Arthroplasty Today 5 (2019) 497–502

Contents lists available at ScienceDirect
Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Original research

Patient-optimizing enhanced recovery pathways for total knee and hip arthroplasty in Medicare patients: implication for transition to ambulatory surgery centers

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A R T I C L E   I N F O

Article history:
Received 26 April 2019
Received in revised form 9 August 2019
Accepted 14 August 2019
Available online 25 September 2019

Keywords:
Local infiltration analgesia
Opioids
Outpatient surgery
Pain management
Rural medicine
Total knee arthroplasty

A B S T R A C T

Background: Medicare-insured patients may be candidates for outpatient total knee and hip arthroplasty (TKA/THA) because postsurgical complications are often age unrelated. We evaluated an opioid-minimizing enhanced recovery after surgery (ERAS) pathway in an inpatient setting designed to presurgically optimize and prepare patients to reduce risk of avoidable postsurgical complications and maximize feasibility of same-day discharge.

Methods: This single-center retrospective chart review included 601 unique consecutive Medicare-insured patients who underwent TKA (n = 337) or THA (n = 308) between June 1, 2015 and November 16, 2017. The ERAS pathway included presurgical nonarthroplasty treatment of osteoarthritis; physical, medical, and social optimization; and medication trials to individualize perioperative analgesia. All patients were discharged directly home without home services. Adverse events, satisfaction, and opioid use were analyzed descriptively.

Results: Mean (range) age was 72 (32-92) years; 56.7% of patients were women; 84.0% were discharged the same day, 13.8% in 1 day, and 2.2% in >1 day. Rates of minor and severe adverse events within 30 days were 0.5% and 1.1%, respectively. There were no intubations, sepsis, or deaths. Twelve patients (1.9%) had unplanned readmissions within 30 days. Patient-reported satisfaction with facility, analgesia, and communication were high. Most patients (84.2%) did not require >1 seven-day opioid prescription from the surgeon within 8 weeks postsurgery.

Conclusions: Using a patient-optimizing, opioid-minimizing ERAS pathway without home services, Medicare-insured patients undergoing TKA/THA experienced low complication rates and high satisfaction. Exploratory analysis suggests limited postsurgical opioid use. This presurgical patient-engagement approach may aid transition to freestanding ambulatory surgery centers.

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Introduction

Outpatient total knee arthroplasty (TKA) and total hip arthroplasty (THA) are growing rapidly in volume. It is estimated that by 2026, 51% will be performed as outpatient procedures [1]. Concerns remain over elevated risk of complications in older patients. Even with the removal of TKA from the Centers for Medicare and Medicaid Services (CMS) inpatient-only list, TKA cannot be performed in a freestanding ambulatory surgery center (ASC).

A recent retrospective study showed that 70% of patients undergoing TKA/THA at an academic medical center would theoretically have been eligible for the procedure at an ASC [2]. The most common reasons for ineligibility were not age related but rather medical in nature (ie, body mass index, severity of comorbidities, and untreated obstructive sleep apnea). This suggests that Medicare status alone may not be a relevant exclusion criterion for ambulatory TKA/THA; therefore, expansion to freestanding ASCs for Medicare-insured patients warrants CMS consideration.

Uncontrolled pain and opioid-related nausea are common factors delaying discharge [3]. Use of opioid medication increases risk for chronic opioid use [4], and opioid-related adverse events (AEs)
are associated with prolonged hospital stays, readmission, mortality [5], and increased costs [6]. Controlling pain while minimizing opioid use has been a major focus of many TKA/THA programs [7]. Enhanced recovery after surgery (ERAS) pathways incorporating multimodal, opioid-sparing protocols have been shown to improve clinical and economic outcomes after TKA [7]. ERAS pathways incorporating presurgical physical, social, and medical optimization may be especially critical in elderly patients who experience barriers to healthcare owing to lack of transportation, social isolation, and cost. ERAS pathways offer Medicare patients quality care that meets the “Triple Aim” of healthcare: improving patient experience, improving population health, and reducing healthcare costs.

The objective of this study is to assess outcomes and feasibility of same-day discharge using a presurgical patient-optimizing, opioid-sparing ERAS pathway in Medicare-insured patients undergoing TKA/THA without home healthcare services. The pathway focused on expanding the eligible patient population, improving patient satisfaction, reducing postsurgical complications and cost, and minimizing the duration of postsurgical opioid use.

