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Research Article

Implementation of a Comprehensive Hip Fracture Care Program in a Community Hospital Setting

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Abstract

Introduction: Hip fractures are common and costly in the elderly population, often contributing to loss of function and independence. Prompt surgical care may improve clinical and economic outcomes.

Materials and Methods: We implemented a protocol-driven care program focused on minimizing time spent immobilized awaiting surgery and streamlining the care pathway for hip fracture. The Hip Fracture Care Program (HFCP) was implemented in a single facility in the Willis Knighton Health System. Time to surgery, length of stay, and cost of length of stay were compared before and after the intervention, utilizing an interrupted time series analysis to account for background trends.

Results: One-hundred and sixty patients received HFCP care for acute femur fracture requiring surgical fixation. Compared to 379 patients serving as the pre-implementation comparison group, patients receiving the HFCP intervention were more likely to have minor disease severity and mortality risk. Bivariate analysis demonstrated HFCP was associated with a reduced mean length of stay (from 5.99 to 5.33, p=0.016). Interrupted time series analysis adjusting for disease severity showed no statistically significant difference in length of stay or time to surgery after implementation of the intervention. Mean overall cost based on length of stay was reduced in the post-intervention period, but results were not statistically significant.

Discussion: Early cost savings are promising, and program refinement may translate to additional utilization improvements and implications for value-based health care delivery.

Conclusions: A standardized care program can be successfully implemented in a community hospital. The program led to non-significant reductions in overall LOS and estimated cost savings attributable to LOS reductions. Further efforts to evaluate the effect on complications and other patient-centered outcomes are needed.

Keywords: Femoral Fracture; Hip Fracture; Integrated Delivery of Health Care; Patient Care Team; Quality Assurance.

List of Abbreviations: BPCI-A: Bundled Payments for Care Improvement -Advanced; RG: Diagnosis-Related Group; ED: Emergency Department; HFCP: Hip Fracture Care Program; LOS: Length of Stay; OR: Operating Room

Introduction

Hip fractures are a significant public health concern in the United States. The prognosis for older adults after fracture is poor: fewer than fifty percent of patients regain function within one year, and they face significantly increased risk of death or institutionalization within two years of fracture [1,2]. Incident hip fracture also significantly increases the risk of additional fracture, including non-hip fracture [3]. Patients who receive prompt surgical care experience reduced mortality and complications [4], suggesting that interventions designed to streamline time to surgery may improve clinical and economic outcomes for both patients and institutions. Evidence-based guidelines recommend formal care programs designed to follow patients from admission through discharge and promote coordinated care across specialties [5]. Organized, multidisciplinary fracture programs have in some cases successfully reduced patient morbidity, shortened length of stay, and improved

functional outcomes [6-10]. Whether early success can be reliably reproduced and sustained across geographic and acuity settings remains a question [11,12]. Additionally, some quality improvement initiatives may require costly staffing requirements or capital improvements that are not feasible in community hospital settings [13,14]. In the US, Medicare continues to introduce value-based payment plans to foster the highest quality of care at the lowest cost. Similarly, hospitals and insurers are adopting value-based programs to improve health outcomes in vulnerable patient populations. Hip fracture care has been a focus of such value-based care programs due to prevalence, cost, and variability in current care models. Hip fracture care programs are an emerging standard among hospitals seeking to generate value not only for patients, but also for payers and society. The purpose of the current study was to evaluate whether implementing a standardized, protocol-driven Hip Fracture Care Program (HFCP) reduces the economic burden and improves patient care among patients treated in a community hospital.

