7-10-2024

A Guideline-Based Approach to Increase Early Mobilization in the Pediatric Patient Following Cardiothoracic Surgery

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B.S. Nursing, Saint Louis University, 2019

A Dissertation submitted to the Graduate School at the University of Missouri-St. Louis
in partial fulfillment of the requirements for the degree
Doctor of Nursing Practice with an emphasis in Acute Care Pediatric Nurse Practitioner

August
2024

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Abstract

Problem: Prolonged bedrest during the post-operative period contributes to complications that lengthen hospital stay and increase mortality and medical costs. Early mobilization is recognized as safe and feasible in critically ill children. However, there is no standardized procedure nor method of identifying patients who are safe to mobilize in a pediatric cardiac intensive care unit (ICU).

Method: The quality improvement (QI) project employed a descriptive observational design utilizing a retrospective-prospective method to assess the effects of implementing an early mobilization guideline in a pediatric cardiac ICU. The project included a convenience sample of all patients admitted to the pediatric cardiac ICU post cardiothoracic surgery, excluding those on extracorporeal membrane oxygenation or with an open chest. Data was collected pre- and post-implementation and included age, gender, and time (days) to first documented mobilization post-operatively.

Results: A (*N*=97) patients met inclusion criteria during the data collection periods. Pre-implementation (Sept 1-Dec 1) (*n*=56) and post-implementation (March 10-May 26) (*n*=41). The early mobilization guideline did not increase the percentage of patients with documented mobilization on post-operative day (POD) 1. A decrease in mean time (days) to mobilization, from 2.24 to 2.05 days, and a decrease in mean ranks of time to mobilization, from 48.28 to 47.6, was observed. A chi-square test for independence, two-tailed paired sample t-test, and Mann-Whitney U test were performed.

***Implications for practice*:** Utilization of an early mobilization guideline in the pediatric cardiac ICU may decrease prolonged bed rest of post-operative patients. There remains opportunity to further support the building of a culture that promotes early mobilization.

Early Mobilization After Pediatric Cardiothoracic Surgery

Approximately 40,000 children undergo cardiac surgery in the United States (US) annually (Pasquali, et al., 2020). This population is at considerable risk of morbidity and mortality related to their specific disease process, surgery, and cardiac intensive care unit stay. Outcomes for pediatric cardiac surgery vary significantly across hospitals in the United States, and improvements in outcomes appear to have plateaued in the last decade (Gaies, et al., 2019). These findings suggest an opportunity to improve the quality of care in children undergoing heart surgery.

Prolonged bedrest during the post-operative period in individuals who undergo cardiac surgery contributes to complications that lengthen hospital stay, increase mortality, and increase medical costs (Cuello-Garcia, et al., 2018). An analysis of outcome data from 102 congenital heart programs in the US between 2014-2017 reported mortality rates of 1.6 to 5.0 percent; mean length of stay between 10.5 to 19.2 days; and major complication rates of 7 to 23.5 percent (Pasquali, et al., 2020). The application of physical activity following surgery, or the onset of critical illness is referred to as early mobilization and been used to mitigate the adverse physiological sequalae of surgical stress and bedrest in adults. A systematic review of early mobilization in adult patients after heart surgery reported that early mobilization has a positive impact on length of stay, post-operative complications, and functional capacity (Ramos Dos Santos, et al., 2017).

Early mobilization strategies include any active movement in which patients use their own muscle strength, ranging from in-bed exercises and sitting on the edge of the bed, to standing and eventually ambulating. Currently, there is a lack of research on early mobilization in pediatric critical care, let alone in pediatric patients after heart surgery. A

global initiative titled The Enhanced Recovery After Cardiac Surgery Program (ERAS) includes early ambulation in its' evidence-based bundle of interventions aimed at improving surgical outcomes (Engelman, et al., 2019). One-year results from ERAS application reported decreased ICU stay and overall length of stay, decreased opioid use, and increased patient and staff satisfaction (Williams, et al., 2019). Boston Children's Hospital is currently the first and only pediatric congenital heart program to implement ERAS and includes "getting out of bed on the day of surgery" in a bundle of interventions currently being implemented to improve post-operative outcomes (Boston Children's Hospital, n.d.).

At this time, there is not a protocol in place for early mobilization in the cardiac intensive care unit within a midsized pediatric hospital located in the Midwest. Early mobilization in post- operative patients is encouraged by the medical team; however, there is not a protocol in place and occurrences are not measured. The purpose of this quality improvement project is to develop and implement a nurse-driven early mobilization guideline for the pediatric patient who underwent cardiac surgery. The guideline will identify patients that are appropriate for early mobilization and outline the mobilization process for the bedside nurse. The evidence-based practice (EBP) framework to be used for this project will be a 12-week Plan-Do-Study-Act (PDSA) cycle. The aim of the project is to increase the percentage of patients who mobilize on post-operative day one by 20%. The primary outcome measure will occurrences of early mobilization on post-operative day one. The secondary outcome measure will be time (in days) to first mobilization during the post-operative period. Occurrences will be measured by nursing and physical therapy documentation in patient's electronic health

record. The question for study is: in pediatric patients who underwent cardiac surgery, does implementing a nurse-driven early mobilization guideline, versus no early mobilization guideline, increase early mobilization occurrences on post-operative day one?

