Quality Improvement

Implementation of an Early Mobility Protocol in the Neuroscience ICU

Jessica S. Jarvis, MSN, APRN, AGACNP-BC, CNRN, SCRN[1]; Robert Blessing, DNP, ACNP[1]; Colleen Naglee, MD[1]; Julie Thompson, PhD[2]; Staci S. Reynolds, PhD, RN, ACNS-BC, CCRN, CNRN, SCRN, CPHQ[2]

[1] Duke University Hospital
[2] Duke University School of Nursing
Corresponding author: Staci S. Reynolds at Staci.reynolds@duke.edu

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ABSTRACT

Background: Early mobility is a safe and effective intervention to improve patient outcomes in the neuroscience intensive care unit (ICU). However, mobilization of patients in a neuroscience ICU within an academic medical center was suboptimal, with less than 36% of patients achieving their highest level of mobility.
Aim: The purpose of the quality improvement project was to develop and implement a multidisciplinary early mobility protocol, including a safety screening tool.
Methods: Iterative Plan-Do-Study-Act cycles were implemented from April to August 2022. The screening tool assisted nurses in assessing the patient's eligibility for early mobilization. A mobility section addressing patient-specific mobility screening, barriers to mobility, and a daily mobility plan was added to the provider note templates. Baseline data were collected from September to November 2021; post-implementation data were collected from April to August 2022.
Results: A total of 198 patient charts were reviewed, 70 pre-implementation and 128 post-implementation. There was a reduction in the mean time between admission to the first documented out-of-bed activity from 3.24 to 2.01 days ($p=0.06$). The mean number of documented out-of-bed activities significantly increased from 6.13 to 8.35 ($p = 0.002$). Hospital length of stay significantly decreased from 19.8 to 12.42 days, $p=.006$.
Conclusions: Implementing an early mobility screening tool and protocol in the neuroscience ICU increased mobility for patients with neurological diagnoses. Other hospitals should consider implementing a similar process to help improve patient outcomes.

Key words: neurocritical care; progressive mobility; nurse; quality

INTRODUCTION

Immobility can lead to multi-organ complications and functional impairment in critically ill patients, as well as increase hospital length of stay (Alaparthi et al., 2020; Cameron et al., 2015; Dirkes & Kozlowski, 2019; Zhang et al., 2019; Marra et al., 2017). Muscle loss due to immobility starts within 48 hours from onset of critical illness with a 1% to 5.5% rate of muscle strength loss per day, and as much as 40% loss during the first week of immobility (Cameron et al., 2015). Twenty-five to 100 percent of critically ill patients will suffer from intensive care unit (ICU)-associated weakness due to prolonged bed rest and immobility (Zhang et al., 2019; Marra et al., 2017). Additionally, ICU-associated weakness can have longstanding effects, with survivors reporting ongoing functional impairment up to five years post-hospitalization (Marra et al., 2017).

Early mobilization is an effective intervention to decrease complications of immobility in the ICU (Zhang et al., 2019; Marra et al., 2017; Bernhardt et al., 2008). However, implementing early mobility can be challenging due to hemodynamic instability, staffing challenges, and sedation (Hermes et al., 2020). The complexity of early mobility is increased in the neuroscience ICU due to concerns for increased intracranial pressure, decreased cerebral perfusion, hemiparesis, external ventricular drains, and altered cognition and perception (Alaparthi et al., 2020). Patients in the neuroscience ICU are not mobilized as frequently or intensely as post-ICU patients despite the benefits of, and decreased complications with, early mobility programs (Cameron et al., 2015). Early mobility may be safe in some neuroscience ICU populations. Indeed, Bernhardt and colleagues (2008) conducted a randomized controlled trial evaluating the effectiveness of very early mobilization in patients with stroke (within 24 hours of stroke symptom onset), finding the intervention to be safe and feasible.

Multidisciplinary mobility protocols for neuroscience ICU patients are safe, cost-effective, and feasible (Falkenstein et al., 2020; Hernandez et al., 2021; Klein et al., 2018; Olkowski & Shah, 2017; Bahouth et al., 2018; Bernhardt et al., 2008). Mobility protocols can increase nursing-driven mobility interventions, decrease the time to first mobilization, and increase the overall number of mobilizations (Falkenstein et al., 2020; Bahouth et al., 2018). Daily screening assists with determining the appropriate level of mobility based on safety criteria and patient assessment and characteristics (Lang et al., 2020). Studies suggest that the timing and frequency of mobilization for patients in the neuroscience ICU should be individualized based on diagnosis and patient characteristics and determined by the multidisciplinary team (Hernandez et al., 2021; Olkowski & Shah, 2017).

