Transfer Delays From the Neurologic Intensive Care Unit: A Prospective Cohort Study

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Abstract

Introduction: Neurocritical care beds are a scarce, valuable resource. The purpose of this pilot study was to quantify discharge delays from the neurologic intensive care unit (NICU) at a tertiary-care teaching hospital and to examine the impact on overall hospital length of stay (LOS). Secondary goals were to evaluate (1) the effect of NICU delays on patient physical/occupational therapy services and (2) the accuracy of clinician estimates of NICU discharge date and hospital LOS. **Methods:** We conducted a prospective cohort study of consecutive patients discharged over 1 month from NICU. A patient was defined to have experienced a delay when deemed medically ready for NICU discharge (ie, floor transfer) but without actual NICU discharge within 8 hours of the ready time. **Results:** Sixty-five patients were discharged from the NICU with an average delay of 25 hours 51 minutes (median 13 hours 3 minutes), of which 60% (39 of 65) of patients were delayed at least 8 hours, while 25% (16 of 65) were delayed at least 48 hours. The primary reason for delay was lack of floor bed availability. NICU admissions that experienced a delay did not have a significantly longer hospital LOS. Clinician estimates on admission of NICU discharge date were within 24 hours for 63% of admissions. **Conclusion:** Discharge delays from the NICU were common but did not significantly increase hospital LOS in this cohort. Delays did not have a significant impact on total physical therapy or occupational therapy duration. Clinician estimates of NICU discharge dates were relatively accurate.

Keywords

transfer delay, discharge, length of stay, neurocritical care, ICU throughput, neurohospitalist

Introduction

Specialized neurocritical care improves clinical outcomes and reduces costs.¹⁻³ Consequently, diminished access to neurocritical care beds may adversely affect outcomes and cost efficiency. In high-volume neurocritical care centers, neurologic intensive care unit (NICU) bed access is affected by various factors, including discharge delays to the ward (ie, floor transfer).

When decreased NICU access and bed shortages occur, NICU patients may be “boarded” in the emergency department (ED) or medical and surgical ICUs not dedicated to neurocritical care—such situations are associated with increased mortality for critically ill neurologic patients.^{4,5} Critically ill patients who experience a delay of at least 6 hours in transfer from the ED to the ICU have increased hospital length of stay (LOS) and higher mortality.⁴ Similarly, critically ill patients with stroke who are delayed greater than 5 hours in transfer from the ED to the NICU experience worse outcomes at hospital discharge.⁶ Less data exist on delays of transfer from the intensive care unit (ICU) to the general wards.

An Australian tertiary teaching hospital study showed that such transfer delays (greater than 8 hours) occurred in 27% of patients in combined medical and surgical ICUs.⁷ Median delay time was 21.3 hours. A lack of ward bed availability was the cause of delay in over 80% of cases. Delays were least common for patients who underwent planned ICU admissions after elective procedures. Most delays occurred during weekends. Delays were more frequent in patients deemed more ill

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or complex. An Israeli tertiary teaching hospital study found that 33% of ICU discharges were delayed by greater than 24 hours.⁸ Forty-six percent of these delays were due to administrative issues (eg., floor bed availability), while 21% were delayed because of floor physician or nurse preference. Similar to the Australian study, ICU LOS was independently associated with delay in transfer. We are not aware of any studies addressing this problem from the United States or within NICUs.

In addition to bed access, ICU transfer delays have adverse economic, psychological, and social consequences. Intensive care unit days cost 2.5 to 7 times more than non-ICU hospital days.^{9,10} In addition to the potential financial burden, excess ICU days may be detrimental to overall recovery secondary to patient psychological stress and poor sleep in the ICU.^{11,12}

The main objective of this study was to quantify delays in discharge from our NICU and to investigate the related impact on overall hospital LOS as a quality and safety initiative. Secondary goals were to evaluate (1) the impact of the delays on physical/occupational therapy service duration and (2) the accuracy of clinician estimates (at the time of admission) of expected discharge dates from the NICU and hospital. Clinician estimates on expected discharges are critical to the discharge planning process but have not been tested for accuracy previously in the NICU literature.

Methods

Study Design

We conducted a prospective cohort study of patients discharged from NICU of the Massachusetts General Hospital over 39 consecutive days from March 6, 2013, to April 14, 2013. This was part of a quality improvement initiative to improve bed access and reduce LOS. All medical neurology (ie, neuromedicine) patients admitted to the NICU were defined to meet study inclusion criteria. Patients admitted for primary neurosurgical procedures or those admitted to the neurosurgical team were excluded from the study.