Literature Review

An extensive literature search was preformed to evaluate early mobilization in the pediatric critical care population. Academic Search Complete, The Cochrane Library, The Cumulative Index to Nursing and Allied Health Literature (CINAHL), MEDLINE, and PubMed Central search engines were utilized. The terms *early mobilization*, *early ambulation, pediatric, critical care*, *intensive care unit*, *PICU,* and *post-operative* were utilized with AND and OR Boolean operators. The initial number of publications generated was 607. The search was then refined to meet the criteria of published in English language, within 2018 to 2023, in full-text, children 0-18 years of age, and peer-reviewed publications. Exclusion criteria were pediatric settings outside of the intensive care unit and interventions with a focus on chest-physiotherapy. A refined search applying inclusion and exclusion criteria generated 28 publications. An ancestry approach was also utilized to identify relevant articles by reviewing the references of generated publications. An abstract screening was preformed and ultimately 11 articles were selected for this literature review.

Early mobilization in critically ill adult patients is safe and effective in preventing adverse outcomes and is now the standard of care in that population (Noone, et al., 2023). Implementation of early mobilization is only newly studied in the pediatric population; thus, the literature is lacking diversity. The publications selected include a systematic

review, a systematic review with meta-analysis, a literature review, a randomized control trial, an observational study, an interventional study, a qualitative study, quality improvement initiatives, and practice recommendations. Themes throughout the literature were identified and include feasibility, safety and concern for adverse events, and the need for a multidisciplinary approach.

With the emergence of early mobilization in pediatric critical care, it is important to assess the feasibility of such initiatives. Feasibility evaluates the availability of resources needed and how to overcome potential obstacles. The wEECYCLE pilot study by Choong et al., (2017) assessed the feasibility of early mobilization with an in-bed cycling device in a PICU in Canada. A total of 20 patients ages 3 to 17 years old were enrolled. Choong et al., (2017) deemed early mobilization feasible and reported the main threat to feasibility was availability of physical therapists. More specifically, 39% of planned mobility sessions were not able to occur due to unavailability of the physiotherapist. Similarly, Herbsman et al., (2020) trialed scheduling patients for therapy sessions to maximize staff efficiency as part of an early mobilization bundle, however, scheduling sessions was determined to be ineffective due to the complex workflow of the PICU.

An interventional study by Simpson et al., (2023) assessed the feasibility of routine patient screening on reducing time to mobilization in a PICU in Australia. A total of 71 children were enrolled. Feasibility was demonstrated by 62% of patients mobilizing within 72 hours of PICU admission. Additionally, a quality improvement project by Lisanti et al., (2022) also assessed feasibility in terms of mobilizing patients with transthoracic intracardiac catheters. Despite the unique population, Lisanti et al.,

(2022) had the largest population sample—1358 patients—out of all studies included in this review. It was determined that holding and mobilizing patients with transthoracic intracardiac catheters was feasible with established dressing, securement, and mobilization guideline in place (Lisanti, et al., 2022). Although early mobilization in the PICU setting was reported to be feasible by Choong et al., (2019), Herbsman et al., (2020), Simpson et al., (2023), and Lisanti et al., (2022), these studies were conducted in single-center PICUs throughout the world, thus limiting generalizability.

In addition to feasibility, the safety of early mobilization in pediatric critical care was a focus in many studies selected for this review. Healthcare providers and families alike often express concern with the safety of mobilizing critically ill children (Noone, et al., 2023). Concern for adverse events involving lines, drains, and medical equipment have been described. Lisanti, et al., (2022) reported three occurrences of transthoracic intracardiac catheter malposition within 12 hours of mobilization., but no major adverse events. Data on adverse events in this study could have been under-reported, as it was based on self-report only. Simpson et al., (2023) reported no adverse events in 177 participant mobilization days utilizing routine patient screening and identification of safe and appropriate mobilization goals based on patient acuity. The wEECYCLE pilot reported no adverse events with mobilization utilizing in-bed cycling (Choong, et al., 2019). In a quality improvement project, Colwell, et al., (2018) utilized a goal-directed multidisciplinary mobilization protocol and reported the following complications in 3.5% of mobilization encounters: emesis, transient tachypnea and tachycardia. Data on adverse events reported by these studies supports that early mobilization in critically ill children is safe and adverse events are rare (Choong, et al., 2019; Coldwell, et al., 2018). To

further support the idea that early mobilization is safe for critically ill children, a systematic review including 11 studies reported only 13 (1.1%) children experienced an adverse event related to mobilization (Cuello-Garcia, et al., 2018). While safety has been demonstrated in the available literature, safety criteria and contraindications for early mobilization differ slightly between studies and suggests an area for future research. Most recent practice recommendations consensed from 10 multidisciplinary field experts suggests evaluating system-based clinical safety criteria and completing a pre-mobilization checklist to ensure the child's safety (Choong, et al., 2018).