Mobilization of patients in a 31-bed neuroscience ICU within an academic health center was suboptimal. From June to November 2021, less than 36% of patients who were deemed safe to mobilize achieved their highest level of mobility. As such, a multidisciplinary Early Mobility Team was created, including the neuroscience ICU co-medical director, nursing leadership, advanced practice providers, Clinical Nurse Specialist, unit-based mobility champion, and physical therapists. The team identified that the current mobility tool adopted by the health system's mobility program was not consistently used by nurses, and the tool did not take into consideration the complexities of patients with neurological diagnoses when assessing for safety of mobility or level of mobility. The purpose of the quality improvement project was to implement a multidisciplinary early mobility protocol, including a safety-screening tool, to improve early mobility in the neuroscience

ICU. The specific aims of the project were to: (1) decrease the time from unit admission to first mobilization, (2) increase the frequency of out of bed activities, (3) evaluate daily screening of patients for mobility eligibility and documentation of barriers, (4) evaluate documentation of and compliance with the early mobility plan, and (5) decrease hospital length of stay.

METHODS

Design, setting, and sample

A pre and post-implementation quality improvement design was used. The project was conducted in a 31-bed neuroscience ICU that is a part of a large academic health system in the Southeastern United States that has been designated as a Comprehensive Stroke Center and Level one trauma center. The neuroscience ICU admits patients with complex neurological diagnoses including stroke (ischemic, hemorrhagic, subarachnoid hemorrhage), brain tumors, seizures, neuromuscular and neurodegenerative disorders, and traumatic brain and spine injuries. The project was deemed to not be human subjects research from the university's Institutional Review Board.

Intervention

An early mobility screening tool and protocol was developed and implemented. The screening tool (Figure 1) was developed from a literature review conducted by the Early Mobility Team to assist nurses in assessing the patient's eligibility for early mobilization, including exclusion, caution, and safe criteria for early mobility (Hernandez et al., 2021; Olkowski & Shah, 2017; Lang et al., 2020; Sakai et al., 2020). A screening tool visual aid was posted at nursing stations for easy accessibility.

A mobility section addressing patient-specific mobility screening, barriers to mobility, and a daily mobility plan was added to the provider note templates. The early mobility protocol highlighted the roles and responsibilities of the multidisciplinary team. To begin, the bedside nurse was directed to complete the adult Bedside Mobility Assessment Tool (BMAT) and assess the patient's mobility status; this assessment was documented in the electronic health record (EHR). The nurse was also directed to review the early mobility screening tool (Figure 1) prior to multidisciplinary patient rounds. During multidisciplinary rounds, which included the bedside nurse, physicians, and advanced practice providers, barriers to early mobility were discussed.

The multidisciplinary team developed an individualized mobility plan for each patient, and documented the patient-specific barriers and plan in the EHR. To ensure consistency between nursing shifts, the provider also placed (or updated) the mobility order in the EHR to reflect the early mobility plan. Finally, the nurse mobilized the patient per the early mobility plan, and documented this activity in the EHR, including the patient's tolerance with the activity and any complications. If the patient was not mobilized per the early mobility plan, the nurse was directed to communicate the rationale to the provider. During multidisciplinary rounds the following day, the early mobility plan and any concerns/issues from the previous day were discussed, and the mobility plan was updated as necessary. See Figure 2 for an overview of the neuroscience ICU early mobility protocol.

Figure 1.

