Center for Trauma Survivorship improves postdischarge follow-up and retention

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BACKGROUND: Although the need for high-level care persists postdischarge, severely injured trauma survivors have historically poor adherence to follow-up. We hypothesized that a dedicated Center for Trauma Survivorship (CTS) improves follow-up and facilitates postdischarge specialty care.

METHODS: A retrospective study of "CTS eligible" trauma patients before (January to December 2017) and after (January to December 2019) creation of the CTS was performed. Patients with an intensive care unit stay ≥2 days or a New Injury Severity Score of ≥16 are CTS eligible. The before (PRE) cohort was followed through December 2018 and the after (CTS) cohort through December 2020. Primary outcome was follow-up within the hospital system exclusive of mental health and rehabilitative therapy appointments. Secondary outcomes include postdischarge surgical procedures and specialty-specific follow-up.

RESULTS: There were no significant differences in demographics or hospital duration in the PRE (n = 177) and CTS (n = 119) cohorts. Of the CTS group, 91% presented for outpatient follow-up within the hospital system, compared with 73% in the PRE group ($p < 0.001$). In the PRE cohort, only 39% were seen by the trauma service compared with 62% in the CTS cohort ($p < 0.001$). Center for Trauma Survivorship patients also had increased follow-up with other providers (80% vs. 65%; $p = 0.006$). Notably, 33% of CTS patients had additional surgery compared with only 20% in the PRE group ($p = 0.011$). Center for Trauma Survivorship patients had more than 20% more outpatient visits (1,280 vs. 1,006 visits).

CONCLUSION: Despite the follow-up period for the CTS cohort occurring during the peak of the COVID-19 pandemic, limiting availability of outpatient services, our CTS significantly improved follow-up with trauma providers, as well as with other specialties. The CTS patients also underwent significantly more secondary operations. These data demonstrate that creation of a CTS can improve the postdischarge care of severely injured trauma survivors, allowing for care coordination within the health care system, retaining patients, generating revenue, and providing needed follow-up care. (*J Trauma Acute Care Surg.* 2022;93: 118–123. Copyright © 2022 Wolters Kluwer Health, Inc. All rights reserved.)

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Trauma is a major public health issue across the United States resulting in profound disruptions to people's lives and livelihood.[1] The effectiveness and success of trauma systems and trauma centers have resulted in improved survivorship of patients with severe injuries. The long-term impact and sequelae of serious injury go well beyond just the initial hospitalization and include persistent physical and behavioral health issues.[2] Given the burden of injury, often requiring multiple specialties, these patients have extensive and complicated postdischarge needs. Unfortunately, many patients and caregivers not only think that those needs are not being met following discharge but also report feeling abandoned by the trauma system.[3] To optimize long-term outcomes and improve recovery, patients require the same comprehensive postdischarge treatment and care that they received in the trauma center.

Patients at urban level I trauma centers have historically poor follow-up after discharge.[4] Recent studies have examined reasons for poor follow-up rates. These studies reported conflicting and even contrary findings for factors associated with decreased follow-up.[4–6] These disparate findings imply that the poor follow-up is not solely due to the trauma patient population. Systemic barriers exist in health care delivery that limit postdischarge access and make navigating after discharge care problematic. These barriers to implementing postdischarge recovery programs in trauma patients are reported to include a difficulty with scheduling and making appointments, lack of time and money to go to appointments, transportation, and administrative support.[7] A paucity of research exists around these factors, and

