The influence of unit-based nurse practitioners on hospital outcomes and readmission rates for patients with trauma

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BACKGROUND: With the increased restrictions on resident work hours, hospitals increasingly are relying on advance practice nurses and physician assistants to help meet the patient care demand. We have created a workflow model wherein unit-based nurse practitioners (UBNPs) provide the minute-to-minute care for patients with trauma in one specific unit in our hospital, with supervision by the attending surgeons. Patients with trauma may also be admitted to other units, where the care model is a traditional resident-run (RR) service, again with supervision by the attending staff. Our aim was to determine if there were differences between the care provided by UBNPs and residents.

METHODS: We queried our trauma database for all patients admitted to our urban, academic, Level I trauma center from January 1, 2007, to August 31, 2010. Patients discharged alive from the trauma service were identified and cross-referenced with an administrative database to collect demographics, injury characteristics, comorbidities, complications, and discharge information. Patients cared for by the UBNPs were compared with those cared for by the RR service. $\chi^2$, Fisher's exact, and Student's t tests were used to determine significance. Significant factors were then tested with a multivariate linear regression analysis. $p < 0.05$ was considered significant.

RESULTS: During the study period, 3,859 patients were discharged alive from the trauma service, 2,759 (71.5%) from the UBNPs service, and 1,100 (28.5%) from the RR service. Demographic data and mean Injury Severity Score (11.6 vs. 11.1, $p = 0.24$) were similar for the two groups, although mean abdominal Abbreviated Injury Score was higher for the UBNP group (0.6 vs. 0.5, $p = 0.02$). UBNP patients were more likely to be diagnosed with deep venous thrombosis (4% vs. 2.5%, $p = 0.02$) and were more likely to be discharged to home (67% vs. 60%, $p = 0.002$). Mean (SD) length of stay for UBNP patients was 6.5 (8.8) days compared with 7 (10.8) days for RR patients, although this difference did not reach statistical significance ($p = 0.17$). The 30-day hospital readmission rates were similar for both groups (4.0% vs. 4.4%, $p = 0.63$).

CONCLUSION: Care provided by UBNPs is equivalent to that provided by residents. With the restriction on resident work hours and greater reliance on nurse practitioners, patient care does not suffer. Moreover, a difference of 0.5 days in mean length of stay for the UBNP patients equates with more than 1,300 fewer patient care days. This difference, although not statistically significant, may be clinically relevant to physicians and administrators and may offset the cost of hiring UBNPs to help meet the patient care demand. (J Trauma Acute Care Surg. 2012;73: 474–478. Copyright © 2012 by Lippincott Williams & Wilkins)

LEVEL OF EVIDENCE: Therapeutic study, level IV.

KEY WORDS: Unit-based nurse practitioners; trauma; outcomes.
**PATIENTS AND METHODS**

**Description of the UBNP Model**

Our group of experienced NPs (average experience caring for patients with trauma, 15.6 years) provide the direct daily care, 7 days a week, 365 days a year, for all patients with trauma admitted to one designated unit, supervised by the trauma attending physician. Typically, there are two UBNPs present on any given day, except weekends when only one UBNP is present. Resident involvement with the patients admitted to the UBNP floor is limited to invasive procedures (e.g., central venous catheters, chest tubes, etc.) and overnight cross-coverage. Our UBNPs do not bill separately from the attending physicians. All patients with trauma admitted to the UBNP unit are discussed in daily multidisciplinary rounds, which include the UBNPs, bedside nurses, trauma attending physicians, physical and occupational therapists, pharmacists, and social workers.

The primary determinant of admission location for patients with trauma is bed availability. If the UBNP floor has no available beds, patients with trauma will be admitted to other floors in the hospital and are cared for by a traditional RR service with direct trauma attending physician supervision. Most patients will be admitted to one specific surgical floor, with a similar level of nursing experience with patients with trauma, although patients from other surgical practices are also cared for on this unit. If both units are full, which occurs not infrequently, patients will be admitted to any available surgical bed, regardless of the familiarity of the nursing staff with care for patient with trauma. All patients with trauma receive care from pharmacists, physical therapists, and social workers regardless of bed location. Scheduled daily multidisciplinary rounds on the non-UBNP floor do not typically include the physicians or residents because the timing typically is not conducive to the varied schedules of the nine or so services whose patients are admitted to these floors. Although the social workers are assigned to the trauma service and work with these patients regardless of their admission location, the nurses, physical therapists, and pharmacists are assigned by location, and their experience with trauma patient care may not be similar to that of the providers on the UBNP unit.

