Establishing an Orthopedic Excess Hospital Days in Acute Care Program

Michele Fang, MD[1]*, Frances Mao, MD[1], Eric Hume, MD[2,3], S Ryan Greysen, MD, MHS[1,3]

[1]*Division of General Internal Medicine, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania;* [2]*Department of Orthopedic Surgery, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania;* [3]*Leonard Davis Institute of Health Economics, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania.*

BACKGROUND: Excess days in acute care (EDAC) after total joint arthroplasty (TJA) represent a large economic burden. We developed an Orthopedic EDAC program that triages TJA patients to the appropriate service line (orthopedic vs medicine) and level of care (observation vs inpatient) on re-presentation. We developed and used evidence-based protocols for the treatment of TJA patients who are rehospitalized.

METHODS: We defined Orthopedic EDAC as the length of stay (LOS) during readmission and observation stays. Our target population included TJA and revision TJA patients. Patients between April 2017 and September 2017 and between October 2017 and September 2018 were defined as pre-implementation and post-implementation of the Orthopedic EDAC program, respectively.

RESULTS: A total of 2,662 patients underwent TJA and revision TJA during the pre-implementation and post-implementation periods. Twenty-three patients were managed on observation status during the study period. Readmissions decreased from 49 (6.1%) during pre-implementation to 37 (2.0%) during post-implementation (P = .004). By design, more rehospitalized patients were on the orthopedic surgery service after implementation of the Orthopedic EDAC program (n = 49; 70%) versus before (n = 22; 35%; P = .028). EDAC LOS decreased from 7.75 days to 4.73 days (P = .005).

CONCLUSION: In this single-center, before-after pilot of a novel Orthopedic EDAC program, we demonstrated a reduction in readmissions and Orthopedic EDAC LOS, as well as improved continuity of care for TJA patients on re-presentation. *Journal of Hospital Medicine* 2020;15: 659-664. © 2020 Society of Hospital Medicine

Total joint arthroplasty (TJA) procedures currently account for more Medicare expenses than any other inpatient procedure.[1] In 2015, Centers for Medicare & Medicaid Services (CMS) announced the Comprehensive Care for Joint Replacement (CJR) model in which hospitals are paid one bundled payment for all related items and services utilized within a 90-day episode of care.[2] Recent studies have suggested that the best opportunity to lower episode costs appears to be in the post-acute care setting and reducing readmissions.[1,3]

Surgical comanagement, which provides shared management of surgical patients between surgeons and hospitalists, is typically used in orthopedic surgery, neurosurgery, vascular surgery, and general surgery.[4] Among patients with at least one medical comorbidity, surgical comanagement decreases length of stay (LOS), 30-day readmission rate for medical causes, and the proportion of patients with at least two medical consultants.[5,6] Not all studies have shown that comanagement is beneficial. Maxwell et al found no significant differences in mortality or morbidity among hip fracture patients who did or did not receive comanagement[7]; however, comanaged patients were older and had more significant comorbidities, and there was no standard definition of comanagement among the participating institutions.

Comanagement after patients are discharged is a concept that has not been previously published but may become important with the Bundled Payments for Care Improvement initiative and high costs of excess days in acute care (EDAC). Hospitalists may be able to continue their work after discharge as part of the 90-day episode of care.[8] TJA patients often have comorbidities, and surgical site infections and cardiovascular events are the most common causes of 30-day TJA readmissions.[9]

At our institution, 25% of TJA patients who presented to the Emergency Department (ED) within 90 days of surgery required a stay of less than 48 hours for conditions that did not require inpatient level of care. In addition, 50% of readmissions were secondary to medical complications. We also found significant variation in the management of common postoperative complications, such as postoperative fever, dislocation, anemia, and shortness of breath, especially among the different service lines caring for these patients. Therefore, we developed an Orthopedic EDAC program to reduce readmissions and to implement standardized admission algorithms and evidenced-based treatment protocols for common postoperative problems.

*Corresponding author: Michele Fang, MD; Email: Michele.fang@uphs.upenn.edu; Telephone: 215-662-3797; Twitter: @PennHospitalist.