Material and methods

This is a retrospective chart review of 601 consecutive unique Medicare-insured patients who underwent primary inpatient TKA or THA between June 1, 2015 and November 16, 2017, performed by 1 surgeon at a rural hospital inpatient facility. Two Institutional Review Boards approved the study. Patient data were deidentified, and the Institutional Review Boards granted a waiver of written informed consent.

The comprehensive outpatient ERAS pathway was developed over >10 years by the senior author of this report based on patient needs and outcomes. It encompassed the entire period from the initiation of conservative/nonsurgical care of arthritis to the decision to undergo TKA/THA to at-home recovery (Appendix A). The key elements of the pathway included patient engagement, creation of realistic expectations, and presurgical development of an individualized, opioid-sparing, multimodal pain control program. There were no inclusion or exclusion criteria for entry into the ERAS pathway. Patients were required to participate in their own care and preparation for surgery.

Patient engagement included conservative/nonarthroplasty management of hip and knee osteoarthritis per evidence-based clinical practice guidelines [8,9]; education; and medical, physical, and social optimization. Conservative care of osteoarthritis was initiated at the patient’s first clinic visit before consideration of surgical intervention and included physical optimization via physical therapy. As part of conservative osteoarthritis care, a home program of strengthening and stretching exercises (1 h/d) and a walking or other upright weight-bearing aerobic program (6 h/wk) to reduce pain and improve function was customized to each patient [8,9]. Other elements included weight loss, nonopioid pain medication trials, appropriate intra-articular steroid/viscosupplementation injections, and medical optimization of modifiable problems.

Medical optimization included goals to correct not only the medical problems (ie, modifiable risk factors) known to increase a patient’s risk of complications but also those found by the senior author to improve patient outcomes and satisfaction by increasing patient compliance and engagement. The conservative care of arthritis program was designed to not only treat arthritis symptoms, but also prepare the patient for joint replacement when the decision was made to pursue that option, thereby minimizing delays to surgery. The senior author’s desire was to expand the population of patients suitable for outpatient joint replacement by preparing patients physically and medically for successful outpatient joint replacement.

Once conservative care of arthritis failed to meet the patient’s expectations, patients were assisted as needed in additional presurgical physical, medical, and social optimization to meet the goals for TKA/THA with same-day discharge. Patients who decided to have surgery were not required to meet any inclusion criteria for entry into this part of the ERAS pathway; all patients were assisted with meeting the goals for surgery for as long as needed. Patient engagement in his or her care was a significant aspect of surgery preparation. Those unwilling to engage, participate, and comply with the ERAS pathway were offered continued nonsurgical care of osteoarthritis or referred elsewhere for care.

As part of their social optimization, patients were required to have a “JointCoach.” The JointCoach could be a family member or friend. The JointCoach often assisted the patient during the conservative/nonsurgical care of arthritis program and was required to be present at the appointment for the patient’s decision to undergo surgery so that the patient’s and JointCoach’s readiness could be determined and additional preparation could be provided as needed. For the JointCoach, readiness included understanding and willingness to perform their duties. If the patient or JointCoach was found to be unprepared or unwilling, surgery was delayed until both were fully prepared or a new JointCoach could be found. The JointCoach was also responsible for being present at the patient’s hospital stay, to be by of surgery and to stay with the patient for 3 days after surgery to ensure medication compliance and adherence to exercise and analgesia protocols, with the aim of improving outcomes and reducing complications. Early in the process, the patient and JointCoach participated in education regarding realistic expectations for pain, the dangers of opioid use, opioid tapering, sleep hygiene, exercise and walking programs, walker safety, wound care, and home preparation. Refresher education was provided on the day of surgery by the senior author and staff, including nurses, physical therapists, and mid-level providers. Patients were not discharged from the surgical facility until they met all physical criteria for discharge and were considered to be medically, physically, and socially prepared to be in their home without the aid of home health services. Therefore, before surgery, a short course of physical therapy was initiated to educate the patient on the use of adaptive/recovery aids (eg, walkers), home preparation and safety, activities of daily living, postsurgical flexibility/strengthening/exercise programs, joint precautions, and postsurgical icing and elevation for pain and edema control. This presurgical physical therapy was initiated to ensure that patients could demonstrate (both before and after surgery) that they knew how to use the postsurgical recovery aids; could perform activities of daily living and exercises; understood medications, precautions, and appropriate icing/elevating; and had a safe home environment.

