Geriatric Hip Fracture Care: Fixing a Fragmented System

Mary E Anderson, MD; Kelly McDevitt, RN, MS, ONC; Ethan Cumbler, MD; Heather Bennett, MS, MBA; Zachary Robison, MBA; Bryan Gomez; Jason W Stoneback, MD

Perm J 2017;21:16-104

E-pub: 04/14/2017

<https://doi.org/10.7812/TPP/16-104>

ABSTRACT

Context: Fragmentation in geriatric hip fracture care is a growing concern because of the aging population. Patients with hip fractures at our institution historically were admitted to multiple different services and units, leading to unnecessary variation in inpatient care. Such inconsistency contributed to delays in surgery, discharge, and functional recovery; hospital-acquired complications; failure to adhere to best practices in osteoporosis management; and poor coordination with outpatient practitioners.

Objective: To describe a stepwise approach to systems redesign for this patient population.

Design: We designed and implemented a comprehensive geriatric hip fracture program for patients aged 65 years and older at our academic Medical Center in October 2014. Key interventions included admission of all ward-status patients to the Orthopedics Service with hospitalist comanagement; geographic placement on the Orthopedics Unit; and standardized, evidence-based electronic order sets bundling geriatric best practices and a streamlined workflow for discharge planning.

Main Outcome Measures: Hospital length of stay.

Results: We identified 271 admissions among 267 patients between January 1, 2012, and March 31, 2016; of those, 154 were before and 117 were after program implementation. Mean hospital length of stay significantly improved from 6.4 to 5.5 days ($p = 0.004$). The 30-day all-cause readmission rate and discharge disposition remained stable. The percentage of patients receiving osteoporosis evaluation and treatment increased significantly. The rate of completed 30-day outpatient follow-up also improved.

Conclusion: Our comprehensive geriatric hip fracture program achieved and sustained gains in the quality and efficiency of care by improving fragmentation in the health care system.

INTRODUCTION

Hip fractures are a major health burden on the geriatric population in the US. In 2010, an estimated 258,000 people aged 65 years and older were hospitalized with hip fractures.¹ Hip fractures can be highly debilitating, resulting in loss of functional independence and a mortality rate approaching 30% at 1 year.² Direct costs for hip fractures reach \$18 billion per year (in 2002 dollars).³ With the aging population, hip fracture rates are projected to rise by 240% in women and 310% in men by 2050.⁴

Geriatric hip fracture care has historically suffered under fragmented care

delivery systems. Patients may be admitted to numerous services and units in a single hospital, leading to unnecessary variation in inpatient care. Such inconsistency is associated with delays in surgery, longer hospitalizations, and higher readmission rates.^{5,6} More than half of all in-hospital deaths among geriatric patients with hip fractures may be preventable.⁷ Both inpatient and outpatient practitioners often fail to diagnose osteoporosis in these patients and to initiate secondary fracture prevention.⁸⁻¹⁰ This “osteoporosis care gap” has been attributed in large part to a lack of coordination among orthopedic surgeons,

hospitalists, primary care physicians, geriatricians, and other subspecialists.¹¹

Recognition of the fragmentation in geriatric hip fracture care has prompted a call to action by major professional societies, hospital regulatory agencies, insurers, and national and international health organizations.^{3,12-20} Despite the strong evidence in favor of a population health management-based approach to geriatric hip fracture care, it can be challenging to introduce any change initiative at the local level. A step-by-step framework for successful systems redesign for this patient population is difficult to find. Our aim is to provide a practical how-to guide for implementing a comprehensive geriatric hip fracture program using experiences at our own institution.

METHODS

Setting

The University of Colorado Hospital is a 620-bed, urban, quaternary-care academic Medical Center in Aurora, CO. It carries a Level II trauma center designation.

Geriatric patients with hip fractures have traditionally been admitted to either the Orthopedic Surgery Service or Internal Medicine (IM) services at the discretion of the emergency medicine physician and on-call orthopedic surgeon with older, more medically complex patients directed toward IM care. Patients admitted to the Orthopedic Surgery Service are cared for by orthopedic residents, a physician assistant, and the attending surgeon; patients receive subspecialty consultation or comanagement by the hospitalists on the Medicine Consult Service if requested. Patients older than age 75 years who are admitted

Mary E Anderson, MD, is an Assistant Professor in the Hospital Medicine Section of the Division of General Internal Medicine at the University of Colorado Denver School of Medicine. E-mail: mary.anderson@ucdenver.edu. Kelly McDevitt, RN, MS, ONC, is a Clinical Nurse Manager in the Department of Orthopedic Surgery at the University of Colorado Hospital in Aurora. E-mail: kelly.mcdevitt@uchealth.org. Ethan Cumbler, MD, is a Professor in the Hospital Medicine Section of the Division of General Internal Medicine at the University of Colorado Denver School of Medicine. E-mail: ethan.cumbler@ucdenver.edu. Heather Bennett, MS, MBA, is a Data Analyst for the Institute of Healthcare Quality, Safety, and Efficiency at the University of Colorado Hospital in Aurora. E-mail: heather.bennett@uchealth.org. Zachary Robison, MBA, is a Process Improvement Consultant for the Institute of Healthcare Quality, Safety, and Efficiency at the University of Colorado Hospital in Aurora. E-mail: zach.robison@gmail.com. Bryan Gomez is a Process Improvement Consultant for the Institute of Healthcare Quality, Safety, and Efficiency at the University of Colorado Hospital in Aurora. E-mail: bryan.w.gomez@gmail.com. Jason W Stoneback, MD, is an Assistant Professor in the Department of Orthopedic Surgery at the University of Colorado Denver School of Medicine. E-mail: jason.stoneback@ucdenver.edu.

to the IM services receive care from 1 of 2 “Acute Care for the Elderly” teams, which are staffed by rotating IM house staff and attending hospitalists, general internists, or geriatricians. Patients under age 75 years go to 1 of 8 general medicine teams under a “drip” admission algorithm; these teams are staffed by rotating IM house staff or advanced practice providers and attending hospitalists, general internists, or subspecialists. Patients can also be admitted to the Family Medicine Service or subspecialty services.

