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Reducing costs and improving patient recovery through a nurse-driven centralized spinal orthoses program on a post-surgical unit: A quality improvement initiative

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ABSTRACT

Background: An external vendor providing off-the-shelf spinal orthoses to inpatients created significant costs and barriers to quality care for spinal surgery patients. A nursing leadership team initiated a quality improvement project to reduce the cost of providing off-the-shelf spinal orthoses and improve the care provided to spinal patients.
Objective: To develop and evaluate a nursing-led process for providing off-the-shelf orthoses to spinal surgery patients and eliminate high costs.
Design: Quality improvement project evaluated as a retrospective interrupted time-series
Setting: Post Surgery Inpatient Unit Level II Trauma Center in a United States hospital located in Florida
Participants: Vendor Program: 134 patients; Centralized Program: 155 patients
Methods: The nursing leadership team developed a centralized spinal orthoses program where the bedside nurse fitted the patient with a spinal orthosis, eliminating the need for an external orthotist. The study quantifies changes in study metrics by comparing patients identified through chart review who received care in the vendor program to those who received care in the centralized program utilizing nonparametric statistical techniques.
Results: The centralized nursing-led spinal orthosis program allowed the unit to mobilize patients more quickly than patients managed under the vendor program (3.85 hr. [95 % CI: 1.27 to 7.26 hrs] reduction; $p = 0.004$). The overall length of stay was reduced by 0.78 days ([1.34 – 0.02 days]; $p = 0.063$) or 18.72 h. While the statistical test did not indicate significance, the 18.72-hour reduction in length of stay represents a potential clinically relevant finding. Evaluating patients that suffered a primary spinal injury and no complications (vendor program: 54 patients; centralized program: 86 patients) showed a similar reduction in time to mobilization (4.5 hr reduction [0.53 to 12.93 hrs]; $p = 0.025$), but the length of stay reduction increased to 1.02 days [0.12 to 1.97 days], a difference determined to be statistically significant ($p = 0.014$). Centralizing the process for providing off-the-shelf spinal orthoses reduced the cost of a thoracic-lumbar sacral orthosis by $1,483 and the price of a lumbar-sacral orthosis by $1,327. Throughout the study, the new program reduced the cost of providing spinal orthoses by $175,319.

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Conclusions: The results demonstrate that the nursing-led centralized spinal orthosis program positively impacted the quality of care provided to our patients while also reducing the cost of delivering the orthoses.
Tweetable abstract: A nursing-led centralized spinal orthosis program reduces the cost of care while reducing time to mobilization and length of stay.

What is already known

- Healthcare costs continue to increase, and hospital administration stresses that nursing leadership, such as nurse unit manager, nurse quality manager, nursing director, or chief nursing officer, should control costs while maintaining the quality of care.
- External vendors that provide services at the hospital contribute to the cost of care.

Data availability

The corresponding author will make the de-identified data and the analysis R scripts available upon reasonable written request.

What this paper adds

- A nursing-led spinal orthosis program demonstrates cost savings by eliminating an external vendor.
- Centralizing the process of providing spinal orthoses led to reduced mobilization time and decreased length of stay, demonstrating how a centralized process might improve the quality of care.

Data availability

The corresponding author will make the de-identified data and the analysis R scripts available upon reasonable written request.

1. Background

In 2021, hospital expenditures in the United States grew 4.4 % to $1323.9 billion, and physician and clinical services expenditures increased 5.6 % to $864.6 billion ("NHE Fact Sheet," 2023). With the continued increase in healthcare costs and pressure to improve patient satisfaction, clinicians proactively identify continuous enhancement opportunities to improve the quality and costs of care while maintaining safe and efficient best practice interventions. At the study hospital, quality improvement project teams utilize the Triple Aim system to achieve this goal (Berwick et al., 2017). This system implements change by improving patient experience, health, and outcomes while reducing care costs.