TABLE 1. Demographics

Characteristic	PRE (n = 177)	CTS (n = 119)	*p*
Age, mean (SD), y	45 (18)	45 (18)	0.816
Sex, n (%)			0.140
Male	154 (87)	96 (81)	
Female	23 (13)	23 (19)	
Race, n (%)			0.691
Black	83 (47)	57 (48)	
White	28 (16)	23 (19)	
Other	60 (34)	37 (31)	
Unknown	6 (3)	2 (2)	
Ethnicity, n (%)			
Hispanic	48 (27)	35 (29)	0.071
Non-Hispanic	118 (67)	83 (70)	
Unknown	11 (6)	1 (1)	
Mechanism of injury, n (%)			0.288
Blunt	140 (79)	100 (84)	
Penetrating	37 (21)	19 (16)	
ICU LOS, mean (SD)	14 (12)	15 (13)	0.515
Hospital LOS, mean (SD)	27 (35)	28 (20)	0.718
Discharge destination, n (%)			0.016
Home	90 (51)	41 (34)	
Acute rehab	57 (32)	49 (41)	
Subacute rehab	22 (12)	26 (22)	
Long-term care	5 (3)	3 (3)	
Other	3 (2)	0 (0)	

LOS, length of stay.

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increasing patient retention within a health system has not been well evaluated in trauma patients.

The Center for Trauma Survivorship (CTS) was created to improve postdischarge care of severely injured trauma patients. Improving postdischarge care starts with improving patient retention and rates of follow-up. We hypothesized that the CTS would improve rates of postdischarge follow-up within the health system. We postulated that this improved follow-up would have a downstream effect that ripples throughout the system by increasing outpatient appointments and potentially decrease emergency department (ED) utilization and hospital readmissions.

PATIENTS AND METHODS

Study Design

A before and after study design was used to evaluate the effect of the CTS on follow-up rates in trauma patients at a large, urban level I trauma center. The institutional trauma registry was queried to identify the cohort of patients that would have been eligible for the CTS in the year before its inception (PRE group). The CTS records were used for the after (CTS) cohort to identify the patients approached for enrollment in the CTS. The institutional review board approved this study. The article was written using the Strengthening the Reporting of Observational Studies in Epidemiology Statement guidelines[8] (Supplemental Digital Content, Supplementary Data 1, http://links.lww.com/TA/C489).

Study Population

The PRE cohort was admitted to the hospital January through December 2017 and was followed through December 2018. The CTS cohort was admitted January through December 2019 and followed through December 2020. All patients eligible for the CTS were included, and there were no separate exclusion criteria.

Center for Trauma Survivorship

Patients eligible for CTS services are those older than 18 years with an intensive care unit (ICU) length of stay of at least 2 days and/or a New Injury Severity Score (NISS) of at least 16 who were discharged alive from the trauma center. The CTS was developed in response to patient and caregiver feedback to provide care coordination and complete physical and mental health care.[3] The center is consisted of a trauma surgeon, physiatrist, behavioral health specialist, health care navigator, nurse practitioner, and social worker. Patients are approached during their initial hospitalization before discharge by CTS staff. A CTS visit is set up in lieu of follow-up in the standard trauma clinic. Appointments and transportation to appointments are coordinated by the CTS.

Each CTS visit is comprehensive and includes a complete assessment of physical, emotional, and behavioral health. During the first CTS visit, patients are screened for posttraumatic stress disorder and depression. Patients are then referred to behavioral health services as appropriate. Further visits with the CTS and other specialties, as appropriate, are coordinated by the CTS. Patients always have phone access to CTS staff.

TABLE 2. Follow-up Visits

Characteristic	PRE (n = 177)	CTS (n = 119)	*p*
Any follow-up, n (%)	130 (73)	108 (91)	<0.001
Total no. all follow-up visits	1,006	1,280	
Trauma clinic/CTS follow-up, n (%)	69 (39)	74 (62)	<0.001
No. trauma clinic/CTS visits	139	237	
Follow-up with nontrauma outpatient providers, n (%)	115 (65)	95 (80)	0.006
Total no. all nontrauma outpatient visits	867	1,043	
Surgical provider outpatient follow-up, n (%)	105 (59)	91 (76)	0.002
Total no. outpatient surgical visits	556	666	
Medical provider outpatient follow-up, n (%)	48 (27)	39 (33)	0.295
Total no. outpatient medical visits	172	140	
Postdischarge surgery, n (%)	35 (20)	39 (33)	0.011
Total no. postdischarge surgeries	61	60	