Setting

Massachusetts General Hospital is a 950-bed, university-affiliated, tertiary-care teaching hospital and level 1 trauma center with approximately 48 000 admissions per year. The NICU is a 22-bed unit with patients divided between 2 teams, one of which primarily attends to neuromedicine patients, while the other primarily attends to neurosurgical patients. The neuromedicine ICU census ranges between 10 and 16 patients.

Data Collection

General demographics regarding admission diagnoses, age, and gender were collected. The data were acquired as part of a quality improvement initiative and did not require approval from our institutional review board. Consecutive neuromedicine patients'

NICU discharges were included. The "ready-for-transfer" time was defined as the time at which the primary team placed a time-stamped transfer order into the computerized order-entry system, requesting a general ward bed. The NICU team was instructed not to place such an order until the patient was actually ready to transfer without contingency. When an order was not entered, "ready-for-transfer" time was defined as the time of finalization of the daily progress note, which documented a ward bed request. The time of NICU discharge was the time at which transfer orders were activated upon arrival to the floor, indicating the patient was physically transferred from the NICU to the ward. The NICU team was queried daily regarding the reason for transfer delay. Admission diagnosis was obtained by chart review. The NICU readmissions were considered separate admissions and analyzed independently. Delay time was measured as the difference between the "ready-for-transfer" time and time of discharge. Delay times greater than 3 standard deviations from the mean in the group analyses were moved to control for outliers. To allow dichotomous comparison, absolute delay was defined as transfer from NICU greater than 8 hours from time first ready. Physical therapy and occupational therapy service dates, location, and duration of encounters were recorded for each patient. The NICU case manager was queried regarding whether or not patients were screened for discharge placement and on what day this first occurred. The estimated NICU discharge date was entered by the neuromedicine ICU attending into the attending admission note.

Statistical Analysis

Single-factor analysis of variance (ANOVA) tests were performed for general demographic data divided between admission diagnoses. Single factor ANOVA ($\alpha = 0$) and individual 2-way *t* tests were performed between diagnostic groups assuming an unequal variance and used to compare difference in discharge delay days. Multivariate analyses were performed to determine the impact of delays on total physical and occupational therapy time, by generating 2 sets of separate linear regression models. Delay was categorized as a dichotomous variable, based on 8 hours versus 24 hours cutoffs (a separate analysis was performed using each cutoff independently). In each linear model, the following covariates were prespecified for inclusion: admission diagnosis, age, gender, duration of physical therapy and occupational therapy encounters during ICU stay, and overall hospital LOS. Software packages used for statistical analysis were ToolPak add-in for Microsoft Excel 2010 and STATA 10.0. All statistical tests were considered significant at $P < .05$ (2-tailed tests).

Results

Patient Characteristics

Sixty-five total transfers from the NICU were included. There were 62 unique admissions and 3 readmissions. Forty-eight percent (30 of 62) of the unique admissions were women. The

average age was 61.3 years (standard deviation: 17, median: 62, range: 22-93). There were 55 transfers to the neurology ward and 9 direct discharges directly from the NICU to a rehabilitation facility. There was 1 transfer to the cardiac surgical intensive care unit (SICU). Seven transfers from the NICU to the neurology ward were designated intensive comfort measures, a care state geared toward palliative services only. The most common admitting diagnosis was intracerebral hemorrhage (ICH; $n = 19$, 30.6%), followed by other ($n = 12$, 19.3%), ischemic stroke ($n = 12$, 19.3%), seizure ($n = 7$, 11.3%), tumor ($n = 7$, 11.3%), and subdural hematoma ($n = 5$, 8.0%). For all patients, average NICU LOS was 6 days (median: 4, range: 1-20) and average overall hospital LOS was 14.3 days (median: 9, range 2-151).

Delay Time

The average delay in transfer time from the NICU was 25 hours 51 minutes (median: 13 hours 3 minutes, range: 54 minutes-123 hours 22 minutes; see Figure 1). Of the 65 total admissions, 39 were delayed for transfer by at least 8 hours after the initial bed request was placed, while 26 admissions were delayed by at least 24 hours, and 16 were delayed more than 48 hours from time of transfer request. Of the 7 “intensive comfort measures” patients, 6 experienced greater than 8 hours of delay from the NICU to the ward, including 2 who experienced greater than 24 hours of delay. Admissions with a primary diagnosis of ICH were more likely to experience a delay in transfer when compared to those with an admission diagnosis of seizures ($P = .014$), subdural hemorrhage ($P = .037$), or tumor ($P = .038$).