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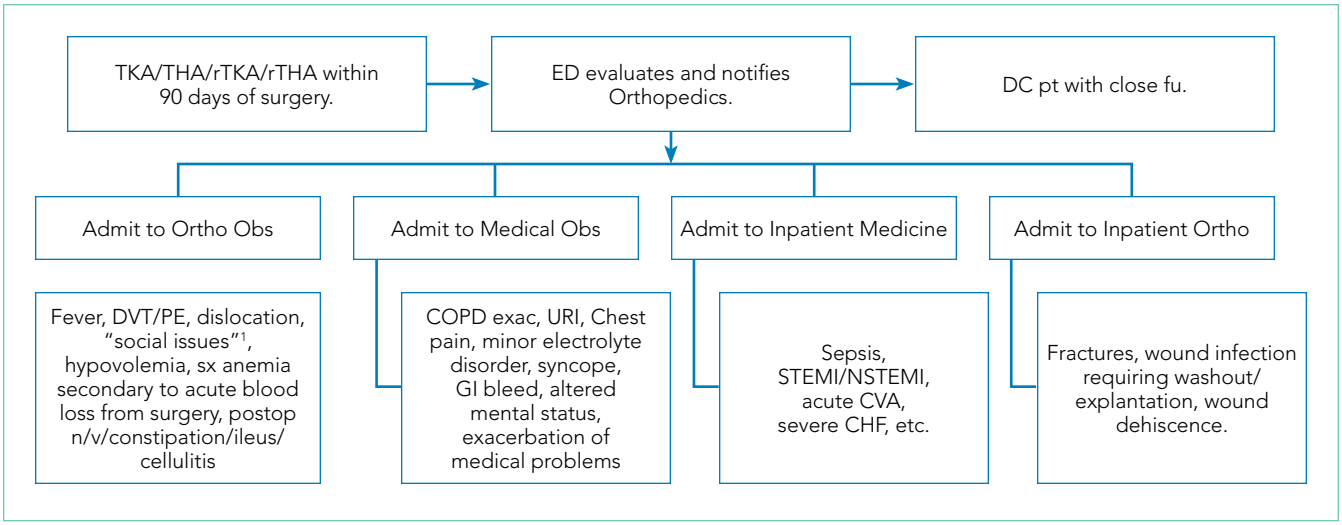

FIG. Admitting Algorithm for Total Joint Replacement Patients Presenting Within 90 Days of Their Surgery

[1]For example, patient did not like skilled nursing facility would be considered a social issue.

Abbreviations: CHF, congestive heart failure; COPD exac, chronic obstructive pulmonary disease exacerbation; CVA, cerebral vascular accident; DC, discharge ; ED, emergency department; fu, follow-up; GI, gastrointestinal (eg, diarrhea, constipation); NSTEMI, non-ST elevation myocardial infarction; n/v, nausea and vomiting; Obs, observation; pt, patient; rTHA, revision Total Hip Arthroplasty (THA); rTKA, revision Total Knee Arthroplasty (TKA); STEMI, ST elevation myocardial infarction; sx, symptoms; THA, Total Hip Arthroplasty; TKA, Total Knee Arthroplasty.

METHODS

Setting/Participants

We included patients who underwent total knee arthroplasty (TKA), total hip arthroplasty (THA), revision TKA, or revision THA from April 1, 2017, to September 30, 2018, at an urban teaching hospital. Patients were followed for 90 days after discharge. Factors such as age, sex, race, primary payer, Medicare Severity-Diagnosis Related Group (MS-DRG), discharge destination (home, home with home health, skilled nursing facility [SNF], acute rehab, other), and EDAC LOS were compared. An interdisciplinary committee comprising representatives from orthopedic surgery, hospital medicine, emergency medicine, and case management formulated observation criteria for the Orthopedic EDAC program. To be eligible for inclusion, observation patients had to have re-presented within 90 days from their initial surgery, could not be safely discharged home immediately from the ED, and did not require inpatient level of care. Patients qualifying for orthopedic observation were assigned rooms on the orthopedic wards to maintain continuity with nursing, physical therapy/occupational therapy, and case management staff. The University of Pennsylvania institutional review board reviewed this study and determined the project to be exempt.