The perceived need for rest, from both caregivers and healthcare providers, perpetuates the immobilization of critically ill children (Muira, et al., 2020). In order to change the culture and better understand this barrier, Noone et al., (2022) preformed a literature review on the perceptions of nurses, patients, and caregivers regarding early mobilization. A total of six quantitative and three qualitative studies were included and assert that experienced nurses and nurses with adult experience are more likely to support early mobilization in the pediatric population (Noone, et al., 2022). Additionally, lack of standardization, proper education, and adequate resources and equipment was noted to be a barrier to early mobilization across multiple studies (Choong, et al., 2018; Noone, et al., 2022). Among all studies included in this literature review, a single study by Noone et al. (2022), reported on the experience of pediatric patients with early mobilization, highlighting a need for further research.

An additional study by Joyce et al., (2018) surveyed 71 PICU providers—all of whom reported that early mobilization is beneficial, noting decreased length of ICU stay reported as the greatest perceived benefit. Joyce et al., (2018) also reported that

providers feel most comfortable mobilizing patients over 8 years old, however, the survey used was not validated. It is notable to include that perceived barriers to early mobilization differ among the multidisciplinary team. More specifically, Lisanti, et al., (2020) reported that largest barrier for physicians and nurses is the dislodgement of medical equipment (endotracheal tubes, central venous catheters, nasogastric tubes), while Joyce et al., (2018) reported that the largest barrier for physical and occupational therapists is workload constraints. It is imperative to explore perceptions of early mobilization and address associated barriers before its implementation in pediatric critical care.

A Plan-Do-Study-Act (PDSA) cycle will serve as the evidence base practice framework to guide this project. A PDSA cycle was selected to guide implementation of the intervention within a particular setting, test change, and adjust. Currently, the cardiac intensive care unit is need of a standardized way of identifying patients who are safe to mobilize. A comprehensive nurse-driven guideline will be written, implemented, then studied over the 12-week PDSA cycle. Implementation of an early mobilization protocol may increase early mobilization occurrences, identify barriers to early mobilization, and improve patient outcomes.

In summary, the available literature supports the feasibility and safety of mobilizing critically ill children. Studies investigating the perceptions of early mobilization affirm that providers and caregivers see benefit in early mobilization, but its application is often halted by patient and family related factors and resource limitations (Joyce, et al., 2018; Noone, et al., 2022). A variety of approaches have been applied, including early mobilization bundles, daily patient screening and goal assignment,

multidisciplinary programs, and the use of devices such as in-bed cycling. Limited evidence is available to support efficacy for early mobilization. However, findings suggest that early mobilization may have a positive effect on duration of mechanical ventilation, duration of PICU stay, and overall morbidity (Cuello-Carcia, et al., 2018). The overall heterogenicity of early mobilization interventions, study designs, and clinical settings limits generalizability of findings and highlights the need for larger, more robust studies in this area.

Methods

Design

This quality improvement project utilized a descriptive, observational design. More specifically, a retrospective-prospective method was used evaluate the implementation of an early mobilization guideline in a pediatric cardiac intensive care unit utilizing a PDSA cycle framework. Retrospective chart review data was conducted on all patients admitted to the unit post-operatively from September 1st, 2023 to December 1st, 2023 (12 weeks) to gather baseline data. Specifically, mobilization data was obtained from nursing flowsheet and therapy progress note documentation in the patient's electronic medical record. The early mobilization guideline was implemented and education was completed in the first week of March 2024. Prospective chart review data was collected in the same fashion from March 10th, 2024 to May 26th, 2024 (11 weeks).

Setting

The quality improvement project took place in a 32-bed combined cardiac ICU and stepdown unit within a large academic pediatric hospital in the Midwest. Children

admitted to the unit reside both locally and regionally to the hospital due to the hospital's cardiothoracic surgical expertise. The Society of Thoracic Surgeons has designated this unit as a high-volume center. In 2022, a total of 399 cardiovascular surgical procedures were performed. The unit is staffed with two core physical therapists (PT), two core occupational therapists (OT), and approximately 140 registered nurses. Both PT and OT received automatic consults on all post-operative patients per the post-operative order set. Nurse to patient ratios on post-operative day (POD) 1 are commonly 1:1, but rarely 1:2 dependent on patient acuity and staffing needs.

Sample

The quality improvement project utilized a convenience sample of all post-operative patients admitted to the unit. The pre-implementation group consisted of patients with operations from September 1st, 2023 to December 1st, 2023. The month of December was chosen to be excluded from baseline data collection due to potential non-typical operation scheduling practices during that month. The post-implementation group consisted of patients with operations from March 10th, 2024 to May 26th, 2024. The post-implementation timeframe was shorter than anticipated, lasting 11 weeks instead of the planned 12 weeks, due to a delay in guideline implementation and project time constraints. The investigator utilized the cardiothoracic surgery schedule to identify patients. Patients receiving extracorporeal membrane oxygenation were excluded due to concern for cannula dislodgement. Additionally, patients who had an open chest following their operation were excluded. The decision was made to include patients of all ages, including neonates and infants, as they can participate in mobilization activities suitable for their development, such as being held or supported sitting.