The presurgical creation of customized, multimodal, opioid-sparing pain management was implemented. Presurgical 2-day opioid medication trials were employed to develop individualized pain, nausea, itching, constipation, urinary retention, and anesthesiology treatment plans for each patient. Information pertaining to previous use and efficacy of opioid, antinausea, anti-itch, and anticonstipation medications was collected and combined with patient-specific information (eg, age, weight, height, history of constipation, medications, and medical history) to determine the appropriate dosages for the trial. Multiple trials were performed if needed to determine the best treatment plan. For the opioid medication trial, patients were instructed to take antinausea and anti-itch medications before eating and to take their oral opioid after eating, 4 times daily. Patients were also encouraged to be active. The goal was to reduce discomfort by 60% without significant side effects. Anticonstipation medication (polyethylene glycol and docusate sodium twice daily), along with adequate fluids to prevent dehydration, were commenced 1 day prior to the opioid

A. Van Horne, J. Van Horne / Arthroplasty Today 5 (2019) 497–502
medication trial; anticonstipation rescue medication was also available if necessary. The individualized opioid pain medication program (with appropriate anticonstipation, anti-itch, and anti-nausea medication) was initiated immediately before surgery. With the exception of the 2-day presurgical opioid medication trial(s), opioids were not prescribed for use before surgery; though, no patient was refused surgery due to chronic or presurgical opioid use. Patients and their JointCoaches were directed to taper patients off the opioid medication as soon as possible after surgery.

A nonopioid pain medication program (acetaminophen, meloxicam, or celecoxib), developed at the time of conservative care, was initiated 1 week before surgery and continued for at least 6 weeks after surgery to reduce postsurgical pain and help patients rapidly taper off opioid medications. Multimodal pain control included anesthesia. Hypotensive and multimodal analgesia methods (Table 1) were used during surgery to minimize trauma, pain, blood loss, and infection risk and promote early function and mobility.

Patients with no previous history of deep vein thrombosis (DVT) or pulmonary embolism (PE) received aspirin 325 mg immediately before surgery and knee-high compression stockings to wear for 2 weeks; compression devices were used during surgery and while at the surgery center. To meet the surgical facility’s perception of Medicare requirements for anticoagulation, a single postsurgical dose of warfarin 1.25 mg was given in the recovery area. No additional dose of warfarin was given in patients without chronic anticoagulation medication use or increased risk factors for DVT or PE, but these patients continued taking aspirin 325 mg once daily for 6 weeks. Exercises for the prevention of DVT were initiated in the recovery room, and ambulation was generally initiated within 1–2 hours after surgery. A similar process was followed for patients with a history of DVT or PE; however, these patients received aspirin 325 mg once daily for 1 week and a warfarin protocol for 6 weeks. If currently using anticoagulants, patients were given presurgical enoxaparin bridging as medically indicated and aspirin 325 mg once daily for 1 week postsurgery. If currently using warfarin, the patient’s regular maintenance dose was restarted immediately after surgery. The use of any other chronic anticoagulant was reintiated 3 days after surgery.

TKA was performed using the subvastus approach with an integrated knee system without tourniquet. In the senior author’s experience, using the subvastus approach poses less risk of the patient disrupting the extensor mechanism repair during the aggressive postsurgical flexibility and self-stretching protocol. THA was performed using the anterior approach with a complete hip system, acetabular cup system, and fracture table. Patients received spinal anesthesia; awake sedation; adductor canal block with bupivacaine HCl (TKA only); pericartilaginous infiltration with liposomal bupivacaine 266 mg (EXPAREL; bupivacaine liposome injectable suspension; Pacira BioSciences, Inc., Parsippany, NJ), bupivacaine HCl, and adjuncts; anterior lateral femoral cutaneous nerve field block by the surgeon with liposomal bupivacaine 266 mg and bupivacaine HCl (THA only); and restricted intravenous opioids. Hemostasis was obtained using hypotensive anesthesia, tranexamic acid, electrocautery, and bipolar tissue sealer without a tourniquet. After surgery, the patient and his or her JointCoach were moved to a stepdown unit where they were provided with a review of walker training, exercise, dressing care, medication management, icing and elevation, and avoidance of complications. Patients were discharged home without home health services on a multimodal pain regimen (nonopioid analgesics and a 7-day opioid supply). Staff at the surgical facility called patients the day after surgery, and patients were encouraged to call the triage line (during business hours) or the surgeon/partners (after business hours) as needed. The senior author’s staff also contacted patients 2–5 business days postsurgery to evaluate progress and answer questions. Patients were encouraged to call before visiting an emergency department (ED) or urgent care (UC) but were instructed to visit an ED if they experienced a heart attack or stroke, could not breathe, or fell and could not get up. Postsurgical outpatient physical therapy was initiated within 3 business days of surgery. Therapy was ordered for 6 visits over 4 weeks and renewed at the 4-week postoperative visit for an additional 4 visits over 4 weeks if deemed medically appropriate by the physical therapist.

