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Rate of Nonsurgical Admissions at a Level 1 Trauma Center: Impact of a Trauma Nurse Practitioner Model

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ABSTRACT

The American College of Surgeons (ACS) mandates all trauma centers conduct individual case reviews of nonsurgical admissions when rates of allocation to this service exceed 10% of all inpatient traumas. Nonsurgical admission rates at the study institution, which is a Level I trauma center, historically exceeded this ACS criterion. In an effort to decrease nonsurgical admissions, the study institution recruited trauma nurse practitioners (TNPs) who began managing low acuity patients with oversight from trauma attending physicians. This study examines the impact of TNPs on the rate of nonsurgical admissions. A retrospective cohort study was conducted with 1,400 patients between January 2017 and October 2018. Two cohorts examined in this study included trauma patients whose care was managed by the TNPs versus those admitted under the care of hospitalists. The rate of admission to nonsurgical services (NSS) was 19.6% in 2017 and 13.9% in 2018, which yielded a significant decrease from previous years' percentages ($p < .001$). The average hospital length of stay was 1.17 days shorter in the TNP group, which translated into a savings of approximately $876,330 in hospital charges for the study period. Additional significant findings noted in favor of the TNP cohort were for discharge orders placed prior to noon, discharge location, and reduced time to the operating room. This TNP model proved to be successful in significantly reducing admissions to NSS and substantiated the quality of patient care provided by TNPs. Hospitals struggling to meet the ACS criterion for NSS admissions may consider implementing a similar TNP model.

Key Words

Nonsurgical admissions, Nurse practitioner, Outcomes, Trauma

The American College of Surgeons' (ACS) Resources for Optimal Care of the Injured Patient outline guidelines to ensure the availability of optimal resources for the provision of patient care at trauma centers (Committee on Trauma, ACS, 2014). The resources statement mentions that trauma patients admitted to Levels I and II sustaining severe injuries should be admitted or evaluated by a surgical service that includes certified trauma providers. The ACS mandates that trauma centers conduct individual case reviews of nonsurgical admissions when rates of allocation to this service exceed 10% of all inpatient traumas.

Nonsurgical admission rates at the study institution, which is a Level 1 trauma center, had historically exceeded this ACS criterion. From 2014 to 2016, the annual nonsurgical admission rates were 26.8%, 23.5%, and 20.5%, respectively. These rates led to the inception and evolution of the institution's current trauma nurse practitioner (TNP) model. Trauma services had employed TNPs for more than a decade; however, to decrease patient admissions to nonsurgical services, additional staff members were hired, and TNPs started managing low acuity patients with oversight from trauma attending physicians. Low acuity patients are those who present with stable comorbidities and have sustained single-system injuries.

Approval from the trauma attending physicians is mandatory for TNPs to manage this patient population. The TNPs are not an independent service but rather a component of trauma services. The volume of patients managed by TNPs varies with the time of the year, with summer

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Author Contributions: Jessica Hardway, DNP, APRN, FNP-C, assisted with conceptualization of the study, provided oversight for manuscript writing, and was involved in writing and critical revision of the manuscript; Damayanti Samanta, MS, organized data collection, conducted data analysis, and was involved in writing and revision of the manuscript; Kelly Jo Evans, BSN, RN, TCRN, assisted with conceptualization of the study and reviewing the study manuscript; and Audis Bethea, PharmD, BCPS, BCCP, assisted with conceptualization of the study and provided oversight for study design and data analysis.

The authors no conflict of interest to report.

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DOI: 10.1097/JTN.0000000000000506

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being the most active period. The patient to provider ratio is dependent on the rate of patient admissions as well as the number of TNPs working. Higher acuity patients, including Priority I and II patients, are also admitted under the trauma attending physicians but are managed by surgical residents. Trauma services staffed seven full-time TNPs by 2017 along with a fully staffed surgical resident rotation per month. On average, the TNP group has 2 years of nurse practitioner (NP) experience and 11 years of trauma experience.

Previous publications have cited the increasing role of NPs as an impetus to focus research on examining their work as it pertains to outcomes associated with the provision of patient care (Gardner et al., 2010). In addition, measurement of outcomes in health care has become increasingly imperative as federal and state regulatory organizations, institutions, and employers advocate for quality health care with a focus on patient outcomes and efficiency. These end points are monitored not only to evaluate performance but also to act in accordance with accreditation and certification requirements. As NPs' role expands in the provision of patient care in a hospital setting, the measurement of their quality of care becomes an essential component of performance evaluation (Kapu & Kleinpell, 2013).