Once discharged, geriatric patients with hip fractures are under the immediate care of practitioners at skilled nursing facilities, inpatient rehabilitation facilities, or primary care clinics, either internal or external to our system. Our system alone operates nine primary care clinics: four IM clinics, four Family Medicine clinics, and the Seniors Clinic. All patients have the ability to receive postoperative care in the Orthopedics Clinic.

Stepwise Framework for Program

Our stepwise approach to implementing a comprehensive geriatric hip fracture program is outlined in Figure 1.

Step 1:

Capitalize on Local Forces for Change

Our institution saw greater than 20% growth in trauma patient volume from 2012 to 2013 because of the expansion of trauma services.²¹ It specifically witnessed a 40% increase in the number of geriatric patients with hip fractures after the hiring of 2 dedicated orthopedic trauma surgeons, outreach to emergency medical services, and the opening of a larger, state-of-the-art Emergency Department (ED) and second inpatient tower by Spring 2013. Health system leadership also designated the Department of Orthopedic Surgery as one of the priorities for targeted service line growth. Growing market share and the strategic imperative to solidify the organization's reputation in orthopedic care converged on practitioners' dissatisfaction with the fragmented state of geriatric hip fracture care to create a “sense of urgency for change,” the critical first step in change management according to Kotter.²² The need to deliver high-quality care and provide efficient throughput would drive our transformation efforts.

Step 2:

Assemble the Leadership Team

We first assembled a committed clinical leadership team consisting of the Director of Orthopedic Inpatient Medical Services, the hospitalist Director of the Medicine Consult Service, and the clinical nurse manager for the Orthopedics Unit. The Institute for Healthcare Quality, Safety, and Efficiency on campus provided access to a process improvement specialist, data analyst, and project coach, who rounded out our core working group.

Other content experts and stakeholders who were engaged during the course of the initiative are listed in the Sidebar: Team Composition and Stakeholders for a Comprehensive Geriatric Hip Fracture Program.

Step 3:

Define the Population of Interest

We defined geriatric patients with hip fractures as those patients aged 65 years and

older who sustained an acute hip fracture after minimal trauma such as a fall from standing height. We excluded patients with nonfragility hip fractures (eg, after a motor vehicle accident), nonhip femur fractures, periprosthetic fractures, or pathologic fractures (eg, those caused by malignancy).

We identified the geriatric hip fracture population using the following procedural descriptions in our electronic medical record: closed reduction femur fracture/fracture with pinning/hip, intramedullary rodding femur antegrade, open reduction internal fixation femur/femur proximal/hip, pinning percutaneous hip/femur, trochanteric femoral nailing, and hemiarthroplasty hip. These descriptions were more reliable than either Current Procedural Terminology (CPT) or International Classification of Diseases, Ninth Revision (ICD-9) codes. We performed a manual audit after electronic data extraction to

Figure 1. Stepwise framework for implementing a comprehensive geriatric hip fracture program.

validate the data. We could not include the small proportion of patients receiving a total hip arthroplasty because it was prohibitive to manually screen out all the patients undergoing this procedure electively for osteoarthritis. We also could not capture the small proportion of nonoperative patients with this method. However, the population definitions were sufficient to move forward with our quality-improvement initiative.

Step 4:

Conduct a Gap Analysis

We performed a preliminary data analysis to better characterize the current state of geriatric hip fracture care at our institution. In 2013, patients were admitted to 13 different teams on 8 different units. Among the patients on the Orthopedic Surgery Service, those off the Orthopedics Unit had a longer length of stay (LOS) compared with those on the unit (7.5 vs 4.9 days). The rate of osteoporosis evaluation and treatment was low (ie, only 38%,

66%, and 13% of patients, respectively, were discharged on a regimen of calcium, vitamin D, and an antiosteoporosis medication). Only 32% of patients with a primary care provider (PCP) internal to our system completed follow-up within 30 days of discharge. Certain elements of care also appeared to be worsening over time. For example, the average LOS for geriatric patients with hip fractures had progressively risen from 6.1 days in 2012 to 6.5 days in 2013.

We also conducted “Voice of the Patient” interviews to gain a better understanding of the patient experience after a hip fracture. Overall, patients provided positive feedback about their interactions with hospital staff, but their responses reinforced the notion that osteoporosis tended to be overlooked in both the inpatient and outpatient settings (eg, “I don’t think we have heard much about bone density testing or osteoporosis” and “The primary care physician did not bring it up.”)

The gaps in geriatric hip fracture care at our institution could be best summarized as 1) a lack of a cohesive interprofessional team taking ownership of this patient population along the continuum of care and 2) a lack of standardized, evidence-based care.

Step 5:

Create and Communicate a Vision

Our clinical leadership team articulated a vision of a comprehensive geriatric hip fracture program, with streamlined care from arrival to postdischarge follow-up. We communicated our vision in as many modalities as possible, including our hospital newsletter, grand rounds for both the Department of Orthopedic Surgery and the Hospital Medicine Group, NICHE (Nurses Improving Care for Health System Elders) Committee meetings, staff meetings on the Orthopedics Unit, informal hallway conversations with frontline practitioners, and one-on-one meetings with executive stakeholders. Using data from our gap analysis, we tailored our message to highlight those aspects of the case for change most motivating to each group of stakeholders. We drew attention to how the fragmented system of care affected both them and patients and encouraged their participation in the solution.

Step 6:

Scope the Project

Given our broad vision for a comprehensive geriatric hip fracture program, we scoped our efforts into manageable steps. Conceptually we divided our program into 5 “buckets” along the continuum of care: ED care, preoperative care, intraoperative care, postoperative care, and postdischarge care. We did not focus on intraoperative care because the on-boarding of the 2 orthopedic trauma surgeons had already resulted in a streamlined on-call schedule, protected operating room time, and improved supply chain management. We decided to first address preoperative and postoperative care.

