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Population-based approaches to treatment and readmission after spinal cord injury

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Abstract

BACKGROUND—Recent studies in surgical and non-surgical specialities have suggested that patients admitted on the weekend may have worse outcomes. In particular, patients with stroke and acute cardiovascular events have shown worse outcomes with weekend treatment. It is unclear whether this extends to patients with spinal cord injury (SCI). This study was designed to evaluate factors for readmission after index hospitalization for spinal cord injury.

METHODS—This cohort was constructed from the State Inpatient Databases of California, New York, and Florida. 14,396 patients with SCI were identified. The primary outcome measure evaluated was 30-day readmission. Secondary measures include in-hospital complications.

Univariate and multivariate analysis were utilized to evaluate covariates. χ^2, Fisher's exact, and linear, logistic, and modified Poisson regression methods were utilized for statistical analysis. Propensity score methods were used with matched pairs analysis performed by the McNemar's test.

RESULTS—Weekend admission was not associated with increased 30- day readmission rates in multivariate analysis. Race and discharge to a facility (RR 1.60 (1.43–1.79)) or home with home care (RR 1.23 (1.07–1.42)), were statistically significant risk factors for readmission. Payor status did not affect rates of readmission. In propensity score matched pairs analysis, weekend admission was not associated with increased odds of 30-day readmission (OR 1.04 (0.89–1.21)). Patients admitted to high volume centers had significantly lower risk of readmission when compared with patients admitted to low volume centers.

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CONCLUSION—Our results suggest that the weekend effect, described previously in other patient populations, may not play as important a role in patients with SCI.

Keywords

spinal cord injury; trauma; weekend effect; spine surgery; insurance; healthcare disparities; race

Introduction

Spinal cord injury (SCI) is a significant public health problem afflicting approximately 12,400 patients in the United States annually.[1] The incidence of new SCIs is estimated at nearly 40 cases per million persons annually,[2] and the average age of affected individuals is less than 40 years.[3] It is estimated that approximately 259,000 Americans are currently living with these injuries.[4] Recovery from a complete SCI is exceedingly rare, leaving most patients with significant permanent disability. Treatment of these injuries is multimodal, and is often complicated by other significant associated comorbidities and the necessity for long-term and expensive disease management. Given the individual and societal costs associated with SCI, there is interest in identifying specific practice patterns and demographic factors that influence patient outcomes. A key driver of costs related to the index hospitalization includes perioperative complications and readmissions.[5] Thus, both health care providers and insurers are interested in identifying of risk factors for these events.

Previous studies on a variety of different acute medical conditions have raised concerns that patients admitted to hospital on a weekend have worse outcomes than those admitted during the week.[6–13] A recent study found that nurse staffing ratios, rather than day of the week, impacted mortality after stroke.[14] These studies raise interesting questions concerning care of patients with SCI, as it is unclear what factors may influence outcome after neurologic injury, including the timing of the event and related care in the hospital.

Population-based databases allow construction of large cohorts of patients to address research questions and generate hypotheses. This study utilized census-level state inpatient databases (SID) to identify patient factors associated with readmission to the hospital, and to study weekend treatment and its effect on in-hospital complications and readmission to the hospital. Based on analysis of our institutional data (data not published), we hypothesize that weekend care for SCI patients is not associated with increased 30-day readmissions or increased hospital complications.

Methods

Study design and patient population

This was a retrospective cohort study using the Agency for Healthcare Research & Quality Healthcare Cost and Utilization Project SID for California (CA), Florida (FL), and New York (NY) from 2006 to 2010 to identify adults patients suffering traumatic spinal injuries identified by ICD-9-CM diagnosis codes (see Supplemental Table 1). Patients were required to have a traumatic injury (ICD-9-CM diagnosis codes 800.x–959.x excluding 905.x–909.x) as the principle diagnosis or an E-code for traumatic mechanism of injury (see Supplemental

Table 1) to be included in the index study population. Index hospitalization complications were identified using ICD-9-CM diagnosis codes (Supplemental Table 1). Unique patient-level and encrypted patient-day identifiers were used to track sequential visits over time within the same state.[15] Patients under age 18 years, missing identifiers, with hospital stay over 365 days, and those with an admission for spinal injury in 2005 were excluded from analysis. Patients residing in a different state than the admitting hospital were excluded, as those patients may not have equal risk for readmission.