To the best of authors' knowledge, no studies have compared patient outcomes between hospitalist and NP service lines in a trauma setting. Accordingly, this study endeavors to compare morbidity and mortality outcomes in trauma patients admitted under the care of TNPs versus hospitalists and examine the impact of the TNP model on the allocation of patients to hospitalist services.

PURPOSE

To evaluate annual nonsurgical admissions rate following full implementation of the TNP model, which focused on providing provision of care to low acuity patients. In addition, the study endeavors to compare patient outcomes between the TNP and hospitalist service lines.

RESEARCH QUESTIONS/HYPOTHESIS

Patient allocation rate to nonsurgical services will significantly decline following full implementation of the TNP model.

METHODS

This is a retrospective cohort study conducted at a Level I trauma center in Charleston, WV, which provides services to southwestern West Virginia and areas of bordering states including Ohio, Virginia, and Kentucky. Patients included in this study sustained traumatic injury and presented at the Level I trauma center between January 2017 and October 2018.

Two cohorts examined in this study included trauma patients whose care was managed by the TNPs versus those admitted under the care of hospitalists. Patients transferred to other service lines following admission to the TNP or hospitalist group were excluded from the study to make sure that patients were exclusively managed by these service lines. Patients admitted to the hospitalist group who had to be transferred to the intensive care unit (ICU) were also excluded as these patients were perceived to be more severe than patients managed by the TNP service.

Following approval from the institution's review board, data were obtained from the institution's trauma registry. Baseline patient characteristics included age, injury severity score, gender, comorbidities, admission injuries, and surgical procedures. Additional variables addressed in this study included outcome end points of hospital length of stay (LOS), in-hospital mortality, discharge orders placed before noon, discharge locations (home and skilled nursing facility [SNF]), missed injury, 30-day readmission, time to the operating room (OR) from admission, and complications (categorized by organ systems). The rates of nonsurgical admissions were also collected for 3 years prior to and during the study period (January 2014 to October 2018).

Data analysis was conducted with IBM-SPSS 22.0 (IBM Corp, Armonk, NY). Descriptive statistics were computed for each variable to describe the patient population. Means and standard deviations were conducted for continuous variables, whereas proportions and frequencies were reported for categorical variables. Continuous variables were compared using independent t tests or Mann–Whitney U tests, and categorical variables were compared using the chi-square or Fisher exact test. Study outcome variables were analyzed with analysis of covariance or binary logistic regression adjusting for differences in patient baseline characteristics. Significance was reported at a level of $p \leq .05$.

RESULTS

There were 749 patients admitted to the TNP group and 651 to the hospitalist group during the study period. The number of admissions for each group was 237 and 433 in 2017 and 512 and 218 in 2018 for the TNP and hospitalist services, respectively. These numbers correlated with an overall nonsurgical admissions rate of 19.6% in 2017 and 13.9% in 2018. From January 2014 to October 2018, there was a significant downward trend in nonsurgical admissions ($p < .001$) (Figure 1).

Patients in the TNP group were significantly younger (58.65 vs. 76.20, $p < .001$) and more likely to be male (40.6% vs. 32.7%, $p = .002$) than those in the hospitalist group. The average number of preexisting conditions was significantly lower in patients under the care of TNPs

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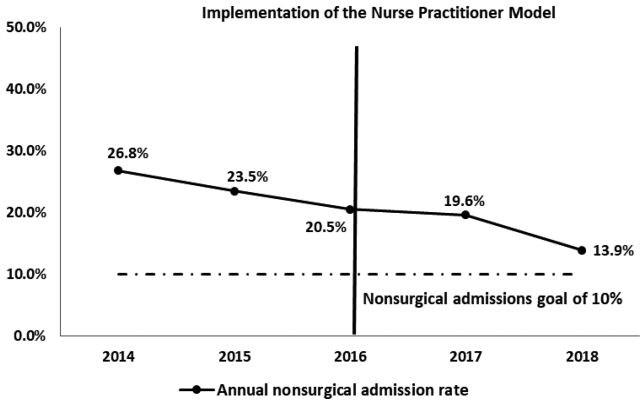

Figure 1. Annual nonsurgical admissions rate.

(1.55 vs. 2.03, $p < .001$). However, the average number of injuries present upon admission (1.64 vs. 1.24, $p < .001$) and the proportion of patients requiring surgical intervention (72.4% vs. 61.3%, $p < .001$) were significantly higher for the TNP group. In the subset of patients who received surgical intervention, the average number of performed procedures was comparable between both groups (1.02 vs. 1.03, $p = .658$) (Table 1).