Study Design

The Figure shows the admitting algorithm for TJA patients re-presenting within 90 days of their surgery. The ED evaluated the eligible patients; if they were not able to discharge the patient home, they notified the orthopedic resident on call for evaluation. Eligible diagnoses for the orthopedic observation in which orthopedics was the primary service included the need for postoperative pain control, fever (without signs or symptoms of sepsis), deep venous thrombosis or pulmonary embolism without hemodynamic instability, hemodynamically stable hypovolemia, symptomatic anemia secondary to acute blood loss anemia following surgery, and postoperative nausea, vomiting, constipation, ileus, and cellulitis. Eligible diagnoses for medical observation on the Medicine service included mild exacerbations of chronic obstructive pulmonary disease (COPD), syncope, upper respiratory tract infections, chest pain, delirium, and other exacerbation of medical problems. Full admission to Orthopedics included patients with wound infections requiring surgical washout, periprosthetic fractures/hematoma requiring operative management, and wound dehiscence requiring repair. All other readmissions requiring a stay of 48 or more hours were admitted to the medical or subspecialty medical service lines (eg, internal medicine, family medicine, geriatrics, cardiology, or pulmonary critical care).

Development of Evidence-Based Algorithms

Patients who re-presented to acute care (for either observation stays or readmissions) were treated based on standardized algorithms. The interdisciplinary work group developed evidence-based evaluation and treatment plans for common postoperative problems, including postoperative fever, postoperative shortness of breath, and postoperative septic joints. This was based on a comprehensive literature review and consensus among emergency medicine, hospital medicine, and orthopedic surgery. Appendix 1 illustrates an example of a standardized algorithm for the workup of hypoxia.

Definition of Readmissions and EDAC

Readmission and observation stays were flagged on re-presentation, and reasons for readmission or observation status were analyzed. Observation cutoffs of "successful" (<48 hours) vs "unsuccessful" (≥48 hours and/or conversion to inpatient status) were based on the CMS Two-Midnight Rule in accordance with past studies.[10] Readmissions were defined as patients who required an acute stay of 48 or more hours within 90 days of dis-

charge from their original surgical stay. Patients admitted under observation status who required a stay of less than 48 hours did not count as a readmission but did count toward EDAC.

We acknowledge that our definition of Orthopedic EDAC is not the same as CMS's definition of EDAC for other conditions such as congestive heart failure, which includes hours in observation, readmissions, and ED visits. We focused on studying and reducing days in the hospital (observation status and readmissions), and our intervention was not intended to prevent issues that would cause patients to present to the ED. Therefore, including ED visits in our operational definition of EDAC would add an unnecessary source of confounding that would bias our results toward the null hypothesis.

Data Collection and Data Analysis

The Orthopedic EDAC program was implemented on October 1, 2017, based on the above triage and treatment plans. We analyzed demographic and outcome data (readmissions, LOS, time in observation status, reason for readmission/observation status) for 6 months prior (April 1, 2017, to September 30, 2017) and 1 year after (October 1, 2017, to September 30, 2018). Microsoft Excel (Jones, 2013) was used for data analysis. Paired *t*-test with $P < .05$ was predefined as significant.

Eligible patients were identified from previous admission diagnoses obtained through Vizient, which is a collaboration of academic medical centers that maintains a hospital discharge data set (the Clinical Data Base/Resource Manager CDB/RM). It included patient demographics, discharge diagnoses, procedures, and outcomes.[11] The Vizient database is a respected source of data and has been used for several scholarly studies.[10-12] We queried the Vizient Clinical Data Base/Resource Manager v. 8.12.0.11 (Vizient Inc., Irvine, TX) for the following data from both before and after the program's implementation: disposition, LOS, insurance information, gender, type of surgery, MS-DRG, and race.