At postsurgical week 2, patients who provided e-mail addresses received Internet-based satisfaction surveys via CareSense (DePuy Synthes, Conshohocken, PA). The surveys were adapted from the Hospital Consumer Assessment of Healthcare Providers and Systems Survey, a national, standardized survey and data collection methodology for measuring patient perspectives on hospital care [10]. Visits to the ED or UC and hospital admissions within 60 days postsurgery were determined by patient report and internal medical records pertaining to care in the 8-week postsurgical period, which were further validated using medical records obtained from regional medical facilities where the patient may have obtained care. Opioid refills from the surgeon within 8 weeks postsurgery and AEs, as defined by a previous American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) study [11], were also assessed within 30 and 60 days postsurgery via patient survey, internal medical records, and regional medical facility records inquiries. Data were summarized descriptively and are presented as mean (standard deviation) for continuous variables and frequency (%) for categorical variables.

**Results**

The analysis included 601 unique patients who underwent TKA (n = 337) or THA (n = 308) surgeries. No patient was excluded from the analyses. Overall, mean (range) age was 72 (32–92) years, 92.1% were ≥65 years old, 56.7% were women, 30.5% had heart disease, and 13.6% had diabetes. Three patients hired a JointCoach rather than using a family member or friend. There were no intubations or transfusions on the day of surgery and no directly surgery-related transfusions. Most patients (84.0%) were discharged home without home health services on the same day as surgery, 13.8% on 1 day, and 2.2% in >1 day. Rates of severe and minor AEs were 1.1% and 0.5%, respectively, within 30 days postsurgery and 1.7% and 0.9% within 60 days postsurgery (Table 2). Rates of unplanned medical and surgical readmissions were 1.7% and 0.2%, respectively, within 30 days and 1.5% and 0.6% within 60 days. There were no deaths or reports of sepsis. Thirteen patients (2.0%) had an ED visit without admission. Most patients reported that they would recommend the surgical facility “very much” or “a good amount” (98.9%) and were “very much” or “a good amount” satisfied with pain management (98.3%) and education and communication (>97%; Table 3). Most patients (84.2%) did not

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**Table 1** Surgical protocol.

| Method            | TKA                           | THA                           |
|-------------------|-------------------------------|-------------------------------|
| Implant           | SIGMA                         | CORAIL and PINNACLE cup       |
| Approach          | Subvastus                     | Ankle; Hana table, C-arm      |
| Tourniquet use    | No                            |                               |
| Bipolar tissue    | Radiofrequency energy         | Radiofrequency energy         |
| Sealer            | and saline hemostatic sealing | and saline hemostatic sealing |
| device            | device                        | device                        |
| Sutures           | Spiral knotless tissue        | Spiral knotless tissue        |
|                   | control device                | control device                |
| Skin closure      | 2-ctyl cyanoacrylate          | 2-ctyl cyanoacrylate          |
| Surgical system   | and self-adhering mesh        | and self-adhering mesh        |
| Dressing          | Silver-impregnated            | Silver-impregnated            |
| Drain use         | No                            | No                            |

SIGMA, CORAIL, and PINNACLE are registered trademarks of DePuy Synthes (Raynham, MA); Hana is a registered trademark of Mizuho OSI (Union City, CA).
require an opioid prescription beyond the initial 7-day prescription at discharge.