Effect on Overall Length of Stay

When transfer delay was defined as greater than 8 hours, there was no statistically significant increase in hospital LOS for the delayed group versus the nondelayed group. In fact, the patients who experienced no delay had an increased total hospital LOS compared to those with delay, 15.6 days (± 14.6) compared to 9.1 days (± 7.1), respectively ($P = .02$). When transfer delay was defined as greater than 24 hours, there was still no significant effect on hospital LOS comparing the delayed transfer group versus the nondelayed group ($P = .41$).

Clinician Estimates

There were 54 clinician estimates regarding date of transfer from NICU—recorded by the NICU attending at the time of admission note, and 63% and 81% of clinician estimates of transfer ready time were within 24 hours and 48 hours, respectively, of the actual transfer ready time. In these cases, physicians underestimated the NICU LOS 70% of the time. There was no statistically significant difference among the accuracy of predicting NICU LOS within 24 hours or 48 hours among different admission diagnoses ($P = .319$ and $P = .433$, respectively).

Figure 1. Neurologic intensive care unit (NICU) transfer delays for individual patients ($n = 65$) in hours.

Case Management

Case management screened 42 patients for placement during the study. Eleven patients were screened for placement on the same day of discharge from the NICU to the ward, and 2 additional patients were screened the day after transfer. Of those 13 patients, 7 patients experienced delay days.

Impact on Total Physical Therapy and Occupational Therapy Time

Using univariate analyses for total time patients underwent physical and occupational therapy services, there was no statistically significant difference between delayed and nondelayed patients ($P = .113$). Using multivariate linear regression models (adjusted for admission diagnosis, age, gender, total ICU physical or occupational therapy time, ICU LOS, and total hospital LOS), there were no associations between the presence of delay and duration of physical and occupational therapy services (all P values $> .20$). Overall LOS was the only predictor of both total physical (coefficient = 8.14, 95% CI 0.06-16.22, $P = .048$) and occupational (coefficient = 6.1, 95% CI 2.4-9.8, $P = .002$) therapy duration, regardless of delay definition.

Discussion

In this cohort of patients, the average length of NICU transfer delay was over 24 hours. Delays were due to lack of floor bed availability. We demonstrated that NICU transfer delays did not affect overall hospital LOS. This result is surprising and contrary to our initial hypothesis. Of note, an ongoing hospital-wide study across all departments, using a much larger population over a longer time period, shows that ICU transfer delays, in fact, cause increases in overall LOS (Retsef Levi, PhD and Lee Schwamm, MD, personal communication, July 9, 2015). Failure to demonstrate an effect of transfer delay on overall hospital LOS may be due to sample size or due to our ability to discharge some patients directly from the NICU to home or acute rehabilitant centers—a relatively new

practice at our institution. The practice of fast tracking those patients expected to have lengthy delays in transfer from the NICU to direct discharge may mitigate the effects of delays on hospital LOS in our hospital. Alternatively, delays in the NICU for some patients may translate to overall decreased LOS by disproportionately decreasing the number of ward days required. Additionally, there may be differences in case management in the NICU that mitigate the effect of transfer delays on overall hospital LOS, and if so these differences should be explored further.

While NICU transfer delays did not lead to a statistically significant increase in hospital LOS, such delays have significant cost implications. Although ICU bed costs are debated, the daily costs of NICU beds are greater than ward beds.¹³ Thus, the proportion of hospital LOS within the NICU is an important driver of cost. In the current study, 11% (7 of 65) of all transfers were intensive comfort measures patients, 86% (6 of 7) of whom experienced delays of at least 8 hours. Such patients represent a transfer delay cohort for whom the NICU costs greatly outweigh their care level requirements.