The five included MS-DRGs represented major hip and knee joint replacements with and without major comorbid conditions (MCCs; MS-DRG 469 and MS-DRG 470, respectively) and revision hip or knee replacement with MCCs, with comorbid conditions (CCs), and without MCCs or CCs (MS-DRG 466, MS-DRG 467, and MS-DRG 468, respectively). MCCs included but were not limited to decubitus ulcer, severe malnutrition, quadriplegia, and end-stage renal disease. Examples of CCs included transplant patients, lymphoma, leukemia, and malignancies (except breast or prostate), based on CMS definitions.[13]

TABLE 1. **Demographics of Pre-implementation and Post-implementation of an Orthopedic EDAC Program**[1]

	Pre-implementation (n = 799) (n, %)	Post-implementation (n = 1,863) (n, %)
MS-DRG 469[2]	27 (3.4)	58 (3.1)
MS-DRG 470[3]	638 (80.0)	1,490 (80.0)
MS-DRG 466[4]	20 (2.5)	27 (1.4)
MS-DRG 467[5]	69 (8.6)	164 (8.8)
MS-DRG 468[6]	44 (5.5)	124 (6.6)
Age (n, SD)	63.8 (11.3)	63.5 (11.1)
Female	484 (60.5)	1095 (58.8)
White	403 (50.4)	978 (52.5)
Black	321 (40.2)	675 (36.2)
Other Race	74 (9.3)	210 (11.3)
Medicare	406 (50.9)	917 (49.2)
Medicaid	91(11.4)	193 (10.4)
Commercial	297 (37.2)	733 (39.3)
Other insurance	3 (0.4)	20 (1.1)
Discharge to home	495 (62.0)	1173 (63.0)
Discharge to SNF	266 (33.3)	612 (32.9)
Discharge to acute rehab	35 (4.4)	69 (3.7)
Other discharge	0	3 (0.2)
Average LOS (days, SD)	3.0 (2.1)	2.9 (1.9)
Readmission *	49 (6.1)	37 (2.0)

[1]Pre-implementation includes April 1, 2017, to September 30, 2017, and post-implementation includes October 1, 2017, to September 30, 2018.
[2]Major hip and knee joint replacement or reattachment of lower extremity with MCC.
[3]Major hip and knee joint replacement or reattachment of lower extremity without MCC.
[4]Revision of hip or knee replacement with MCC.
[5]Revision of hip or knee replacement with CC.
[6]Revision of hip or knee replacement without CC/MCC
*$P < .05$ defined as significant.
Abbreviations: CC, complications or comorbidities; LOS, length of stay; MCC, major complications or comorbidities; MS-DRG, Medicare Severity-Diagnosis Related Group; rehab, rehabilitation; SD, standard deviation; SNF, skilled nursing facility.

RESULTS

Table 1 compares the demographics of the pre-implementation and post-implementation periods. There were a total of 2,662 admissions (799 before program implementation and 1,863 after). TKA and THA patients without MCCs (MS-DRG 470) accounted for 80% of patients during both periods. In both periods, approximately 60% of patients were female, 50% of patients were White, 40% were Black, and 10% were another race. The mean age was 63.6 years old. Most patients had Medicare or commercial insurance. Discharge destinations were similar during both periods.

Table 2 illustrates how the patients who re-presented to acute care were triaged based on the algorithm described in the Figure. Among the 64 patients who re-presented during the pre-implementation period, there were no observation stays; there were 38 patients who were placed under medicine inpatient services. During post-implementation, there were 48 patients (29 on orthopedics, 17 on medicine, and 2 on other service lines) who were admitted

TABLE 2. **Service Lines for Patients Re-presenting Before or After Implementation of Orthopedic EDAC Program**

Readmission Level of Care	Pre-implementation (n=64/799 patients)	Post-implementation (n=71/1863)	*P* value
Orthopedic Service Line			
Primary Inpatient	22 (35.1%)	20 (28.1%)	.0006
Observation	0	29 (40.8%)	.048
Medicine Service Line			
Primary Inpatient	38 (59.4%)	3 (4.2%)	.035
Observation	0	17 (24.9%)	.005
Other Service Line			
Primary Inpatient	4 (6.3%)	0	NA
Observation	0	2 (2.8%)	.35

TABLE 3. **Orthopedic EDAC LOS* Based on Study Period and Readmission Diagnosis**

