



AHRQ Safety Program for Improving Surgical Care and Recovery (ISCR)

ISCR Comprehensive Joint Replacement Pathway Worksheet

Use this worksheet to develop an enhanced recovery pathway for hip and knee replacement operations at your hospital. The information in this tool is based on a recent evidence review conducted by the national project team at the American College of Surgeons and Johns Hopkins Armstrong Institute for Patient Safety and Quality.¹⁻³ The evidence review included literature search, followed by review of relevant articles including meta-analyses and systematic reviews when available as well as review of relevant published guidelines. This worksheet should be used by your team, in conjunction with the evidence review and local experts, to develop a clinical pathway that incorporates the principles of enhanced recovery (patient education and engagement, opioid-sparing multimodal analgesia, and early restoration of functional status) and best practices for preventable harms (surgical site infection, venous thromboembolism and urinary tract infection). This worksheet includes some common approaches for incorporating these principles in your pathway but there may be other approaches that are also appropriate. We anticipate that pathways will vary from hospital to hospital because certain skills or medications may not be available but it is important to try to adhere to as many of the principles as possible. There may be other components that you want to standardize in your pathway – especially related to some of the intra-operative elements of the procedure.

Disclaimer:

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Any practice described in this document must be applied by health care practitioners in accordance with professional judgment and standards of care in regard to the unique circumstances that may apply in each situation they encounter.

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ISCR Comprehensive Joint Replacement Pathway

Drugs and dosages are given as examples.
Please consult with a pharmacist as you develop your pathway.
All medications have side effects that should be taken into consideration on an individual patient basis prior to administration.

PREOPERATIVE

Patient Education

Patients should receive preoperative education, including detailed information on the surgical procedure and components of the enhanced recovery pathway in which patients are expected to participate (smoking cessation, diabetes management, preoperative bathing, reduced fasting, carbohydrate loading, surgical site infection prevention, early ambulation, early oral (PO) intake, venous thromboembolism (VTE) prophylaxis, possible use of regional anesthesia, avoiding or minimizing opioid pain medication, and discharge planning).

It is important that the preoperative education include training on rehabilitation and physical therapy in addition to the above elements. This can take the form of classes or one-on-one sessions. While there is minimal objective evidence on the impact of preoperative education on postoperative outcomes, there is little downside to these efforts and they should be incorporated into any clinical pathways.

PREOPERATIVE: RISK FACTOR ASSESSMENT

Diabetes Management

Preoperative diabetes mellitus in patients undergoing elective joint replacement may adversely affect postoperative outcomes. Diabetes mellitus should be screened for and identified prior to undergoing joint replacement surgery and should be optimized through consultation with primary care or endocrinology. No clear cutoff value (or method) has been established and for now, decisions about surgical management in diabetic patients should be tailored to the individual.

Smoking/Tobacco Cessation

Smoking is associated with increased risk for postoperative complications. Patients should abstain from smoking at least 4 weeks pre- and post-elective joint replacement surgery. Preoperative interventions (counseling and/or nicotine replacement therapy) focused on smoking cessation are recommended.

Obesity

Obese patients, especially those with a body mass index (BMI) greater than 40 are at increased risk of adverse outcomes and often experience delayed and dampened functional recovery.

Consideration should be made for establishing institution-specific guidelines as to the BMI over which the average patient will suffer greater risk of harm than benefit.

Opioid Use

Current evidence suggests that only a small fraction of the patients on opioids preoperatively will be able to fully wean themselves post-operatively but those who can successfully wean themselves from opioids before surgery may have better outcomes than those who cannot. Information about long-term opioid use should be incorporated into discussions with patients before surgery and guide informed clinical decision making with patients and support offered for addressing opioid use before surgery be considered.

Anemia

Patients undergoing elective joint replacement should be screened for preoperative anemia and referred for appropriate workup and treatment if necessary. Medically optimization with either oral or intravenous iron supplementation based on an institution-specific hemoglobin goal may be considered.

Immune Modulating Therapy

Although there is concern about the impact of immune modulating agents on perioperative outcomes, there is limited evidence to guide clinical decision making at this time.

Malnutrition

Malnourished patients may be at increased risk of perioperative complications with joint replacement but there is no consensus on optimal screening or interventions.

IMMEDIATE PREOPERATIVE

Preoperative Bathing

Patients should undergo at-home bathing at least the night before surgery with either soap or antiseptic agent.⁴ Carriers of *S. aureus* should be identified and a decolonization regimen should be considered prior to surgery.

