
I	0.99 (0.85–1.14)
II	1 (Reference)
N/A	1.10 (0.80–1.50)

Continued next page

TABLE 4. *(Continued)*

Patient Characteristics	OR (95% CI)
Teaching status	
Community	1 (Reference)
Nonteaching	0.92 (0.74–1.16)
University	1.13 (0.97–1.30)

*Multivariable logistic regression accounting for the correlation of case-mix by center.

of a dismal long-term cognitive and functional outcome. Previous research has demonstrated wide variation in timing of WLST for traumatic brain injury patients after adjusting for injury severity and baseline characteristics.[46] Importantly, this research showed that centers predisposed toward early WLST did not have disproportionately high overall mortality rates, indicating that early WLST was not representative of an overly pessimistic approach to patients with severe head injuries whose care was hastily withdrawn.[46] Trends between mortality rate and time to WLST were not included in our analysis, but we recognize this as a promising direction for future research with strong implications for the use of risk-adjusted mortality as a quality indicator for trauma centers.[47] Among institutional indicators, university teaching status and Level I trauma center designations were found to be significantly associated with late WLST in the unadjusted analysis. This association did not remain significant after controlling for patient, injury, and other institutional characteristics, making it likely that the association is explained by the case mix in university teaching and level I designated trauma centers.

Our study has some important limitations. We analyzed time to WLST at TQIP participating hospitals only, which may add an inherent bias toward centers that focus on quality improvement, perhaps underestimating variation in time to WLST. The analysis was of an observational nature, making it possible that there were unmeasured confounding factors and causality cannot be inferred. Specifically, it is unknown whether a physician attempted to facilitate a discussion around redirecting care for these patients, and the family refused or was unavailable, or whether shared decision making was simply not attempted. Future investigation into the variation in time to WLST in this population should include information such as documentation by the attending physician regarding futility of care and documentation of family discussions around redirection of care, as well as the qualitative nature of such discussions.

We were not able to analyze ICU structural factors that may have an impact on the timing of WLST. Many institutional ICU characteristics have been found to be associated with the frequency of do-not-resuscitate (DNR) orders in the trauma population, and it follows that the same pattern may occur for WLST orders.[48] In a medical ICU population, mandatory attending intensivist coverage around the clock resulted in earlier decision making at the end of life and increased the quality of end-of-life care, evidenced by increased family presence at the time of death, and decreased rate of intubation against patient preferences.[49] It is likely that ICU structural factors such as bed size, closed versus open model, organizational structure (medical, surgical, or mixed), and the presence of critical care fellows or surgical residents impact decision making practices at the end of life and should be examined in the future.

Finally, in performing this analysis we assumed a priori that delay in WLST likely lead to increased patient and family suffering, increased health care resource use, nonbeneficial care at the end of life, and misaligned health goals for the patient. Due to the retrospective nature of the study, these important outcomes were unable to be assessed, but should be included in future research that examines the timing of WLST given the importance of patient preference in end-of-life care.

CONCLUSION

There is wide variation in time to WLST in the trauma population among centers. African American race, and to a lesser extent, Hispanic race, was associated with late WLST, even when controlling for patient, injury, and institutional characteristics. Some of this disparity may be attributable to patient preferences around end-of-life care, but hospital culture and physician bias may also play a role. To ensure the provision of quality trauma care to these patients, an approach to initiating discussions regarding the WLST must be timely, culturally sensitive, and compassionate. Clinical cultural competence interventions can equip health care providers with the knowledge, tools, and communication skills necessary to provide quality cross-cultural end-of-life care.

AUTHORSHIP

M.A.H. contributed to the literature search, study design, data analysis, data interpretation, and writing. J.P.B. contributed to the data analysis, data interpretation, and writing. K.E.E. contributed to the statistical analysis, data analysis, data interpretation, and writing. A.B.N. contributed to the study design, data analysis, data interpretation, writing, critical revision, and final approval.

ACKNOWLEDGMENTS

We thank Ryan Murphy, Christopher Hoeft, and Melanie Neal from the American College of Surgeons TQIP for their assistance with the data acquisition.

DISCLOSURE

The authors declare no conflicts of interest.

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DISCUSSION

Weiden Alan Guo (Buffalo, New York): First of all, I would like to thank the AAST for providing me this opportunity

to discuss this important study, although with a very short notice — I just got the request on this past Sunday.

Racial disparities in healthcare have been extensively studied in recent years especially in relation with healthcare quality improvements. We know a disproportionally high trauma mortality and poor functional outcomes for the racial minorities, according to the study by Adil Haider. However, we have little knowledge about racial disparities in the time needed before decision to withdrawal of life-sustaining treatment in trauma.