Index admissions for spinal injury between 2006 and 2010 were identified. The SIDs from 2005 provided a baseline period to identify comorbidities and to decrease the likelihood that patients with chronic SCI would be included. The SIDs from 2011 provided minimum one-year follow-up for all patients with index admission in 2010. ICD-9-CM procedure and diagnosis codes were utilized to identify patients undergoing spine surgery, surgical approaches, and complications during the index hospitalization (see Supplemental Table 1).

The final cohort of patients with admission to hospital for an acute SCI from 2006–2010 included 14,396 patients. Given approximately 12,400 new SCI per year in the United States,[1] one would expect approximately 15,000 new SCIs in a 5 year cohort of patients from California, New York, and Florida based on the 2010 Census data.[16] For readmission analyses, patients who died during index admission were excluded. Using the index admission for SCI and any hospitalization during the previous year, pre-existing comorbidities were identified according to two different methods: the algorithm defined by Elixhauser and colleagues[17] and the Charlson Comorbidity Index.[18] Missing information for race is likely not missing at random in administrative databases,[19] so was included as a separate category in analysis. Native Americans, Pacific Islanders, and “Other” race were included together as “Other.” Since spinal cord injury care is concentrated at high volume centers, we categorized treating hospital by annual volume of spinal cord injury.[20]

We utilized the Trauma Mortality Prediction Model (TMPM) to model the risk of death based on presenting injuries as scored using ICD-9-CM diagnosis codes.[21, 22] The TMPM was augmented with age, sex, and injury mechanism to model probability of death.

Propensity Score Modeling

We used nonparsimonious multivariable logistic regression to create the propensity score model with weekend admission as the dependent variable.[23, 24] The predicted probabilities of weekend admission were used to identify two populations of patients, one with weekday admissions and one with weekend admissions, with the same probability of weekend admission and balanced covariates. After propensity score matching on the predicted probability for weekend admission, comparison of the matched pairs can be used to determine whether individuals admitted with SCI on a weekend had higher or lower risk of 30-day readmission than patients with SCI admitted during the week with similar mix of injury severity, as modeled by the TMPM, and medical comorbidities. Because we studied readmission, patients who died during initial hospital admission were excluded before calculating the propensity score. Patients admitted on the weekend were matched 1:1 with patients admitted during the week using a greedy matching algorithm with caliper width of

0.2 standard deviations of the logit of the propensity score.[25] Standardized differences between matched covariates were calculated to assess balance between matched pairs.[26]

Statistical Analysis

Chi-square and Student's *t*-tests were used for univariate comparisons. Variables with p <0.10 in univariate testing were included in the initial multivariate models. Because of the commonality of the expected outcome, odds ratios likely provide an inflated value of the measure of association. Thus, a modified Poisson regression was utilized to calculate the relative risk (RR) for readmission.[27] Univariate analysis of propensity score-matched pairs was performed with the McNemar's test. 2-sided p values of <0.05 were considered significant. All statistical analysis was performed using SAS Enterprise 6.1 (SAS Institute, Cary, NC).

Results

Cohort Analysis

14,396 unique patients with SCI were admitted to hospitals in the three states from 2006–2010 were identified. 362 (10.44%) of patients admitted on the weekend and 902 (8.26%) of patients admitted on a weekday died during index hospitalization. After removing patients who died, 13,129 patients remained for readmission analysis. 414 of 3107 (13.32%) patients admitted on the weekend, and 1423 of 10022 (14.20%) patients admitted on a weekday were readmitted within 30 days of discharge. Univariate analysis of weekday versus weekend admission is reported in Table 1. Age, race, payer, anatomic site of SCI, and many comorbidities differed between patients admitted on a weekday and those admitted on the weekend (Table 1). Patients admitted on the weekend were more likely to be admitted to a high volume center. Univariate analysis of patient characteristics associated with 30-day readmission is reported in Table 2. Older age, sex, race, and most comorbidities were significantly associated with 30-day readmission. Though the difference in means of the TMPM predictions was not statistically different between readmitted and non-readmitted patients, it is a validated measure of injury severity,[21, 22] and therefore we included it in multivariate analysis. Patients with Medicare had higher risk of readmission, while private insurance showed a protective effect (Table 2). Patient residence and weekend admission were not associated with 30 day readmission (Table 2). Each additional day in the hospital during the index SCI admission was associated with increased risk of readmission in univariate analysis.