Step 7:

Construct a Project Charter

Our project charter served as an invaluable organizational tool (see Figure 2). It included the following elements: background, problem statement, aim statement, reporting measures, team members, operational definitions, project timeline,

Team Composition and Stakeholders for a Comprehensive Geriatric Hip Fracture Program

Clinical leadership team

- Director of Orthopedic Inpatient Medical Services
- Director of Medicine Consult Service
- Clinical nurse manager for Orthopedic Unit

Other core working group members

- Process improvement specialist
- Data analyst
- Project coach with geriatrics expertise

Clinical stakeholders/content experts

- Emergency medicine physician and nursing representative(s)
- Hospital managers
- Attending orthopedic surgeon(s)
- Orthopedic residents
- Orthopedic physician assistant(s)
- Clinical nurse educator on Orthopedics Unit
- Pharmacist on Orthopedics Unit
- Manager of Inpatient Rehabilitation Therapy Services
- Registered dietitian on Orthopedics Unit
- Social worker/case manager on Orthopedics Unit
- Patient-resident liaison on Orthopedics Unit
- Endocrinologist/Director of Metabolic Bone Clinic
- Order Set Coordinator for electronic medical record
- Primary care and Seniors Clinic physician representatives

Executive stakeholders

- Chief Operating Officer
- Chief Nursing Officer
- Chair of Department of Orthopedic Surgery
- Director of Hospital Medicine Group

and scope and boundaries of the project. These items are also described in more detail in Steps 1, 2, 3, 6, and 8.

In devising our initial project aim statement, we recognized that no single metric would perfectly encapsulate our overarching goal of comprehensive geriatric hip fracture care. We ultimately chose hospital LOS because this information was obtainable, would lend itself to the development of a business case, and would generally reflect coordinated and complication-free perioperative care. We aimed to reduce the average hospital LOS for geriatric patients with hip fractures at the University of Colorado Hospital by 0.5 days by January 1, 2015.

Step 8: Establish Reporting Measures

Metrics for evaluating geriatric hip fracture care have been proposed.^{3,15,23-25} Our primary outcome measure was hospital LOS, which we defined as time from admission to discharge. Our process measures included time to surgery, which we defined as the time from admission to surgical incision; the percentage of patients admitted to the Orthopedic Surgery Service; the percentage of patients discharged from the Orthopedics Unit; and the percentage of patients in which our new admission order set for geriatric hip fractures was used (see Step 10). Our primary balancing measures were the 30-day all-cause readmission rate to our institution and discharge disposition.

We monitored several additional quality metrics: percentage of patients with a basic laboratory evaluation for secondary causes of osteoporosis (complete blood cell count, basic metabolic panel with calcium, hepatic function panel, and 25-hydroxyvitamin D level); percentage of patients discharged

Figure 2. Project charter.^a (A larger version is available online at: www.thepermanentejournal.org/files/2017/16-104-Figure-2.pdf.)

^a Epic is made by Epic Systems Corp, Verona, WI.

on a regimen of calcium, vitamin D, and an antiosteoporosis medication; percentage of patients with appointments scheduled before discharge with their PCP, the Metabolic Bone Clinic, and the Orthopedics Clinic; and percentage of patients with completed follow-up with their internal PCP, Metabolic Bone Clinic, and Orthopedics Clinic within 30 days of discharge.

Step 9: Consider the Business Case

Improving the cost of geriatric hip fracture care is integral to enhancing its value. One of the best ways to garner support from executive stakeholders is to demonstrate the business case for a project. We

estimated the financial benefit of a LOS reduction using the equation in Figure 3.

Cost savings and revenue estimates were based on the approximate contribution margin for medical-surgical hospital admissions used by the Institute for Healthcare Quality, Safety, and Efficiency and assumed the hospital was operating at capacity. The hospital contribution margin was thought to be a conservative estimate for patients with hip fractures.

Step 10: Design and Implement Interventions

Our gap analysis demonstrated the need for a cohesive interprofessional team and standardized, evidence-based care. To

Figure 3. Financial Benefit Equation.

LOS = length of stay.

achieve our project aim, we developed the following three interventions:

1. *Admission of all ward-status patients with hip fractures to the single Orthopedic Surgery Service with hospitalist comanagement, including nonoperative cases:* Unlike the IM services at our institution, the Orthopedic Surgery Service was not constrained by age cutoffs, a “drip” admission algorithm, or team caps. It was also staffed by a smaller, more defined cohort of clinicians. The hospitalist-run Medicine Consult Service already had a strong relationship comanaging orthopedic patients and could provide 24/7 in-house coverage for preoperative assessment and subsequent care. We obtained buy-in for revising the admission criteria by emphasizing how the change would save emergency medicine, orthopedic, and IM practitioners the time of negotiating the admitting service on a case-by-case basis.
2. *Geographic placement of patients with hip fractures on the Orthopedics Unit:* The Orthopedics Unit served as the home unit for the Orthopedic Surgery Service and Medicine Consult Service. It offered nurses and physical and occupational therapists with orthopedic expertise, as well as a dedicated pharmacist, dietitian, social worker, case manager, and patient-resident liaison who scheduled follow-up appointments and arranged for durable medical equipment. It also had established interprofessional morning discharge planning rounds. We worked with hospital managers to assign geriatric patients with hip fractures priority placement on the unit.
3. *Standardization of care:* With interprofessional input, we designed electronic geriatric hip fracture admission, preoperative, and postoperative order sets (Table 1). The admission order set bundled best practices of geriatric care and contained automatic consults to Physical and Occupational Therapy for early postoperative mobilization and to Social Work/Case Management for early discharge planning. The order sets also standardized inpatient osteoporosis workup and treatment, as well as an automatic referral to the Metabolic Bone Clinic in the Endocrinology Division.