**Study Methodology**

With institutional review board approval, we queried our trauma database and identified all admissions to the trauma service from January 1, 2007 to August 31, 2010. This period was chosen to coincide with the implementation of the UBNP model. Before this time, NPs were integrated with the resident physicians into one team.

Patients who were discharged directly from the intensive care unit (ICU) were excluded from our analysis. Data collected included demographic data, mechanism of injury, Injury Severity Score (ISS), and Abbreviated Injury Scale (AIS) score. We then cross-referenced our hospital administrative database to identify comorbidities present at admission, including chronic obstructive pulmonary disease (COPD), diabetes mellitus, coronary artery disease, congestive heart failure, and chronic renal failure. From this administrative database, we also identified the occurrence of complications during the hospital stay, including pneumonia, surgical site infection (SSI), deep venous thrombosis (DVT), pulmonary embolism (PE), and acute renal failure (ARF). Standardized definitions of comorbidities and complications from the Agency for Healthcare Research and Quality were used. The discharge destination, as well as any early readmissions that may have occurred, were also obtained.

Descriptive statistics for categorical variables are reported as frequency and percentage, whereas continuous variables are reported as mean (SD). Categorical variables were compared between the UBNP and RR patients using Fisher’s exact tests where appropriate, whereas continuous variables were compared using two sample t tests. All statistical tests and analyses were performed with Stata (StataCorp 2011, Stata Statistical Software, Release 12, StataCorp LP, College Station, TX).

**RESULTS**

During the study period, 4,152 trauma admissions occurred. Of these, 196 died after admission for an overall mortality rate of 4.7%. All of these deaths occurred in the operating room or in the surgical ICU. Four of the patients who died had been admitted to the UBNP unit before death, two had been on the RR floors. This difference was not statistically significant (p = 0.87). These deaths were excluded from further comparisons. Ninety-seven patients were discharged directly from the ICU. The remaining 3,859 patients were included in our analysis. The mean (SD) age for the overall group was 42.5 (20) years and 2,751 of the patients (71%) were male. Most patients were either African American (53%) or white (40%). Approximately 45% of the patients had private insurance or were self-paid (Table 1).

Most patients (71.5%) were admitted to the UBNP service compared with the RR service (2,759 vs. 1,100). The average provider-to-patient ratio was 1:7 for the UBNP service.

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*p < 0.05 is considered significant.*
and 1:3 for the RR service. The demographics of both groups were overall similar (Table 1). No significant differences existed in the insurance status between the two groups. The rate of comorbidities in both patient groups was also similar (Table 2). Diabetes mellitus was the most frequent coexisting condition in both groups (8% vs. 7%, \( p = 0.22 \)), followed by COPD (6.7% vs. 6.4%, \( p = 0.73 \)). Other concomitant medical problems were rare.

Although a significant proportion of our patients (24%) were admitted after a penetrating injury, most injuries (76%) were from a blunt mechanism (Table 3). Motor vehicle collisions were the most common at 24%, followed by falls (22%) and pedestrian injuries (6%). A number of other injury mechanisms (19%) were present, including assaults, work-related injuries, and injuries with unknown mechanism (not captured in the database). The mechanism of injury was not significantly different for patients admitted to the UBNP service compared with the RR service, and the frequencies of operative and invasive procedures were similar for both groups.

Overall, our patients had a mean (SD) ISS of 11.4 (11). Mean ISS was not significantly different between the UBNP patients and the RR patients (11.6 vs. 11.1, \( p = 0.24 \)). When the individual AIS scores were considered, however, the UBNP patients had a higher mean (SD) abdominal AIS score (0.6 [1.2] vs. 0.5 [1.1], \( p = 0.006 \)), but a lower mean (SD) face AIS score (0.35 [0.78] vs. 0.42 [0.86], \( p = 0.01 \)). The mean Glasgow Coma Scale score at admission was the same for both groups (13.9, \( p = 0.79 \)).