Neuroscience ICU early mobility screening tool

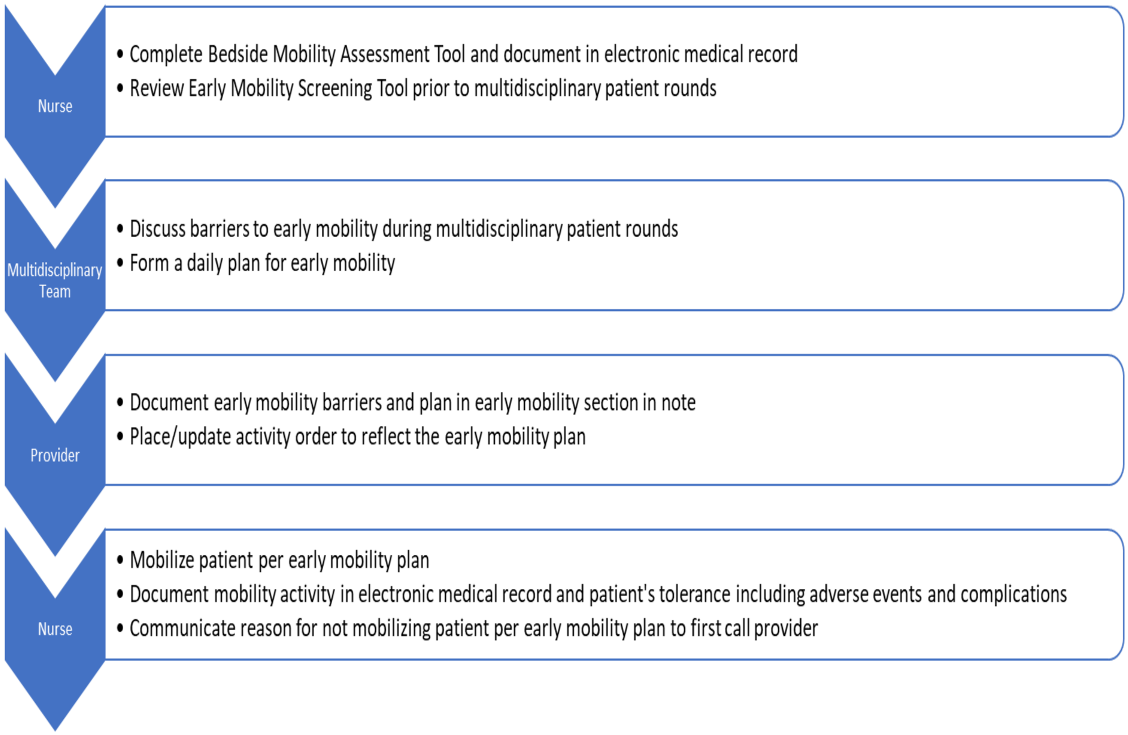
✓		DO NOT MOBILIZE	DISCUSS MOBILITY WITH CARE TEAM	MOBILIZE
	Neurological Considerations	☐ Acute neurological change ☐ Cerebral edema requiring hyperosmolar therapy ☐ Head of bed flat restrictions ☐ Hemorrhage expansion on imaging ☐ Rebleeding from aneurysm ☐ Severe vasospasm requiring vasopressors ☐ Spinal instability ☐ Subdural drain without NSU clearance ☐ Uncontrolled seizures ☐ Unsecured aneurysm ☐ Unstable autonomic dysreflexia	☐ Evidence of seizures within the last 24h ☐ Less than 24h from onset of stroke or hemorrhage ☐ Mild to moderate vasospasm ☐ Neurological worsening within the last 24h ☐ Sympathetic hyperactivity	☐ Cervical collar and/or braces available ☐ Greater than 24h from onset of stroke or hemorrhage ☐ Helmet available if hemicraniectomy ☐ No evidence of current seizure activity ☐ No evidence of vasospasm ☐ No neurological changes within 24h ☐ Stable hemorrhage on imaging x 24h
	EVD	☐ Elevated or unstable intracranial pressure (ICP $\geq$ 20) ☐ Requiring pharmacological or nonpharmacological measures to treat ICP ☐ Patient unable to tolerate EVD clamped for 30 minutes	☐ ICP $\geq$ 20 in the last 24 hours ☐ ICP sensitive to repositioning or stimulation	☐ ICP < 20 for greater than 24h ☐ Patient can tolerate EVD clamped for 30 minutes
	Hemodynamics	☐ Blood pressure outside parameters despite interventions ☐ Compromised respiratory function ☐ New or increased antihypertensive/ vasopressor requirement ☐ Mechanical ventilation with PEEP ≥10, FiO2 >75%, or APRV Mode ☐ Spinal cord injury and not meeting MAP goals	☐ Antihypertensive/vasopressor requirement stable ☐ Blood pressure within parameters with interventions ☐ MAP < 60 ☐ Resting HR <50 or >130 ☐ Spinal cord injury with MAP goals with vasopressor support	☐ Blood pressure within parameters without interventions ☐ Hemodynamic parameters met without intervention ☐ Maintaining airway without support ☐ Spinal cord injury meeting MAP goals without vasopressors
	Other	☐ Active bleeding ☐ Mobility not consistent with goals of care ☐ Orthopedic or abdominal injuries that preclude mobility (i.e. unstable spine or pelvis, solid organ injury) ☐ Severe agitation (RASS $\geq$ +3)	☐ External cooling ☐ Femoral access ☐ Moderate agitation (+1 or +2)	☐ Minimal agitation

Cancellation criteria:

Arrythmia Device dislodgement Fall Neurological exam worsening Unstable hemodynamics

Figure 2.