Immobilization of the lower spine with a spinal orthosis represents a conservative treatment for stable spinal injuries or a surgeon-required intervention following spinal surgery. Historically, an orthotist would graft a custom spinal orthosis for each patient leading to a costly expense for spinal injury patients; however, with the advent of off-the-shelf orthotics, an orthotic pre-manufactured in different sizes and adjusted to fit the patient at the time of use to provide the same immobilization as a custom orthotic, provides an alternative. Orthotic vendors commonly provide both custom and off-the-shelf orthotics; however, recent studies demonstrate that hospitals can realize significant cost savings and eliminate delays in care by providing off-the-shelf spinal orthotics directly to their patients (Hanson et al., 2019; Willey et al., 2022).

Surgeons at the study hospital require lumbar, thoracic, and sacral spinal surgery patients to remain on bed rest until the patient receives a spinal orthosis. Before this project, the hospital utilized an external orthotist to evaluate, measure, and fit the patient for off-the-shelf and custom thoracic lumbar-sacral or lumbar-sacral orthotics. This process required at least 24 h to complete, unnecessarily prolonging immobilization in bed and increasing the risk of complications for the patient (Chakravarthy et al., 2019; Huang et al., 2021; Nazemi et al., 2017). Additionally, the hospital absorbed the costs of the provided orthotic, creating a resource burden for the hospital. A cost analysis associated with the vendor found that the charges to the hospital exceeded the average cost of the off-the-shelf orthotics by a factor of four (Hanson et al., 2019). In essence, the external vendor charged the hospital service fees to evaluate, measure, and fit the patient, in addition to charging the same amount for an off-the-shelf orthotic as charged for a custom orthotic created to fit the patient's specific anatomy. The unit nursing manager also identified instances, where patients admitted on a different floor received two orthotics due to poor documentation, further increasing costs absorbed by the hospital. The poor service provided by the original vendor negatively impacted the quality of care and caused significant hospital spending, creating an opportunity for positive change.

These quality issues led to a Triple Aim project to centralize providing off-the-shelf orthoses to certain spinal surgery patients under a nursing leadership team, including the nursing manager, clinical resource nurse, and the unit's associate vice president. The nursing leadership team formed an interdisciplinary task force to optimize the process for providing spine surgery patients with a spinal

orthotic by the bedside nursing team. The primary objective is to reduce costs and, secondarily, improve the quality of care for our patients as measured through time to mobilization and length of stay.

2. Methods

2.1. Study facility

The authors completed this study on the post-surgery inpatient floor at a Level II Trauma Center in Central Florida. The 864-bed hospital received 40,966 adult admissions, 199,927 emergency department visits, and completed 20,517 surgical cases in FY 2022. The medical staff consists of over 600 employed and independent clinicians. The post-surgery inpatient unit has 48 beds and 115 staff. The hospital's Internal Review Board approved the study protocol and waived the requirement for informed consent.

2.2. Quality improvement initiative

The nursing leadership team from the inpatient surgery department led an interdisciplinary task force aimed to address the quality and financial issues identified with the current process. The task force included critical stakeholders from finance, supply chain, industrial engineering, and clinical informatics, intending to reduce costs and improve the process for brace ordering and application for spinal surgery patients. During this process, the team utilized Lean Six Sigma strategies to identify flaws in the current process and analyze, redesign, and improve the new process to suit the organization's needs better.

The task force investigated utilizing off-the-shelf orthoses that the surgical unit stocked and the nursing team fitted to patients to ensure timely mobilization of patients and reduce excessive charges associated with spinal orthoses. Taskforce representatives from the finance and supply chain provided historical spending data with the vendor and helped identify alternative vendors for evaluating off-the-shelf spinal orthoses. The representative from industrial engineering helped the nursing team optimize the new process for providing the service using Lean Six Sigma strategies. Clinical informatics team members worked within the task force to create electronic health record interfaces to implement and evaluate the centralized program.

To enable this initiative, the supply chain team identified vendors to meet the necessary bracing requirements with a device that the nursing team could customize and learn quickly. Nursing and supply chain team members identified a customizable off-the-shelf system requiring only two brace types, lumbar-sacral and thoracic, lumbar sacral orthoses, in three sizes to meet our unit's needs. The supply chain team members helped the nursing leadership team members determine appropriate par inventory levels to ensure the capability to provide spinal orthoses on demand. The project team identified a location on the unit to store inventoried spinal orthoses to facilitate unit workflows.