Reduced Fasting

Reduced fasting with intake of solids until 6 hours prior to induction and intake of clear liquids until 2 hours prior to induction is recommended for patients unless they have documented delayed gastric emptying or other contraindications.

Carbohydrate Loading

Preoperative carbohydrate loading is a recommended component of most enhanced recovery protocols, though there is limited evidence demonstrating benefit specifically in orthopaedic surgery patients. Preoperative carbohydrate loading is not recommended in patients with diabetes.

Multimodal Pre-Anesthesia Medication

- a. Analgesics: Routine administration of multiple analgesics in the immediate preoperative period is recommended. Recommended medications include acetaminophen and non-steroidal anti-inflammatory agents.
- b. Anti-emetics and adjunct agents: Routine administration of anti-emetic agents and other adjuncts should be considered in patients without contraindications.

INTRAOPERATIVE

Glycemic Control:

Glucose control should be considered in all patients regardless of diabetic status, beginning in the immediate preoperative period and continuing until discharge to prevent hyperglycemia. Hyperglycemia is prevalent in both diabetic and non-diabetic hospitalized patients and has been associated with surgical site infections and complications. A 2017 Centers for Disease Control and Prevention guideline recommends target blood glucose levels less than 200 mg/dL.⁴

Prophylactic Antibiotics

Prophylactic antibiotics should be administered prior to incision. Selection should be based on surgical site infection (SSI) pathogens commonly associated with the specific procedure type, local antimicrobial resistance patterns, and a balance of benefits vs. potential risks associated with the antibiotic (e.g., risk for *C. difficile* infection or emergence of multi-drug resistant organisms). First-generation cephalosporins are the most commonly studied in joint replacement procedures. Vancomycin should be included with cefazolin or used as an alternative agent in institutions that have a high prevalence of methicillin resistant *Staphylococcus aureus* (MRSA) SSIs and for patients who are known to be colonized with MRSA. Intra-operative redosing and weight-based dosing should follow guideline recommendations. There is no evidence to support the use of prophylactic antibiotics more than 24 hours post-operatively.⁶

Skin Preparation

Skin preparation should be done with an alcohol-based antiseptic (either alcohol plus chlorhexidine or alcohol plus an iodophor) unless contraindicated.⁴

Standard Intraoperative Anesthesia Pathway

Intraoperative anesthesia should be tailored to optimize anesthetic depth while facilitating rapid awakening after completion of surgical procedure. Minimize use of opioids and use anesthetic agents/techniques, such as—

- a. Regional anesthesia (e.g., neuraxial or peripheral nerve blocks/catheters or intrathecal morphine) when available is preferred over general anesthesia
- b. Intravenous (IV) infusions of anesthetics (e.g., propofol)
- c. Non-opioid analgesia adjuncts (e.g., IV lidocaine or ketamine)

Postoperative Nausea and Vomiting Prophylaxis

Standardized pathways should include multimodal strategies to prevent post-operative nausea and vomiting in the perioperative period.

Tranexamic acid

Tranexamic acid is an anti-fibrinolytic drug should be considered in all patients without contraindications to minimize intra- and post-operative blood loss and transfusion in joint replacement procedures. However, the optimal dose, timing, and route of administration are currently undefined.

Ventilation

A lung-protective ventilation strategy is recommended. Tidal volumes of 6-8 mL/kg predicted body weight may decrease pulmonary complications. There is conflicting evidence about the benefit of routine perioperative oxygen supplementation, but it may be considered in patients intraoperatively and immediately postoperatively.

Normothermia

Normothermia should be maintained throughout the preoperative, intraoperative, and immediate postoperative period. Preoperative warming maybe helpful in maintaining intraoperative normothermia and should be especially considered for patients who are elderly, patients with cardiopulmonary disease, and long procedures.

Euvoemia

Intraoperative fluid management should be individualized to minimize fluid and maintain euvoemia. There is a lack of procedure-specific evidence for the value of goal-directed fluid therapy in elective joint replacement surgeries.

Surgical Drains

Routine use of surgical drains in elective joint replacement surgery is not recommended.

Intra-Articular, Local Infiltration and Peri-Articular Injection

Intra-articular injection or local/peri-articular infiltration of local analgesics may be helpful for controlling post-operative pain when regional analgesia is not available. Optimal management of post-operative pain will facilitate early mobilization.