Neuroscience ICU early mobility protocol



Education

Education was developed by a clinical nurse specialist, physical therapist, and nurse practitioner (NP; project lead). Education on the protocol and appropriate documentation was provided to nurses and providers via a 13-minute recorded online module sent via email. The module emphasized how to complete, document, and utilize the early mobility screening during nurse-led patient rounds. Individuals were asked to view the module within a 2-week period in March 2022. Prior to project implementation compliance with module completion reached 47% for nurses and 56% for providers. Additional education regarding the updates to the provider note templates and mobility documentation was given to providers during a provider staff meeting in March 2022. Providers were encouraged to ask clarifying questions during the staff meeting; if a provider had further questions, the NP project lead addressed them individually. As the NP project lead and co-medical director of the unit were both active members of the Early Mobility Team, there was support and engagement by the other healthcare providers. Early mobility was discussed daily for the first month post-implementation during nursing huddles then monthly at nursing and provider staff meetings. Members of the Early Mobility Team presented on early mobility at nursing staff meetings pre- and post-implementation.

Initial reservations were noted by the nursing staff regarding mobilizing patients with devices and lower mobility scores according to the health system's mobility tool. The early mobility screening tool provided the nurses with objective criteria to qualify or disqualify these patients for mobility. The nursing mobility champions engaged nurses by encouraging the day and night shifts to record each patient mobilization per shift and rewarding random staff members from the leading shifts each month with small prizes. Nursing compliance with screening and interventions was assessed by the department nurse manager, assistant nurse managers, and the co-medical director via weekly chart review following project implementation. Subsequent staff interventions for noncompliance included email and verbal reminders, in-person formal meetings with expectations reviewed and attestation of understanding, general counseling, and performance improvement plans which were completed in progression as listed based on the number of occurrences. Most nurses received email reminders, and there were 24 incidences of verbal coaching and five formal meetings completed. Further support was provided to the nursing staff by pairing the nurses in groups with physical therapists for training to increase their comfort, knowledge, and proficiency with mobilizing patients.

Data collection and analysis

The sample included patients admitted to the neuroscience ICU with a neurological diagnosis and an ICU length of stay greater than two days; those on comfort care, who died within seven days of being admitted to the neuroscience ICU, or who were admitted without a neurological diagnosis were not included. Data were collected via retrospective chart review. Demographic and clinical data were collected for each patient, including age, sex, race, ethnicity, primary diagnosis, whether they had an external ventricular drain or were mechanically intubated, and their Glasgow Coma Scale (GCS) score at first mobilization. Baseline data were collected from September to November 2021. The early mobility screen and protocol were implemented in March 2022. Post-implementation data were collected from April to August 2022.

Table 1.

Overview of patient's demographic and clinical characteristics

Variable	Pre-implementation Mean (SD) N (%)	Post-implementation Mean (SD) N (%)	p-value
Demographic data			
Age	57.23 (16.43)	59.84 (18.17)	.32
Sex			.883