Discussion

The ERAS pathway for outpatient knee and hip replacements was developed over a 10-year period, through trial and error, using the best information available at the time and the senior author’s experience. The materials, approaches, medications, and anesthesia used were found to yield the most consistent results and lowest perceived complications in the senior author’s operative joint practice. Using an opioid-minimizing and medically, physically, and socially optimizing ERAS pathway designed to engage patients in their own care and to minimize the risk of postsurgical complications. Comparing complication rates from datasets such as the Humana (Louisville, KY) administrative databases such as the Humana (Louisville, KY) administrative claims database (rates 2–8 times higher than NSQIP), rates in our study may compare even more favorably with national averages. Likewise, very few hired a JointCoach in place of recruiting a family member or friend. JointCoaches were rarely rejected as being inadequate, although some needed remedial education. In those cases, surgery was rescheduled until the JointCoach was deemed competent and appropriate. In several cases in which the JointCoach was determined to be unprepared for the required tasks after surgery, a friend or other family member was substituted before proceeding with surgery. These findings suggest that Medicare patients may be suitable candidates for TKA/THA in freestanding ASCs and that CMS reimbursement restriction, not clinical eligibility, is the main limiting factor.

Our findings suggest that same-day discharge does not increase risk for postsurgical complications. Comparing complication rates can be difficult because of inconstancies in how they are collected and reported. To facilitate comparison, we applied the same definitions used in a previous study of patients in the ACS-NSQIP database who underwent TKA/THA in outpatient and inpatient settings [11]. Rates of complications compare favorably to those from the ACS-NSQIP database, limited to the NSQIP system (Table 4) [11]. If, as a recent analysis suggests [13], the NSQIP database underreports such complications compared with other large, national databases such as the Humana (Louisville, KY) administrative claims database (rates 2–8 times higher than NSQIP), rates in our study may compare even more favorably with national averages. The number of patients filling a second opioid prescription (requiring opioid pain medication beyond 1-week prescription) was also lower than previously reported [4,14], suggesting that the presurgical determination of appropriate opioid medication and dose contained in the ERAS pathway provided adequate postsurgical analgesia during recovery. It also indicates that the Centers for Disease Control and Prevention guideline of a 3-day to 7-day opioid prescription for most patients with acute pain is not an

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**Table 2**

Postoperative complications.

| Complication, n (%)a | 30 d | 60 d |
|---------------------|------|------|
|                     | TKA (n = 337) | THA (n = 308) | Total (N = 645) | TKA (n = 337) | THA (n = 308) | Total (N = 645) |
| Severe AEb          | 2 (0.6) | 5 (1.6) | 7 (1.1) | 5 (1.5) | 6 (1.9) | 11 (1.7) |
| DVT/PE              | 2 (0.6) | 1 (0.3) | 3 (0.5) | 2 (0.6) | 2 (0.6) | 4 (0.6) |
| Return to surgery   | 0      | 1 (0.3) | 1 (0.2) | 3 (0.9) | 1 (0.3) | 4 (0.6) |
| Deep wound infection| 0      | 1 (0.3) | 1 (0.2) | 0      | 1 (0.3) | 1 (0.2) |
| Stroke/cerebrovascular accident | 0 | 1 (0.3) | 1 (0.2) | 0 | 1 (0.3) | 1 (0.2) |
| Myocardial infarction| 0      | 1 (0.3) | 1 (0.2) | 0      | 1 (0.3) | 1 (0.2) |
| Minor AE            | 1 (0.3) | 2 (0.6) | 3 (0.5) | 2 (0.6) | 4 (1.3) | 6 (0.9) |
| Urinary tract infection | 0     | 1 (0.3) | 1 (0.2) | 1 (0.3) | 3 (1.0) | 4 (0.6) |
| Pneumonia           | 1 (0.3) | 1 (0.3) | 2 (0.3) | 1 (0.3) | 1 (0.3) | 2 (0.3) |
| Unplanned readmission| 6 (1.8) | 6 (1.9) | 12 (1.9) | 8 (2.4) | 8 (2.6) | 16 (2.5) |
| Medicalc            | 5 (1.5) | 6 (1.9) | 11 (1.7) | 6 (1.8) | 6 (1.9) | 12 (1.9) |
| Pneumonia           | 1 (0.3) | 1 (0.3) | 2 (0.3) | 1 (0.3) | 1 (0.3) | 2 (0.3) |
| Myocardial infarction| 1 (0.3) | 1 (0.3) | 2 (0.3) | 1 (0.3) | 1 (0.3) | 2 (0.3) |
| Ulcer/gastrointestinal complication | 1 (0.3) | 0 | 1 (0.2) | 1 (0.3) | 0 | 1 (0.2) |
| Stroke              | 0      | 1 (0.3) | 1 (0.2) | 0      | 1 (0.3) | 1 (0.2) |
| DVT/PE              | 0      | 0      | 0      | 1 (0.3) | 0      | 1 (0.2) |
| Other medical reasond | 2 (0.6) | 3 (1.0) | 5 (0.8) | 2 (0.6) | 3 (1.0) | 5 (0.8) |
| Fracture            | 1 (0.3) | 0      | 1 (0.2) | 2 (0.6) | 2 (0.6) | 4 (0.6) |
| Infection or wound complication | 0 | 0 | 0 | 1 (0.3) | 1 (0.2) |
| Dislocation         | 0      | 0      | 0      | 1 (0.3) | 0      | 1 (0.2) |