One key area where the patients cared for by the UBNP and RR services differed was in complications experienced during the hospitalization. UBNP patients were more likely to be diagnosed with a DVT during their admission than do RR patients (4% vs. 2.5%, \( p = 0.02 \)). The rates of other complications, such as SSI, pneumonia, and ARF, were similar (Table 4). Despite the differences in DVT rates, the mean (SD) length of stay (LOS) for patients cared for on the UBNP service was similar to that for RR service (6.5 [8.8] days vs. 7 [10.8] days, \( p = 0.17 \)).

The discharge destination of our UBNP patients was significantly different from the RR patients (Table 5). A much higher proportion of UBNP patients were discharged to their homes, and a lower proportion were discharged to SNF. This difference in discharge destination was not seen in the RR patients.
percentage of patients were discharged to home compared with the RR service (67% vs. 60%, \( p = 0.002 \)). The UBNP patients were less likely to be discharged to hospice (0.04% vs. 0.27%, \( p = 0.04 \)) or to a supervised residential facility (0.76% vs. 1.6%, \( p = 0.03 \)), although the number of patients in these categories was low. These differences in discharge destination did not result in a difference in readmission rate (Table 4; 4.0% vs. 4.4%, \( p = 0.63 \)).

**DISCUSSION**

In the last 20 years, the number of PAs and NPs in clinical practice has increased dramatically, with a projected total exceeding 200,000 by the year 2015.\(^1\)\(^-\)\(^3\) Multiple factors have driven this increase, including governmental cost-containment initiatives, the decreasing numbers of graduating medical students who are choosing primary care as a career, and the recent restriction on resident work hours.\(^4\)

Although most of these nonphysician providers (88%) are involved in the delivery of primary care, other specialties have also used these individuals in inpatient care, as surgical assistants, and as research assistants.\(^5\) Trauma services across the country are also increasingly hiring nonphysician providers to help promote continuity in patient care and to compensate for lost resident physician work hours.\(^6\)

On January 1, 2007, we created a UBNP service to care for most of our patients with trauma. This model was created in an effort to use the limited resident workforce in an efficient manner that would still provide the educational opportunities and experience necessary for physicians in training. Indeed, this model has dramatically reduced the provider-to-patient ratio for the resident service (1:3, as compared with 1:7 for the UBNPs). The residents are thus able to use their limited time for many other educational activities, including operating, responding to trauma alerts, attending educational conferences, and self-directed learning. The question remained, however, is this model safe for patients?

With this report, we have shown that patient care has not suffered with the use of the UBNP model. The UBNP patients were similar in demographics and injury severity to those cared for by the RR service. The rates of SSI, PE, and ARF were comparable as well, despite a significantly higher mean abdominal AIS score for UBNP patients. These data suggest that UBNPs have equivalent outcomes to those provided by resident physicians.

The rate of DVT in our UBNP patient group was higher than that of the resident service (4% vs. 2.5%, \( p = 0.02 \)), although the risk factors (ISS, extremity injury, etc.) were not different. One possible explanation is that the UBNPs may be more familiar with, and thus more likely to adhere to, our aggressive DVT screening policy. At least one other study found that NPs are more likely to be compliant with practice guidelines.\(^6\) This study has prompted us to analyze the compliance with our guidelines based on the location of the patient. The influence of the attending physician or fellow supervising the trauma teams is interesting. It would seem reasonable to expect similar outcomes from both teams based on the fact that the attending supervises both groups. Despite the difference in our two groups, the rates of DVT for both were within the range of published studies.\(^7\)\(^-\)\(^8\)

Another interesting finding from our analysis was the difference in LOS, with UBNP patients having a mean LOS of 6.5 days compared with 7 days for RR patients. Although this difference did not reach statistical significance, the absolute difference of 0.5 days multiplied by the number of patients cared for by the UBNPs (2,759) results in a difference of more than 1,300 patient days. In our hospital, which is typically running at capacity or overcapacity, this difference may be tremendously important to clinicians and hospital administrators. This clinical relevance is strengthened when one considers that transfer of patients with trauma out of the ICU to the floor is dependent on bed availability. It is often said that results from published studies are statistically significant but not clinically relevant; this may be a case where the findings are not statistically significant but are clinically important. Although this study was not designed as a cost analysis of the UBNP model, the contribution of even a slightly lower LOS to the cost of caring for patients with trauma should be considered in any such analysis. In fact, the addition of NPs to the trauma team has resulted in added value in at least one other study.\(^9\)