Male	34 (48.6%)	64 (50%)	
Female	36 (51.4%)	64 (50%)	
Race			.779
White	36 (51.4%)	65 (50.8%)	
Black	28 (40%)	46 (35.9%)	
American Indian or Alaskan Native	1 (1.4%)	2 (1.6%)	
Asian	0 (0%)	3 (2.3%)	
Not reported/ Other	5 (7.1%)	12 (9.4%)	
Ethnicity			.597
Non-Hispanic	64 (91.4%)	114 (89.1%)	
Hispanic	3 (4.3%)	11 (8.6%)	
Not reported	3 (4.3%)	3 (2.3%)	
Primary diagnosis			
Ischemic Stroke, TIA	19 (27.1%)	30 (23.4%)	.607
Hemorrhagic Stroke	5 (7.1%)	22 (17.2%)	.053
Subdural Hemorrhage	3 (4.3%)	5 (3.9%)	.999
Subarachnoid Hemorrhage	6 (8.6%)	7 (5.5%)	.389
Intracranial Tumor	9 (12.9%)	8 (6.3%)	.121
Spine	5 (7.1%)	17 (13.3%)	.240
Trauma	4 (5.7%)	10 (7.8%)	.774
Neurodegenerative and Neuromuscular Disorders	6 (8.6%)	1 (0.8%)	.008
Seizure	5 (7.1%)	10 (7.8%)	.999
Other	7 (10%)	10 (7.8%)	.604
Aneurysm, Endovascular/neurosurgical procedure	1 (1.4%)	8 (6.3%)	.163
Presence of an external ventricular drain	6 (8.6%)	10 (7.8%)	.999
Mechanically intubated at first mobilization	5 (19.2%)	2 (5.7%)	.125
GCS at first mobilization	13.62 (1.98)	14.30 (1.27)	.017
NIHSS at first mobilization	9 (7.31)	7.38 (6.34)	.305
Hunt & Hess score at admission	1.50 (0.84)	1.60 (0.90)	.852
ICH score at admission	1.86 (1.46)	1.71 (1.15)	.792

GCS=Glasgow Coma Scale; NIHSS=National Institutes of Health Stroke Scale; ICH=intracranial hemorrhage

Sample size was based on the independent samples t-test with 80% power, alpha set to 0.05, and a moderate effect size (0.50) for the first two aims. Data on the patient's time from admission to the neuroscience ICU to first mobilization (defined as documentation of an out-of-bed activity) and frequency of out-of-bed activities were graphically displayed on a run chart. Daily screening for mobility eligibility, documentation of barriers and the early mobility plan, and compliance with the early mobility plan are described using descriptive statistics. Measures were analyzed using an independent samples t-test when the data was distributed normally and a Mann-Whitney U test for data with deviations from normality.

RESULTS

A total of 198 patient charts were reviewed, 70 pre-implementation and 128 post-implementation. There were no differences in age, sex, race, or ethnicity in the pre- and post-implementation samples. There were significantly more patients with neurodegenerative disease in the pre-implementation sample (p=.043), and a trend towards more patients with hemorrhagic stroke in the post-implementation sample (p=.053). Patients' GCS at first mobilization was also significantly different, with a pre-implementation GCS mean of 13.62 (standard deviation [SD]=1.98) compared to the post-implementation mean of 14.3 (SD=1.27), p=.017. See Table 1 for an overview of the patient's demographic and clinical data. There were no patients who were included in both the pre- and post-implementation periods. One patient was included twice in the pre-implementation period due to two separate admissions.

As data were not normally distributed, a Mann-Whitney U test was conducted. There was a trend toward a reduced time between admission to the neuroscience ICU and the first documented out-of-bed activity (in days) from pre-implementation (median=1.64, IQR=3.22) to post-implementation (median=0.97, IQR=1.36), although it was not statistically significant (Z = -1.87; p= 0.061; r=0.13 [small effect size]). The run chart provides a graphical display of the improvements over time (Figure 3).

The median number of documented out-of-bed activities significantly increased from 3 (IQR=6) pre-implementation to 5 (IQR=8.75) post-implementation (Z = -3.11; p = 0.002; r = 0.221 [small effect size]). The run chart in Figure 4 provides a graphical display of the improvement in out-of-bed activities.

The following provides average percentages for how often post-implementation data were documented: (1) early mobility screening documented 84.4% of the time, (2) early mobility barriers were documented 52.6% of the time, (3) early mobility plans were documented 76.4% of the required time, and (4) documentation of out of bed activities consistent with the early mobility plan occurred 71.6% of the time. Common barriers discussed during rounds included neurological diagnosis, weakness, mental status, clinical status, mechanical ventilation, sedation, and blood pressure instability. Hospital length of stay also significantly decreased from 19.8 days (SD=19.78) to 12.42 days (SD=12.17) (p=0.006; d = .481 [small effect size]) after implementing the early mobility screening tool and protocol.

Figure 3.