The nursing manager and clinical resource nurse arranged multiple training sessions with the new medical supply vendor representative to ensure all nursing and physical therapy team members understood how to measure, fit, and apply the orthotic to patients. Clinical informatics team members developed an easy-to-use ordering form in the electronic health system with drop-down selections for the products stocked and the available accessories indicated per clinician preference. Once a clinician orders an orthosis, the electronic health record system automatically notifies the patient's registered nurse. Each notification provides the nurse instructions on measuring the patient and what brace components to use to fulfill the clinician's order.

The patient's registered nurse or ancillary support staff uses the information provided in the order and the decision tree guide located in the storeroom to select the correct orthosis for the patient. The decision tree guide directs the staff member to the proper numbered shelf to help ensure the patient receives the appropriate orthosis. The team member places the orthosis in the patient's room so that no delay in ambulation occurs when the clinician approves ambulation, often on the same day or the following morning. After receiving the ambulation order, a registered nurse, ancillary support staff, or a physical therapist places the orthotic on the patient and performs the ordered level of ambulation.

Improved brace availability enabled the nursing leadership team to develop a universal postoperative care bundle to improve patient care. The bundle development team, which consists of nurses from the inpatient post-surgery unit, planned to reduce the incidence of postoperative complications in the unit by using evidence-based interventions proven to minimize the risk to the patient. Bundle elements included early ambulation (by 0700), immediate postoperative use of incentive spirometry, universal sequential compression devices, and pneumatic stockings. Each of these interventions helps to minimize the risk of post-surgical complications and maximize recovery (Debono et al., 2021; Zaed et al., 2022). The bundle also included patient education on pain medication and its side effects to help patients recover more efficiently and avoid dependency on the medication(Pennington et al., 2021; Prabhakar et al., 2022).

The nursing leadership team tracks real-time postoperative bundle compliance and effectiveness on a Gemba board. We placed the Gemba board in a location for all staff and patient consumption to demonstrate our commitment to quality of care. Hospital administration stays informed on the bundle's success by attending weekly Gemba walks to understand new initiatives and trends and celebrate successes (Bourgault et al., 2018).

2.3. Study design and analysis

This study evaluated the impact of the nursing-led centralized spinal orthoses program implemented in the post-surgery inpatient unit for all patients who required spinal surgery. The authors performed a retrospective chart review to identify the applicable patients. Patients who received a spinal orthosis (off-the-shelf or custom) from our former vendor primarily between January 2019 and

February 2020 (fifteen patients received an orthosis after implementation of the centralized program) formed the Vendor Group (n = 134), and patients who received off-the-shelf spinal orthoses from the nursing-led centralized program between February 2020 and October 2021 formed the Centralized Group (n = 155).

Data extracted during the chart review includes basic demographic information and study-related variables from the facility's electronic health record system. The hospital's data analysis team identified and extracted applicable data for the study. The project allowed the study team to flag all patients who received a spinal orthosis from either the vendor or the centralized process. The extraction query pulled the following study variables from identified patient records: primary and secondary diagnosis, including the reason for surgery, brace type, brace cost, discharge location, insurance/payer type, complications or delays in spinal care from another injury, and the following dates and times: admission, time of orthosis order, time of the first ambulation, and hospital discharge. The research team used the date and times to calculate times to ambulation (from admission and brace order) and length of stay. The researchers used diagnoses, discharge locations, and payer type to identify different subgroups that may experience increased benefits from the centralized spinal orthosis program.

Electronic records for patients managed under the vendor program sometimes did not list the orthosis delivery date and time. The research team accounted for the missing data by estimating the earliest possible delivery time using the order, ambulation times, and delivery patterns for the vendor. The vendor typically delivered spinal orthoses at the beginning or end of the day. This strategy ensured that the delivery estimation bias introduced into data favored the vendor program, not the new centralized program.

While cost savings represented the primary motivation for this project, the nursing leadership team anecdotally noted an improved ability to mobilize patients and provide care to their patients by controlling the process of delivering spinal orthoses. As such, the secondary outcomes for this study included time to first ambulation/mobilization, length of stay, and cost savings for spinal orthoses.