It is possible that one reason for the slightly lower LOS was the higher number of UBNP patients who were discharged to home (67% vs. 60%) because placement in other health care facilities is often delayed by bed availability. It is not entirely clear why this difference exists, although it may be caused by the increased availability of the UBNPs to work with family members in teaching home care and dressing changes while the patient is still hospitalized. Such time spent with caregivers may give them the confidence to care for the injured patients at home without additional assistance.

Another factor that may have contributed to the slight difference in LOS is the scheduled daily multidisciplinary rounds, which take place for the UBNP patients. Although all patients with trauma receive care from physical therapists, pharmacists, and social workers regardless of location, no scheduled multidisciplinary rounds occur. The residents must therefore coordinate with each provider separately, resulting in a less efficient use of the resident’s time. It is possible that this inefficiency contributes to the slightly longer stay of 0.5 days because coordination of the recommendations from different services and providers can be difficult. One may argue that it is the scheduled discharge rounds that result in the efficiency of the system, rather than the UBNPs. We think that the two are inseparable. Provider involvement in scheduled multidisciplinary rounds occurs precisely because we have UBNPs who are not pulled in other directions away from the unit.

NP involvement in patient care has been described in many settings. Christmas et al.\(^10\) demonstrated a shorter stay of more than 2 days after incorporating NPs into their trauma team. Similarly, Spisso et al.\(^11\) found a decrease of 1.05 days in hospital LOS. In these studies, the NPs were incorporated into the existing structure of the trauma team, rather than as a separate entity as in our study. Other comparisons have involved a separate care team, without a physical separation into different units.\(^12\)\(^-\)\(^15\) One such study of note was performed in a pediatric trauma population; the authors found higher patient satisfaction ratings in several categories and a shorter stay for NPs.\(^16\)
Ours is the first study to compare a unit-based NP model directly with a resident service. This model has been described in two publications as a theoretical model,\textsuperscript{17,18} but we were unable to find published studies evaluating the effectiveness of this model. Although the care provided by the UBNPs in our report was equivalent to RR, we think that there are many other benefits of this model, including a decreased service workload for the residents on the trauma service. Residents are responsible not only for the care of patients on the floor and in the ICU but also for the initial trauma resuscitation, outpatient clinic visits, and the operative care of patients with trauma. In addition, residents are expected to attend formal teaching conferences, participate in research activities, and study independently. Having the majority of the patients cared for by the UBNPs allows more freedom for these activities. Further research needs to be done to determine if this results in a measurable difference for the residents (i.e., increased American Board of Surgery In-Training Exam scores, articles published, etc.). Satisfaction with the experience on the trauma service is high, based on confidential resident rotation evaluations (data not shown). Our UBNPs also consistently report high satisfaction with their roles and responsibilities. Only one UBNP (of six total) has left the practice since the creation of this model.

Our report has several limitations. First, this was a retrospective database study, so selection bias could have been a problem. Bed availability is the main determinant of where a patient is admitted in our hospital, and it is unlikely that this would have a nonrandom effect on our patient cohorts, although subtle differences in the timing of ICU discharge may have been present, for example. Because our data were extracted from an existing database, we were unable to determine the temporal relationships between complications. Thus, we are not able to state if an ICU admission, for example, occurred immediately after initial trauma resuscitation or if it occurred after clinical deterioration on the floor. It is possible that subtle differences of this kind were not captured. Another possible problem is that we only captured readmissions to our hospital—readmissions to other hospitals may have occurred, although it seems reasonable that these outside readmissions would be as likely to occur for the patients cared for by either team.

CONCLUSION

Care provided by UBNPs is clinically equivalent to that provided by RR services. UBNP-run services may also result in clinically important decreases in patient days in the hospital, which may offset the cost of hiring and training NPs. The use of UBNPs is justified to compensate for the decreasing availability of resident physicians without a compromise in patient outcomes.

AUTHORSHIP


DISCLOSURE

The authors declare no conflicts of interest.

REFERENCES