RESEARCH

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An Outcome Analysis of Nurse Practitioners in Acute Care Trauma Services

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ABSTRACT

The department of trauma at a Level 1 trauma center sought to improve outcomes by enhancing the continuity of care for patients admitted to trauma services. Departmental leadership explored opportunities to improve this aspect of patient care through expansion of existing trauma nurse practitioner (NP) services. The restructured trauma NP service model was implemented in September 2013. A retrospective study was conducted with patients who presented at the trauma center between September 2012 and August 2015. Patients with at least a 24-hr hospital length of stay (LOS) were separated into 3 comparator groups by 12-month increments: 12 months pre-, 12 months during, and 12 months postimplementation. Data revealed improvement in hospital LOS, intensive care unit LOS, time to place rehabilitation consultation, and placement of discharge orders before noon. A significant decline in the rate of complications including pneumonia and deep vein thrombosis (DVT) was also noted. Accordingly, expansion of the trauma NP model resulted in significant improvements in patient and process of care outcomes. This model for NP services may prove to be beneficial for acute care settings at other hospitals with high volume trauma services.

Key Words

Nurse practitioner, Outcomes, Trauma

BACKGROUND

Within the last 20 years, hospitals are increasingly relying on advanced practice nurses to meet the demands of patient care (Morris et al., 2012). According to the American Association of Nurse Practitioners ("NP Fact Sheet," 2017), there are more than 222,000 licensed nurse practitioners (NP) in the United States. The number of NPs has escalated because of legislative amendments that sanctioned an expanded scope of practice for NPs. In addition, limitations on resident work hours, shortage of physicians, optimization of human and capital resources, and the growing and changing patient population have further influenced this increase (Morris et al., 2012; Rejtar, Ranstrom, & Allcox, 2017; Sise et al., 2011). The role of NPs has also evolved over time as they have transitioned from the realm of primary care to becoming an integral part of the provision of acute care services (Resler, Hackworth, Mayo, & Rouse, 2014).

Nurse practitioners are considered to be an economical and practical approach in coordinating patient care in many trauma services (Collins et al., 2014). Trauma care is affected by high costs associated with severe injuries and an increasing number of patients without adequate insurance coverage. Rapid flow of patients through a trauma system is critical to operational efficiency (Dutton et al., 2003). Charleston Area Medical Center, a 821-bed tertiary care center in West Virginia, provides Level 1 trauma services to southwestern West Virginia and areas of bordering states. In an attempt to improve outcomes through enhancing the continuity of care for patients admitted to trauma services, the department of trauma explored opportunities to expand existing trauma NP services. Efforts focused on processes that would augment

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continuity for patients as they transitioned through various levels of care during their respective hospitalization. The original NP model had 2 full-time NPs and focused primarily on providing care through the expedition of discharges. The expansion of services required strategically positioning NPs in multiple patient care settings, facilitating their involvement globally throughout all components of patients' admission, including intensive care unit (ICU), floor, and post–acute clinic visits.

The revised trauma NP service model was implemented in September 2013. Services were expanded to meet identified needs and address perceived areas of weakness within the current structure of the institution's trauma services. Accomplishing this task required NP services to establish a presence and practice in several new venues. The NPs became a daily participant in multidisciplinary rounds in the ICU, which served to provide a consistent team member presence as patients transitioned from the ICU to the floor. Under the supervision of an attending surgeon, the NP team also began managing stable, noncritical traumas to improve continuity and progression of care in this subpopulation of trauma patients. In addition, a NP clinic was also created to promote continuity and follow-up for these patients after their acute phase of care. To aid in maintaining the integrity of patients' care, the resident service team provided support to the NP efforts on an as needed basis while the trauma attending performed bedside rounds with the NPs on a daily basis. The evolution of the NP service required expansion of the team from two to five full-time NPs. The three additional NPs were hired at different time points within a period of 1 year from September 2013. The original service model provided inhospital coverage Monday to Friday; however, under the new model, NPs provide inhospital service coverage 7 days a week. Moving forward, the aim was to sustain the current service and expand provider numbers into the future.

PURPOSE

With the institution's commitment to significant expansion of the NP service, it was crucial to quantify its impact on patient care. The current study endeavored to comprehensively assess trends in outcomes of patients admitted to trauma services over a period of 3 years that included a year prior to, a year during, and a year post-implementation of the NP service model.

RESEARCH HYPOTHESIS

Expansion of NP services facilitated an improvement in outcomes associated with trauma admissions.