Differences in patients' baseline characteristics were accounted for by using multivariate analyses of study outcomes. The duration of hospital LOS was significantly lower for patients under the care of TNPs (4.80 vs. 5.97, $p = .006$). The difference in hospital LOS of 1.17 days translated into a decrease in hospital charges of approximately $876,330 for the study period. This calculation was made on an estimate based on hospital LOS. Hospital discharge data revealed that TNPs placed a significantly higher percentage of discharge orders prior to noon (68.6% vs. 36.7%, $p < .001$). Trauma nurse practitioners also discharged a significantly higher proportion of their patients home (68.8% vs. 41.8%, $p < .001$), whereas a lower percentage was discharged to SNF (23.0% vs. 47.6%, $p < .001$). With regard to patients undergoing surgical procedures, time to OR was significantly shorter in the TNP cohort (17.86 vs. 28.86, $p < .001$) (Table 2).

Examination of additional outcomes of in-hospital mortality and 30-day readmission did not differ significantly between the two groups (Table 2). There was only one patient in the study with reported missed injuries; this patient was managed by the hospitalist service. A comparison of postadmission complications revealed a significantly higher rate of hematological complications (anemia and acute blood loss) (8.5% vs. 0.9%, $p < .001$) in the TNP group; however, all additional complications were comparable between the study groups (Table 3). Of those patients having hematological complications, 78.6% received a blood transfusion.

DISCUSSIONS

The NP position was developed to address areas of unmet health care needs. They were originally intended to provide primary care but then expanded into the hospital setting with various specialty roles (Taylor & Staruchowicz, 2012). Nurse practitioners have played a progressively important role in administering high-quality patient care. Existing literature well documents the role of TNPs related to positive patient outcomes including hospital LOS, ICU LOS, time to place rehabilitation consult, missed injuries, and hospitals charges (Bethea, Samanta, White, Payne, & Hardway, 2019; Collins et al., 2014; Holliday, Samanta, Budinger, Hardway, & Bethea, 2017; Sise et al., 2011). Nurse practitioners provide high-quality, safe, and effective care to large patient populations in diverse settings. They have a significant role in promoting health

TABLE 1 Baseline Patient Characteristics

	TNP Service	Hospitalist Service	
	N = 749	*N* = 651	*p*
Age	58.65 ± 22.8	76.20 ± 14.07	**<.001**
Injury Severity Score	6.76 ± 3.03	6.84 ± 3.05	.629
Gender (male)	304 (40.6%)	213 (32.7%)	**.002**
Average no. of comorbidities	1.55 ± 1.23	2.03 ± 1.13	**<.001**
Average no. of injuries	1.64 ± 0.85	1.24 ± 0.53	**<.001**
Rate of surgical procedures	542 (72.4%)	399 (61.3%)	**<.001**
	***N* = 542**	***N* = 399**	
Average no. of procedures	1.02 ± 0.17	1.03 ± 0.20	.658

Note. TPN = trauma nurse practitioner. Bold face indicates statistical significance p ≤ .05.

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TABLE 2 Study Outcomes

	TNP Service	Hospitalist Service	
	N = 749)	*N* = 651	*p*
Hospital length of stay, days	4.80 ± 3.24	5.97 ± 3.59	**.006**
In-hospital mortality	2 (0.3%)	0 (0.0%)	.989
Discharge order before noon	514 (68.6%)	239 (36.7%)	**<.001**
Discharge location			
Home	515 (68.8%)	272 (41.8%)	**<.001**
Skilled nursing facility	172 (23.0%)	310 (47.6%)	**<.001**
30-day readmission	4 (0.5%)	2 (0.3%)	.389
	***N* = 542**	***N* = 399**	
Time to surgical procedure, hr	17.86 ± 16.65	28.86 ± 37.90	**<.001**

Note. TPN = trauma nurse practitioner. Bold face indicates statistical significance p ≤ .05.

practices. Future models will benefit by utilizing the ever-increasing number of NPs (Gillard et al., 2011; Johal & Dodd, 2017; Morris et al., 2012).

The study institution capitalized on this opportunity by expanding its TNP service model. By 2017, the department housed seven TNPs responsible for managing low acuity patients with oversight from the attending physicians. Following the implementation of this model, a significant decrease was noted in the nonsurgical admissions rate. Although the study institution has not met the ACS criteria of less than 10% of nonsurgical admissions, it has made encouraging progress toward reaching the goal. Reduction in nonsurgical admission rates appears to be possible due to TNPs managing trauma patients under their service. As the patient population managed under the TNP service continued to grow, it was crucial to evaluate morbidity and mortality outcomes in their patients.