Data analysis occurred in R statistical software (version 4.3.1) using the RStudio user interface (version 2023.06.0). Shapiro-Wilk tests showed that continuous data did not follow a normal distribution; therefore, the analyst used the Wilcoxon Rank Sum test to identify statistically significant differences between the two groups and report shifts in the median with 95 % confidence intervals. The study's primary objective aimed to determine if the centralized program positively affected patient outcomes, namely a decrease in length of stay and time to mobilization. As such, the reported p-values comparing outcomes result from a one-sided statistical test evaluating if the analyzed outcome decreased following the implementation of the nursing-led centralized spinal orthosis program. This data treatment helps minimize outlier data's influence on statistical analysis. We report all continuous data as a median with the interquartile range for the variable. We analyzed categorical demographic data with a two-sided Fisher's Exact or Chi-squared test. A significant difference required a p-value less than 0.05.

3. Results

Table 1 presents the demographic data for spinal surgery patients treated under vendor (n = 134) and centralized programs (n = 155). Statistical analysis found that the two groups were not statistically different in age, gender, primary or secondary spine injury, and insurance type. However, case source (p = 0.023) and discharge location (p = 0.022) differed significantly between the two study

Table 1
Demographics of vendor and centralized patient cohorts.

Variable	Vendor	Centralized	P-Value	Odds Ratio
Patients	134	155	NA	NA
Age	69 (18 - 90)	67 (17 - 88)	0.61	NA
Gender (M/F)	67/67	72/83	0.56	NA
Primary Diagnosis				
Secondary Spine Injury	**14 (10.4 %)**	**11 (7.1 %)**	0.42	NA
Primary Spine Condition	**120 (89.6 %)**	**144 (92.9 %)**		
Spinal Stenosis	34 (25.4 %)	41 (26.5 %)	1.00	NA
Spondylosis and Spondylolisthesis	33 (24.6 %)	52 (33.5 %)	0.59	NA
Vertebra Fracture or Collapse Injury	26 (19.4 %)	8 (5.2 %)	0.001	0.21 [0.09 - 0.49]
Disc Related Injury	22 (16.4 %)	36 (23.2 %)	0.70	NA
Other Spine Condition	5 (3.7 %)	6 (3.8 %)	1.00	NA
Case Source				
Office Referral	90 (67.2 %)	123 (79.4 %)	0.023	1.89 [1.11 - 3.19]
Emergency\Trauma	44 (32.8 %)	32 (20.6 %)		
Discharge Location				
Home	28 (20.9 %)	58 (37.4 %)	0.012	2.26 [1.33 - 3.84]
Home Health	57 (42.5 %)	65 (41.9 %)	1.000	NA
Rehab	16 (11.9 %)	17 (11.0 %)	0.85	NA
Skilled Nursing Unit	25 (18.7 %)	10 (6.5 %)	0.010	0.30 [0.14 - 0.65]
Other (Death, LTAC, Hospice, and Psychiatric Facility)	8 (6.0 %)	5 (3.2 %)	0.394	NA
Insurance				
Medicare or Medicare Advantage	81 (60.4 %)	100 (64.5 %)	0.076	NA
Medicaid	9 (6.7 %)	11 (7.1 %)		
Private	34 (25.6 %)	42 (27.1 %)		
Government or Worker's Compensation	8 (6.0 %)	0 (0.0 %)		
Self-Pay	2 (1.5 %)	2 (1.3 %)		

periods. More patients treated during the centralized period received surgery after office referral (Odds Ratio: 1.89 [1.11 - 3.19]). Post-hoc analysis of discharge location found that the hospital discharged more patients home during the centralized program ($p = 0.012$; OR: 2.26 [1.33–3.84]) and more patients to a skilled nursing facility during the vendor program ($p = 0.010$; OR: 0.30 [0.14 - 0.65]). A sub-analysis of spinal conditions found a higher occurrence in the vendor group for vertebra fractures and collapsed vertebrae ($p = 0.017$; OR: 0.21 [0.09 - 0.49]).