METHODS

After approval by the institutional review board, a retrospective review of patients admitted to an 821-bed tertiary care, Level 1 trauma center was conducted between September 2012 and August 2015. Study patients were identified by the institution's trauma registry. Identified patients were included if they were admitted to trauma services with a hospital LOS of at least 24 hours. All patients meeting the study criteria were separated into three cohorts: 12 months prior to implementation of the NP service (September 2012 to August 2013), during implementation of the NP service (September 2013 to August 2014), and 12 months following the implementation of the NP service (September 2014 to August 2015). These 3 years of data were collected to evaluate changes in patient outcomes.

Patients were identified and data were obtained through the institution's trauma registry. Data included patient characteristics and outcomes: age, Injury Severity Score (ISS), Glasgow Comma Scale score at the scene of injury, Abbreviated Injury Severity scores, preexisting conditions, hospital LOS, ICU LOS, time to place rehabilitation consultation, 30-day readmissions, missed injury rates, unplanned ICU admissions, discharge order placed before noon, and complications during hospital stay. Evaluated complications included pneumonia, urinary tract infection, surgical site infection/deep surgical infection, acute renal failure, DVT, pulmonary embolism, and sepsis.

Descriptive statistics were computed for each variable to describe the patient population. Continuous variables examining patient characteristics were reported as means and standard deviations and compared using 1-way analysis of variance. Categorical variables were presented as proportions and compared using χ^2 or Fisher exact test. Outcome variables were analyzed with analysis of covariance or binary logistic regression adjusting for differences in patient characteristics. An exception was made for ISS as differences in average ISS over the study period were of minimal clinical relevance. All comparisons were performed at a level of significance of $p \leq .05$. Data analysis was performed using SPSS Version 22.0 (IBM Corp, Armonk, New York).

RESULTS

A total of 3,284 trauma patients were included in the analysis: 1,088 prior to implementation, 1,009 during the 12 months of implementation, and 1,187 in the first 12 months following implementation of the NP service. Average age and Glasgow Comma Scale score of patients remained comparable; however, ISS significantly declined over the study period (13.09 vs. 12.08 vs. 11.77, $p = .000$). In addition to ISS as an injury severity marker, Abbreviated Injury Severity for the six body regions were examined and they remained equivalent over the study period. With regard to comorbidities, the proportion of patients with preexisting conditions of neurologic disease (6.3% vs. 9.9% vs. 9.0%, $p = .006$) and diabetes (12.3%

vs. 12.3% vs. 15.3%, $p = .050$) increased significantly over time. The percentage of patients with preexisting pulmonary conditions, however, significantly decreased (5.5% vs. 7.8% vs. 2.4%, $p = .000$) (Table 1).

Hospital LOS significantly declined over time. During the year of NP service implementation, hospital LOS decreased by 0.04 days and it further declined by 0.98 days in the first year following implementation (6.92 vs. 6.88 vs. 5.94, $p = .007$). Similarly, ICU LOS significantly decreased (4.64 vs. 4.27 vs. 3.56, $p = .001$) during the study periods. The time from admission to placement of rehabilitation consultations also significantly improved following NP service implementation (4.88 vs. 2.66 vs. 3.63, $p = .000$). Although the time to rehabilitation consult increased during the first year postimplementation, it remained significantly lower than the preimplementation time (4.88 vs. 3.63, $p = .001$). Discharge orders placed before noon also significantly improved over the course of the study (47.0% vs. 50.3% vs. 64.3%, $p = .000$). Changes in 30-day readmission (3.8% vs. 3.1% vs. 2.0%, $p = .078$) and missed injury rate (1.0% vs. 0.4% vs. 0.3%, $p = .061$) improved but did not reach statistical significance. Rates of unplanned ICU admissions did not significantly change (Table 2). Inpatient complication rates for pneumonia (8.6% vs. 8.3% vs. 5.1%, $p = .002$) and DVT (3.4% vs. 3.5% vs. 1.9%, $p = .028$) also significantly decreased postimplementation of the NP service (Table 3).

DISCUSSION

Trauma patients often present with complex injuries requiring coordination of care among various physician as well as nonphysician services. Many trauma services have included NPs to improve continuity of patient care and overcome potential hindrances created by the reduction in resident hours (Haan et al., 2007). The Level 1 trauma center at the current study's institution expanded its

TABLE 1 Patient Characteristics[a]