Materials and Methods

Patients

The population of interest was patients over the age of 65 who were admitted for fixation of hip fracture between August 2014 and February 2018 at the Pierremont campus of Willis-Knighton Health System. The Pierremont Health Center is a 200-bed hospital and the highest-volume facility for hip-fracture care in the Willis-Knighton system. Most orthopedic patients are admitted to a floor of the hospital which focuses on orthopedic care. Six orthopedists cover unassigned call. The Pierremont facility serves a rapidly growing population with high rates of obesity, high blood pressure and diabetes. The HFCP presented this facility with an opportunity to improve care for a vulnerable population, reduce mortality, and reduce risk of subsequent fracture through improved long-term management of osteoporosis. This study comprises a retrospective evaluation of the HFCP quality improvement initiative with a before-and-after design, based on the implementation date of the HFCP. De-identified data were collected from the electronic health record for patients with a fracture and one of the following fracture repair Diagnosis Related Groups (DRGs): 480-482 and 469-470. The study was conducted as a part of the hospital's quality improvement initiatives and was therefore considered exempt from Institutional Review Board review requirements.

Intervention

The HFCP consists of a protocol-driven approach designed to facilitate surgical intervention within 24 hours of fracture and optimize the treatment plan from admission through discharge. Key components of the HCFP included addition of an orthopedics coordinator; staff education; and use of a care bundle including pressure-reducing surfaces, avoidance of skeletal traction, antibiotic and antithrombotic prophylaxis, mobilization, and early involvement of case management. After consultation with key stakeholders, the program was implemented in February 2017 (Figure 1). This implementation period (February 2017) was defined as a washout or transitional period; therefore, no patient data from this period were included in the pre-post analysis. The HFCP care team consisted of the existing team of nurses, physicians, ancillary staff, and an orthopedics coordinator who oversaw the program. The HFCP begins in the Emergency Department (ED) with nursing and ED physicians and extends beyond the walls of the acute care hospital to post-acute care facilities. In practice, the ED team has established a standardized set of orders specific to patients with hip fracture. A fragility fracture consult is generated from the ED order set which alerts the orthopedic coordinator to oversee and assist with coordinating the patient's stay. For each patient, the surgical coordinators and surgeon champion mutually ascertain criteria for timeliness of surgery. If patients present to the hospital before noon and are surgical candidates, surgery is performed the same day. Patients presenting in the afternoon or evening are readied for surgery to be performed the next morning. The case management team is quickly alerted regarding presentation of all hip fracture patients; this ensures alignment between surgical timing and discharge planning.

Figure 1: HFCP Implementation Timeline.

Analyses

The primary outcome was mean Length of Stay (LOS), including post-operative stay in the acute care setting. Secondary outcomes included time to surgery and cost of length of stay. Time to surgery was calculated as time from ED to Operating Room (OR), operationalized as ED to admission plus admission to surgery time. The following data elements were captured for all patients: age, sex, admission status (elective, emergency, urgent), admission location (through ED - yes/no), LOS (total and post-operative), discharge month/year, discharge disposition, payor, principal diagnosis, principal procedure, DRG, time from ED to OR, average severity level, and average risk of mortality level. Average severity level and average risk of mortality level represent relative severity and mortality risk per 3M APR-DRG classification, respectively. The application averages the severity level and mortality risk subclass levels of all patients for which the physician has been the discharging physician. Continuous data were summarized with counts, medians, means, ranges and standard deviations. Categorical data were summarized with frequencies and percentages. Differences between the pre- and post- implementation groups were analyzed using unpaired t-tests for continuous variables, and the chi-square test for categorical data. Patients treated during the washout/transition period were excluded from all analyses. An analysis using interrupted time series, or segmented regression analysis, was conducted for the primary outcome (LOS) and secondary outcome (time from ED to surgery). Interrupted time series analysis controls for trends in outcomes that may be attributable to external factors preceding a change in practice and was used to evaluate whether the program had an effect significantly greater than the underlying time trend [15,16]. Mean values for each monthly period were used to build the models. An adjusted time series analysis was also performed using the disease severity variable to control for any differences in patient mix in the pre- and post-implementation periods. For all analyses, a p-value of less than 0.05 was regarded as statistically significant. Data was analyzed using R Studio 1.1456 (R Studio, Inc., Boston, MA).