In a multivariable Poisson regression model (Table 3), black race, older age, Medicare primary payer, and discharge location other than home were associated with significantly increased risk of 30-day readmission. Patients treated at hospitals with increased volume of SCI admissions had lower risk of readmission. We studied both Charlson comorbidity categories and Elixhauser comorbidities. In comparison with the Charlson categories, inclusion of the individual Elixhauser comorbidities in the Poisson model resulted in better model fit (−2 log (Likelihood Ratio) difference 1365.63, χ^2 with 10 degrees of freedom, p<0.0001). Several Elixhauser comorbidities were associated with increased risk of readmission, including peripheral vascular disease, neurological disorder, renal failure, lymphoma, metastatic cancer, weight loss, psychosis, depression, and diabetes (Table 3). Patients treated at hospitals with a high annual volume of patients with SCI had the lowest risk of readmission (Table 3). 10402 of 13,129 (79.23%) patients with spine injuries in this cohort were treated in hospitals in the top quartile of SCI admissions (data not shown).

Pneumonia, decubitus ulcer, respiratory failure, acute renal failure, and central venous catheter infections during the index SCI hospitalization were associated with increased risk of readmission (Table 3). Admission on the weekend was not significant in either univariate (Table 2) or multivariate analysis. Initial SCI hospitalization length of stay was significantly longer in patients readmitted within 30 days compared to those not readmitted (data not shown). Length of stay was collinear with TMPM, so was removed for multivariate regression. Thoracic injury was associated with higher risk of readmission (Table 3).

Propensity-Score Matched Pairs Analysis

To further evaluate the effect of weekend admission on readmission and in-hospital complications, we constructed propensity-score matched pairs as described above. We included TMPM, age, sex, race, patient residence, hospital SCI volume, comorbidities, and location of SCI in the model to create the propensity score, with weekend admission as the dependent variable. The TMPM predicts the probability of mortality given traumatic injuries,[21] so was used to balance severity of injury between groups. Supplemental Table 2 reports the frequencies of variables included in the logistic regression model to create the propensity score for the matched-pairs cohort. We were able to match 3099 of 3107 (99.7%) patients admitted on the weekend to a control patient with equal likelihood for weekend admission, but who was admitted on a weekday. We analyzed the adequacy of the match by comparing standardized differences[26] and probability distributions of the propensity score (data not shown).

We performed analyses of 30-day readmission and other outcomes (Table 4) using the propensity score matched pairs. Numbers of discordant pairs, where one of the pair was affected and the other was not, are presented in Table 4. The ratio of discordant pairs allows for calculation of the odds ratio. Weekend admission was not associated with readmission within 30 days or discharge location. Patients admitted on the weekend had lower odds of index hospitalization medical complications, including deep venous thrombosis, decubitus ulcer, urinary tract infection, and sepsis compared to weekday admission (Table 4). Length of stay was shorter in patients admitted on the weekend (16.54 (15.65–17.44)) versus those admitted on a weekday (26.0 (24.78–27.33)).

Discussion

In this study, we analyzed a retrospective cohort of SCI patients admitted to hospitals in California, New York, and Florida over a 5-year period. We found no evidence of a "weekend" effect with regards to readmission or index hospital complications in multivariate analysis of patients with SCI. Patients readmitted within 30 days were older and more likely to have medical comorbidities (Table 2). Multivariate analysis showed increased risk of readmission for African-Americans, patients discharged home with home care or to another facility (e.g., long-term care, skilled nursing facility), and those admitted to lower SCI volume hospitals (Table 3). Patients admitted on a weekend with acute SCI were less likely to have perioperative medical complications and did not have increased risk of readmission within 30 days (Table 4).