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a Patients with ≥1 complication.

b The following severe AEs were not experienced: organ or space infection, wound dehiscence, unplanned intubation, peripheral nerve injury, ventilator >48 h, renal insufficiency or failure, cardiac arrest, sepsis, septic shock, and death.

c The following unplanned medical readmissions were not experienced: renal insufficiency or failure, urinary tract infection, superficial infection, sepsis/septic shock, anemia, pulmonary complication, and mental disorders.

d Other medical reasons included syncope (n = 2) and urinary retention (n = 3).

e The following unplanned surgical readmissions were not experienced: hernia or hematoma, mechanical failure or complication, acute pain, hemarthrosis, sprain/contusion, and other surgical reason.
unreasonable goal. However, our analysis should be considered exploratory, as we did not assess whether patients received additional opioid prescriptions from other providers. Moreover, we did not analyze as part of the current study. This outcome requires further study with consideration of the many different cost contributors for TJA such as physical therapy and patient optimization, anesthesia, hospital stay, and ED and UC visits. We have successfully implemented the same ERAS pathway at a freestanding ASC, where nearly all commercially insured patients were able to receive TKA/THA. Together, these results are promising with regard to feasibility of TKA/THA at a freestanding ASC for Medicare-insured patients.

Study limitations include the retrospective design, with potential for uncontrolled confounding factors, lack of a control group, and the moderate sample size. Although all surgeries were performed at a single center by 1 surgeon, which may limit generalizability, this provided consistency with regard to nursing care, physical therapy instruction, anesthesia, surgical protocols, and infiltration techniques for liposomal bupivacaine. We did not

### Table 3

| Composite score | Responses, n (%) |
|-----------------|-----------------|
| Recommendation of the facility<sup>a</sup> | n = 436 |
| Yes, very much | 366 (83.9) |
| Yes, a good amount | 65 (14.9) |
| Yes, slightly | 4 (0.9) |
| No, not at all | 1 (0.2) |
| Pain management<sup>b</sup> | n = 1309 |
| Yes, very much | 1080 (82.5) |
| Yes, a good amount | 207 (15.8) |
| Yes, slightly | 19 (1.5) |
| No, not at all | 3 (0.2) |
| Education about surgery, medication, and recovery<sup>d</sup> | n = 872 |
| Yes, very much | 786 (90.1) |
| Yes, a good amount | 80 (9.2) |
| Yes, slightly | 6 (0.7) |
| No | 0 |
| Discharge education<sup>e</sup> | n = 876 |
| Yes, very much | 685 (78.2) |
| Yes, a good amount | 172 (19.6) |
| Yes, slightly | 16 (1.8) |
| No | 3 (0.3) |
| Communication with nurses<sup>f</sup> | n = 874 |
| Yes, very much | 757 (86.6) |
| Yes, a good amount | 110 (12.6) |
| Yes, slightly | 6 (0.7) |
| No | 1 (0.1) |
| Communication with physician<sup>g</sup> | n = 873 |
| Yes, very much | 831 (95.2) |
| Yes, a good amount | 39 (4.5) |
| Yes, slightly | 3 (0.3) |
| No | 0 |

<sup>a</sup> Sample size based on the number of responses, which in some cases exceeded the number of patients because some categories involved multiple questions.