Accordingly, outcomes in patients admitted under the TNP service were compared with those of the hospitalist service. Positive outcomes in favor of the TNP cohort was noted for hospital LOS, time to OR, discharge order placed before noon, and discharge locations. All of these outcomes are valuable to the hospital and its

TABLE 3 Outcome of In-Hospital Complications

	TNP Service	Hospitalist Service	
Complications	*N* = 749	*N* = 651	*p*
Hematological	64 (8.5%)	6 (0.9%)	**<.001**
Acute kidney injury	3 (0.4%)	7 (1.1%)	.397
Cardiovascular	20 (2.7%)	23 (3.5%)	.764
Infection	9 (1.2%)	15 (2.3%)	.743
Venous thromboembolism	2 (0.3%)	0 (0.0%)	.991
Pulmonary	4 (0.5%)	5 (0.8%)	.464
Genitourinary	4 (0.5%)	1 (0.2%)	.213
Musculoskeletal and integumentary	1 (0.1%)	0 (0.0%)	.989
Substance withdrawal	2 (0.3%)	0 (0.0%)	.990
Gastrointestinal	0 (0.0%)	1 (0.2%)	.997
Neurological	1 (0.1%)	0 (0.0%)	.982

Note. TPN = trauma nurse practitioner. Bold face indicates statistical significance p ≤ .05.

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resources. Reduction in hospital LOS equated to a savings of $876,330 for the study period. Similarly, in comparison with hospitalists, TNPs discharged almost twice the number of patients early in the day, thus assisting with patient flow. Focusing on a discharge plan early in the admission can help save costs by concentrating on the safest and best option for the patient. Trauma nurse practitioners also sent a lower proportion of patients to SNF, which reduced the long wait times for beds to become available at those facilities. In addition, the average time to OR for TNP patients was approximately 11 hr shorter than patients managed by the hospitalists, consequently, leading to shorter hospital LOS and economization of resources.

The positive outcomes in the TNP patient population warrant comparison of these two service lines to understand operational differences between them at the study institution. Lome, Stalnaker, Carlson, Kline, and Sise (2010) mention that NPs use a holistic approach relying on effective communication, attention to details, and flexibility. Trauma nurse practitioners manage trauma patients, perform daily assessments, discharge patients, consult specialists, coordinate health care team members, round on all trauma patients, talk to families, educate patients and families, follow up patients in the clinic, and assist in the care of patients covered by residents while all under the supervision of trauma attending physicians (Lome et al., 2010). Trauma nurse practitioners at the study institution also work as a collaborative group, dividing patient responsibilities and conquering daily tasks. There are a minimum of two to three TNPs scheduled Monday–Friday during the day (7 a.m.–5 p.m.), with one TNP covering from 5 p.m. to 11 p.m. Between 11 p.m. and 7 a.m., the patients are presented by the emergency department (ED) provider to the trauma attending physicians who accept or decline admissions to trauma services. Admission orders are placed by the ED providers with the history and physical examination being completed by the TNP coming on to service at 7 a.m. At the time of the study, there was only one TNP available in the hospital during the weekend covering from 7 a.m. to 5 p.m. It is beneficial to have multiple TNPs available during the day for patient care. Currently, the TNP model consists of multiple rotating shifts for 24/7 coverage. Admissions can now be completed at night by the TNPs.

The continuum of trauma care in the TNP service line is maintained by effective teamwork. When one is not available, the others monitor or complete tasks for patients assigned to their other partners. Because of multiple TNPs working simultaneously, it makes it easier for staff to get quicker results to questions or to have a provider to come to bedside to evaluate patients.

Trauma nurse practitioners are consistent and comprehensive in patient charting including the documentation of diagnoses (e.g., abnormal laboratory work and abnormal vital signs) and plans. This could perhaps explain the higher proportion of hematological complications in patients admitted under the TNP service. Another potential source for this complication is that a higher percentage of patients in the TNP group required operative fixation. However, patients in the TNP service had an earlier time to OR, which could be attributed to using Goldman Cardiac Risk Index for noncardiac surgeries as well as collaborating with cardiology on a patient-by-patient basis.

As mentioned by Crawford (2019), TNPs are an unwavering part of the trauma team. Although there are many different types of NPs, the TNPs used by the study institution are all credentialed and board certified family NPs with further certifications in Advanced Trauma Life Support (ATLS), Trauma Nursing Core Course, Advanced Cardiac Life Support, Basic Life Support, and Pediatric Advanced Life Support. These certifications are completed during the first year of hire and then maintained accordingly. With all being family NPs, they are all trained and educated in family medicine that is useful in managing medical problems that arise in their patients. Hospitalists are not required to hold a certification in ATLS and formal trauma training for hospitalists is not a requirement. However, they may seek to have it for their own personal knowledge.