Previous authors have studied the effect of weekend admission on patient outcomes.[6–12] Several of these studies have shown worse outcomes with weekend admission.[6–8, 10, 11, 13] A more recent study suggested that nurse staffing ratios, rather than the weekend itself, may be the key factor affecting mortality.[14] A multitude of factors, including the availability of diagnostic studies, may also be at play.[28] A population study of spinal oncology patients requiring surgical intervention did not show a deleterious effect of weekend admission, but did report a higher likelihood of delay in surgical treatment if a patient was admitted on the weekend.[29] However, a different population-based study using the Nationwide Inpatient Sample of patients undergoing surgical intervention in cervical spine trauma did report longer length of stay or hospital costs for patients admitted on the weekend compared to weekday.[30] Use of the SIDs of California, Florida, and New York offers important advantages. Patients are trackable over time with an encrypted identifier, and the time to readmission can be calculated.[15] Although the Nationwide Inpatient Sample allows a large sample of inpatient admission across the United States to be studied, the study data are cross-sectional by definition and do not allow analysis at the patient-level since no patient identifiers are available. The SID billing data allows construction of longitudinal cohorts for study of readmission risks and longer-term complications.

Factors that do not impact billing, but may impact patient care, show lower accuracy in administrative databases.[31] The focus on billable coding presents an inherent bias, though the bias is likely not affected by the timing of a trauma admission. The incentive for accurate billing does not change with time of admission.

In our analysis, weekend admission was not associated with readmission at 30 days. However, consistent with our institutional cohort (data not published), weekend admission was not associated with length of hospital stay, readmission within 30 days, and was associated with lower in-hospital medical complications. Bray et al previously reported that negative health outcomes may be more related to staffing levels than with the particular day of the week during which one receives care.[14] Higher volume trauma centers may not suffer the same staffing shortfalls outside of normal work hours, and may be equipped to provide similar care no matter when patients arrive. Thus, admission of patients to primarily large Trauma Centers may nullify any possible weekend effect.

Limitations

This dataset is derived from administrative billing data provided by California, New York, and Florida. There is inherent bias in this data, as described above, in that coding affecting remuneration is more likely to be accurate. Additionally, some factors may be missing in non-random fashion, limiting the applicability of this analysis. Additionally, due to using 3 states, there is chance of readmission to a neighboring state, though we minimized this by restricting the cohort to patients residing in the same state as the admitting hospital.

Significance

This study used a large retrospective cohort of patients from the HCUP State Inpatient Databases to determine whether outcomes in patients with SCI are impacted by weekend admission. Despite the inherent limitations this report represents the largest cohort of SCI patients and evaluation of readmission risk factors.

Conclusion

In this study, we showed in two separate analyses that a cohort of patients with SCI injury had similar risk of readmission independent of day of admission. African-American patients have increased risk of 30-day readmission. Hospitalization in high SCI volume centers was associated with lower risk of readmission compared with low volume centers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Univariate analysis of patient demographics, comorbidities, and anatomic location of spinal cord injury differ by presentation day

Characteristic	Weekday Admission 10022 (76.33%)	Weekend Admission 3107 (23.67%)	p Value
	N (%)	N (%)	
Age			**<0.0001**
Mean ± St.Dev.	52.40 ± 20.61	49.51±20.13	
Sex			0.2693
Male	6870 (68.82)	2164 (69.87)	
Race			**0.0021**
White	5928 (62.24)	1936 (64.62)	
Black	1458 (15.31)	422 (14.09)	
Hispanic	1360 (14.28)	418 (13.95)	
Other	779 (7.77)	220 (7.08)	
Missing	497 (4.96)	111 (3.57)	
TMPM			**0.0171**
Mean ± St.Dev.	9.37±11.88	8.81±11.62	
Elixhauser Comorbidities			
Congestive Heart Failure	573 (5.72)	134 (4.31)	**0.0024**
Valvular Disease	341 (3.40)	99 (3.19)	0.5586
Peripheral Vascular Disease	378 (3.77)	85 (2.74)	**0.0062**
Hypertension	3855 (38.57)	1028 (33.09)	**<0.0001**
Chronic Pulmonary Disease	1213 (12.10)	348 (11.20)	0.1743
Pulmonary Vascular Disease	236 (2.35)	55 (1.77)	0.0531
Paralysis	1858 (18.54)	473 (15.22)	**<0.0001**
Neurological Disease	828 (8.26)	244 (7.85)	0.4674
Diabetes	1688 (16.84)	413 (13.29)	**<0.0001**
Renal Disease	501 (5.00)	104 (3.35)	**<0.0001**
Liver Disease	231 (2.30)	78 (2.51)	**0.5091**
Peptic Ulcer Disease	<11	<11	0.7600
Rheumatological Disease	294 (2.93)	75 (2.41)	0.1257
AIDS	21 (0.21)	<11	0.8679
Lymphoma	43 (0.43)	<11	**0.0305**
Coagulopathy	549 (5.48)	155 (4.99)	0.2902
Metastatic Cancer	93 (0.93)	19 (0.61)	0.0938
Solid Tumor	104 (1.04)	25 (0.80)	0.2498
Hypothyroidism	595 (5.94)	155 (4.99)	**0.0466**
Obesity	632 (6.31)	157 (5.05)	**0.0102**
Weight Loss	666 (6.65)	226 (7.27)	0.2238