Table 1. Description of geriatric hip fracture admission, preoperative, and postoperative order sets

Order set	Items
Admission	
General	Code status
	Vital signs
	Activity: Bedrest
	Diet: NPO after midnight
Nursing assessments	Height and weight
	Intake and output
	Falls screen
	Delirium screen
Nursing interventions	Orthopedic traction orders (as applicable)
	Pressure ulcer prevention measures
	Urinary catheter insertion and removal protocol
	Incentive spirometry, deep breathe, and cough
	Delirium prevention measures
Physician consults	Inpatient consult to Medicine Consult Service
	Ambulatory referral to Metabolic Bone Clinic
Ancillary consults	Pharmacy consult for immunization screening
	Social Work/Case Management consult for discharge planning
	Physical and Occupational Therapy consult for early postoperative mobilization
	Nutrition consult for nutrition counseling for osteoporosis
Laboratory studies	Type and screen
	Osteoporosis workup: Complete blood cell count, basic metabolic panel with calcium, hepatic function panel, 25-hydroxyvitamin D, and thyroid stimulating hormone
	International normalized ratio and partial thromboplastin time
Imaging	Low AP pelvis radiograph
	AP full-length femur and cross-table lateral full-length femur radiographs
Other tests	Electrocardiogram
Medications	Intravenous fluids to keep line open
	Pain medications, bowel regimen, and antiemetics
	Osteoporosis treatment: Calcium, cholecalciferol, ^a and alendronate ^b
	Venous thromboembolism prophylaxis
Preoperative Order Set	
Preoperative	Inpatient consult to anesthesiologist
	Surgical site infection prevention bundle
	Preoperative antibiotics
Postoperative Order Set	
Postoperative	Activity: Up in chair with meals, ambulate with assistance
	Hip precautions per physical therapy protocols (as applicable)
	Weight-bearing instructions
	Low AP pelvis radiograph to evaluate alignment of hardware in Postanesthesia Care Unit
	Dual-energy x-ray absorptiometry scan ^c
	Postoperative antibiotics

^a Medicine Consult Service to switch cholecalciferol to ergocalciferol if 25-hydroxyvitamin D level returned at less than 20 ng/dL.

^b Alendronate postdated to start 2 weeks from admission to allow time for initiation of vitamin D supplementation to minimize the risk of hypocalcemia in the event of severe vitamin D deficiency; Medicine Consult Service to discontinue alendronate if the patient had a contraindication (ie, esophageal dysmotility, creatinine clearance < 35 mL/min, or on comfort care).

^c Certain restrictions based on age and estimated life expectancy.

AP = anterior-posterior; NPO = nil per os (nothing by mouth).

This clinic’s role was to serve as a consistent layer of support for osteoporosis care across the diverse primary care practices.

In designing the order sets, we adhered to the principles of human-factors engineering. We solicited feedback from the orthopedic residents who would be the end-users. We arranged order set elements in an intuitive order and preselected them when possible, making evidence-based care the default. In the process, we pared down the number of mouse clicks and free-text entries required for admission orders from a cumbersome 227 and 88 to 14 and 1, respectively.

We rolled out our geriatric hip fracture program with these three interventions on October 29, 2014, to coincide with World Osteoporosis Day and International Orthopedic Nurses Day. We crafted an intentional communication plan in anticipation of the “go-live,” including an e-mail newsletter and in-person meetings with practitioners, staff, and other stakeholders. In keeping with the change management model by Kotter,²² we planned for and created short-term wins as a show of appreciation and to reinforce adherence to the interventions. For example, we celebrated with the orthopedic residents

after they admitted the first geriatric hip fracture patient to the Orthopedic Surgery Service on the Orthopedics Unit using the new order sets.

Step 11: Evaluate Outcomes and Adherence to Interventions

We monitored the primary outcome metric, process and balancing measures, and additional quality metrics on a monthly basis. We analyzed the data with a Student *t*-test for continuous variables, Fisher exact test for dichotomous variables, and χ^2 test for categorical variables, using January 1, 2012, through October 28, 2014, as the preintervention period and October 29, 2014, through March 31, 2016, as the postintervention period. A 2-sided *p* value of below 0.05 was considered statistically significant. Data analyses were performed using Minitab 17 statistical software (Minitab Inc, State College, PA).

Step 12: Review Lessons Learned and Expand Scope of Project

Recognizing that we could further improve transitions of care, we next focused on postdischarge care. Together with physician representatives from affiliated primary care clinics, we implemented a pathway in August 2015 to improve our 30-day PCP follow-up rates. We formalized the expectation that PCP

appointments should be scheduled before discharge. For patients going home, the goal follow-up time was within 7 days of discharge. For patients going to a skilled nursing facility or inpatient rehabilitation facility, the goal follow-up time was 21 to 30 days from discharge, to account for US Centers for Medicare and Medicaid Services (Medicare) coverage rules. We aimed for 2-week follow-up in the Orthopedics Clinic and the Metabolic Bone Clinic. In February 2016, we introduced an electronic discharge order set that reiterated these goals and provided detailed discharge instructions for patients.

Ethical Considerations

Using the Colorado Multiple Institutional Review Board framework, this quality-improvement initiative did not meet the definition of human subjects research per US Department of Health and Human Services regulations.

RESULTS

We identified 271 geriatric hip fracture admissions among 267 patients during the study period, including 154 before and 117 after implementation of our program. The 4 patients who sustained bilateral hip fractures during the study period were hospitalized for their first hip fracture before implementation of our program. Patient characteristics before and after implementation were similar (Table 2).

Mean hospital LOS significantly improved from 6.4 days before implementation to 5.5 days after implementation (*p* = 0.004), reversing the prior trend of rising LOS (Table 3). Mean time to surgery trended down from 29.0 to 26.5 hours (*p* = 0.168). From before to after implementation, the percentage of patients admitted to the Orthopedic Surgery Service increased from 65% to 96% (*p* < 0.001), the percentage discharged from the Orthopedics Unit increased from 67% to 85% (*p* < 0.001), and the percentage both on-service and on-unit increased from 55% to 82% (*p* < 0.001). Adherence to use of the admission order set was 96%. The 30-day all-cause readmission rate to our institution remained stable (3.2% vs 2.7%, *p* = 0.520). Patients were also just as likely to be discharged

Table 2. Patient characteristics ^a			
Characteristic	Preintervention, n = 154	Postintervention, n = 117	p value
Mean age, years (median, SD)	80.9 (82.5, 9.0)	79.5 (80.0, 7.9)	0.191
Women, no. (%)	112 (73)	72 (62)	0.066
Type of fracture, no. (%)			
Femoral neck, displaced	60 (39)	45 (38)	0.129
Femoral neck, nondisplaced	10 (6)	19 (16)	
Intertrochanteric	77 (50)	47 (40)	
Subtrochanteric/other	7 (5)	6 (5)	
ASA class, no. (%)			
1	0 (0)	0 (0)	0.817
2	31 (20)	22 (19)	
3	102 (66)	83 (71)	
4	20 (13)	11 (9)	
5	1 (1)	1 (1)	
Therapeutic anticoagulation on admission, no. (%)			
Warfarin	21 (14)	12 (10)	0.102
Direct oral anticoagulant	1 (1)	5 (4)	
None	132 (86)	100 (86)	

^aSome percentages do not total to 100% because of rounding.
ASA = American Society of Anesthesiologists; SD = standard deviation.

home rather than elsewhere before and after program implementation (21% vs 16%, $p = 0.244$).