The two programs showed a difference in the cost of providing a spinal orthosis and fitting service to spinal surgery patients. The vendor program cost the hospital $1770 for a thoracic-lumbar sacral orthosis and $1584 for a lumbar-sacral orthosis, regardless of whether the vendor provided a customized or off-the-shelf brace. In contrast, the centralized program allowed the nursing team to provide the same service for $287 for a thoracic-lumbar sacral orthosis and $257 for a lumbar-sacral orthosis. Cost savings realized by centralizing the process for spinal orthoses totaled $175,319 for patients treated in the centralized program. The hospital also eliminated $122,462 in fees charged by the vendor to evaluate, fit, adjust, and deliver spinal orthotics to the hospital. Therefore, overall cost savings from implementing the centralized program equaled $297,781 for the centralized period. When annualized, the cost savings equate to $178,669 per year.

Fig. 1 summarizes findings for time-to-patient mobilization from admission (A&B) and the length of stay (C&D) for all included patients. Both outcome measures reflect the diverse range of patient acuity at the study facility by the multiple outliers outside the whisker margins (Fig. 1A&C). A two-sided Wilcoxon Rank Sum test identified a significant difference in time to mobilization from admission (Median: Centralized = 29.96 hrs vs. vendor = 34.49 hrs.; $p = 0.004$; median shift: −3.85 h [−7.26 to −1.27 h]; odds ratio: 1.50 [1.15 – 1.97]) and a trend toward a statistically significant reduction in length of stay (Median: Centralized = 5.22 days vs. vendor = 6 days; $p = 0.063$; median shift: −0.78 days [95 % CI: −1.34 to 0.02 days]; odds ratio: 1.29 [0.99 – 1.69]) for patients managed under the centralized program. Fig. 1B and 1D eliminate the outliers to better visualize group differences. Although the statistical test for the length of stay identified only a trend, an overall median shift of 0.78 days, or 18.72 h, could indicate a clinically significant change in length of stay.

The patient cohort identified for this study includes trauma patients presenting in critical condition, patients with chronic conditions, and relatively healthy patients requiring elective spinal surgery. Complications delay care during hospitalization, leading to prolonged length of stay. As such, patients without complications benefited most from centralizing the process to provide and fit off-the-shelf spinal orthoses. One hundred seventy patients met this definition, with 86 in the centralized program and 54 in the vendor program ($p = 0.013$; odds ratio: 1.85 [1.16 – 2.95]).

Fig. 2 displays the results from the analysis of patients who did not experience a complication during hospitalization. Patients managed under the centralized program experienced quicker mobilization ($p = 0.025$) with a median shift of −4.50 h (95 % CI: −12.93 to −0.53 h; odds ratio: 1.50 [1.06 – 2.13]) (Fig. 2A and C) and a shorter length of stay ($p = 0.014$) with a median shift of −1.02 days (95 % CI: −1.97 to −0.12; odds ratio: 1.56 [1.10 – 2.21]) (Fig. 2B and D). The centralized program discharged 79 % of patients without complications to home (with or without home health) compared to 56 % in the vendor program ($p = 0.0017$).

Supplemental Table 1 provides the statistics used to create the box and whisker plots in Figs. 1 and 2. The table allows the reader to compare actual quartile locations and whisker extents for each group side by side.