The authors should be commended for undertaking this extensive analysis of this 4-year TQIP data to tackle this issue. Dr. Nathens and his colleagues have previously looked at the timing of withdrawal of life sustaining therapies in patients with severe traumatic brain injury. Obviously, the current study is the continuation of their efforts, to look at the same issue, but this time in trauma patients with all causes. They concluded in this study that the racial minorities are a significant predictor for the late withdrawal of life sustaining treatment.

I'd like to pose several questions for the authors.

1. First I want to ask you about the definition of time to withdrawal. You defined the length of time as from the emergency department arrival to the time when withdrawal of care was ordered by physicians. However, you may realize that some patients might initially present with a relatively stable condition, or the physicians were unable to accurately assess the patient's condition initially in the ED. The patients' condition might just worsen 24-48 hours after the admission. A typical example is a worsened intracranial hemorrhage on subsequent CT scan with impending herniation. If this is the case, then you should start the clock 24–48 hours after the admission, but not the moment when the patients hit the ER door.

2. I also want to know why you only collected the GCS motor subscore for the statistical analysis. Although studies have demonstrated that the motor component of the GCS yields similar predictions as the sum GCS score, better prediction of the motor component occurs only with very high or very low GCS scores. By using the GCS motor subscore in your study, you are creating heterogeneous powers of prediction across the board. Furthermore, GCS is only for the purpose of predicting outcomes for TBI. I guess a certain portion of the patients did not have a TBI. Did you collect GCS from these patients too? And if yes, what does it mean?

3. Previous studies indicate that ethnic minority patients are more likely to utilize emergency medical services as an entry point into the health system, due to lack of medical insurance. Now your patients are in ICU, intubated and on life sustaining treatment. Is there any correlation between the insurance type and the resource utilization of life-sustaining treatment in your study? I'd recommend that you look at this information, especially that of the minorities, from the database, to make you data more convincing.

4. The value of healthcare is directly proportional to the quality of process and the quality of outcome, and is inversely proportional to the cost. In the case of end of life care in the trauma patients, the outcome is death and we cannot do anything about it. But, we can do something about the quality of process. So what is the take home message from your study for us to improve the quality of process?

5. Lastly, I have a comment. Your data are all about factors influencing decision of withdrawal of life-sustaining treatment — not only race, but also gender, age, insurance type, mechanisms of injury, level of trauma center designation, etc. I'd therefore suggest that you change the title a little bit and have a different perspective in the Introduction and Discussion in the manuscript in order to cover all the bases of the data.

Regardless of the issues raised above, I applaud the authors for their valuable work to bring this dilemma to our attention. Dr. Hornor, I congratulate you on your excellent presentation!

Dr. Victoria Sharp (Farmington Hills, Michigan): Victoria Sharp, Farmington, Michigan. Excellent paper. Really interesting topic. I just wonder, too, if there is a way for you to evaluate familial and patient religious preferences, if this may be a predicting factor, as well.

I know many of us have had experiences having these end-of-life conversations with families often leads to religious discussion, as well. Thank you.

Dr. Melissa A. Hornor (Chicago, Illinois): Thank you for your interesting comments, Dr. Guo and Dr. Sharpe. So first I'll get to your questions, Dr. Guo.

The definition of time-to-withdrawal was, as you said, from patient admission to physician initiation of withdrawal of life-sustaining treatment order. I do get your point that it could be that a patient was doing alright for several days and then had an acute de-compensation- so the end-of-life discussion process didn't contribute to prolonged time to withdrawal, which is what we were trying to investigate.

So perhaps in the future – we could use ICU admission date as the start time for time-to-withdrawal of lifesaving treatment as the definition instead.

Next, to your question about using GCS motor score in the analysis instead of the total GCS score. The GCS motor score was used due to its ability to predict poor TBI outcomes, another sensitivity analysis we would perform would be using the total GCS score in the multivariable analysis instead.

And then your next question was about examining the association between socio-economic status with late withdrawal of lifesaving treatment, that would be a very interesting thing to examine. We just didn't have that data available in TQIP.

And then your next question was around what we can do about this problem. I will refer back to Dr. Maier's lecture just a few hours ago on the new initiatives being built through TQIP around palliative care best practices.

So there are new variables that are going lend increased granularity to TQIP data on what is happening at the end of life for these patients, such as whether an end of life discussion occurred, whether the patient's advance directives are in place, and many other variables. So I think this will really allow us to better investigate these trends.

And then the question from Dr. Sharpe was whether there would be a way to also examine the association of religious preferences with this trend.

I do agree that anecdotally I have seen that as a resident, that religious preferences can affect the family's decision around withdrawal of care.

That would be a very interesting thing to investigate in the future. But, unfortunately, isn't available with the current data we have right now.