Results for the additional quality measures are also shown in Table 3. The percentage of patients receiving a basic laboratory evaluation for secondary causes of osteoporosis improved after implementation compared with before the program. Specifically, physician ordering of 25-hydroxyvitamin D levels increased from 68% to 89% ($p < 0.001$). The percentage of patients before and after implementation discharged on a regimen of calcium (55% vs 99%), vitamin D (70% vs 96%), and an antiosteoporosis medication (24% vs 85%) also improved significantly ($p < 0.001$ for all). Patients were more likely to have a follow-up appointment scheduled

before discharge with their PCP (15% vs 28%, $p = 0.006$), the Metabolic Bone Clinic (3% vs 53%, $p < 0.001$), and the Orthopedics Clinic (82% vs 93%, $p = 0.005$). Completed follow-up within 30 days also improved for the Metabolic Bone Clinic (3% vs 28%, $p < 0.001$).

DISCUSSION

Our comprehensive geriatric hip fracture program represents important progress in fixing the long-standing fragmentation in care at our institution. Through our stepwise framework for systems redesign, we have sustained an approximately 1-day reduction in LOS over 17 months, exceeding our aim of 0.5 days, and made significant gains in other quality metrics.

Our findings compare favorably with national outcomes reported for geriatric patients with hip fractures in the US. According to Medicare data, the mean hospital LOS for geriatric patients with hip fractures in this country is 6.1 days.² Our geriatric hip fracture program reduced LOS for our population from above to below the national average. We believe that we achieved more coordinated and proactive care by consolidating patients under a cohesive interprofessional team and standardizing care expectations. Given that mean time to surgery did not significantly decrease, most of the LOS improvements occurred postoperatively. It is unlikely that the LOS reduction resulted from premature discharges or from prioritization of throughput over functional outcomes. Although it is difficult to directly compare our 30-day all-cause readmission rate with the national average of 12.4% because we were able to track only readmissions to our own institution, there was no difference in readmissions from before to after implementation.² We also preserved patients' ability to return to independent living at discharge. More than 16% of our patients were discharged directly to home with or without home health care services, compared with 7.8% nationally.²

Other studies have found that a joint model of care with shared responsibility improves outcomes for geriatric patients with hip fractures. Integrated orthogeriatric comanagement models of care are now strongly recommended given their potential to improve LOS, time to surgery, perioperative complications, functional outcomes, short- and long-term mortality, and costs.²⁶⁻⁴² Successful orthogeriatric comanagement models employing hospitalists or general internists, rather than geriatricians, have also been reported, with similar LOS reductions between 2.3 and 2.7 days.^{5,43} We opted for hospitalist comanagement for practical reasons, because hospitalists have a more robust inpatient presence at our institution.

Other studies have also evaluated strategies for improving osteoporosis care. Coordinator-based fracture liaison services are widely promoted as an effective means of improving adherence to best practices in osteoporosis management.^{4,12,44-50} Such

Table 3. Outcomes of comprehensive geriatric hip fracture program

Characteristic	Preintervention, ^a n = 154	Postintervention, ^a n = 117	p value
Mean hospital LOS, days (median, SD)	6.4 (5.0, 4.87)	5.5 (5.0, 2.22)	0.004
Time to surgery, hours (median, SD)	29.0 (22.5, 24.9)	26.5 (22.3, 17.5)	0.168
30-day all-cause readmissions, no. (%) ^b	5 (3.2)	3 (2.7)	0.520
Disposition on discharge, no. (%)			
Home with or without home health care	33 (21)	19 (16)	0.244
Skilled nursing facility or nursing home	105 (68)	93 (79)	
Died	1 (1)	0 (0)	
Other	15 (10)	5 (5)	
Laboratory evaluation for secondary causes of osteoporosis, no. (%)			
Complete blood cell count	154 (100)	116 (99)	1.000
Basic metabolic panel with calcium	151 (98)	111 (95)	0.963
Hepatic function panel	74 (48)	104 (89)	< 0.001
25-hydroxyvitamin D	105 (68)	104 (89)	< 0.001
Pharmacotherapy on discharge, no. (%) ^c			
Calcium	84 (55)	116 (99)	< 0.001
Vitamin D	107 (70)	112 (96)	< 0.001
Antioosteoporosis medication	34 (24)	70 (85)	< 0.001
Follow-up appointment scheduled before discharge, no. (%)			
PCP (internal or external to system)	23 (15)	33 (28)	0.006
Metabolic Bone Clinic	5 (3)	62 (53)	< 0.001
Orthopedics Clinic	126 (82)	109 (93)	0.005
Follow-up appointment completed within 30 days, no. (%)			
PCP (internal to system)	14 (26)	13 (45)	0.363
Metabolic Bone Clinic	4 (3)	32 (28)	< 0.001
Orthopedics Clinic	118 (77)	96 (82)	0.175

^a Preintervention was from January 1, 2012, to October 28, 2014; postintervention was from October 29, 2014, to March 31, 2016.

^b To our institution.

^c Patients not discharged on a regimen of calcium, vitamin D, or antioosteoporosis medication were excluded from the denominator if there was a contraindication to calcium, vitamin D, or bisphosphonate documented, or if the patient was deceased.

LOS = length of stay; PCP = primary care physician; SD = standard deviation

services have been shown to improve the rates of postfracture assessment and treatment from approximately 20% to 80% or 90%.¹² We had no funding to hire a fracture liaison service coordinator at the outset of our initiative; however, we were able to achieve similar rates of osteoporosis evaluation and treatment with our program. Implementing a fracture liaison service may be a reasonable next step to further improve our transitions of care with PCPs and our Metabolic Bone Clinic. A more in-depth look at our referral process and access to outpatient care, as well as a process for scheduling all follow-up appointments for the same postdischarge day, may also improve patients' ability to complete follow-up within 30 days of discharge.