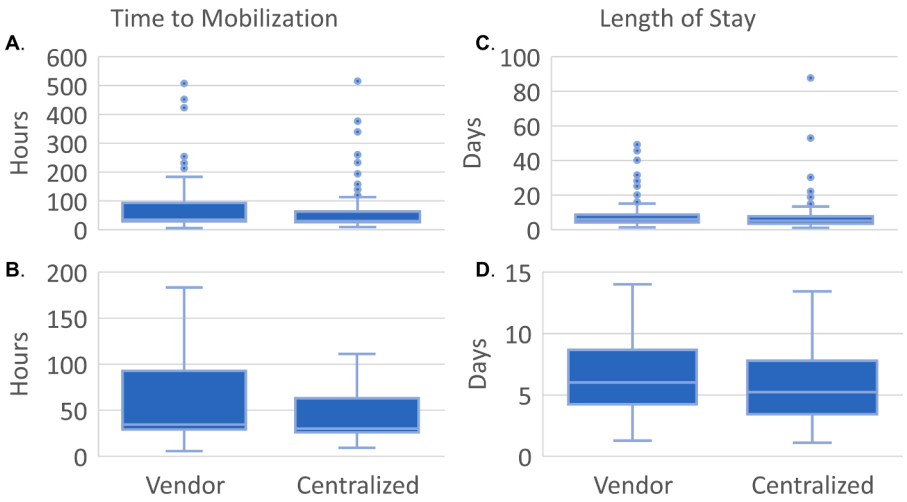


Fig. 1. Centralization of spinal orthoses decreases time to mobilization and trends towards a length of stay reduction. Time to mobilization (A&B.) and length of stay (C&D.), of patients managed before and after centralization of spinal orthoses. Panels A and C show all patient data, including outliers from each program cohort (dots outside the upper whisker). Panels B and D display the data with outliers removed to illustrate better the decrease in the centralized program's time to mobilization. Box extent identifies the 25th and 75th percentile for the population. The line through the box identifies the median. Whisker extent represents 1.5 * the interquartile range. The shifts in the box and whiskers represent the outcomes of the Wilcoxon-Rank Sum Test Outcomes.

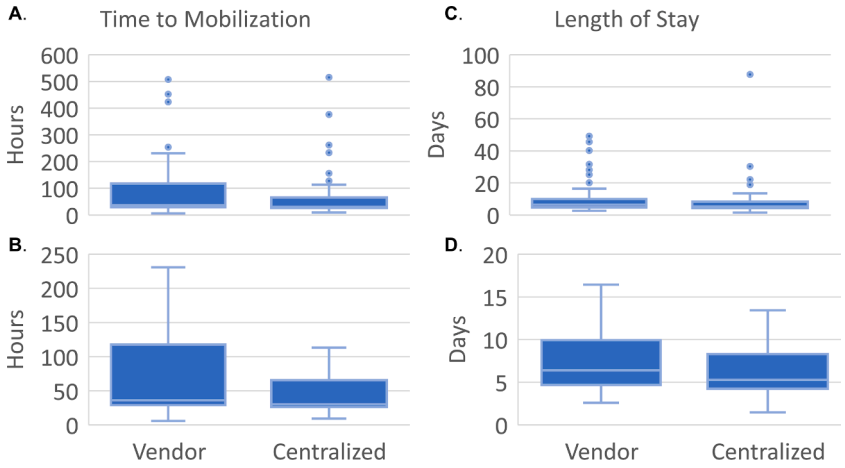


Fig. 2. Patients with no complications experienced shorter times to mobilization and length of stay under the centralized program. Time to mobilization (A&B.) and length of stay (C&D.), of patients without complication managed before and after centralization of spinal orthoses. Panels A and C show all patient data, including outliers from each program cohort (dots outside the upper whisker). Panels B and D display the data with outliers removed to illustrate better the centralized program's benefits to included patients. Box extent identifies the 25th and 75th percentile for each population. The line through the box identifies the median. Whisker extent represents 1.5 * the interquartile range. The shifts in the box and whiskers represent the outcomes of the Wilcoxon-Rank Sum Test Outcomes.

4. Discussion

Taking ownership of providing spinal orthoses to surgical spinal patients resulted in a higher quality of care across our unit. The program significantly reduced hospital costs by providing off-the-shelf orthoses directly to patients. During the study, the hospital experienced a direct cost savings of $175,319 for the brace and an additional $122,462 in fees charged by the vendor for fitting, delivery, and adjustments, all processes internalized by the centralized program. These direct cost savings do not include indirect savings potentially realized from the program. The new program helped our team mobilize patients timelier to maximize recovery. Overall, we identified a trend indicating an 18.72-hour reduction in length of stay, a potential clinically relevant finding to accompany the significant decrease in time to mobilization. We investigated the length of stay trend further by focussing on patients without complications during care. This sub-population under the centralized program experienced a similar significant reduction in time to mobilization and a significant decrease in length of stay (1.02-day reduction).

This project's primary goal was to reduce the cost of care without compromising the quality of care provided to our spinal surgery patients. We accomplished this goal by working through our interdisciplinary task force to identify an alternative to the vendor and working with the manufacturer to train and educate our bedside clinician staff to fit the patients. The cost savings and secondary benefits reported in this study are similar to those reported in the literature. Hanson and colleagues showed that "off-the-shelf" adjustable orthoses positively affect patient recovery when used in place of a custom orthotic. The researchers found that brace-associated costs decreased significantly ($1352.41 versus $3719.53, respectively) (Hanson et al., 2019). A similar study led by physical therapists to centralize the process of fitting and providing off-the-shelf orthotics found a cost savings of $2023.40 per patient, in addition to shorter times to ambulation and lengths of stay (Willey et al., 2022). These cost savings per patient are similar to the $1921.20 identified in the current study.