Results

Patient characteristics

A total of 539 patients were eligible for inclusion in the analysis. Records for the pre-implementation period were reviewed retrospectively. The study population consisted of 379 patients with hip fracture surgery prior to HFCP implementation, compared to 160 after full HFCP implementation. No statistical differences were observed for mean age (82.0 vs. 80.7) or sex (74.1% vs. 78.8% female) between patients in the pre- and post-intervention periods, respectively (Table 1). Patient demographics in both periods were similar to those of the geriatric hip fracture population in the United States, based on published studies of the American College of Surgeons National Surgical Quality Improvement Program database, the longitudinal Health and Retirement Survey, and the Kaiser Permanente hip fracture registry [17-19]. Patients in the post-implementation period had lower disease severity and mortality risk and were less likely to be enrolled in Medicare compared with patients in the pre-intervention period.

	Pre-implementation (n=379)	Post-implementation (n=160)
Age, mean years (SD)	82.0 (8.2)	80.7 (10.6)
Female (%)	74.1	78.8
Admission status urgent/emergency (%)	44.3	41.3
Type of health insurance (%) *		
Medicare	96.6	89.4
Other / not specified	3.4	10.6
Disease severity (%) *†		
Minor	16.1	32.5
Moderate	41.7	43.8
Major	30.9	20.6
Extreme	11.3	3.1
Mortality risk (%) *‡		
Minor	12.1	26.9
Moderate	45.1	41.9
Major	33.5	26.9
Extreme	9.2	4.4

SD = standard deviation; * $p<0.05$ for pre vs. post difference; Categories may not total to 100% due to rounding.

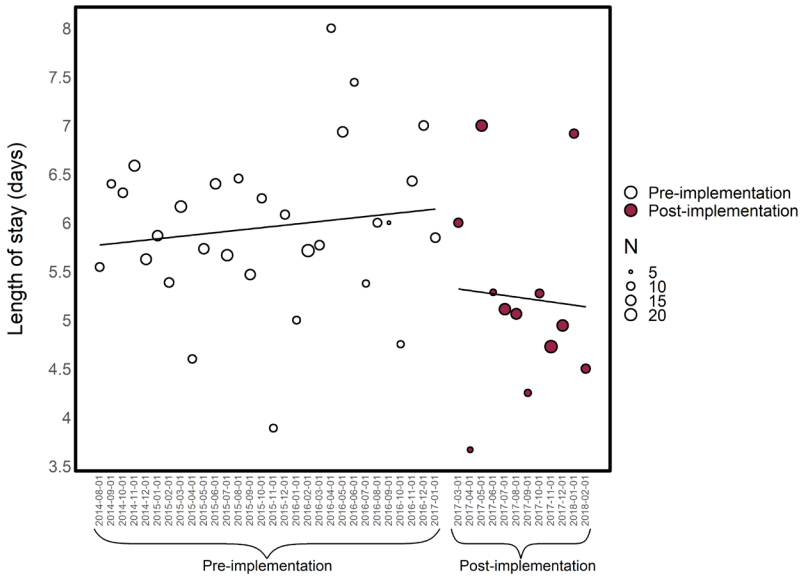
† Disease severity: Proprietary calculation from electronic health record, based on the 3M APR-DRG classification; ‡ Mortality risk: Proprietary calculation from electronic health record, based on the 3M APR-DRG classification

Table 1: Patient Characteristics: Pre- and Post- Implementation of Hip Fracture Care Program.

Hip Fracture Care Program

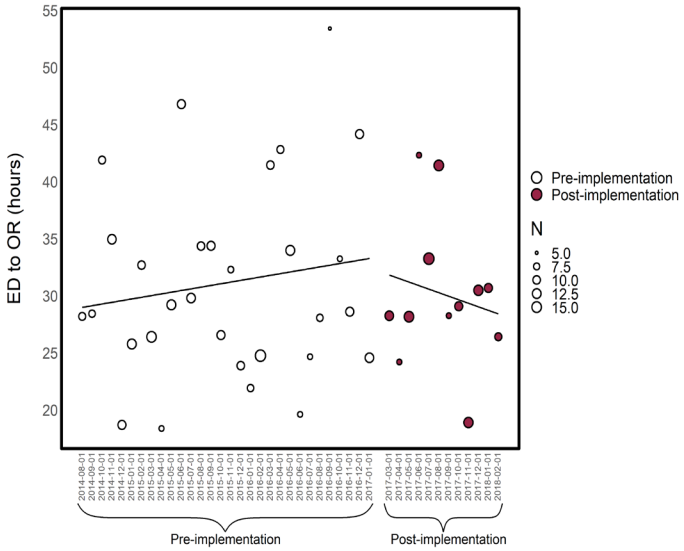
In bivariate analysis, mean length of stay was 5.99 days versus 5.33 days (p=0.016) from pre- to post-intervention. When analyzed within interrupted time series (Figure 2), this result was