TABLE 3. Surgical Subspecialty Follow-up

Characteristic	PRE (n = 177)	CTS (n = 119)	*p*
Neurosurgery	32 (18%)	26 (22%)	0.423
Neurosurgery no. visits	82	67	
Ophthalmology	6 (3%)	10 (8%)	0.065
Ophthalmology no. visits	11	37	
Orthopedic surgery	64 (36%)	61 (51%)	0.010
Orthopedic surgery no. visits	339	375	
Otolaryngology	8 (5%)	10 (8%)	0.170
Otolaryngology no. visits	32	55	
Plastic surgery	14 (8%)	16 (13%)	0.122
Plastic surgery no. visits	46	79	
Urology	8 (5%)	7 (6%)	0.600
Urology no. visits	15	20	
Vascular surgery	6 (3%)	3 (3%)	0.669
Vascular surgery no. visits	15	9	
Other surgical subspecialties	9 (5%)	15 (13%)	0.020
Other surgical subspecialties no. visits	16	24	
Any surgical outpatient visits	105 (59%)	91 (76%)	0.002
Total no. surgical subspecialty visits	556	666	

Data Collection

Demographic, injury, hospital, and follow up data were obtained from the patient's electronic medical record. Demographic and injury data include age, sex, race, ethnicity, and mechanism of injury. Hospital data include ICU length of stay, hospital length of stay, and discharge disposition. Follow-up data consist of the number of visits by specialty, utilization of the ED, and surgical operations. The primary outcome of interest was follow-up within the hospital system. Secondary outcomes include specialty-specific follow-up, ED usage, and postdischarge surgical procedures. Data were collected using REDCap.[9,10]

Statistical Analysis

Statistical analysis was completed using IBM SPSS Statistics for Windows version 28.0 (IBM Corp, Armonk, NY). Continuous variables are expressed as means and SD. Means were compared using independent *t* tests. Categorical variables are reported as numbers with percentages. Categorical proportions were compared using χ^2 analyses. *p* Values of <0.05 were considered significant.

The PRE and CTS cohorts were compared with each other using the aforementioned statistical analyses. The CTS cohort

TABLE 4. Emergency Department Utilization

Characteristic	PRE (n = 177)	CTS (n = 119)	*p*
RTER 0–6 mo, n (%)	47 (27%)	46 (39%)	0.028
RTER no. visits 0–6 mo	91	90	
% RTER subsequently admitted 0–6 mo, n (%)	20 (43%)	23 (50%)	0.471
RTER 6–12 mo, n (%)	21 (12%)	14 (12%)	0.979
RTER no. visits 6–12 mo	34	21	
% RTER subsequently admitted 6–12 mo, n (%)	5 (24%)	4 (29%)	0.752

RTER, return to emergency room.

was further separated into two separate subgroups. One subgroup includes the patients who followed up in the CTS, and the other includes the patients invited to follow up in the CTS but did not. These groups were similarly compared.

RESULTS

Study Population

There were 177 patients meeting CTS eligibility criteria in the PRE cohort. There were 119 patients who met the criteria in the CTS group. The PRE and CTS cohorts were similar in age, sex, race, ethnicity, mechanism of injury, and ICU and hospital lengths of stay (Table 1). In both cohorts, the average age was 45 years, and patients were majority male, Black, and non-Hispanic with a blunt mechanism of injury. The patients spent an average of 2 weeks in the ICU and 4 weeks in the hospital. Discharge destination was significantly different between the two cohorts

