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Downstream hospital system effects of a comprehensive trauma recovery services program

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Abstract

BACKGROUND: Trauma patients are often noted to have poor compliance but high recidivism and readmission rates. Participation in a trauma recovery services (TRS) program, which provides peer support and other psychosocial resources, may impact the trajectory of patient recovery by decreasing barriers to follow-up. We hypothesized that TRS participants would have greater downstream nonemergent use of our hospital system over the year following trauma, manifested by more positive encounters, fewer negative encounters, and lower emergency department (ED) charges.

METHODS: We studied trauma survivors (March 2017 to March 2018) offered TRS. Hospital encounters and charges 1 year from index admission were compared between patients who accepted and declined TRS. Positive encounters were defined as outpatient visits and planned admissions; negative encounters were defined as no shows, ED visits, and unplanned admissions. Charges were grouped as cumulative ED and non-ED charges (including outpatient and subsequent admission charges). Adjusted logistic and linear regression analyses were used to identify factors associated with positive/negative encounters and ED charges.

RESULTS: Of 511 identified patients (68% male; injury severity score, 14 [9–19]), 362 (71%) accepted TRS. Trauma recovery services patients were older, had higher injury severity, and longer index admission length of stay (all $p < 0.05$). After adjusting for confounders, TRS patients

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were more likely to have at least one positive encounter and were similarly likely to have negative encounters as patients who declined services. Total aggregate charges for this group was US $74 million, of which US $30 million occurred downstream of the index admission. Accepting TRS was associated with lower ED charges.

CONCLUSION: A comprehensive TRS program including education, peer mentors, and a support network may provide value to the patient and the health care system by reducing subsequent care provided by the ED in the year after a trauma without affecting nonemergent care.

Keywords

Trauma outcomes; peer mentoring; trauma recovery

Trauma patients have earned a reputation for failing to follow-up for appointments,[1] and this systematic noncompliance after discharge from the hospital is associated with increased complications, readmissions, and costs.[2–4] Planned encounters have a positive impact in that they have the potential to prevent encounters with negative impact, for example, readmissions for complications or trips to the emergency departments (EDs). Unfortunately, trauma patients are also known to have high rates of negative encounters such as recidivism and unplanned readmissions.[5,6] Barriers to compliance with prescribed outpatient treatment plans are likely multi-factorial and occur at the intersection of patient sociodemographic issues, ability to interact with a complex health care system, and understanding of the importance of appropriate follow-up.[7,8] It is unknown whether a comprehensive psychosocial support program would positively impact trauma survivors' downstream utilization of the health care system.

Unfortunately, the treatment for these psychosocial issues is not within the typical scope of practice of trauma surgeons. In many complex diseases, such as cancer, psychiatric diseases, and addiction, continued interaction with the health care system via outpatient visits and nonmedical support services is associated with fewer subsequent hospitalizations.[2,3,9] Comprehensive support services that include peer mentors have also been used in complex patients with promising results.[10–18] For example, a systematic review of peer support interventions on health outcomes in patients with heart disease showed that peer support improved self-efficacy, activity, pain, and reduced emergency room visits.[13] However, research on the cost-effectiveness of these services is sparse and shows varying results, often without significant short-term cost savings.[19–23]

At our institution, a robust program in trauma recovery services (TRS) is offered to patients who have had major trauma. Patients who choose to engage with TRS have access to peer visits from trauma survivors, counseling services, referrals to victim service programs, and many other programs. While anecdotal evidence suggests that these services are meaningful to patients and improve their posttrauma recovery, we sought to measure the impact of these services on our hospital and health system by examining the relationship between TRS, patient encounters, and hospital charges. We rated encounters as positive or negative; positive encounters were defined as outpatient visits and planned admissions, and negative encounters were defined as no shows, ED visits, and unplanned admissions. Our institution serves a high-risk population; before TRS implementation, our trauma recidivism rate was

25%.[6] We hypothesized that patients who engaged with the TRS program, compared with those who declined, would have more positive encounters and fewer negative encounters over the following year. We also hypothesized that engagement with the TRS program would lead to fewer charges from the ED in the year following admission.