Data Collection/Analysis

Data was collected via retrospective and prospective medical record review. Demographic data collected included patient age and gender. Time (days) to first documented mobilization post-operatively, as well as type of mobilization activity documented by nursing or therapy services was collected. Given the range of cardiac defects and resulting surgical procedures performed, and considering the objectives of this study, neither cardiac defect nor procedure type were collected as part of the data.

The data were de-identified and stored in an Excel document on a password-protected computer. Descriptive statistics were used to summarize and compare the pre- and post-intervention groups. A two-tailed paired sample t-test was conducted to examine whether the mean difference in time (days) to first documented mobilization was statistically significant between the pre- and post-implementation groups. A chi-square test for independence was conducted to examine whether the percentage of patients with documented mobilization on POD 1 was statistically significant between the pre- and post-implementation groups. A second chi-square test for independence was conducted to examine whether the number of overall patients with documented mobilization on POD 1 was statistically significant between age groups. Lastly, a Mann-Whitney U test was conducted to determine if there was a statistically significant difference in documented time to mobilization between the pre- and post-intervention groups. All statistical analyses were performed using SPSS software.

Procedure

The student investigator discussed a mobility initiative with unit stakeholders, including, ICU medical providers, the cardiothoracic surgery team, the ventricular assist

device (VAD) coordinator, nursing leadership, the patient safety and quality improvement specialist, as well as PT and OT. After describing the project, the stakeholders agreed to focus on the early mobilization of post-operative patients. An early mobilization guideline (as shown in Appendix A-1), including safety criteria required for mobilization (as sown in Appendix A-2), was developed and agreed upon by unit stakeholders. The safety criteria outlined in the guideline was inspired by the systematic review of pediatric early mobilization protocols by Piva, et al. (2019) and practice recommendations by Choong, et al. (2018).

Once the finalized guideline was uploaded into the hospital's online policy database, the student investigator delivered education to the unit registered nurses (RNs). A bedside teaching format was utilized, focusing on the appropriate use of the early mobilization guideline, the benefits of early mobilization during the post-operative period, and correct mobilization technique. To ensure comprehensive guidance on proper mobilization techniques, the student investigator collaborated with PT and OT services.

The guideline describes the expectation to discuss mobility with the medical team during morning rounds. To encourage daily discussion, the existing RN daily rounding script was revised to include patient eligibility for early mobilization (as shown in Appendix A-3). The nursing staff, alone or in collaboration with therapy services, are responsible for mobilizing patients who meet safety criteria beginning on POD 1. Mobilization activities include being held, supported sitting, sitting in a chair or infant seat, sitting on the edge of the bed or dangling, and ambulating. After each mobilization activity, nursing staff are expected to document the activity from a pre-populated list within the nursing flowsheets.

Approval Process

The investigator received approval and support for the quality improvement project from the organization and all stakeholders. Formal, written approval was obtained from the University of Missouri-St. Louis International Review Board (IRB) prior to implementation and retrospective data collection. The proposed project is classified as a quality improvement project and, therefore, IRB exempt.

Results

Demographics

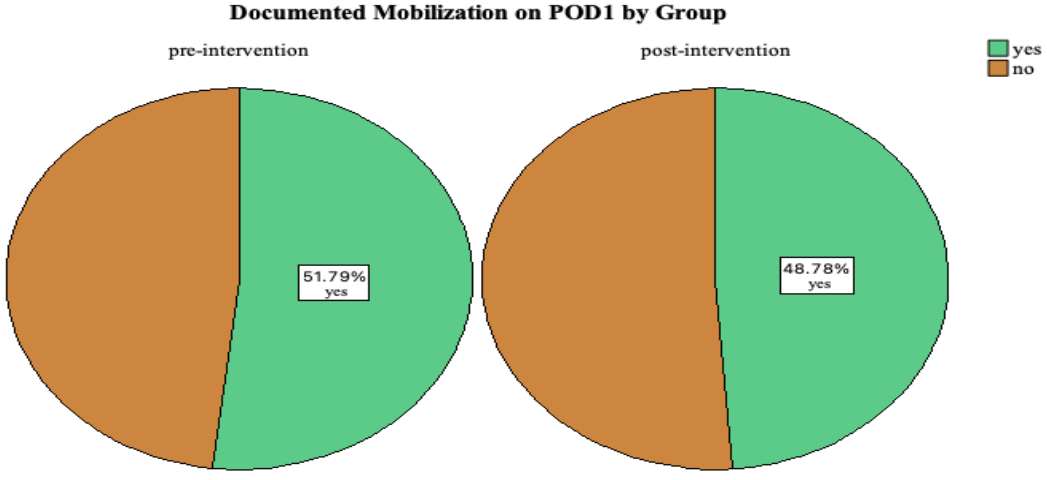
The total number of patients that met inclusion criteria in the pre-implementation group from September 1st, 2023 to December 1st, 2023 was 56 (n = 56). The total number of patients that met inclusion criteria in the post-implementation group from March 10th, 2024 to May 26th, 2024 was 41 (n = 41). Despite similar time frames between the pre- and post-implementation groups, 12 and 11 weeks respectively, the post-implementation group yielded a smaller cohort. Altogether, a total of 97 patients (N = 97) were included in this quality improvement project. Males comprised 61.2% of the total sample (n = 60). The patients ages ranges from 3 days to 23 years old; 55.1% of the patients were under one year of age (n = 54). In the pre-implementation group, 50% of the patients were under one year of age (n = 28). In the post-implementation group, 63.4% of patients were under one year of age (n = 26). Despite having a higher percentage of patients under one year of age, the post-implementation group had a higher mean age (M = 4.47, SD = 6.55) compared to the pre-implementation group (M = 3.63, SD = 5.14) (see Table 1).