This quality-improvement initiative has several strengths. Our application of strategies from disciplines outside medicine, including change management and human-factors engineering, greatly facilitated our ability to lead and sustain change. The high level of adherence to our three interventions speaks to the buy-in of the orthopedic surgeons in particular, because they were responsible for accepting geriatric hip fracture admissions from the ED and for using the admission order sets; anecdotally, the emergency medicine physicians and other inpatient practitioners and staff also appreciated having a clear, standardized workflow. Our "population health management" approach aligns well with the Institute for Healthcare Improvement's Triple Aim.⁵¹ In addition to improving the quality of care processes, our interventions also improved efficiency, thereby reducing the cost of geriatric hip fracture care. Using our actual LOS reduction of 0.9 days for 117 patients, we conservatively estimated the cost savings for our hospital to date at approximately \$190,000. Our choice of interventions, including the electronic order sets, also positions us to be able to disseminate our initiative to other hospitals in our system.

This quality-improvement initiative has several limitations. First, we did not adjust results for comorbid conditions or severity of illness. Second, given our multiple concurrent interventions, it was not possible to assess the impact of any

one intervention in isolation. Third, we have not yet been able to formally evaluate patient or practitioner satisfaction or long-term outcomes such as functional status, secondary fracture rate, or one-year mortality. Our institution had no preexisting infrastructure for tracking these metrics in our patient population. Fourth, our initial interventions did not address the ED phase of care. We are currently working to develop an ED care pathway for geriatric patients with hip fractures. This pathway will incorporate fascia iliaca compartment blocks, with the goal to improve pain scores and the overall opioid burden for patients. Finally, this was a single-center initiative. Although this limits generalization to other institutions, our stepwise approach may serve as a guide for others interested in implementing comprehensive geriatric hip fracture care.

CONCLUSION

Our comprehensive geriatric hip fracture program improved hospital LOS, osteoporosis care, and outpatient follow-up with potentially substantial cost savings by targeting the fragmented system of care at our institution. Our experience offers important insights for the larger US health care system as it attempts to meet the needs of a rapidly aging population. ♦

Disclosure Statement

The authors have no conflicts of interest to disclose.

Acknowledgments

The authors thank Jeffrey Glasheen, MD; Read Pierce, MD; and the rest of the faculty of the Institute for Healthcare Quality, Safety, and Efficiency for their instruction and support. They also thank Micol Rothman, JoAnn Young Marrs, and all the 8W practitioners and staff for their contributions to the University of Colorado Hospital Geriatric Hip Fracture Program.

A modified abstract was presented in poster format at the Society of Hospital Medicine 2015 Annual Meeting on March 30, 2015, in National Harbor, MD. A modified abstract was also presented in storyboard format at the Institute for Healthcare Improvement's 27th Annual National Forum on December 8, 2015, in Orlando, FL, where it was 1 of 20 winners of The Permanente Journal Service Quality Award.

Kathleen Loudon, ELS, of Loudon Health Communications provided editorial assistance.

How to Cite this Article

Anderson ME, McDewitt K, Cumbler E, et al. Geriatric hip fracture care: Fixing a fragmented system. *Perm J* 2017;21:16-104. DOI: <https://doi.org/10.1278/TPP/16-104>.

References

1. Stevens JA, Rudd RA. The impact of decreasing U.S. hip fracture rates on future hip fracture estimates. *Osteoporos Int* 2013 Oct;24(10):2725-8. DOI: <https://doi.org/10.1007/s00198-013-2375-9>.
2. Becker DJ, Arora T, Kilgore ML, et al. Trends in the utilization and outcomes of Medicare patients hospitalized for hip fracture, 2000-2008. *J Aging Health* 2014 Apr;26(3):360-79. DOI: <https://doi.org/10.1177/0898264313516994>.
3. Improving and measuring osteoporosis management [Internet]. Oakbrook Terrace, IL: The Joint Commission; 2008 [cited 2016 Jan 19]. Available from: www.jointcommission.org/assets/1/18/OsteoMono_REVFinal_31208.pdf.
4. International fracture liaison service toolkit [Internet]. Nyon, Switzerland: International Osteoporosis Foundation; 2014 [cited 2016 Jan 19]. Available from: http://capturethefracture.org/sites/default/files/2014-IOF-CTF-FLS_toolkit.pdf.
5. Phy MP, Vanness DJ, Melton LJ 3rd, et al. Effects of a hospitalist model on elderly patients with hip fracture. *Arch Intern Med* 2005 Apr 11;165(7):796-801. DOI: <https://doi.org/10.1001/archinte.165.7.796>.
6. Greenberg SE, VanHouten JP, Lakomkin N, et al. Does admission to medicine or orthopaedics impact a geriatric hip patient's hospital length of stay? *J Orthop Trauma* 2016 Feb;30(2):95-9. DOI: <https://doi.org/10.1097/bot.0000000000000440>.
7. Tarrant SM, Hardy BM, Byth PL, Brown TL, Attia J, Balogh ZJ. Preventable mortality in geriatric hip fracture inpatients. *Bone Joint J* 2014 Sep;96-B(9):1178-84. DOI: <https://doi.org/10.1302/0301-620x.96b9.32814>.
8. Kamel HK, Hussain MS, Tariq S, Perry HM, Morley JE. Failure to diagnose and treat osteoporosis in elderly patients hospitalized with hip fracture. *Am J Med* 2000 Sep;109(4):326-8. DOI: [https://doi.org/10.1016/s0002-9343\(00\)00457-5](https://doi.org/10.1016/s0002-9343(00)00457-5).
9. Byszewski A, Lemay G, Molnar F, Azad N, McMartin SE. Closing the osteoporosis care gap in hip fracture patients: An opportunity to decrease recurrent fractures and hospital admissions. *J Osteoporos* 2011;2011:404969. DOI: <https://doi.org/10.4061/2011/404969>.
10. Greenspan SL, Wyman, A, Hoovan FH, et al. Predictors of treatment with osteoporosis medications after recent fragility fractures in a multinational cohort of postmenopausal women. *J Am Geriatr Soc* 2012 Mar;60(3):455-61. DOI: <https://doi.org/10.1111/j.1532-5415.2011.03854.x>.
11. Elliot-Gibson V, Bogoch ER, Jamal SA, Beaton DE. Practice patterns in the diagnosis and treatment of osteoporosis after a fragility fracture: A systematic review. *Osteoporos Int* 2004 Oct;15(10):767-78. DOI: <https://doi.org/10.1007/s00198-004-1675-5>.
12. Eisman JA, Bogoch ER, Dell R, et al; ASBMR Task Force on Secondary Fracture Prevention. Making the first fracture the last fracture: ASBMR task force report on secondary fracture prevention. *J Bone Miner Res* 2012 Sept;27(9):1-8. DOI: <https://doi.org/10.1002/jbmr.1698>.
13. Tosi LL, Glicklich R, Kannan K, Koval KJ. The American Orthopaedic Association's "own the bone" initiative to prevent secondary fractures. *J Bone Joint Surg Am* 2008 Jan;90(1):163-73. DOI: <https://doi.org/10.2106/jbjs.g.00682>.