TABLE 5. Demographics Within CTS Eligible Cohort

Characteristic	CTS Follow-up (n = 74)	CTS No Follow-up (n = 45)	*p*
Age, mean (SD), y	43 (17)	48 (19)	0.105
Sex, n (%)			0.270
Male	62 (84)	34 (76)	
Female	12 (16)	11 (24)	
Race, n (%)			0.868
Black	36 (49)	21 (47)	
White	15 (20)	8 (18)	
Other/unknown	23 (31)	16 (36)	
Ethnicity, n (%)			0.787
Hispanic	21 (28)	14 (31)	
Non-Hispanic	52 (70)	31 (69)	
Unknown	1 (1)	0	
Mechanism of injury, n (%)			0.100
Blunt	59 (80)	41 (91)	
Penetrating	15 (20)	4 (9)	
ICU LOS, mean (SD)	16 (14)	12 (11)	0.114
Hospital LOS, mean (SD)	29 (20)	27 (20)	0.653
Discharge destination, n (%)			0.902
Home	26 (35)	15 (33)	
Acute rehab	31 (42)	18 (40)	
Subacute rehab/long-term care	17 (23)	12 (27)	

LOS, length of stay.

TABLE 6. Follow-up Visits Within CTS Eligible Cohort

Characteristic	CTS Follow-up (n = 74)	CTS No Follow-up (n = 45)	*p*
Follow-up with nontrauma outpatient providers, n (%)	61 (82)	33 (74)	0.237
Total no. all nontrauma outpatient visits	569	232	
Surgical provider outpatient follow-up, n (%)	57 (77)	33 (73)	0.649
Total no. outpatient surgical visits	457	204	
Medical provider outpatient follow-up, n (%)	29 (39)	10 (22)	0.056
Total no. outpatient medical visits	112	28	
Postdischarge surgery, n (%)	31 (42)	8 (18)	0.007
Total no. postdischarge surgeries	49	11	

with more patients discharged to rehabilitation facilities in the CTS group compared with the PRE group ($p = 0.02$).

PRE Compared With CTS

A significantly higher proportion of patients followed up within the health system in the CTS cohort compared with the PRE cohort (91% vs. 73%, $p < 0.001$) (Table 2). This resulted in 1,280 outpatient visits or an average of 12 visits per patient in the CTS group compared with 1,006 visits or an average of 8 visits per patient in the PRE group. Similarly, there was more than a 50% increase in the rate of follow-up within the trauma department, with the CTS patients following up in the CTS and the PRE patients following up in trauma clinic (62% vs. 39%, $p < 0.001$). There was also a significant increase in follow-up with other outpatient providers. When separated into medical and surgical providers, only follow-up with surgical specialties remained significant, and there was no significant difference in follow-up for medical providers. A higher proportion of patients in the CTS group had surgeries performed after discharge compared with the PRE cohort (33% vs. 20%, $p = 0.011$).

In the patients following up with surgical providers, the CTS cohort averaged more follow-up visits per patient compared with the PRE cohort (seven vs. five visits). The specialties with the most outpatient visits were orthopedic surgery, plastic surgery, and neurosurgery (Table 3). The proportion of patients following up with orthopedic surgery and other surgical subspecialties was significantly higher in the CTS cohort. There were no other significant differences in the rates of the remaining surgical subspecialty follow-ups.

Emergency department utilization after discharge was significantly higher in the CTS cohort in the first 6 months after discharge (39% vs. 27%, $p = 0.028$) but similar in the 6 to 12 months after discharge (12% vs. 12%, $p = 0.979$) (Table 4). The PRE cohort averaged 1.9 visits per patient returning to the ED in the first 6 months, and the CTS averaged 2.0. In the 6 to 12 months postdischarge, the PRE cohort averaged 1.6 ED visits per patient, and the CTS cohort averaged 1.5 ED visits per patient. There was no significant difference in the percentage of patients in either cohort that required admission.