Statistical Analysis

To aim of the QI project was to increase the percentage of patients who mobilized on POD 1 by 20%. A pie chart was created to visualize the percentage of patients with documented mobilization on POD 1, demonstrating a higher percentage in the pre-intervention group 51.79% (*n* = 29) compared to the post-intervention 48.78% (*n* = 20) in the post-intervention group (see Figure 1 below). The actual and expected count of patients with and without documented mobilization on POD 1 was extremely close in both categories for the pre- and post-intervention groups (see Table 2.1). A chi-square test for independence was performed to test for a statistically significant difference in the number of patients with documented mobilization on POD 1 between groups. The test yielded a χ^2 value of .086[a], indicating a weak association between the intervention and documented mobilization on POD 1, that was not found to be statistically significant (*p* = .770) (see Table 2.2).

Figure 1

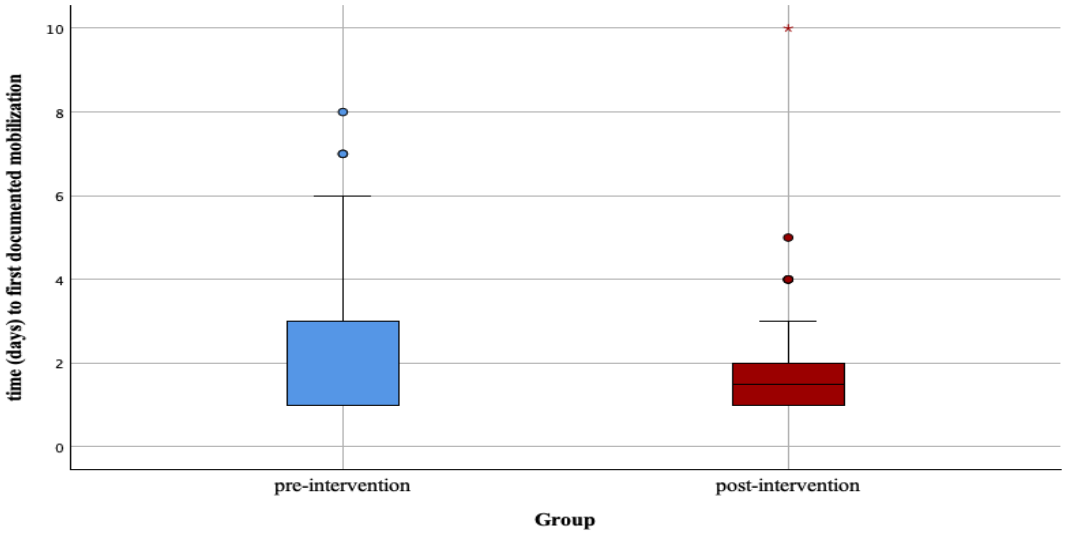
Pie Chart Comparing Percentage of Patients with Documented Mobilization on POD 1 by Group



Although the intervention failed to increase the percentage of patients with documented mobilization on POD 1, it is possible that the intervention impacted the mean time to first documented mobilization. The mean time (days) to first documented mobilization was lower in the post-intervention group (*M* = 2.05, *SD* 1.694) compared to the pre-intervention group (*M* = 2.24, *SD* 1.846) (see Table 3). A box plot was created to visualize the distribution of time to first documented mobilization between the pre- and post-intervention groups (see Figure 2 below). Notably, the box plot illustrates reduced variability and less pronounced outliers in the post-intervention group, with the exception of one extreme outlier. Both the decreased mean and decreased variability suggests potential effectiveness of the intervention in reducing time to mobilization.

Figure 2

Box Plot Comparing the Spread of Time (Days) to First Documented Mobilization by Group