14. Office of the Surgeon General (US). Bone health and osteoporosis: A report of the surgeon general. Rockville, MD: US Department of Health and Human Services, Office of the Surgeon General; 2004.
15. National Committee for Quality Assurance. Focus on obesity and Medicare plan improvement: The state of health care quality 2012 [Internet]. Washington, DC: National Committee for Quality Assurance; 2012 [cited 2016 Jan 19]. Available from: www.ncqa.org/Portals/0/State%20of%20Health%20Care/2012/The_State_of_Health_Care_Quality_2012_10-31-12.pdf.
16. The Joint Commission. Measure 2416: Laboratory investigation for secondary causes of fracture [Internet]. Washington, DC: National Quality Forum; updated 2016 May 10 [cited 2017 Jan 30]. Available from: www.qualityforum.org/QPS/2416.
17. The Joint Commission. Measure 2417: Risk assessment/treatment after fracture [Internet]. Washington, DC: National Quality Forum; updated 2016 Apr 4 [cited 2017 Jan 30]. Available from: www.qualityforum.org/QPS/2417.
18. Cosman F, de Beur SJ, LeBoff MS, et al; National Osteoporosis Foundation. Clinician's guide to prevention and treatment of osteoporosis. *Osteoporos Int* 2014 Oct;25(10):2359-81. DOI: <https://doi.org/10.1007/s00198-014-2794-2>. Erratum in: *Osteoporos Int* 2015 May 19;26(7):2045-7. DOI: <https://doi.org/10.1007/s00198-015-3037-x>.
19. Lee DB, Lowden MR, Patmintra V, Stevenson K. National Bone Health Alliance: An innovative public-private partnership improving America's bone health. *Curr Osteoporos Rep* 2013 Dec;11(4):348-53. DOI: <https://doi.org/10.1007/s11914-013-0159-y>.
20. WHO Technical Report Series 921. Prevention and management of osteoporosis: Report of a WHO scientific group [Internet]. Geneva, Switzerland: World Health Organization; 2003 [cited 2017 Jan 19]. Available from: http://apps.who.int/iris/bitstream/10665/42841/1/WHO_TRS_921.pdf.
21. Neff T. Trauma program redesign helps send volumes soaring. *UCHealth Central Insider* [Internet]. 2013 Oct 8 [cited 2016 Apr 11];7(7):1-3. Available from: www3.uch.edu/uchinsider/trauma%20program%20growth.pdf.
22. Kotter JP. Leading change: Why transformation efforts fail. *Harv Bus Rev* 2007 Jan;1-10.
23. National Hip Fracture Database (NHFD) annual report 2015 [Internet]. London, UK: Royal College of Physicians; 2015 [cited 2017 Jan 19]. Available from: www.nhfd.co.uk/nhfd/nhfd2015reportPR1.pdf.
24. Haywood KL, Griffin XL, Achten J, Costa ML. Developing a core outcome set for hip fracture trials. *Bone Joint J* 2014 Aug;96-B(8):1016-23. DOI: <https://doi.org/10.1302/0301-620X.96B8.33766>.
25. Liem IS, Kammerlander C, Suhm N, et al; Investigation performed with the assistance of the AOTrauma Network. Identifying a standard set of outcome parameters for the evaluation of orthogeriatric co-management for hip fractures. *Injury* 2013 Nov;44(11):1403-12. DOI: <https://doi.org/10.1016/j.injury.2013.06.018>.
26. Prestmo A, Saltvedt I, Helbostad JL, et al. Who benefits from orthogeriatric treatment? Results from the Trondheim hip-fracture trial. *BMC Geriatr* 2016 Feb 19;16:49. DOI: <https://doi.org/10.1186/s12877-016-0218-1>.
27. Thingstad P, Taraldsen K, Saltvedt I, et al. The long-term effect of comprehensive geriatric care on gait after hip fracture: The Trondheim Hip Fracture Trial—a randomised controlled trial. *Osteoporos Int* 2016 Mar;27(3):933-42. DOI: <https://doi.org/10.1186/s12877-016-0218-1>.
28. Hawley S, Javaid MK, Prieto-Alhambra D, et al; REFRESH study group. Clinical effectiveness of orthogeriatric and fracture liaison service models of care for hip fracture patients: Population-based longitudinal study. *Age Ageing* 2016 Mar;45(2):236-42. DOI: <https://doi.org/10.1093/ageing/afv204>.
29. Kristensen PK, Thilleman TM, Søballe K, Johnsen SP. Can improved quality of care explain the success of orthogeriatric units? A population-based cohort study. *Age Ageing* 2016 Jan;45(1):66-71. DOI: <https://doi.org/10.1093/ageing/afv155>.
30. Prestmo A, Hagen G, Sletvold O, et al. Comprehensive geriatric care for patients with hip fractures: A prospective, randomised, controlled trial. *Lancet* 2015 Apr 25;385(9978):1623-33. DOI: [https://doi.org/10.1016/S0140-6736\(14\)62409-0](https://doi.org/10.1016/S0140-6736(14)62409-0).
31. Sabharwal S, Wilson H. Orthogeriatrics in the management of frail older adults with a fragility fracture. *Osteoporos Int* 2015 Oct;26(10):2387-99. DOI: <https://doi.org/10.1007/s00198-015-3166-2>.
32. Ling SN, Kleimeyer C, Lynch G, et al. Can geriatric hip fractures be managed effectively within a level 1 trauma center? *J Orthop Trauma* 2015 Mar;29(3):160-4. DOI: <https://doi.org/10.1097/bot.0000000000000257>.