CTS Subgroups Compared

There were no statistically significant differences in age, sex, race, ethnicity, mechanism of injury, and discharge destination within the CTS cohort in the patients who were seen in the

CTS and those who were eligible but did not follow up (Table 5). The patients seen in the CTS averaged eight outpatients visit per patient with nontrauma outpatient providers, while those not seen in the CTS averaged five outpatient visits per patient. However, the proportion of patients seen by other nontrauma providers was not significantly different between the two groups (Table 6). This was still not significantly different when separated into medical and surgical providers. The subgroup of the CTS cohort that was seen in the CTS did have significant higher proportion of outpatient surgeries (42% vs. 18%, $p = 0.007$). There was no significant difference in the percent of patients returning to the ED in the first 6 months (39% vs. 38%, $p = 0.878$) or the second 6 months (9% vs. 16%, $p = 0.317$) after discharge between the CTS cohort subgroups.

DISCUSSION

The primary outcome of this study was that patients in the CTS cohort followed up at a higher rate and received more robust services than the historical cohort of patients. Trauma patients are a unique patient population with a high risk of being lost to follow-up. Follow-up rates at urban level I trauma centers have been reported to be as low as 31%.[4] Similarly, within our institution, follow-up in the trauma clinic was only 39%, and any follow-up within the system was only 73%. In the CTS cohort, follow-up rates increased to 62% within the trauma department and 91% within the hospital system.

The literature is sparse on programs like the CTS. Some similar programs have been found to be beneficial in improving follow-up rates in trauma patients. One such program is a local access to care program. This program significantly improved scheduling and complying with follow-up appointments.[11] Another program designed to target trauma survivors at high risk for posttraumatic stress disorder or chronic pain also demonstrated increased follow-up.[7] Improving follow-up rates can improve patient care. This should be a goal for all trauma centers, and similar programs should become standard practice.

While there was no significant difference in follow-up with medical providers, there was a significant increase in follow-up with surgical subspecialty providers. Given the extensive injury burden our trauma patients face, this is not surprising but is an important outcome. This resulted in many more outpatient surgical visits and a higher proportion of patients having surgeries subsequently performed. Because these later surgeries are likely necessary for improving functional outcome, another way to interpret these data is that there may be patients in the PRE group who did not receive important surgical care.

The rate of CTS engagement was lower than previously reported and lower than our target benchmark of 80%.[3] In evaluating the charts, it appears that the pandemic and decreased access to the center prior to being able to deliver reliable telehealth was a likely factor. Reduction in trauma volume during the same time period also resulted in the overall decrease in eligible numbers of patients. It was interesting that, when we analyzed the CTS cohort into two subgroups, those who specifically followed up in the CTS and those who did not, there was no significant difference in overall rates of outpatient follow-up. The rate of follow-up only includes physical or official telehealth visits. Because communication by email, text, or phone to the CTS staff was the only way to follow patients for several months during the pandemic, the lack of significant difference is likely due to an underestimation of the overall number of contacts. The rate of follow-up in the CTS eligible but not followed up group was also significantly higher than the PRE cohort. We believe that this is due to several factors. First, the CTS team approaches patients and families multiple times during the initial hospitalization. It is possible that just having a team of providers offer services may have improved the sense of abandonment we previously reported and overall increased follow-up. Second, starting this program may have had an umbrella effect resulting in an overall increased emphasis on follow-up. Of note, the patients treated in the CTS clinic within the CTS group did have increased rates of outpatient surgeries and a higher number of follow-up visits per patient than those not seen in the CTS. Thus, being seen in the CTS likely increased overall patient participation and longer-term retention within the health system. It should also be recognized that these data do not include mental health evaluations and visits, which were only given to those patients who were followed by the CTS.

A study by Taheri et al.[12] in 2007 demonstrated that trauma services result in substantial downstream revenue for the hospital system. They also concluded that services to care for injured patients contribute to financial strength.[12] While our study did not evaluate the financial impact of the CTS, it is a logical conclusion that more services and surgeries will have a beneficial effect on revenue. Additional studies on this and other similar programs are required to evaluate the actual financial impact on a hospital system's downstream revenue through improved patient follow-up and retention.