The hospitalist group manages medical patients and some trauma patients and typically have NPs and/or physician assistants (PAs) working with the physicians. The hospitalist group at the study institution is more of an attending-driven service and there is little autonomy for their NPs or PAs. Hospitalists usually see their patients daily by themselves despite being seen by NPs or PAs. This reduces hospitalists' available time and does not allow them to fully utilize the resources at their disposal. The TNPs are more independent and are utilized in a different manner. Trauma attending physicians do not see the patients daily unless they are in step-down unit status. Patients are seen with the attending on the day of admission, day of discharge, every third day, or if there is any change of condition or at the request of the TNP. Patient rounds involve the trauma attending, residents on service, and a case manager if available. Trauma attending physicians are updated on changes in patient status, but the individual care plans are devised by the TNPs. This flexibility, as well as role autonomy, is credited with their success in patient care.

Furthermore, TNPs at the study institution have a specific trauma floor and a trauma step-down unit in which they provide care for their patients. The trauma floor and the step-down unit are staffed with trauma nurses, a full-time case manager, a social worker, physical/occupational therapists, and the trauma floor nurse

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manager assigned to the trauma floor. A pharmacist is also available in the trauma ICU and on the floor who is knowledgeable of the trauma patient population and is a great resource in providing patient care. The hospitalist group does not have a specific floor, and trauma patients allocated under their service usually do not get admitted to the trauma floor but elsewhere in the hospital. This implies the team taking care of them may not be trauma trained. On the trauma floor, however, the consistent presence of a trauma team allows for more accessible and prompt communication concerning the plan of care between consultants and other staff. Daily discharge planning also occurs in the morning attended by bedside nurses, managers, case coordinators, social workers, and TNPs to discuss patients' needs.

The trauma floor typically achieves effective communication with regard to patients and their needs. This is largely due to having a social worker assigned to the trauma floor. Patients sustaining traumatic injuries may also have many social work needs that need to be addressed. Social workers are part of the interdisciplinary medical team that provides a variety of services including social, emotional, and economic needs (Moore et al., 2016). A study by the National Association of Social Workers (2011) highlighted that hospital social workers have to serve patients with a variety of conditions crossing the entire health care gamut. Social workers can be specialized within a hospital, and one specialty is trauma. Hospitalists work with many social workers depending on the admission location of their patients. Trauma nurse practitioners, however, work with one social worker unless their patients overflow to other floors. This allows for a stable relationship, therefore opening the door for better communication about patients' needs.

CONCLUSIONS

With the expansion of the TNP model, the rate of nonsurgical admissions significantly declined. Although the study institution has not yet managed to reach the ACS criterion of less than 10% admission to a nonsurgical service, it has made significant progress toward achieving this target. As TNPs started managing higher numbers of patients under their care, it became crucial as well to evaluate their patient outcomes. Findings from the current study establish positive outcomes in favor of the TNP group with regard to hospital LOS, early discharge, discharge location, and admission time to OR. These outcomes allow for cost-reduction opportunities for the study institution without compromising health care quality and patient outcomes. Moreover, findings from the current study add novel data to the literature as the existing studies have typically compared hospitalists with the conventional trauma attending service. This study also delineates operational differences between the TNP and hospitalist service lines, which could potentially explain the differences established in patient outcomes. Moving forward, trauma centers struggling to meet the ACS nonsurgical admission rate criterion may benefit by implementing a similar TNP model.

LIMITATIONS

Although the study substantiated the quality of care provided by TNPs, it is not without limitations. The retrospective nature of the study design inherently introduces the potential for selection bias. In addition, the utility of evaluated data depends on the accuracy with which events that occurred in the past were recorded. This serves to significantly limit researchers' ability to practice quality control with the data. Moreover, patients managed by the hospitalist service lacks a dedicated nursing floor in contrast to the TNP group. Diversity in the patient setting could impact outcomes.

KEY POINTS

- Findings from the current study substantiate the positive impact of the TNP service on nonsurgical admissions and patient outcomes.
- The study delineates operational differences between the TNP and hospitalist services in a Level 1 trauma setting.
- Other trauma centers struggling to meet the ACS criterion of less than 10% of nonsurgical admissions of all inpatient traumas may benefit by implementing a similar NP model.

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DOI: 10.1097/JTN.0000000000000511

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