PATIENTS AND METHODS

We retrospectively studied trauma inpatients at an academic level 1 trauma center from March 2017 to March 2018 who survived their index admission and were offered TRS during their admission. The trauma team at MetroHealth evaluates nearly 5,500 trauma patients per year. A key component of the patient support provided at MetroHealth is administered via the TRS team. Survivors are provided trauma-informed patient education and resources, recovery coaches, support groups, peer mentors, and ongoing trauma coaching postdischarge. The TRS program was created in 2013 through a Major Extremity Trauma Research Consortium multicenter grant to implement Trauma Survivors Network programming including education, coaching, and peer mentorship.[24] Since then, services were further expanded through the TRS team, with additional funding through an Ohio Victims of Crime Act grant for patients who are victims of crime. This includes assistance with navigating the Ohio Victims of Crime system, immediate access to basic necessities, housing and financial assistance, transportation support, and therapy. Trauma recovery services identify potential patients via inpatient/outpatient provider referral, automated informatics report from the ED, and chart review. Patients with active psychosis are ineligible for services. Patients and family members are introduced to TRS through a direct face-to-face meeting with a recovery coach, social work coordinator, and/or peer mentor. At the time of education, there is a discussion of available services and a handout for patients. Patients may decline services at any time. All eligible patients, whether or not they accept services, are included in the TRS registry.

Patients who were admitted after trauma and included in the TRS registry were identified for inclusion in our study. Data were collected from the trauma center registry, including demographics, Injury Severity Score (ISS), and hospital length of stay. These data were merged to a prospective TRS database. This database includes information on patients who accepted or rejected services, referral sources, insurance status, number of interactions, types of interactions, and services provided. Medical records were reviewed for outpatient visits, planned admissions, unplanned admissions, no shows, and subsequent ED encounters. Patients who followed up outside of the local metropolitan area or died at the index admission were excluded from analysis. Patients who were incarcerated within the follow-up period, as well as those using veterans' services, were excluded because they both had alternate follow-up pathways outside of MetroHealth, and we could not reliably track follow-up. Patients who died within 1 year of their admission date were included. Any reason for death was noted if available.

The main outcome of interest was postadmission encounters in the hospital system for 1 year following the index trauma admission. Encounters were characterized as positive or negative. Positive encounters were defined as planned patient encounters, which included outpatient visits to any provider and planned admissions to the hospital. Planned admissions

were included as “positive,” as these are often related to follow-up treatments for injuries sustained at the time of trauma. This is an indication that a patient is complying with recommended treatment plans, such as internalization of external fixator devices for orthopedic injury. Negative encounters were defined as “no shows,” visits to the ED, and unplanned admissions to the hospital. Canceled appointments, where patients called to state they were unable to come to an appointment, were not included in analysis.

The secondary outcome of interest was hospital charges accumulated for the 1-year period following the index admission. Hospital charges were categorized by our financial system as ED, inpatient, or outpatient. Charges incurred between the date of admission and discharge date were attributed to the initial inpatient stay. Because of our hospital billing processes, all physician charges, including consultations that occur in the inpatient setting, were categorized as “outpatient” and were not able to be reliably differentiated from true outpatient clinic visit charges. Because ED charges would be the best indicator of patients who either developed complications or chose to follow-up in the ED instead of using recommended outpatient channels, we used a binary definition for charges that occurred after the index admission: charges for care in the ED or non-ED charges, which included all subsequent outpatient and inpatient charges.

Data are presented as median (interquartile range [IQR]) for continuous variables and percent for categorical variables. Patients with and without TRS participation were compared, using a χ^2 test for categorical variables and a Kruskal-Wallis equality of populations test for continuous variables. Factors identified to be significant by two-group analysis were included in the regressions, after removal of factors that demonstrated collinearity. Factors associated with the number of positive and negative encounters were identified with linear regression. Charges were assessed between groups to determine differences in patients who did and did not participate in TRS. Adjusted logistic regression was performed to determine factors associated with positive encounters and negative encounters. Multivariable linear regression was used to assess factors associated with ED and non-ED hospital charges and was adjusted for factors identified in the bivariate analysis. All analyses were performed using STATA SE, version 16.0 (College Station, TX). This study was approved by the MetroHealth Medical Center Institutional Review Board.