33. Lynch G, Tower M, Venturato L. Identifying outcomes associated with co-managed care models for patients who have sustained a hip fracture: An integrated literature review. *Int J Orthop Trauma Nurs* 2015 Aug;19(3):140-54. DOI: <https://doi.org/10.1016/j.ijotn.2014.07.002>.
34. Zeltzer J, Mitchell RJ, Toson B, Harris IA, Ahmad L, Close J. Orthogeriatric services associated with lower 30-day mortality for older patients who undergo surgery for hip fracture. *Med J Aust* 2014 Oct 6;201(7):409-11. DOI: <https://doi.org/10.5694/mja14.00055>.
35. Ventura C, Trombetti S, Pioli G, Belotti LM, De Palma R. Impact of multidisciplinary hip fracture program on timing of surgery in elderly patients. *Osteoporos Int* 2014 Nov;25(11):2591-7. DOI: <https://doi.org/10.1007/s00198-014-2803-5>.
36. Watne LO, Torbergson AC, Conroy S, et al. The effect of a pre- and postoperative orthogeriatric service on cognitive function in patients with hip fracture: Randomized controlled trial (Oslo Orthogeriatric Trial). *BMC Med* 2014 Apr 15;12:63. DOI: <https://doi.org/10.1186/1741-7015-12-63>.
37. Grigoryan KV, Javedan H, Rudolph JL. Orthogeriatric care models and outcomes in hip fracture patients: A systematic review and meta-analysis. *J Orthop Trauma* 2014 Mar;28(3):e49-55. DOI: <https://doi.org/10.1097/bot.0b013e3182a5a045>.
38. Leung AH, Lam TP, Cheung WH, et al. An orthogeriatric collaborative intervention program for fragility fractures: A retrospective cohort study. *J Trauma* 2011 Nov;71(5):1390-4. DOI: <https://doi.org/10.1097/ta.0b013e31821f7e60>.
39. Singler K, Biber R, Wicklein S, Heppner HJ, Sieber CC, Bail HJ. "N-active": A new co-managed, orthogeriatric ward: Observations and prospects. *Z Gerontol Geriatr* 2011 Dec;44(6):368-74. DOI: <https://doi.org/10.1007/s00391-011-0250-x>.
40. Kammerlander C, Gosch M, Blauth M, Lechleitner M, Luger TJ, Roth T. The Tyrolean Geriatric Fracture Center: An orthogeriatric co-management model. *Z Gerontol Geriatr* 2011 Dec;44(6):363-7. DOI: <https://doi.org/10.1007/s00391-011-0253-7>.
41. Adunsky A, Lerner-Geva L, Blumstein T, Boyko V, Mizrahi E, Arad M. Improved survival of hip fracture patients treated within a comprehensive geriatric hip fracture unit, compared with standard of care treatment. *J Am Med Dir Assoc* 2011 Jul;12(6):439-44. DOI: <https://doi.org/10.1016/j.jamda.2010.09.003>.
42. Vidán M, Serra JA, Moreno C, Riquelme G, Ortiz J. Efficacy of a comprehensive geriatric intervention in older patients hospitalized for hip fracture: A randomized, controlled trial. *J Am Geriatr Soc* 2005 Sep;53(9):1476-82. DOI: <https://doi.org/10.1111/j.1532-5415.2005.53466.x>.
43. Suhm N, Kaelin R, Studer P, et al. Orthogeriatric care pathway: A prospective survey of impact on length of stay, mortality and institutionalisation. *Arch Orthop Trauma Surg* 2014 Sep;134(9):1261-9. DOI: <https://doi.org/10.1007/s00402-014-2057-x>.
44. Fracture Prevention CENTRAL: An initiative of the National Bone Health Alliance [Internet]. National Bone Health Alliance; c2015 [cited 2017 Jan 19]. Available from: www.nbha.org/fpc.
45. McLellan AR, Gallacher SJ, Fraser M, McQuillan C. The fracture liaison service: Success of a program for the evaluation and management of patients with osteoporotic fracture. *Osteoporos Int* 2003 Dec;14(12):1028-34. DOI: <https://doi.org/10.1007/s00198-003-1507-z>.
46. Sander B, Elliot-Gibson V, Beaton DE, Bogoch ER, Maetzel A. A coordinator program in post-fracture osteoporosis management improves outcomes and saves costs. *J Bone Joint Surg Am* 2008 Jun;90(6):1197-205. DOI: <https://doi.org/10.2106/jbjs.g.00980>.
47. Marsh D, Akesson K, Beaton DE, et al; IOF CSA Fracture Working Group. Coordinator-based systems for secondary fracture prevention in fragility fracture patients. *Osteoporos Int* 2011 Jul;22(7):2051-65. DOI: <https://doi.org/10.1007/s00198-011-1642-x>.
48. Harrington JT, Barash HL, Day S, Lease J. Redesigning the care of fragility fracture patients to improve osteoporosis management: A health care improvement project. *Arthritis Rheum* 2005 Apr 15;53(2):198-204. DOI: <https://doi.org/10.1002/art.21072>.
49. Cooper MS, Palmer AJ, Seibel MJ. Cost-effectiveness of the Concord Minimal Trauma Fracture Liaison service, a prospective, controlled fracture prevention study. *Osteoporos Int* 2012 Jan;23(1):97-107. DOI: <https://doi.org/10.1007/s00198-011-1802-z>.
50. McLellan AR, Wolowacz SE, Simovetz EA, et al. Fracture liaison services for the evaluation and management of patients with osteoporotic fracture: A cost-effectiveness evaluation based on data collected over 8 years of service provision. *Osteoporos Int* 2011 Jul;22(7):2083-98. DOI: <https://doi.org/10.1007/s00198-011-1534-0>.
51. The IHI Triple Aim Initiative [Internet]. Cambridge, MA: Institute for Healthcare Improvement; c2017 [cited 2017 Jan 19]. Available from: www.ihl.org/engage/initiatives/tripleaim/pages/default.aspx.