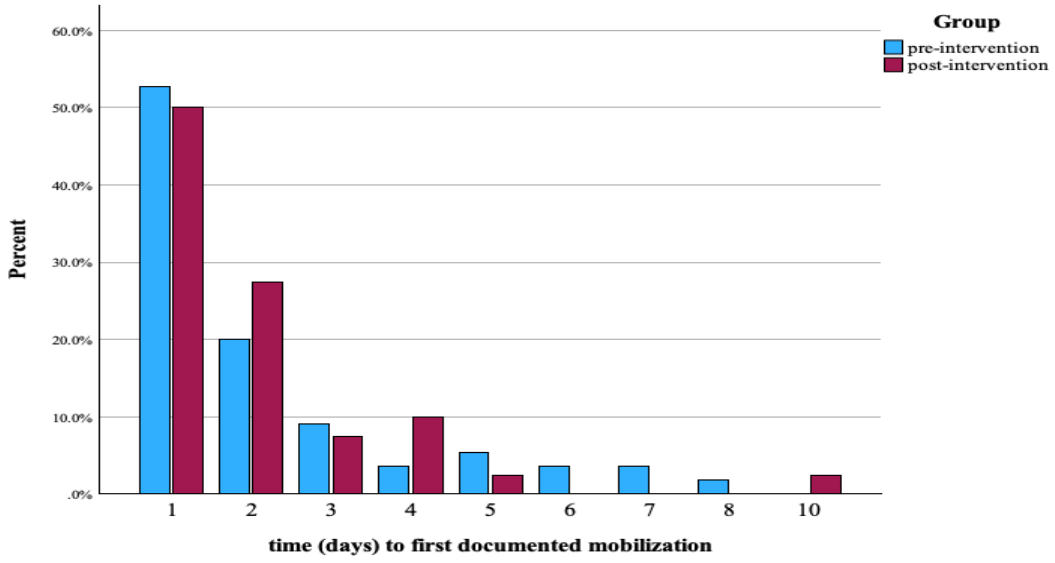
To test for a statistically significant difference in mean time to first documented mobilization, an independent samples t-test was performed. Note, Levene's test for equality of variances determined no significant difference in variances between the group

(F = 1.563, p = .214) and thus equal variances were assumed. Although there is a small mean difference (.186) between groups, it is not statistically significant given the high p-value (p = .616) (see Table 4). Thus, the null hypothesis, that there is no significant difference in the time to mobilization between pre- and post-intervention groups, is retained.

To test for a statistically significant difference in overall time to first documented mobilization, a Mann-Whitney U test was performed. The mean ranks of the pre- and post-intervention groups were very close, 48.28 and 47.61 respectively (see Table 5.1). The test indicates that there is no significant difference between the pre- and post-intervention groups (p = .899) (see Table 5.2). A bar graph was created to visualize overall time to first documented mobilization between the groups (see Figure 3 below). The post-operative day on which patients were first documented to have mobilized was very similar between the pre- and post-intervention groups, with less than a 10% difference on all days.

Figure 3

Bar Graph Comparing Percentage of Patients with First Documented Mobilization Post-Operatively by Time (Days) and Group



A chi-square test for independence was utilized to evaluate the aim of the QI project. To investigate the possible influence of demographics (age, gender) on the aim of the QI project, additional chi-square test for independence was run evaluating the entire sample ($N = 97$). Results indicate that patients 1 year of age and older were significantly more likely to have documented mobilization on POD 1, compared to patients less than 1 year of age ($\chi^2 = 6.587^a$, $p = .010$) (see Table 6). Alternatively, gender did not significantly impact documented mobilization on POD 1 throughout the entire sample ($\chi^2 = .932^a$, $p = .334$) (see Table 7).

Discussion

In the adult post-cardiac surgery population, early mobilization is associated with improved patient outcomes. Early mobilization in the pediatric population is feasible, safe, and may be associated with improved patient outcomes. The aim of this QI project was to increase the percentage of patients in a pediatric cardiac ICU who mobilized on POD 1 by 20%. The intervention included an early mobilization guideline, RN education, and revision of the rounding tool to encourage daily discussion of early mobilization. Data was collected via chart review.

A 12-week PDSA cycle was chosen as the EPB framework, and thus 12 weeks of retrospective post-implementation data was collected ($n = 56$). Due to time limitations, only 11 weeks of prospective post-implementation was collected ($n = 41$). Sample size ($N = 97$) was vulnerable to inclusion criteria and OR scheduling practices. Ideally, the pre- and post-implementation groups would be closer in size for best statistical analysis.

There was no statistical significance shown that the intervention increased the percentage of patients who mobilized on POD 1, and thus the aim of this QI project was

not met. In fact, a slightly higher percentage of patients in the pre-intervention group had documented mobilization on POD 1, 51.8% versus 48.1%, but this was not found to be statistically significant (p = .770). However, the mean time to first documented mobilization was slightly lower in the post-intervention group, 2.05 versus 2.24 days, but this was not statistically significant (p = .616). In a similar fashion, mean ranks of time to mobilization were slightly lower in the post-intervention group, 48.28 versus 47.61, but this was not statistically significant (p = .899).

The only statistical significance found was the impact of age on documented mobilization on POD 1 throughout the entire sample. More specifically, significantly more patients 1 year and older had documented mobilization on POD 1 compared to patients less than 1 year old (p = .010). That being said, it should be noted that the data was unbalanced as the post-intervention group had a greater percentage of patients less than 1 year old, 63.4% versus 50%. Ideally, both groups would have similar age distributions, allowing for a more precise analysis of the intervention's impact and reducing the potential for skewness resulting from age-related differences in mobilization. The mobilization of patients under one year of age is likely influenced by several factors, including generally higher post-operative acuity, a greater likelihood of remaining intubated, and a lack of recognition of mobilization activities within this population.