While cost savings represented the primary objective of this study, we secondarily evaluated time to ambulation and length of stay to evaluate the impact of the internal centralized process for providing spinal orthotics to our patients post-spinal surgery. Overall, we showed decreased mobilization time for patients managed under the centralized program. Positive outcomes from early ambulation postoperatively include increased muscle tone, improved gastrointestinal and urinary function, stimulation of the body's circulatory system, and improved vital capacity (Hoch, 2014). Early ambulation represents a key component to any enhanced recovery after surgery program, regardless of surgery type. Benefits afforded to patients with early mobilization include decreased complication rate, lower postoperative pain, decreased physical decline, and a shorter length of stay(Hoyer et al., 2016; Tazreean et al., 2022; Zaed et al., 2022). Patients managed under the centralized program experienced fewer complications and those without complication achieved early discharge compared to those managed under the vendor program.

This study's findings show a potentially clinically relevant overall reduction in length of stay. When considering only patients who did not experience a complication, this study identified a reduced length of stay for patients managed under the centralized program. These observations agree with findings previously reported in the literature that show early ambulation with a spinal orthotic can help to decrease a patient's length of stay (Hoyer et al., 2016; Stethen et al., 2018; Willey et al., 2022). A reduction in the number of inpatient days results in decreased risk of infection and medication side effects, improvement in the quality of treatment, and increased hospital profitability margins with more efficient bed management (Baek et al., 2018; Horn et al., 2018; Lakomkin and Hadjipanayis, 2017).

Under the vendor program, post-surgical patients had to wait for the fitting, delivery, and any necessary adjustments by the

external vendor or physical therapy. Coordination and logistical delays ultimately prolonged the postoperative period to ambulation. The unit experienced a low incidence of postoperative aspiration from immobilized patients attempting to eat while lying flat in the bed, and mobilization delays negatively impacted the multidisciplinary care team, including the ability of physical therapy to work with the patient. The centralized program allowed the unit to implement a universal postoperative care bundle for all surgical patients. The centralized program ensured our patients received the orthotic as soon as possible and enabled our patients to mobilize at 0700 the next day. In the study, we saw reduced complications for patients in the centralized cohort compared to the vendor program, potentially reflecting the positive impact of quality improvements made during this project and the implementation of the post-operative care bundle. The observed improvements in complication rates and length of stay reduction agree with other studies on early recovery after surgery initiatives in spinal surgery(Burgess and Wainwright, 2019; Zaed et al., 2022).

Since completing the quality improvement project, the facility has continued to experience additional benefits that directly or indirectly resulted from the centralized spinal orthosis program. First, the surgical unit has experienced a noticeable increase in patient and family satisfaction scores, which the nursing leadership team attributes to the postoperative care bundle implemented with the centralized program. The centralized spinal orthosis program has expanded outside the surgical unit, and bedside nurses now provide and fit patients with spinal orthoses in other units, including the emergency department. Fitting spinal orthoses in the emergency department prevents unnecessary admissions for stable spinal fractures. Before the program, the hospital admitted these patients while they waited for the vendor to bring an orthosis. This process change helps free up beds in the ED, increasing throughput and preventing unnecessary bed occupancy, improving healthcare utilization (Edwards et al., 2017; Willey et al., 2022).

5. Limitations

We centralized the process for providing spinal orthoses during the COVID-19 pandemic. The pandemic strained hospital resources and created challenges for the task force to overcome. These factors likely introduced unintended and unpreventable bias related to practice restrictions necessitated by the pandemic. The vendor program had more patients discharged to skilled nursing facilities. In comparison, the centralized program discharged more patients to home, potentially because of limited space or COVID-19 prevention policies at skilled nursing facilities (Thompson et al., 2020). Furthermore, more patients received surgery after an office consultation in the centralized program than in the vendor program, potentially because patients avoided the emergency department during the pandemic. As such, the higher number of patients receiving surgery after office consultation could represent a confounding factor influencing the reported outcomes because these patients are generally healthier than trauma patients.