Run Chart Display of The Average Time (In Days) Between Admission to the Neuroscience ICU to the First Documented Out-of-Bed Activity

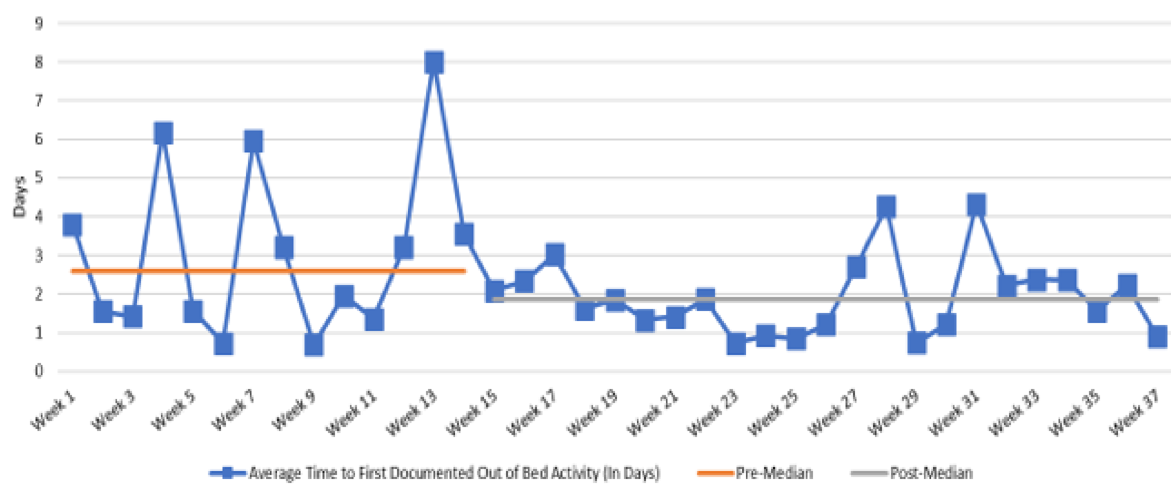
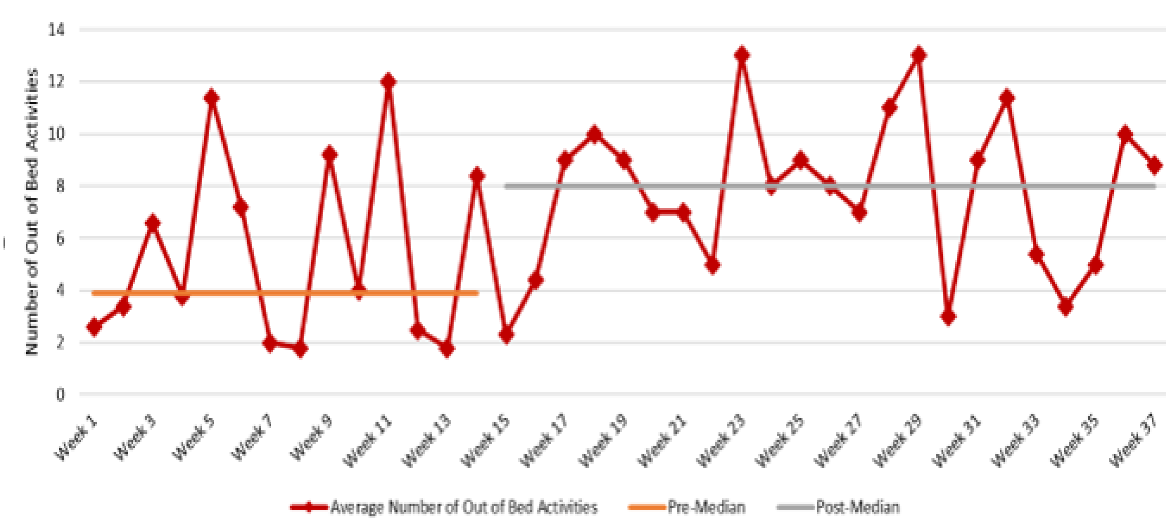


Figure 4.

Run Chart Display of the Number of Documented Out of Bed Activities



DISCUSSION

This project did not show a significant decrease in the time from admission to first mobilization, but did show an increase in the number of documented out-of-bed activities for patients with neurological diagnoses after implementing a multidisciplinary early mobility protocol. Other projects have similarly shown that early mobility algorithms that incorporate daily assessments and screening have decreased time to first mobilization, increased mobilizations, and increased the percentage of patients mobilized within the first seven days of admission for patients with neurological diagnoses (Moyer et al., 2017; Bahouth et al., 2018; Klein et al., 2018). While one study consistently involved physical therapy with mobility (Moyer et al., 2017), another study utilized nurse-led mobility interventions without additional staffing or increases in physical therapy sessions (Bahouth et al., 2018).