The data relied on the documentation of RNs and PTs/OTs. While it is standard practice for these services to document mobilization activities, and this practice remained consistent even after the intervention implementation, it is possible that the mobilization documentation was not precisely accurate, and this a limitation of this study. For

example, if an RN sat their patient on the edge of the bed on POD 1 and it was not documented in the chart, this mobilization would not have been reflected in the data.

An obvious limitation of this study was sample size. Collecting data over a longer period would have allowed for a larger sample size and potentially stronger statistical power. With a larger sample size, the impact of additional factors, including intubation status or length of operation or bypass time, on early mobilization could be examined. Additionally, the potential impact of early mobilization on outcome measures, such as chest tube duration and length of stay, could be explored.

Conclusion

In this QI project, initiation of an early mobilization guideline, RN education, and revision of daily rounding tool to include discussion of early mobilization candidacy did not increase the percentage of patients with documented mobilization on POD 1. The implementation of these interventions, and the possible addition of more, in the pediatric post-cardiothoracic surgery population needs to be reevaluated with an additional 12-week PDSA cycle. Based on feedback and observations from the initial 12-week cycle, ensuring adherence to revised daily rounding script, educating patients and families on the benefits of early mobilization, and increased interdisciplinary collaboration would further support the building of a culture that promotes early mobilization in this pediatric cardiac ICU.

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Appendices

Appendix A-1: Early Mobilization Guideline

The Heart Center

Children's HOSPITAL • ST. LOUIS BJC HealthCare

Washington University in St. Louis Physicians

TITLE: Heart Center Early Mobilization Guideline

PURPOSE: Early mobilization of the critical care pediatric patient is demonstrated to be safe, feasible, and associated with improved patient outcomes. The purpose of this guideline is to establish standard criteria that will allow providers and staff to determine whether a patient is safe to participate in mobilization activities with nursing, therapy (PT/OT), and respiratory therapy teams and provide a standardized procedure.

PROCEDURE:

- Daily discussion during morning rounds to determine if patient meets mobilization safety criteria (attached).
- If patient is in the green category, it is expected to mobilize the patient daily. Mobilization activities may include: being held, sitting on the edge of the bed/dangling, sitting in a chair/feeder seat, and ambulation.
- Obtain provider consent and criteria for mobilizing patients in the yellow category.
- Obtain necessary equipment (gait belt, if applicable) and personnel. Refer to **Transport Stability Scale** and **SLCH Equipment & Supply Transport Checklist** for required personnel and equipment when leaving the patients room.
- Assess and optimize patient's comfort/pain level.
- Ensure airway, lines, and dressings are secured.
- Don patient with non-slip socks.
- Review sternal precautions with patient/family, if applicable.
- Ensure the patient and team are ready for mobilization activity. Explain the plan to patient/family. Assign roles to each team member.
- If patient displays signs of distress or instability during mobilization, stay with the patient, stabilize the patient (seat if standing, etc.), allow for rest and provide necessary support. Seek assistance from medical team as necessary.
- Following mobilization activity, assess securement of airway, lines, and dressings.
- Document mobilization activity in EPIC Peds Cares/Safety flowsheet.

(Keeven, K., 2024)

Appendix A-2: Early Mobilization Guideline Continued; Mobilization Safety Criteria

Heart Center Mobilization Safety Criteria

	Safe to mobilize	Discussion with MD/APRN required	Absolute Contraindications
Neurological		• Continuous EEG	• Uncontrolled seizures • Acute change in mental status • Neuromuscular blockade
Respiratory	• Noninvasive respiratory support (NC, HFNC, RAM, BiPAP/CPAP)	• Intubated* • Inhaled Nitric Oxide • Increased ventilatory support	• Intubated **and** on Difficult Airway Service • HFOV • New tracheostomy prior to first trach change
Cardiovascular	• Stable or weaning vasoactive infusion • External pacing wires **not** in use • Stable VAD (after successful first mobilization, no circuit concerns) • Sternal Precautions	• Epinephrine or vasopressin infusion • External pacemaker in use • VAD (first mobilization attempt or circuit concerns) • AKRT	• Open chest • ECMO** • Ongoing hemodynamically significant arrythmia • At high risk for systemic/pulmonary hypertensive crisis • Hemodynamic instability: Increasing inotropic support Lactic acidosis (lactate >3.5) Active resuscitation Active bleeding
Musculoskeletal		• Osteopenia • Stable fracture	• Unstable fracture
Lines & Drains	• PIV • Central line • Arterial line • Chest tube • Foley • Wound Vac	• Intracardiac line • Hemodialysis line • Pericardial drain • Peritoneal drain	

*RT must be present for mobilization of intubated patients. Refer to **Transport Stability Scale** and **SLCH Equipment & Supply Transport Checklist** for required personnel and equipment when ambulating.
**Defer mobilization of ECMO patients to Mechanical Assist Department

(Keeven, K., 2024)

Appendix A-3: Revision of RN Rounding Script to Include Early Mobilization Prompt (highlighted)