The effect of diagnosis on NICU transfer delay was predictable. Since there exist higher rates of transfer delay for more severely ill patients,⁷ patients with ICH would be expected to have longer transfer delays than other diagnoses given their typical illness severity. With an in-hospital mortality rate of nearly 30%,¹⁴ patients with ICH are often the sickest in the NICU. A possible explanation for the association between the illness severity and ICU transfer delay is the lower priority these patients are given when ward and ICU nurses and physicians are deciding which patients to transfer (when more than 1 patient is awaiting NICU transfer). In other words, when 2 patients are deemed ready for transfer out of the ICU, the one with the lower severity of illness may be transferred first. Other authors have hypothesized that this relationship is secondary to bias from ward nurses who may resist accepting patients who may require more care or resources.⁷

Delay in transfer of patients from the NICU who no longer require NICU level care decreases NICU access to those who do, particularly ED NICU “boarder” patients. Such patients require NICU-level care but remain in the ED because of the lack of NICU bed availability. The NICU-level patients boarding in the ED or experiencing a delay of at least 5 hours in transfer to the NICU from the ED have worse outcomes.⁶ Many hospitals have addressed this concern by boarding patients in nonneurologic ICUs, but such processes still produce worse mortality rates than patients directly admitted to the NICU without delay.⁵

Increased ICU bed capacity shortens ED LOS for patients admitted to the ICU and decreases ambulance diversion from the ED, whereby ambulance diversion has important financial ramifications for hospitals that depend on ambulance traffic for volume.¹⁵ Moreover, ED ambulance diversion is also associated with greater mortality for ICU-level patients.¹⁶ Given the difficulty in adding ICU beds to increase ICU capacity, hospitals have sought other means to increase ICU capacity.

Johns Hopkins University hospitalists implemented an “active bed management” intervention that included twice-daily ICU bed management rounds and regular visits to the ED to assess congestion and flow. This improved throughput from the ED to ICU beds, decreased ED LOS for admitted patients, and decreased “red alert” time, the duration in which the ED was on ambulance diversion for ICU-level patients.¹⁷

In the current study, NICU discharge date predictions (recorded on admission) were accurate in predicting the actual NICU discharge day in 43% of cases. Predictions were within 2 days of discharge in over 80% of cases. Prediction accuracy did not improve based on any particular diagnosis. Given the limited number of patients (and diagnoses), however, this study was underpowered to assess prediction at this level. For any type of ICU patient, there is a paucity of data on clinician estimates for discharge readiness. While ICU LOS predictive models (eg, Acute Physiology and Chronic Health Evaluation (APACHE) IV¹⁸) exist for general and postoperative ICU populations,^{19,20} no models yet exist for NICU patients or NICU-specific diagnoses or procedures. Given the importance that these estimates play in discharge planning, more attention should be paid to improving them. Not surprisingly, estimates of discharge readiness worsen with increased ICU LOS. Even the most experienced clinicians are poor at predicting ICU LOS past 4 days.²¹ Attempts to model ICU LOS have been generally unsuccessful; so far, clinical gestalt seems to be equal to or super to prognostic indexes for general ICU LOS prediction.²¹

The lack of an effect of transfer delay on total physical therapy and occupational therapy time was unexpected. Patients experiencing NICU transfer delay were theorized to receive less total physical and occupational therapy time. However, such services at our institution and NICU appear to be maintained during the transfer delay period. This finding is important because early physical and occupational therapy limits delirium, increases ventilator-free days, decreases ICU and hospital LOS, and ultimately leads to better long-term outcomes.²²⁻²⁵

Limitations

There were multiple limitations and inherent study bias that affect its generalizability and the conclusions that may be drawn. Although we believe the results to be important, they should be viewed as grounds for future multicenter studies. First, the sample size was small and underpowered to properly evaluate secondary aims: (1) accuracy in clinician transfer time estimates and (2) the impact of NICU transfer delay on total physical and occupational therapy time. Furthermore, additional subset analyses were not possible, given the small sample size. Second, this is a single-center at a tertiary-care center, which limits the generalizability of our findings to other institutions. Third, this study was performed over a relatively short time frame and different results may have been found during alternative periods, particularly when different providers were on service.

Despite these limitations, we believe our results will be replicated at both our center and other centers, particularly the

presence of transfer delay in NICU patients. Anecdotally, our colleagues at other institutions with NICUs report similar experiences with NICU transfer delays, as has been the experience in nonneurologic ICUs in Israel and Australia.^{7,8}

Conclusion

We believe that measuring and reporting NICU transfer delays (as opposed to only capturing overall LOS) will be of benefit to other centers as will physician predictions of NICU transfer ready dates. Bed request times should be recorded in neurologic ICUs (as a definable metric) in order to follow and improve patient flow. Given the goal to maximize utilization of scarce NICU resources, adding clinician estimates of NICU LOS may add further value to care coordination and disposition planning, improving patient flow from the ambulance and ED, through the NICU, and to the floor and rehabilitation centers.

Declaration of Conflicting Interests

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