We demonstrated that there was an increase in ED utilization in the CTS cohort initially, but ED utilization became similar between the two groups following the first 6 months. While it seems that ED utilization should decrease with improved outpatient follow up, this finding has been reported previously. A study by Dalton et al.[13] at a nearby urban level I trauma center similarly found that increased follow-up in the trauma clinic did not decrease ED utilization. Another study by Abou-Hanna et al.[14] also demonstrated that scheduled outpatient follow-up independently predicted return to the ED. It is possible that providing CTS services makes patients and caregivers more likely to seek follow-up care at the trauma center rather than a different facility. These data did not examine the specifics and the reasons for ED follow-up. It is also possible that there are substantial qualitative differences in the need for ED services. It should be noted that there was no significant difference in the utilization of the ED in the CTS subgroup comparison. Given the severity of injury, unplanned returns to the ED may not be surprising and may not be an appropriate metric for assessment of quality of care. Further studies are needed to truly understand ED utilization following trauma center discharge.

Limitations

There are several limitations to our study. First, this is a single-site study in a center committed to the program and its philosophy. While this may limit its external validity, the authors believe that the concept is both valid and necessary. Comparable programs in other level I trauma centers have had similar results.[7,11] This study also occurred during the height

of the COVID-19 pandemic with the disruption of health care delivery. There were several months where we had neither in-person nor telehealth outpatient visits. These issues may have impacted our follow-up rates and our ED usage. We also did not directly evaluate patient outcomes but merely focused on delivery of care. Our previously published research focuses on patient and family abandonment and that was not reevaluated here. We believe that improving rates on follow up is one of many steps to improving that feeling and plan to study it more in the future. Another limitation to our study is the possibility of unmeasured differences between the PRE and CTS cohorts. While demographics and degree of injury were similar, there were differences in discharge disposition. This factor is largely based on insurance status, which may be proxy for other socioeconomic factors that drive follow-up. Although unlikely in our safety net institution, this possible difference in insurance coverage could possibly account for more follow-up surgery. However, while the potential sampling bias may explain some of the observed difference in the PRE versus CTS cohort, we still believe that much of the improved follow-up and secondary surgery is likely due to the effect and efforts of the CTS. Furthermore, the presentation of the CTS to patients and families is not standardized. The group inviting patients and families to join the CTS is small, dedicated, and personalized. Especially compared with the impersonal mountain of electronic medical record paperwork that PRE patients received upon discharged. This fact alone could explain the increased tendency of the entire group to follow up compared with the PRE cohort. Although this would be an unintended outcome of the CTS recruitment process, it would certainly be beneficial to patients, families, and the health system. This personalized service could also explain the less than 10% loss to follow-up in the CTS cohort. This study did not include the delivery of behavioral services in our analysis, which is also a big focus of our CTS services and may have influenced overall follow-up and patient satisfaction. These data were beyond the scope of this study and will be evaluated in future analysis. Lastly, this study was not intended to be a comprehensive evaluation of the financial impact of the CTS. It stands to reason that increasing follow-up with appointments and postdischarge surgeries would generate revenue within the health system.

CONCLUSION

The primary outcome of many trauma studies is death. Even as providers, we often think extreme satisfaction when trauma patients are "saved" or discharged alive. Survival alone is not enough of a measure of success of a trauma center.[15] The goal of trauma care is not just decreasing death but enhancing survivorship. The CTS fills the void to improve survivorship of severely injured trauma patients. The CTS increases patient follow-up within the health system, which improves postdischarge care, and in return can provide revenue to the health system.

AUTHORSHIP

C.G. and D.H.L. contributed in the literature search, data analysis, and interpretation. C.G. and D.S. contributed in the data collection. All authors contributed in the study design and critical revision.

DISCLOSURE

The authors declare no conflicts of interest.

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