<sup>b</sup> Would you recommend this surgical facility to others undergoing surgery?

<sup>c</sup> Composite score of 3 questions: (1) During your surgical facility stay, was your pain controlled most of the time? (2) During your surgical stay, were the nurses able to control your pain at a level where you were comfortable? (3) During the course of your joint replacement, was the pain control program effective in keeping your pain at a manageable level?

<sup>d</sup> Composite score of 3 questions: (1) Did you receive adequate educational materials about what to expect during the joint replacement process? (2) Did the educational materials give you a good understanding of the things you were accountable for doing in recovering from your joint replacement surgery? (3) Did the educational materials you received give you a clear understanding of why you need to take each of your medications?

<sup>e</sup> Composite score of 2 questions: (1) When you left the surgical facility, did you fully comprehend items you were accountable for doing in recovering from your joint replacement surgery? (2) When you were discharged from the surgical facility, were you fully aware of the reasons for taking each of your medications?

<sup>f</sup> Composite score of 2 questions: (1) During your surgical facility stay, were the nurses and staff polite and did they treat you kindly? (2) During your surgical facility stay, did the nurses and staff explain items in a way that you could easily comprehend?

<sup>g</sup> Composite score of 2 questions: (1) During your stay at the surgical facility, was the surgeon polite and did he treat you kindly? (2) During your time at the surgical facility, did the surgeon explain important procedural items in a thorough manner?

### Table 4

| Complication, n (%) | ACS-NSQIP | Current study |
|---------------------|-----------|--------------|
| **Surgical (N = 400)** | | |
| Severe AE | 2171 (1.78<sup>a</sup>) | 7 (1.1) | 11 (1.7) |
| Return to surgery | 1046 (0.86) | 1 (0.2) | 4 (0.6) |
| Thrombotic event (DVT/PE) | 790 (0.65) | 3 (0.5) | 4 (0.6) |
| Deep wound infection | 209 (0.17) | 1 (0.2) | 1 (0.2) |
| Organ/space infection | 163 (0.13) | 0 | 0 |
| Sepsis | 152 (0.12) | 0 | 0 |
| Wound dehiscence | 130 (0.11) | 0 | 0 |
| Myocardial infarction | 74 (0.06) | 1 (0.2) | 1 (0.2) |
| Death | 59 (0.05) | 0 | 0 |
| Unplanned intubation | 38 (0.03) | 0 | 0 |
| Renal insufficiency | 31 (0.03) | 0 | 0 |
| Septic shock | 27 (0.02) | 0 | 0 |
| Stroke/CVA | 25 (0.02) | 1 (0.2) | 1 (0.2) |
| Cardiac arrest requiring CPR | 19 (0.02) | 0 | 0 |
| Ventilator >48 h | 18 (0.01) | 0 | 0 |
| Renal failure | 13 (0.01) | 0 | 0 |
| Minor AE | 450 (0.37<sup>a</sup>) | 3 (0.5) | 6 (0.9) |
| Superficial infection | 240 (0.20) | 0 | 0 |
| Urinary tract infection | 131 (0.11) | 1 (0.2) | 4 (0.6) |
| Pneumonia | 88 (0.07) | 2 (0.3) | 2 (0.3) |
| Unplanned readmission | 3336 (2.74<sup>e</sup>) | 12 (1.9) | 16 (2.5) |
| Medical | 1445 (1.19) | 11 (1.7) | 12 (1.9) |
| Thrombotic event (DVT/PE) | 241 (0.20) | 0 | 1 (0.2) |
| Ventilator >48 h | 18 (0.01) | 0 | 0 |
| Renal failure | 13 (0.01) | 0 | 0 |
| Minor AE | 450 (0.37<sup>a</sup>) | 3 (0.5) | 6 (0.9) |
| Superficial infection | 240 (0.20) | 0 | 0 |
| Urinary tract infection | 131 (0.11) | 1 (0.2) | 4 (0.6) |
| Pneumonia | 88 (0.07) | 2 (0.3) | 2 (0.3) |
| MI, CHF, or other cardiovascular complications | 56 (0.05) | 2 (0.3) | 2 (0.3) |
| Sepsis/septic shock | 50 (0.04) | 0 | 0 |
| Pulmonary complications | 35 (0.03) | 0 | 0 |
| Anemia | 31 (0.03) | 0 | 0 |
| Renal insufficiency or failure | 31 (0.03) | 0 | 0 |
| Urinary tract infection | 29 (0.02) | 0 | 0 |
| Mental disorders | 12 (0.01) | 0 | 0 |
| Stroke | 12 (0.01) | 1 (0.2) | 1 (0.2) |
| Other undefined medical reason | 774 (0.64) | 5 (0.8) | 5 (0.8) |
| Surgical | 1886 (1.55<sup>a</sup>) | 1 (0.2) | 4 (0.6) |
| Infection or wound complication | 721 (0.59) | 0 | 1 (0.2) |
| Hernia or hematoma | 95 (0.08) | 0 | 0 |
| Acute pain | 94 (0.08) | 0 | 0 |
| Dislocation | 92 (0.08) | 0 | 1 (0.2) |
| Fracture | 87 (0.07) | 1 (0.2) | 2 (0.3) |
| Mechanical failure or complication | 67 (0.06) | 0 | 0 |
| Hemarthrosis | 16 (0.01) | 0 | 0 |
| Sprain or contusion | 16 (0.01) | 0 | 0 |
| Other surgical reason | 698 (0.57) | 0 | 0 |