Heart Center Work Rounds: Nurse Rounding Script

- **Active concerns/Major concerns for nurses and/or parents**
  - *Example #1: I'm concerned that pain is not well-controlled*
  - *Example #2: I'm concerned that [patient] is having frequent emesis*
  - *Example #3: Parents are concerned that [patient] is not getting better as quickly as they hoped/anticipated (can be stated by either nurse or parents, based on parent preference/ comfort)*

Systems-based report:

Neuro	
Is the patient's pain well controlled? Y/N ❖ Is patient meeting their RASS goal? Y/N ❖ RASS goal: ❖ # sedation boluses required in last shift and last 24h to achieve goal: ____	WAT scores ___ CAPD scores ___
Are therapies ordered? Y/N ❖ Speech/OT/PT ❖ Are therapies being completed? Y/N ❖ If N: why not?	Is patient a candidate for early mobilization? Y/N ❖ If N, why not? Are developmental targets being followed *(activity/schedule/ feeding/holding)*? Y/N ❖ If N, why not?
Cardiopulmonary	
RN Concerns Y/N *(If Y: perfusion/pulses/lung sounds)*	RT Concerns Y/N *(changes in lung compliance, secretion, effectiveness of airway clearance)*
Pacemaker in place? Y/N ❖ If yes- temporary or permanent ❖ If temporary- wires capped or in use ❖ Is box nearby and ready for use?	VAP measures are in place? Y/N ❖ HOB elevated? ❖ Oral Care?
Is the patient on ECMO or VAD? Y/N ❖ Report circuit settings: flow_____ sweep_____ FDO2_____ cardiac index_____ ❖ Report circuit/cannula concerns	Is patient meeting Target Based Care targets? Y/N ❖ If N, why not? (*team discussion)* Is patient on the CAP Bundle? Y/N
Renal/Fluids	
UOP last 24 hours _____; last 12 hours _____ ❖ *Use ml/kg/hr for pts <60 kg* ❖ *Use total mL in patients > 60 kg*	Was fluid balance goal met in last 24h? Y/N ❖ If N- why not?
Is pt on CRRT/PD?—Y/N	Foley in place? – Y/N ❖ Problems with foley? Y/N ❖ Can foley be removed? Y/N *HOUDINI indications for continued use: Hematuria, Obstruction, Urologic Surgery, Decubitus, I&O Critical, Neurogenic bladder, Immobilized)*
Nutrition	
Patient is on enteral feeds—Y/N ❖ Oral? ❖ Tube Feeds? (GT/NG/NJ)	Patient is on TPN/lipids—Y/N

Complete order readback for any changes

Appendix B: Tables

Table 1

Descriptive Statistics for Age (years) by Group

Group	N	Mean	Minimum	Maximum	Std. Deviation
pre-intervention	56	3.6275	.01	23.00	5.138
post-intervention	41	4.4659	.01	21.00	6.549

Table 2.1

Documented Mobilization on POD 1 by Group Crosstabulation

			Documented mobilization on POD1		
			yes	no	Total
Group	pre-intervention	Count	29	27	56
		Expected Count	28.3	27.7	56.0
		% within Group	51.8%	48.2%	100.0%
	post-intervention	Count	20	21	41
		Expected Count	20.7	20.3	41.0
		% within Group	48.8%	51.2%	100.0%
Total		Count	49	48	97
		Expected Count	49.0	48.0	97.0
		% within Group	50.5%	49.5%	100.0%

Table 2.2

Chi-Square Test for Independence [Documented Mobilization on POD 1 by Group]

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.086[a]	1	.770
N of Valid Cases	97		

Table 3

Descriptive Statistics for Time (days) to First Documented Mobilization by Group

Group	N	Mean	Minimum	Maximum	Std. Deviation
pre-intervention	55*	2.24	1	8	1.846
post-intervention	40*	2.05	1	10	1.694

**n*=1 excluded from each group due to no documented mobilization

Table 4

Independent Samples Test Comparing Time (days) to First Documented Mobilization Between Groups

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig (two-tailed) p	Mean Differ-ence	SE Differ-ence	95% Confidence Interval	
									Lower	Upper
time (days) to first documented mobilization	Equal variances assumed	1.563	.214	.503	93	.616	.186	.371	-.550	.922

Table 5.1

Ranks of Time (Days) to First Documented Mobilization by Group

	Group	N	Mean Rank	Sum of Ranks
time (days) to first documented mobilization	pre-intervention	55	48.28	2655.50
	post-intervention	40	47.61	1904.50
	Total	95		

Table 5.2

Mann-Whitney U Test Statistics

	time (days) to first documented mobilization
Mann-Whitney U	1084.500
Z	-.127
Asymp. Sig. (2-tailed)	.899

a. Grouping Variable: Group

Table 6

Chi-Square Test for Independence [Documented Mobilization on POD 1 by Age (≥ 1 year)]

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.587[a]	1	.010
N of Valid Cases	97		

Table 7

Chi-Square Test for Independence [Documented Mobilization on POD 1 by Gender]

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.932[a]	1	.334
N of Valid Cases	97		