Characteristic	Weekday Admission 10022 (76.33%)	Weekend Admission 3107 (23.67%)	p Value
	N (%)	**N (%)**	
Electrolyte Disorder	2523 (25.17)	759 (24.43)	0.4015
Anemia, Blood Loss	148 (1.48)	27 (0.87)	**0.0099**
Anemia, Deficiency	1688 (16.84)	462 (14.87)	**0.0094**
Alcohol Abuse	1341 (13.38)	554 (17.83)	0.4676
Drug Abuse	815 (8.13)	291 (9.37)	**0.0305**
Psychoses	602 (6.01)	197 (6.34)	0.4966
Depression	1062 (10.60)	309 (9.95)	0.2996
Spinal Cord Injury			
Cervical	5833 (58.20)	1906 (61.35)	**0.0019**
Thoracic	2557 (25.51)	712 (22.92)	**0.0034**
Lumbosacral	2202 (21.97)	646 (20.79)	0.1633
Weekend Admission	2693 (23.85)	414 (22.54)	0.2198
State			**<0.0001**
California	4727 (47.17)	1335 (42.97)	
Florida	2793 (27.87)	1099 (35.37)	
New York	2502 (24.97)	673 (21.66)	
No. transferred from another hospital	3729 (37.21)	261 (8.40)	**<0.0001**
Patient Residence			0.0601
Large Metro Area (>1 million)	6869 (68.55)	2062 (66.39)	
Small Metro Area (<1 million)	2568 (25.63)	840 (27.04)	
Micropolitan Area or Other	584 (5.83)	204 (6.57)	
Expected Payer			**<0.0001**
Medicare	3054 (30.48)	766 (24.66)	
Medicaid	1874 (18.70)	509 (16.39)	
Private Insurance	3390 (33.83)	1279 (41.18)	
Other	1702 (16.99)	552 (17.77)	
Hospital, Annual Number of SCI Admissions			**<0.0001**
<10	4096 (40.87)	1117 (35.95)	
10–19	2137 (21.32)	767 (24.69)	
20–29	1229 (12.26)	430 (13.84)	
>30	2560 (25.54)	793 (25.52)	

All numeric data (age) were evaluated with t-tests. All categorical data (all other variables above) were evaluated with χ^2 tests.
Trauma Mortality Prediction Model (TMPM) score is modeled as described in Glance et al, 2009.

Table 2

Association of demographic and presenting characteristics of 13,129 patients surviving admission with 30 day readmission