RESULTS

Within the 1-year period, TRS were offered to 594 patients admitted for traumatic injury. Of these, 10 patients died, and 68 patients were excluded from analysis because of incarceration or remote follow-up. An additional five patients were excluded because their TRS engagement started more than a month after injury. The remaining 511 patients were included in our analysis. Of our 511 patients, 350 (68%) were male, 328 (64%) were White, the median age is 45 years (IQR, 25–58 years), and median ISS was 14 (IQR, 9–19). Nearly all the patients (n = 471, 92%) were admitted to the trauma service at the index admission. Median hospital length of stay was 5 days (IQR, 3–10 days). All 511 patients were offered TRS, and 362 patients (71%) accepted TRS. Two patients died within 1 year of their admission date; one died from unrelated chronic disease, and the other had no recorded reason for death.

The most common service provided was visits from trauma survivor peer mentors (330, 91%). Patients also received care bags, coaching calls, and other services such as emergency financial assistance. Seventy individuals (19%) were eligible for additional services as victims of crime. Patients who accepted TRS were significantly different from those who declined services in multiple ways (Table 1); they tended to be older (median age, 46 years vs. 34 years; $p = 0.0001$), were more severely injured (median ISS, 14 vs. 10; $p < 0.0001$), and were less likely to have a penetrating trauma (16% vs. 40%, $p < 0.0001$) than patients who declined services. Patients who accepted TRS had a longer length of stay and were less likely to be discharged to home.

Most (88%) of our patients had at least one positive downstream encounter (Table 2), which included outpatient encounters and planned admissions. Trauma recovery services patients were more likely to have a positive encounter in every category. These patients had a higher number of all positive encounters, more outpatient encounters, and more planned admissions than patients who did not accept TRS. The effect of TRS on positive encounters was present after adjusting for other factors in logistic regression (Table 3). Trauma recovery services patients (74%) also had at least one negative encounter (Table 2). Many patients had no-shows, visits to the EDs, and unplanned admissions to the hospital. Patients who accepted TRS were not more likely than patients who did not accept TRS to have negative encounters. After adjusted logistic regression, the only factor that was associated with negative encounters was age; patients with older age were less likely to have negative encounters.

Total aggregated charges for this population for a 1 year period was US $73.6 million, for which US $43.5 million was related to the index admission and $30.1 million was related to downstream charges. US $1 million of downstream charges were from ED visits; the remainder was from outpatient and inpatient visits, analyzed together as non-ED charges. The median ED charge was US $0 in each group, indicating that most patients in both groups did not return to the ED. Charges that originated from the ED were significantly lower for patients who had accepted TRS (median TRS, US $0 (0–651) vs. US $0 (0–2005); $p = 0.03$), suggesting that among patients who did return to the ED, treatment was more costly for patients who did not accept TRS. Non-ED charges were significantly higher in the TRS group (median, US $14,099 (1,125–66,785) vs. US $2,211 (344–24,378); $p = 0.0001$). Factors associated with downstream charges are presented in Table 4. Hospital length of stay and ISS, both proxies for severity of the initial injury and complexity of initial hospital course, were associated with downstream non-ED charges. Trauma recovery services participation was the only factor noted to be associated with ED charges in adjusted analysis.

DISCUSSION

Downstream “value” of patient-centered services for trauma patients such as our TRS program is elusive. Meaningful outcome measures that adequately describe the value of these services for the patient and hospital have yet to be defined. Comprehensive patient support programs have the potential to improve the patient experience, recovery, and downstream health, as well as increase compliance and decrease unplanned utilization of the health care system. The purpose of this study was to assess the impact of TRS on subsequent

patient encounters and financial outcomes. In our study, patients who accepted TRS were more severely injured than patients who did not accept services. This resulted in longer initial hospitalization, more intensive follow-up plans, and more overall follow-up visits within our system. Since TRS patients were more severely injured, we might expect to see more ED visits or unplanned admissions. Despite their higher severity of injury, patients with TRS were not more likely to present to the ED. Similarly, utilization within the ED (assessed by charges) was lower for TRS patients.

Factors associated with following up within our system were colinear. Patients who were more likely to accept TRS also had more follow-up encounters and had more downstream charges. While it is difficult to distinguish the effects of each factor because they are all associated with injury severity, in adjusted regression analysis, TRS participation was independently associated with patients returning to our hospital system for planned inpatient and outpatient visits. However, the magnitude of downstream charges appeared to be more affected by the initial injury severity and hospital length of stay. In a regression model of downstream non-ED charges where hospital length of stay and ISS are omitted (not shown), TRS engagement is significantly associated with charges (β coefficient, US $31 K; 95% confidence interval, US $8 K to US $54 K; $p = 0.009$). This demonstrates that acceptance of TRS and severity of the index hospitalization likely occur together, and the contribution of each is difficult to differentiate. In our system, it is likely that TRS are being accepted by patients with the highest and costliest trajectories. Our study supports the impression that these interventions assist patients in navigating the complex recovery process.