CHF, congestive heart failure; CPR, cardiopulmonary resuscitation; CVA, cerebrovascular accident; MI, myocardial infarction.

<sup>a</sup> Number of unique patients with ≥1 event.

Improvement Initiative scorecard. However, costs for surgery were not analyzed as part of the current study. This outcome requires further study with consideration of the many different cost contributors for TJA such as physical therapy and patient optimization, anesthesia, hospital stay, and ED and UC visits. We have successfully implemented the same ERAS pathway at a freestanding ASC, where nearly all commercially insured patients were able to receive TKA/THA. Together, these results are promising with regard to feasibility of TKA/THA at a freestanding ASC for Medicare-insured patients.

Study limitations include the retrospective design, with potential for uncontrolled confounding factors, lack of a control group, and the moderate sample size. Although all surgeries were performed at a single center by 1 surgeon, which may limit generalizability, this provided consistency with regard to nursing care, physical therapy instruction, anesthesia, surgical protocols, and infiltration techniques for liposomal bupivacaine. We did not
track how many patients declined to participate in the patient-optimizing ERAS pathway in favor of other care, and patients may self-select against participating in a program where they must take responsibility for their own care. Considering the volume of patients seen and number of surgeries performed, the ERAS pathway and its results are very popular in the rural area where the senior author practices. The vast majority of patients were referred by word of mouth or from primary care physicians who are pleased with the program results. The program was developed to be inclusive of any patient who wanted to participate while being mindful of those for whom this pathway would be unsafe, who should therefore be referred to a larger and more comprehensive facility.

Our findings suggest that this ERAS pathway offering presurgical patient engagement, presurgical optimization of modifiable risk factors, and individually customized opioid-minimizing pain management may yield low rates of complications and high patient satisfaction. Opioid use findings suggest that this approach has the potential to help meet Centers for Disease Control and Prevention guidelines for postsurgical opioid use but were exploratory in nature and require more thorough and robust assessment. The individual elements contained within the protocol also need to be validated through comparative studies, but the protocol as a whole was highly successful in a Medicare population that was willing to engage and participate in their care. The findings also suggest that Medicare patients may undergo same-day TKA/THA with low rates of complications and that the potential exists for safe and successful TKA/THA at freestanding ASCs.

Conclusions

Using a patient-optimizing, opioid-minimizing ERAS pathway without home services, Medicare-insured patients undergoing TKA/THA experienced low rates of complications and high satisfaction. This approach of presurgical patient engagement may provide avenues for transition to freestanding ASCs.

Acknowledgments

Editorial support for development of this manuscript was provided by Krystina Neuman, PhD, at C4 MedSolutions, LLC (Yardley, PA), a CHC Group company, and was funded by Pacira BioSciences, Inc. Pacira BioSciences, Inc. participated in the review of the manuscript. The authors were independently responsible for the study design and collection, analysis, and interpretation of data, as well as the final approval to submit for publication.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.artd.2019.08.008.

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