Characteristic	No 30-day readmission 11292 (86.01%)	Readmitted within 30 days 1837 (13.99%)	p Value
	N (%)	N (%)	
Age, y			**<0.0001**
Mean ± St.Dev.	50.85 ± 20.38	57.07 ± 20.67	
Sex			0.1344
Male	7794 (69.32)	1240 (67.57)	
Race			**0.0189**
White	6750 (62.77)	1114 (63.01)	
Black	1583 (14.72)	297 (16.80)	
Hispanic	1549 (14.41)	229 (12.95)	
Other	871 (7.71)	128 (6.97)	
Missing	539 (4.77)	69 (3.76)	
Elixhauser Comorbidities			
Congestive Heart Failure	514 (4.55)	193 (10.51)	**<0.0001**
Valvular Disease	337 (2.98)	103 (5.61)	**<0.0001**
Peripheral Vascular Disease	345 (3.06)	118 (6.42)	**< 0.0001**
Hypertension	3997 (35.40)	886 (48.23)	**<0.0001**
Chronic Pulmonary Disease	1262 (11.18)	299 (16.28)	**<0.0001**
Pulmonary Vascular Disease	232 (2.05)	59 (3.21)	**0.0018**
Paralysis	1932 (17.11)	399 (21.72)	**<0.0001**
Neurological Disease	842 (7.46)	230 (12.52)	**<0.0001**
Diabetes	1666 (14.75)	435 (23.68)	**<0.0001**
Renal Disease	435 (3.85)	170 (9.25)	**<0.0001**
Liver Disease	239 (2.12)	70 (3.81)	**<0.0001**
Peptic Ulcer Disease	<11	<11	0.9821
Rheumatological Disease	297 (2.63)	72 (3.92)	**0.0019**
AIDS	21 (0.19)	< 11	0.0928
Lymphoma	34 (0.30)	14 (0.76)	**0.0024**
Coagulopathy	559 (4.95)	145 (7.89)	**<0.0001**
Metastatic Cancer	78 (0.69)	34 (1.85)	**<0.0001**
Solid Tumor	105 (0.93)	24 (1.31)	0.1291
Hypothyroidism	603 (5.34)	147 (8.00)	**<0.0001**
Obesity	646 (5.72)	143 (7.78)	**0.0006**
Weight Loss	683 (6.05)	209 (11.38)	**<0.0001**
Electrolyte Disorder	2639 (23.37)	643 (35.00)	**<0.0001**
Anemia, Blood Loss	132 (1.17)	43 (2.34)	**<0.0001**

Characteristic	No 30-day readmission 11292 (86.01%)	Readmitted within 30 days 1837 (13.99%)	p Value
	N (%)	**N (%)**	
Anemia, Deficiency	1706 (15.11)	444 (24.17)	**<0.0001**
Alcohol Abuse	1640 (14.52)	255 (13.88)	0.4676
Drug Abuse	939 (8.32)	167 (9.09)	0.2672
Psychoses	632 (5.60)	167 (9.09)	**<0.0001**
Depression	1109 (9.82)	262 (14.26)	**<0.0001**
Spinal Cord Injury			
Cervical	6679 (59.15)	1060 (57.70)	0.2429
Thoracic	2745 (24.31)	524 (28.52)	**<0.0001**
Lumbosacral	2470 (21.87)	378 (20.58)	0.2110
Weekend Admission	2693 (23.85)	414 (22.54)	0.2198
State			0.20
California	5227 (46.29)	835 (45.45)	
Florida	3316 (29.37)	576 (31.36)	
New York	2749 (24.34)	426 (23.19)	
No. transferred from another hospital	3462 (30.66)	528 (28.74)	0.0977
Patient Residence			0.9962
Large Metro Area (>1 million)	7681 (68.03)	1250 (68.05)	
Small Metro Area (<1 million)	2932 (25.97)	476 (25.91)	
Micropolitan Area or Other	677 (6.00)	111 (6.04)	
Expected Payer			**<0.0001**
Medicare	3060 (27.11)	760 (41.37)	
Medicaid	2036 (18.04)	347 (18.89)	
Private Insurance	4142 (36.69)	527 (28.69)	
Other	2051 (18.17)	203 (11.05)	
Hospital, Annual Number of SCI Admissions			**<0.0001**
<10	4372 (38.72)	841 (45.78)	
10–19	2549 (22.57)	355 (19.32)	
20–29	1430 (12.66)	229 (12.47)	
>30	2941 (26.04)	412 (22.43)	
In-Hospital Complications			
Pneumonia	1520 (13.46)	404 (21.99)	**<0.0001**
Decubitus Ulcer	1158 (10.26)	321 (17.47)	**<0.0001**
Respiratory Failure	1177 (10.42)	328 (17.86)	**<0.0001**
Acute Renal Failure	396 (3.51)	150 (8.17)	**<0.0001**
Central Venous Catheter Infection	40 (0.35)	23 (1.25)	**<0.0001**
Sepsis	713 (6.31)	224 (12.19)	**<0.0001**
Clostridium difficile	254 (2.25)	82 (4.46)	**<0.0001**
Urinary Tract Infection	2442 (21.63)	509 (27.71)	**<0.0001**

All numeric data (age) were evaluated with t-tests. All categorical data (all other variables above) were evaluated with χ^2 tests. Trauma Mortality Prediction Model (TMPM) score is modeled as described in Glance et al, 2009.