	Pre-intervention EDAC LOS (days)	Post-intervention EDAC LOS (days)	*P* value
Aggregate EDAC (avg ± stdev)	7.75 ± 5.8^	4.73 ± 4.43	.005
Wound infection (avg ± stdev)	7.89 ± 7.92	5.89 ± 6.66	.082
Exac of Medical condition (avg ± stdev)	4.85 ± 3.23	3.33 ± 1.16	.063
Medical complication (fever, GI, etc) avg ± stdev)	6.33 ± 2.14^	3.65 ± 2.35	.006
PP mech failure (avg ± stdev)	6.65 ± 8.16	4.91 ± 1.27	.079

*Orthopedic EDAC LOS = observation + readmission days
^Outlier removed (100 day stay)
Abbreviations: avg, average; exac, exacerbation; GI, gastrointestinal (eg, nausea, vomiting, ileus, etc); mech, mechanical (eg, periprosthetic fracture); pp, periprosthetic; stdev, standard deviation.

under observation status. Twenty-three patients were discharged on observation status. Of those patients, 20 were admitted to orthopedic observation and 3 patients to medicine observation. Among the 71 patients who re-presented during the post-implementation period, 40.8% (29 patients) were admitted to inpatient orthopedic services, and 17 patients were readmitted to medicine services (24.9%). Among re-presenting patients, 70% were admitted to orthopedics inpatient and observation combined, in contrast to just 35% during the pre-implementation period.

Readmissions decreased from 6.1% during pre-implementation to 2% during post-implementation ($P = .004$). In addition, the LOS for patients re-presenting during post-implementation was significantly lower than it was during pre-implementation. Table 3 details the associated LOS based on study period and readmission diagnosis. The aggregate LOS for all readmissions decreased from 7.75 days to 4.73 days ($P = .005$). The LOS decreased across all realms of readmission diagnoses. An outlier with an LOS greater than 100 days was removed from the pre-implementation group.

Appendix 2 further looked at patients who had observation orders, reasons for observation stay, and which patients were able to be discharged on observation status. Patients with medical complications such as fever and urinary tract infection were more likely to be discharged on observation status than were patients with wound drainage or redness that was concerning for a periprosthetic joint infection.

DISCUSSION

To our knowledge, this is the first description of a published Orthopedic EDAC program using orthopedic observation, standardized admitting and treatment algorithms, and comanagement of patients who re-presented after their original surgery. The development of an Orthopedic EDAC program at our hospital with comanagement was successful in reducing readmissions, decreasing LOS for readmitted patients, and increasing continuity of care. A number of points require more elaboration.

The Orthopedic EDAC program's improvement in both reducing readmissions and decreasing LOS for EDAC (including days for observation and readmissions) was not caused by simply shifting patients with shorter LOS from inpatient to observation because the inpatients did not have a longer LOS. We had lower Orthopedic EDAC during the post-implementation vs pre-implementation even when considering EDAC in terms of both observation and readmissions. The decrease in readmissions is not only from the patients that were discharged on observation status, but also a result of other concurrent interventions, such as encouraging discharge to home rather than to rehabilitation facilities and more rigorous preoperative optimization.

The national rates of 30- and 90-day readmissions after primary TKA were 4% (95% CI, 3.8%-4.0%) and 7% (95% CI, 6.8%-7.2%), respectively,[10] and the average cost of readmission for medical causes was $22,775 for THA and $11,682 for TKA.[12] If one considers the 23 "saved readmissions" with 12 surgical complications and 11 medical complications, we "saved" roughly $591,105. Also, with the decrease in LOS for each readmission for any cause from 7.75 days to 4.73 days, the 48 readmissions had a 150 day lower LOS overall. With the average hospital day costing $2,289/day at nonprofit hospitals,[13] there are additional cost savings of $343,350 overall. Therefore, the grand total estimated savings during this pilot was $934,455.