We examined 1 year of hospital encounters, to review both “positive” and “negative” encounters and the nature of interactions with the hospital system after trauma. Trauma patients who accepted TRS had more positive encounters than patients who declined services, suggesting that individuals were likely adhering to follow-up plans, which is crucial for recovery. We might expect patients who are more severely injured to have more negative encounters, such as ED visits and unplanned admissions, as a result of more complex traumatic disease. Instead, we found no significant difference in negative encounters between patients who did and did not accept TRS despite the higher injury severity of TRS patients. This finding suggests that TRS engagement may mitigate some no-shows and trips to the emergency room, although this finding is difficult to confirm using our data.

It is well established that scheduling and coordinating follow-up appointments are a major challenge during the recovery phase for nontrauma patients with complex medical disease, which can be partially mitigated by peer support services.[10–14,17] Peer and other comprehensive support mechanisms may also help guide trauma patients through the recovery process and overcome coordination and logistic challenges that are barriers to follow-up. This may aid patients to follow-up in a “planned” fashion and adhere to treatment plans rather than present to the ED after symptoms and complications develop.

Trauma remains a costly condition, and reduction of unnecessary costs is crucial. Nonelective hospital readmission following traumatic injury is associated with a median cost of more than US $8,000 within 30 days of discharge of the initial treatment of traumatic

injury.[25] Trauma recidivism is significantly associated with an increased risk of trauma readmission, highlighting the importance of addressing root causes to prevent reinjury and decrease health care costs by prevention of costly treatments for complications.[26] We hypothesized that our TRS program might reduce costs by increasing rates of adherence to follow-up plans and decreasing costs from unplanned care. Unfortunately, because of the structure of our financial data, we were unable to link specific admission costs as planned or unplanned. Because of this limitation, ED costs were examined as the available financial proxy for unplanned care. Total costs were driven by the index hospitalization length of stay and ISS, both proxies for the complexity of the initial trauma and are not affected by TRS engagement after adjustment in the models. However, ED charges, our proxy for unplanned care, were lower for patients who accepted TRS. While these data are not conclusive, TRS patients had both more positive encounters and less costly ED utilization, while maintaining similar rates of unplanned readmission. This supports the idea that engagement by trauma survivors during the recovery period can help them take advantage of “positive” avenues available in the health care system.

There are several limitations to consider when examining our study. Since this was a retrospective study, selection bias existed within the patient population such that the TRS group was significantly different from the group that declined services. Trauma recovery services patients, being more injured, were more likely to be discharged to inpatient settings and may have been more likely to follow-up because these institutions were coordinating follow-up care. We also were unable to adjust for factors that were not present in these databases, such as mental health issues and socioeconomic status such as employment or education. Finally, the time from initial hospitalization and start of services differed among patients. Some were offered and began receiving services while still in the hospital, while others were referred to TRS after discharge at a follow-up appointment. To fully examine the program as an adjunct to the trauma admission, patients whose services started more than a month from the time of injury were excluded. Because of the manner of financial data categorization, we were able to review charges and not hospital costs. We were also unable to distinguish between planned and unplanned readmission or physician costs. We believe that charges are a good proxy for hospital utilization, although it is likely they do not represent the true costs to the hospital for these complex patients.

CONCLUSIONS

A comprehensive trauma recovery program may provide value to both patients and the health care system. We found that those who accepted TRS had more positive encounters within our health care system. Trauma recovery services patients were older and more injured, and it may be assumed that they would have more follow-up than non-TRS patients. However, the high number of positive encounters indicates that these individuals had complex follow-up plans and were likely following these plans as prescribed. We also found that TRS and non-TRS patients had similar negative encounters despite the higher injury severity of the TRS group. Finally, ED charges were significantly lower for those who accepted TRS than those who declined services. Comprehensive trauma recovery programs are an important adjunct to standard medical care and may augment and sustain recovery trajectory in severely injured patients.

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DISCLOSURE

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TABLE 1.