Table 3

Multivariable regression of parameters associated with risk of 30-day readmission

Characteristic	Multivariable Regression	
	Estimated Relative Risk	95% CI
Age (10 year increase)	1.06	1.03–1.09
Race		
White	Reference	
African-American	1.17	1.04–1.32
Hispanic	1.02	0.90–1.17
Other	0.94	0.80–1.11
Missing	0.89	0.71–1.11
Expected Payer		
Medicare	Reference	
Medicaid	1.05	0.90–1.22
Private Insurance	0.87	0.77–1.00
Other	0.80	0.67–0.95
Discharge Location		
Home	Reference	
Home with Home Care	1.23	1.07–1.42
Other	1.60	1.43–1.79
Hospital, Annual Number of SCI Admissions		
<10	1.13	1.01–1.27
10–19	1.00	0.88–1.14
20–29	1.14	0.98–1.32
>30	Reference	
Comorbidities		
Peripheral Vascular Disease	1.27	1.08–1.50
Neurological Disorder	1.17	1.03–1.33
Renal Failure	1.28	1.10–1.50
Lymphoma	1.67	1.05–2.67

Characteristic	Multivariable Regression	
	Estimated Relative Risk	95% CI
Metastatic Cancer	1.62	1.18–2.21
Weight Loss	1.21	1.06–1.38
Psychoses	1.33	1.15–1.53
Depression	1.21	1.07–1.36
Diabetes	1.23	1.11–1.37
Injuries and in-hospital complications		
Thoracic SCI	1.15	1.04–1.26
Spinal Fusion		
No surgery	Reference	
1 level	1.00	0.75–1.33
2–3 levels	0.80	0.71–0.89
4–8 levels	0.83	0.73–0.94
>9 levels	0.89	0.60–1.32
Pneumonia	1.25	1.11–1.40
Decubitus Ulcer	1.27	1.13–1.42
Respiratory Failure	1.27	1.12–1.43
Acute Renal Failure	1.25	1.07–1.46
Central Venous Catheter Infection	1.78	1.27–2.49

In multivariable regression, several variables did not achieve significance, including multiple Elixhauser comorbidities, weekend admission, wound dehiscence, osteomyelitis, prolonged ventilation, and surgical complication.

Table 4

Weekend treatment does not increase odds of readmission within 30 days, but is associated with lower in-hospital medical complications when analyzed using propensity score matched pairs

Outcome	N, Weekend patient affected with Weekday patient Unaffected	N, Weekend patient unaffected with Weekday patient affected	Odds Ratio	OR (95 % CI)		Test Statistic	P value
				Lower Limit	Upper Limit		
Primary Outcome of Interest							
Readmitted within 30 days	352	339	1.04	0.89	1.21	0.245	0.6209
Secondary Outcomes (in-hospital medical and surgical complications)							
Discharge Home	716	725	0.99	0.89	1.10	0.056	0.8126
DVT	71	141	0.50	0.38	0.67	23.113	**<0.0001**
Decubitus Ulcer	189	325	0.58	0.49	0.70	35.984	**<0.0001**
UTI	340	566	0.60	0.53	0.69	56.375	**<0.0001**
Wound Infection	59	91	0.65	0.47	0.90	6.827	**0.0090**
C. difficile	55	75	0.73	0.52	1.04	3.077	0.0794
Central Line Infection	<11	13	0.62	0.26	1.48	1.190	0.2752
Pneumonia	340	393	0.87	0.75	1.00	3.832	0.0503
Renal Failure	95	117	0.81	0.62	1.06	2.283	0.1308
Sepsis	167	192	0.87	0.71	1.07	1.741	0.1870
Fusion	677	813	0.83	0.75	0.92	12.413	**0.0004**
Surgical Complication	74	94	0.79	0.58	1.07	2.381	0.1228

The discordant pairs from the propensity score matching are presented.