The decrease in post-implementation LOS vs pre-implementation LOS was likely multifactorial. The Orthopedic EDAC program improved continuity of care with orthopedic surgery and support staff (registered nurses, social workers, physical therapists) and utilized standardized protocols for work-up of common postoperative problems. These evidence-based protocols reduced waste that resulted in less testing with fewer incidental findings and side effects. The clinical history and patient circumstance did not need to be reestablished and tests did not need to be duplicated, which led to decreased LOS. Observation status allowed us to return patients to SNFs without the tedious procedure of insurance reauthorization and reevaluation by physical therapy and occupational therapy. Other factors such as "discharge before noon" and early physical therapy services ongoing during post-implementation also contributed to the decreased LOS.

Our Orthopedic EDAC program did not deliberately place patients on observation status who met full inpatient criteria solely to decrease the readmission rate. Our average LOS on observation status was 26 hours. In contrast, a study of observation stays at another tertiary academic medical center showed longer LOS: The average observation LOS was 33.3 hours with 44.4% of stays less than 24 hours and 16.5% greater than 48 hours.[11] The use of EDAC hours in our study, which included both observation hours and readmission hours, made our impact more than simply a shifting of readmissions to observation stays.

It is important to utilize observation stays as they were intended—ie, stays requiring less than 48 hours. Over the past 10 years, the incidence and duration of observation stays has increased significantly while readmissions have decreased.[14,15] Observation status has serious financial implications, and it is estimated that 10% of observation stays end up costing the patient more than an inpatient stay would and patients must pay 20% of services after the Part B deductible.[16,17] In addition, Medicare beneficiaries have no cap on costs for an observation stay.[16] Therefore, it is important to determine which patients and diagnoses are best suited for observation status. We found that younger patients without comorbidities who came from home and presented with complications such as fever and syncope were most likely to be successfully discharged on observation status with the Orthopedic EDAC program. SNF patients on observation status in particular may have large hospital bills because they often require 3 midnight stays but do not meet inpatient level of care and are thus not covered as inpatients.[18]

The Orthopedic EDAC program emphasized continuity of care with the primary orthopedic surgery team. Prior to implementation, orthopedics was often not even notified when their patients were in the ED or readmitted because the prevailing practice was that once surgery was completed, the surgeon's job was done. Post-implementation, orthopedics was called for every bundled patient re-presenting within 90 days after a TJA. The triage protocol (Figure) was agreed upon prior to implementation by orthopedics, hospital medicine, and emergency medicine. Orthopedic attendings wanted to play a larger role and more strongly influence care of their patients on re-presentation because these attendings had become frustrated with the great disparities in work-up when patients went to various other services instead. Pre-implementation, many patients admitted to the primary orthopedic service had lower acuity, and they tended to be younger and have less medical complexity. Post-implementation, primary orthopedic services took care of more patients under observation status and those with "mechanical" complications that required surgery.

It is important to note that, while comanagement is common preoperatively and immediately postoperatively, studies of comanaged patients on re-presentation have apparently not been previously published. In addition, a recent study by Maxwell et al found that patients who were comanaged perioperatively had higher mortality and morbidity than did patients who were not comanaged.[7] These findings reflect the need for more studies to be done to best optimize the use of comanagement. Comanagement as part of the Orthopedic EDAC program at our institution was successful in keeping patients who re-presented on the orthopedic service, decreasing LOS, and decreasing readmissions.

The study has some limitations. First, this was a retrospective study, so confounding variables may not be completely eliminated. Second, our study was conducted at a single center for total joint arthroplasty and did not consider other orthopedic conditions; however, our readmission numbers and demographics are similar to past studies. Third, we had small numbers of readmissions and observation patients, which resulted in a small effect size; however, our intervention demonstrated significant changes in LOS and readmissions. Fourth, our data is based on prior billing and coding, which may not always be accurate or inclusive. Fifth, we did not have THA or TKA patients on overnight recovery status or same day surgeries during either period studied; however, we are developing infrastructure to implement this in the future. Finally, ED visit data was not readily available to us, so we were not able to calculate the traditional EDAC. Despite these limitations, this study provides an important look at how an Orthopedic EDAC program can decrease readmissions, decrease LOS, and improve continuity of care in patients undergoing TJA.

CONCLUSION

An Orthopedic EDAC program with comanagement may decrease readmissions, improve continuity of care on re-presentation, and decrease LOS for total joint arthroplasty patients who presented after initial surgery and lead to substantial cost savings.

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