	September 2012 to August 2013	September 2013 to August 2014	September 2014 to August 2015	
	N = 1088	*N* = 1009	*N* = 1187	*p*
Age, years, *M* ± SD	44.60 ± 20.62	46.16 ± 21.48	46.49 ± 20.95	.079
Abbreviated Injury Severity score, *M* ± SD	13.19 ± 8.70	12.08 ± 7.95	11.77 ± 7.90	**.000**
Glasgow Comma Scale score at scene, *M* ± SD	13.61 ± 3.13	13.57 ± 3.19	13.84 ± 2.80	.297
Abbreviated Injury Severity score, *M* ± SD				
Head/neck	2.58 ± 1.02	2.56 ± 0.99	2.59 ± 1.01	.891
Face	1.78 ± 0.50	1.76 ± 0.53	1.74 ± 0.51	.638
Chest	2.52 ± 0.79	2.57 ± 0.82	2.55 ± 0.77	.629
Abdomen/pelvic	2.47 ± 0.80	2.43 ± 0.73	2.31 ± 0.80	.054
Extremities/pelvic girdle	2.27 ± 0.58	2.24 ± 0.56	2.30 ± 0.60	.338
Comorbidities				
Pulmonary	5.5%	7.8%	2.4%	**.000**
Cardiovascular	34.7%	36.1%	38.3%	.142
Neurologic	6.1%	9.6%	8.8%	**.007**
Gastrointestinal	1.5%	2.0%	1.7%	.663
Psychiatric	56.2%	55.1%	57.4%	.563
Renal	0.6%	1.1%	0.8%	.503
Diabetes	12.3%	12.3%	15.3%	**.050**
Hematologic	6.9%	9.0%	8.8%	.146
Cancer	0.3%	03%	0.1%	.481
Autoimmune	1.4%	1.9%	1.7%	.656

[a]*Values in boldface indicate statistical significance ($p \leq .05$).*

TABLE 2 Study Outcomes[a]

	September 2012 to August 2013	September 2013 to August 2014	September 2014 to August 2015	
	N = 1088	*N* = 1009	*N* = 1187	*p*
Hospital length of stay, days, *M* ± SD	6.92 ± 8.50	6.88 ± 9.13	5.94 ± 8.27	**.007**
ICU length of stay, days, *M* ± SD	4.64 ± 5.31	4.27 ± 5.17	3.56 ± 4.47	**.001**
Time to place rehabilitation consult, days, *M* ± SD	4.88 ± 4.42	2.66 ± 3.19	3.63 ± 3.98	**.000**
30-day readmission	3.8%	3.1%	2.0%	.078
Missed injury rate	1.0%	0.4%	0.3%	.061
Unplanned ICU admission	3.0%	3.5%	2.2%	.346
Discharge order placed before noon	47.0%	50.3%	64.3%	**.000**

[a]*Values in boldface indicate statistical significance (p ≤ .05).*

existing NP model in September 2013 to promote continuity of patient care and improve outcomes.

Following expansion of the NP service, outcomes of hospital and ICU LOS significantly decreased over time. The decrease in average hospital LOS by 0.98 days from 12 months prior, to 24 months postimplementation of the service equated to a decrease of approximately $1.1 million in hospital charges per year. These outcomes are consistent with the findings of previous studies that have examined the impact of the addition of NPs to patient care models (Christmas et al., 2005; Collins et al., 2014; Sise et al., 2011; Spisso, O'Callaghan, McKennan, & Holcroft, 1990). Collins et al. (2014) evaluated the impact of a pilot program in which NPs were assigned to provide care 5 days a week in the step-down area of their Level 1 trauma center. The implementation of this NP practice model resulted in a decrease in overall trauma service hospital LOS by 0.8 days (Collins et al., 2014). Similar findings were also reported by Spisso et al. (1990) in a study comparing outcomes pre- and postimplementation of NPs in their trauma service. In this study, an average decrease in hospital LOS of 1.05 days was seen in patients admitted to their service 1 year prior to and postimplementation of the NP service. Two additional studies conducted by Christmas et al. (2005) and Sise et al. (2011) also demonstrated significant decline in ICU LOS following integration of NPs in their trauma care unit.

The current study also indicated that the expansion of NP services had a positive impact on the rate of missed injuries. Although missed injuries are not usually life threatening, they can result in significant, long-term sequelae for patients. (Kalemoglu et al., 2006). The rate of missed injuries decreased over the study period but fell just short of achieving statistical significance. Similar findings were

TABLE 3 List of Complications[a]

	September 2012 to August 2013	September 2013 to August 2014	September 2014 to August 2015	
	N = 1088	*N* = 1009	*N* = 1187	*p*
Pneumonia	8.6%	8.3%	5.1%	**.002**
Urinary tract infection	2.5%	4.1%	2.6%	.125
Surgical site infection/deep surgical infection	0.9%	0.7%	0.8%	.806
Acute renal failure	4.5%	4.5%	3.0%	.084
Deep vein thrombosis	3.4%	3.5%	1.9%	**.028**
Pulmonary embolism	1.2%	0.7%	0.8%	.454
Sepsis	0.9%	1.7%	0.8%	.135

[a]*Values in boldface indicate statistical significance (p ≤ .05).*

reported in a study conducted by Resler et al. (2014) in a pediatric trauma center. They reported that a significant percentage of missed injuries were identified with the addition of acute care trained pediatric NPs. The decline in the incidence of missed injuries in both studies was likely a result of improved charting, consistency in the practitioners performing examinations, and improved tracking of injury lists.