Summary of TRS and Non-TRS Patients

	No TRS (n = 149)	TRS (n = 362)	*p*
Age, y	34 (24–52)	46 (28–59)	0.0001
Female, n (%)	37 (25)	124 (34)	0.037
ISS	10 (9–16)	14 (10–20)	<0.0001
Penetrating trauma, n (%)	60 (40)	57 (16)	<0.0001
Hospital length of stay, d	3 (2–6)	7 (4–11)	<0.0001
Intensive care length of stay, d	0 (0–2)	0 (0–4)	0.023
Discharge disposition			<0.0001
Home	111 (75%)	181 (50%)	
Inpatient acute rehab	15 (10%)	94 (26%)	
Other (acute/skilled)	23 (15%)	87 (24%)	
Index admission charges (thousands of US dollars)	44.8 (25.0–68.8)	71.3 (44.2–111.5)	<0.0001

Data are presented as median (IQR) unless specified. *p* Values were calculated using two-sample Wilcoxon rank sum test for continuous variables and χ^2 for categorical variables.

TABLE 2.

Encounter Types for 1 Year Following Trauma Admission

Encounter Types for 1 y	No TRS (n = 149)	TRS (n = 362)	*p*
Positive encounters	123 (83%)	325 (90%)	0.02
No. positive encounters	2 (1–3)	3 (1–6)	0.0001
Outpatient encounters	2 (1–3)	2.5 (1–5)	0.0001
Any planned admissions	27 (18%)	97 (27%)	0.038
No. planned admissions	0 (0–0)	0 (0–1)	0.025
Negative encounters	110 (73%)	268 (74%)	0.96
Any no shows	90 (60%)	222 (61%)	0.85
No. no shows	1 (0–2)	1 (0–3)	0.62
ED visits	65 (44%)	145 (40%)	0.46
No. ED visits	0 (0–2)	0 (0–1)	0.27
Unplanned admissions	15 (10%)	47 (13%)	0.36
No. unplanned admissions	0 (0–0)	0 (0–0)	0.45

Data are presented as median (IQR) unless specified. *p* Values were calculated using two-sample Wilcoxon rank sum test for continuous variables and χ^2 for categorical variables.

TABLE 3.

Factors Associated With Positive and Negative Encounters

Logistic Regression	Odds Ratio	95% Confidence Interval	*p*
Any positive encounter			
TRS	2.15	1.17–3.93	0.013 *
Age	0.99	0.97–1.00	0.81
ISS	1.01	0.97–1.05	0.67
Hospital length of stay	1.06	1.00–1.13	0.041 *
Female	1.27	0.68–2.35	0.45
Penetrating mechanism	2.61	1.12–6.07	0.026 *
Any negative encounter			
TRS	1.11	0.68–1.80	0.69
Age	0.98	0.95–0.99	<0.0001 *
ISS	1.02	0.99–1.05	0.09
Hospital length of stay	1.03	0.99–1.06	0.11
Female	1.11	0.71–1.74	0.65
Penetrating mechanism	1.38	0.78–2.45	0.27

* Logistic regression.

TABLE 4.

Factors Affecting ED and Non-ED Charges for 1 Year

Linear Regression for Charges	Coefficient, US $	95% Confidence Interval	*p*
Total downstream charges			
TRS	2,839	−18,689 to 24,367	0.80
Age	−276	−793 to 241	0.30
ISS	3,402	2,267–4,536	<0.0001
Hospital length of stay	4,039	2,868–5,209	<0.0001
Female	−7,344	−27,339 to 12,650	0.47
Penetrating mechanism	969	−22,651 to 54,589	0.94
ED			
TRS	−1,243	−2,473 to −13	0.048 *
Age	−21	−50 to 9	0.16
ISS	7	−57 to 72	0.82
Hospital length of stay	9	−58 to 76	0.78
Female	−654	−1,797 to 88	0.26
Penetrating mechanism	70	−1,280 to 1,249	0.92
Non-ED (outpatient and admission)			
TRS	4,082	−17,125 to 25,290	0.70
Age	−254	−764 to 254	0.33
ISS	3,395	2,277–4,512	<0.0001
Hospital length of stay	4,029	2,876–5,182	<0.0001
Female	−6,690	−26,388 to 13,007	0.51
Penetrating mechanism	899	−22,370 to 24,168	0.94

Charges are presented in US $.

* Linear regression.