Additionally, this project was able to show a significant decrease in hospital length of stay, which was not noted in other studies (Moyer et al., 2017; Bahouth et al., 2018). However, there were differences between subjects in each group (eg, patients in the post-implementation group had a higher GCS and fewer neurodegenerative diseases) that may have biased these findings. More robust research is needed to replicate this finding. Similarly, Burch and colleagues (2018) found a significant decrease in length of stay (p=.04) with earlier mobility through increased communication between physicians and physical therapists. Future projects may consider including physical therapists during multidisciplinary rounds to further promote early mobility. Other goals for this project were to create and assess the utility of an early mobility screening tool and protocol. Schallom et al. (2020) similarly instituted an early mobility protocol, including daily mobility screening and goals, and a dedicated physical therapist in several ICUs. They found a significant decrease in ICU length of stay, with the neuroscience ICU having the largest increase in number of days patients ambulated in the first seven days (Schallom et al., 2020). Our project supports the use of a multidisciplinary early mobility protocol to improve mobility in the neuroscience ICU.

Implications for Nursing

This quality improvement project has important implications for nursing. This unit-based project shows the feasibility of mobilizing patients with neurological diagnoses in the ICU with nursing staff without increasing physical and occupational therapy involvement. A multidisciplinary approach to implementing an early mobility protocol was important to our team and was shown to be successful by incorporating the components of the early mobility protocol into already existing practices such as multidisciplinary rounds. While implementing changes during the COVID-19 pandemic was difficult as nursing staff were already strained, the decision to utilize the screening tool as a reference tool avoided additional mandatory documentation for nurses. Instead, the provider notes were updated to include documentation of the early mobility screening, barriers, and plan, which created a barrier by preventing more detailed data collection of patient-specific barriers directly from the screening tool. It is important to consider other safety implications of increased mobility that were outside the scope of this project, such as the impact on falls, ICU delirium, pressure injuries, and healthcare-associated infections in patients with neurological diagnoses in the ICU. Metrics should continue to be measured to monitor the sustainability of results, similar to Klein and colleagues (2018), who monitored the impact of an early progressive mobility protocol 12 months post-implementation.

Limitations

This project had several limitations. The project was conducted in one neuroscience ICU at one hospital, which limits generalizability. Data were collected for 5 months post-implementation; a longer timeframe might yield different results. Data were collected from documentation in the EHR, which may not accurately reflect practice. Other projects may consider conducting real-time observational audits to identify improvements in practice. Additionally, there was a significant difference in GCS scores, suggesting patients in the post-implementation period had better level of consciousness. Whereas the difference in GCS was statistically significant (13.62 vs 14.30, $p=.017$), it is likely not clinically significant. However, this may represent a threat to the internal validity of the project. Further, the risk for bias is high. The retrospective nature of the project limits it only to hypothesis-generating and cannot demonstrate actual change. This project is also limited by the dose of mobility, which was likely heterogeneous, in addition to the variety of neurologic diagnoses. Lastly, there was a wide range of data for out-of-bed activities and hospital LOS (ie, SD), which is another limitation.

CONCLUSIONS

Implementing an early mobility screening tool and protocol in the neuroscience ICU increased mobility for patients with neurological diagnoses. Multidisciplinary collaboration was key for the successful creation and implementation of the early mobility protocol. Future projects should consider collecting data related to safety, mobility level, and discharge outcomes after implementing an early mobility protocol.

Author Bios:

Jessica S. Jarvis, MSN, APRN, AGACNP-BC, CNRN, SCRN, is a neuroscience intensive care unit nurse practitioner at Duke University Hospital in Durham, North Carolina, in the United States.

Robert Blessing, DNP, ACNP, is a neuroscience intensive care unit nurse Practitioner at Duke University Hospital.

Colleen Naglee, MD, is a neuroscience intensive care unit physician at Duke University Hospital.

Julie Thompson, PhD, is a statistician at the Duke University School of Nursing.

Staci S. Reynolds, PhD, RN, ACNS-BC, CCRN, CNRN, SCRN, CPHQ, is an associate clinical professor at Duke University School of Nursing.

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