Time to placement of rehabilitation consultation from admission and placement of discharge orders before noon were two additional outcomes that improved following implementation of the NP service at the study institution. These outcomes have not been routinely examined in current literature assessing the impact of acute care NPs on inpatient outcomes. Nevertheless, identifying trauma patients with rehabilitation needs and early intervention likely serves to further expedite discharge from the acute care setting. In addition, previous literature suggests that early involvement of rehabilitation services contributes to improved functional outcomes following traumatic injury (Lawrence, 2006). Similarly, placement of a discharge order(s) before noon allows for improvements in the flow of patients through the trauma system.

Postadmission complications of pneumonia and DVT were found to be significantly lower following the expansion of the NP model. Improvements in pneumonia rates were likely influenced by the significant decrease in the number of admitted patients with baseline pulmonary disease during the study period. Pneumonia rates may have also been impacted by the improvements in patients' LOS seen with the implementation of the expanded NP services model, thus decreasing the overall risk of nosocomial pneumonia. Significant decreases in DVT rates were likely influenced by routine NP evaluation of all trauma service patients for the presence or absence of pharmacologic DVT prophylaxis within the first 48 hours of admission. These select patients were followed for appropriate pharmacologic prophylaxis. This process continued until pharmacologic prophylaxis was initiated or a formal plan for the initiation of pharmacologic prophylaxis was developed and documented. Intuitively, this process likely influenced DVT rates for the service by decreasing unnecessary delays in the initiation of pharmacologic DVT prophylaxis.

Readmission rates also declined over the course of the study. The overall readmission rate decreased by 1.8%, resulting in 21 fewer patient readmissions during the final 12-month study period. Although this improvement fell just short of statistical significance, the decrease in hospital readmissions would have further contributed to the overall cost savings associated with the expansion of the NP model at the study institution. The impact on readmissions with NP involvement in the acute management of trauma patients has been evaluated in a previous study conducted by Morris et al. (2012). This study also conducted in a Level 1 trauma center, compared readmission rates between NP and resident coordinated management. That study, however, reported similar readmission rates between both patient care models (Morris et al., 2012).

CONCLUSION

The current study provides a comprehensive review of outcomes related to the involvement of NPs in the continuum of care for trauma services patients. While there are several studies evaluating the impact of NPs in the provision of care in the trauma patient population, these studies have frequently been more limited in scope. (Christmas et al., 2005; Collins et al., 2014; Morris et al., 2012; Resler et al., 2014; Spisso et al., 1990). Data from the current study, however, serves to comprehensively describe the impact of NPs' involvement in the provision of care to trauma patients. These findings support data from previous studies by broadly evaluating morbidity and process of care variables that serve to directly impact LOS and ultimately an institutions' ability to provide quality care to a high volume of patients. Following expansion of the trauma NP model, improvement in patient outcomes, including hospital LOS, ICU LOS, 30-day readmission, time to place rehabilitation consultation, missed injury, discharge order placement before noon, and complications of pneumonia and DVT, was noted. The trauma NP service model developed at the study institution may prove beneficial in acute care settings at other institutions with high volume trauma services. The future goal for the NP service at the study institution is to continue to expand the model to provide 24 × 7 days coverage. Success of the evolving model will rely on significant support from the medical, nursing, and administration teams.

LIMITATIONS

Although the current study reports improved outcomes following expansion of the NP model, the study is not without limitations. The retrospective design of the study makes it reliant upon the identification, availability, and completeness of patients' medical records. Accordingly, all patients admitted to the trauma center during the study period may not have been identified and included, resulting in selection bias. In addition, the validity of the evaluated data depends on the accuracy with which it has been documented and subsequently collected. This serves to limit researchers' ability to practice quality control with the data. Also, this study does not seek to establish a causal relationship between the implementation of the NP service model and positive outcomes. It describes only the changes in outcomes reported prior to and postimplementation of the model.

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KEY POINTS

- Expansion of nurse practitioner services resulted in improvements in patient outcomes.
- Postimplementation data revealed improvements in time to placement of discharge orders, ICU LOS, and hospital LOS.
- An investment in increasing nurse practitioners' presence on trauma services proved to be a valuable institutional investment.

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