However, pandemic influence does not wholly account for the differences between the two populations. First, a patient must achieve a certain level of independence to be discharged home without nursing care. If the centralized program had no direct impact, then the study results would show no change or an increase in length of stay. In contrast, this study shows decreased length of stay in patients without complications despite the difficulties experienced during the pandemic. Further, evaluating patients without complications helps limit potential confounding related to increased elective surgery in the post-centralization period by focusing on the healthier patients regardless of surgery source.

Pausing elective surgeries between Feb. 2020 and June 2020 limited the number of spinal cases that required an orthosis, leading to a need to re-educate nursing staff on the program once elective surgeries resumed. We also encountered reluctance from providers and the nursing team due to relationships formed with the previous vendor. We overcame this reluctance by demonstrating time savings and ease of use to the nursing staff. Nursing staff also experienced more hands-on care through direct mobilization of their patients, resulting in maximized physical therapy sessions. The hospital's Executive leadership helped achieve provider compliance by demonstrating cost and care efficiency improvements and empowering the nursing manager to confirm compliance with hospital policies concerning the need for custom spinal orthoses provided by the previous vendor.

The evaluation of the quality improvement project's impact followed an interrupted time-series retrospective design where data was collected before and after the implementation of the centralized program. This design introduces the risk of confounders potentially influencing observed outcomes. A hospital unit always strives to improve the quality of care delivered to its patients and to minimize hospitalization duration, which could account for improvements seen in patient mobilization and length of stay. However, the unit did not implement process changes beyond what this paper describes during the study timeframe. As discussed previously, pandemic challenges would likely reduce the quality of care and not lead to the reported improvement. While cofounders may influence the results in any before and after design, the risk of beneficial bias for this study is low.

A retrospective study must rely on chart reviews and documentation quality. During the vendor program, charts did not always confirm the delivery of an orthosis. In these cases, the research team assumed the best-case delivery time to minimize bias for delivery time in favor of the centralized program. A possibility also exists that a complication or extenuating circumstance was not documented appropriately in the charts, or the team did not identify an occurrence that may have artificially inflated study outcomes. While a possibility, the risk of such an occurrence is equally distributed between the two study groups. While risks of bias are always present in retrospective studies, the results reported from this study are similar to those of comparable studies (Hanson et al., 2019; Willey et al., 2022). This study also did not evaluate patients managed conservatively with only an orthosis; however, the observed improvements in time to mobilization and length of stay following surgery likely extend to patients managed conservatively. Anecdotally, we observed this extension by preventing admissions by fitting patients within the emergency department after completion of the study, a capability not possible in the vendor program.

6. Conclusions

Rising healthcare costs and a push to increase the value of our hospital's care prompted a nurse-led process change in spinal orthosis ordering, fitting, and delivery to patients. The new process allowed our unit to significantly reduce the cost of each back orthosis, ultimately saving the hospital almost $300,000 in the first year of implementation on one unit. Additionally, we decreased patients' length of stay by approximately 18 h and ambulated patients 4 h sooner under the centralized programs. The length of stay and time to ambulate was further reduced for patients who did not experience a complication in the hospital, allowing us to discharge more patients home without nursing care. Our success has led the hospital to centralize the process throughout our facility, and the program now helps prevent admissions by providing spinal orthoses in the emergency department. These findings support the implementation of a nursing-led centralized orthosis program and demonstrate how nurse-driven quality improvement programs can help healthcare facilities reduce costs and improve the quality of care for patients.

CRediT authorship contribution statement

Amber Odom: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Leonie James:** Writing – review & editing, Writing – original draft, Investigation, Data curation. **Sheena Butts:** Writing – review & editing, Supervision, Resources, Project administration. **Charles J. French:** Writing – review & editing, Resources, Project administration, Methodology, Funding acquisition, Conceptualization. **Jonathan M. Cayce:** Writing – review & editing, Writing – original draft, Software, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of competing interest

Authors CJF and JMC are employed by DeRoyal. All other authors do not report a conflict of interest

Data availability

The corresponding author will make the de-identified data and the analysis R scripts available upon reasonable written request.

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Supplementary materials

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