not statistically significant; nor was it significant after adjusting for severity level (p=0.426 for pre/post difference). No significant differences for time from ED to OR were detected in bivariate or interrupted time series analysis (Figure 3). Mean cost per inpatient stay calculated on the basis of the observed decrease in mean LOS of 0.7 days, declined from $9,620 to $8,560 (Table 2). Decreasing LOS by the magnitude seen in our study is estimated to have reduced total costs by $415,880 per year (in 2018 dollars) for our hospital system, based on the number of hip fracture patients seen annually across the three hospitals (average total yearly volume of 370 patients). These estimates were obtained from directly observed data without adjustment for patient characteristics or consideration of statistical significance.



N: Number of Patients in Monthly Time Period

Figure 2: Length of stay: Interrupted Time Series Analysis.



N: Number of Patients in Monthly Time Period; ED: Emergency Department; OR: Operating Room

Figure 3: ED to OR time: Interrupted Time Series Analysis.

	Pre-implementation	Post-implementation
	(n=379)	(n=160)
LOS, mean days (SD) *	5.99 (3.15)	5.33 (2.80)
Cost based on LOS * †	$4837 (2,548)	$4303 (2,265)
ED to OR, mean hours (SD)	30.90 (25.62)	30.16 (24.22)
*p<0.05 for pre vs. post difference by bivariate analysis (t test). None of the pre vs. postdifferences were significant by adjusted ITS analysis (LOS: p=0.426; ED to OR time: p=0.595). † Based on an estimated Medicare reimbursement of $1605.94/day		

LOS: Length of Stay; OR: Operating Room; ED: Emergency Department; SD: Standard Deviation

Table 2: Outcomes Pre- and Post- Implementation of Hip Fracture Care Program.

Discussion

Our evaluation of a protocol-driven hip fracture care program showed that it can be successfully implemented in a community hospital. Willis-Knighton was willing to dedicate one Full-Time Equivalent (FTE) employee to oversee the program, which was critical to success. Maintaining a presence on the floor was as impactful as the content of the care pathway protocol itself.

Despite promising reductions in LOS and costs within in bivariate analysis, we did not find statistically significant reductions in time from ED to OR, or in LOS after adjusting for disease severity. There were significant differences in the risk profile for the patient population over time, with more patients in the pre-intervention period presenting with extreme disease severity and mortality risk. We are not aware of any changes to admission practices which would have affected the risk profile at our institution; this finding may therefore be due to chance. After full implementation of the HFCP, mean LOS was lower in our institution than that within some contemporary published reports in similar populations [17,20,21]. Our pre-intervention mean length of stay was also lower than that found post-intervention in several studies, suggesting that our facility's performance at baseline was comparable to centers after quality improvement initiatives had been completed [6,11,22]. This lower baseline may have posed challenges to observing statistically significant reductions in mean LOS in the interrupted time series analysis.

Although some improvement in length of stay was appreciable, several factors hindered further reductions. There is consensus on the importance of timely hip fracture management; however, coordinating those services with other orthopedic objectives (i.e., clinic schedules/visits, patient optimization, surgeon preferences) can be challenging. The commitment of each department to expedite fragility fracture care is critical to program success. The program cannot fully mature if all departments are not committed to an optimal clinical pathway. Other community hospitals seeking to translate quality improvement interventions into measurable outcomes may face similar challenges.

Previous economic analysis suggests that dedicated hip fracture co-management programs are cost-effective with more than 54 patients annually and result in significant cost savings with more than 318 patients annually [23]. The trend in reduced cost of mean LOS in our study population suggests that cost savings may be attainable in medium-volume centers such as the Willis-Knighton Pierremont campus. Decreasing hospital LOS by an average of 0.7 days per patient is estimated to have reduced costs by $1,124 per admission compared to the average cost of the pre-implementation period. This decrease is also estimated to have generated cost savings of $183,212 per year in the participating hospital. However, between-group differences in risk profiles preclude attribution of this observed reduction to the HFCP. Unlike other hip fracture programs that require major changes to the patient care pathway, hospital staff, or facilities [24-26], our intervention can be implemented with limited resources. The only additional staff requirement for HFCP implementation was the orthopedics coordinator, who led the program. We felt this was an efficient approach for our community hospital.

Despite the movement towards value-based healthcare delivery and alternative payment models (e.g., bundled payments), there is still much to be learned about the interaction of cost, efficiency, and quality in hip fracture care. Quality improvement can reduce inefficiency and improve care coordination. The implementation of the HFCP at Willis Knighton Pierremont campus has provided insights in support of organizational value-based healthcare initiatives. Hip fracture care touches at least two episodes within Medicare's new Bundled Payments for Care Improvement Advanced (BPCI-A) model. Participants in programs like BPCI-A are diving into issues that require long-term attention. Optimizing patient care during the hospital stay within these payment models can be linked to improved quality and efficiency. Socioeconomic conditions, multiple comorbidities, increased length of stay, and management of postoperative complications warrant particular attention for their association with deterioration in general health

status, detrimental effects on patient functioning, and elevation of mortality risk. Fewer readmissions, reduced mortality, and improved quality of life may be attainable when length of stay and other risk factors are holistically addressed in delivery of hip fracture care [4].

For hip fracture patients, costs have been shown to be directly proportional to variables such as length of stay, timing of surgery, availability of specialize orthopedic-geriatric units, and access to rehabilitation after hospitalization [27]. Accordingly, the cost of care can be reduced as length of stay is optimized; Willis-Knighton will have saved over $400,000 per year just in length of stay reduction. As the institution implements this program at other campuses and improves average length of stay to a target of 4.5 days, the hospital may save over $884,000 per year. The beneficial effects of the program affect can be felt in the emergency department as well, given the need to optimize throughput. For example, achieving this target LOS would free-up 250 days of bed space each year to improve emergency department throughput. Ongoing engagement with our care team may highlight ways to improve our intervention in the future. Part of that engagement is needed to ensure patient follow-up with their medical team to address the underlying pathology of osteoporosis. Further study is needed to gauge the nature of continued osteoporosis management following hospital discharge. Lessons for continuous quality improvement in our HFCP therefore center around the need for sustained attention beyond the acute care period. We therefore expect focus not only on the immediate peri-surgical care pathway, but also on follow-up care with our partners in the post-acute care continuum.

Key strengths of our study include a protocol-driven approach, broad patient selection criteria, and assessment of a primary endpoint with real-world implications. Population demographics at baseline were similar to those of hip fracture patients nationally, implying that the study results may be generalizable. Limitations include the lack of a randomized control group, limited data on clinical variables, and the use of cost estimates for LOS rather than granular patient-level cost data obtained from the hospital accounting system. Additionally, while the reduction seen in LOS was significant in the bivariate comparison, it was not statistically significant in the interrupted time series comparison either before or after adjustment for baseline severity. This may have been due to the shorter length of observation in the post-intervention period, which reduced the number of available data points for the interrupted time series analysis in the post period. We experienced the typical challenges of quality improvement research, including the difficulty of defining a clear pre/post period in the presence of continuous quality improvement activities. We attempted to define a washout period to mitigate this issue.

Conclusions

A multidisciplinary hip fracture care program can be successfully implemented within a hospital system. The program led to non-significant reductions in overall LOS and estimated cost savings attributable to LOS reductions, while providing the platform for further research, innovations, and development in value-based health care delivery.

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