POSTOPERATIVE**Venous thromboembolism (VTE) Prophylaxis**

Patients should be placed on VTE prophylaxis with an appropriate regimen for an extended duration. No consensus exists regarding optimal regimen and duration of therapy, but at least 28 days total duration is a common target. Options include low molecular weight heparin, vitamin K antagonists, direct oral anticoagulants or aspirin (at least 325 mg a day).

Multimodal Pain Management

A standard, multimodal anti-emetic and opioid-sparing analgesic regimen is recommended for all patients. Medications should be administered orally with cessation of IV medication as early as tolerated by the patient.

- a. Regional analgesia (e.g., peripheral nerve blocks/catheters)
- b. Core non-opioid analgesic regimen
- c. Optional analgesic adjuncts
- d. Optional opioid analgesic agents only as PRN (as needed) dosing

Early Alimentation

Early postoperative feeding with a well-balanced diet is recommended for patients unless they experience nausea or vomiting.

Early Ambulation

Early postoperative mobilization with weight bearing as tolerated is recommended. Patients should be mobilized within 24 hours of surgery with the aim of patients unless a significant contraindication exists. There is no benefit to using continuous passive motion over early ambulation.

Early Urinary Bladder Catheter Removal

Routine urinary bladder catheter removal by postoperative day 1 is recommended for patients undergoing elective joint replacement surgery.

Discharge Planning

Discharge planning should begin well before surgery and involve a multidisciplinary approach including physical therapists, case managers, and social workers.

References:

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6. Bratzler DW, Dellinger EP, Olsen KM, Perl TM, Auwaerter PG, Bolon MK, Fish DN, Napolitano LM, Sawyer RG, Slain D, Steinberg JP, Weinstein RA; American Society of Health-System Pharmacists (ASHP); Infectious Diseases Society of America (IDSA); Surgical Infection Society (SIS); Society for Healthcare Epidemiology of America (SHEA). Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Surg Infect (Larchmt).* 2013 Feb;14(1):73-156. doi: 10.1089/sur.2013.9999. Epub 2013 Mar 5. PubMed PMID: 23461695.

***These evidence reviews can be found on the ISCR website in the Resource Center.



The table below lists some options and examples that hospitals can consider in developing their pathway. The information is intended to be adapted by a hospital based on collective review of the pathway by all local stakeholders. Important stakeholders include surgeons, anesthesia providers, nurses, pharmacists, physical therapists, technicians among other health care providers. As a team, review each component of the pathway and discuss what approach best fits your hospital. Any practice described in this tool must be applied by health care practitioners in accordance with professional judgment and standards of care in regard to the unique circumstances that may apply in each situation they encounter.

Most hospitals find it easiest to agree on a single pathway that best fits the majority of their CJR surgery patients, recognizing that there will be patients that require exceptions.

Component	Example Processes to Consider As a team, go through each component and discuss what approach best fits your hospital. It may be an option other than what is listed below.	Team Decisions/Notes As a team, note exceptions and contraindications to the treatment or medications.	Resources/Tips *Resources can be found on ISCR Web site	Corresponding Variable
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PREOPERATIVE

Patient Education	<p>Recommended approach:</p> <ul style="list-style-type: none"> Review existing patient education materials for orthopedic surgery patients. Either update existing materials or adapt the provided patient education booklet template as needed to your hospital and use it to counsel and educate patients on enhanced recovery principles. Identify staff (surgeons, nurses and/or office staff) who will ensure patients and their families receive and understand education. Coordinate patient education materials with existing joint educational sessions and exercise sessions. 	Sample ISCR CJR Patient Education Booklet	Preadmission Counseling
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PREOPERATIVE RISK ASSESSMENT

Diabetes Management	<p>Recommended approach:</p> <ul style="list-style-type: none"> Review every patient's diabetes status and review or order related laboratory tests as needed. Optimize diabetes in partnership with primary care or endocrinology providers. 	Identify an endocrinologist or primary care provider at your hospital who could be a point person to help you with patients who do not have an established provider.	Diabetes Mellitus Requiring Therapy Preop Hemoglobin A1c
Smoking/Tobacco Cessation	<p>Recommended approach:</p> <ul style="list-style-type: none"> Smoking cessation 4 weeks pre- and post-elective joint surgery Provide counseling and nicotine replacement therapy as needed 	Identify smoking cessation support resources in your area available for preoperative patients.	Current Smoker Smoking Cessation

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Obesity	<p>Recommended approach:</p> <ul style="list-style-type: none"> • Patients should have their Body Mass Index (BMI) measured and risks associated with an elevated BMI should be considered as part of the preoperative evaluation and risk counseling • No formal recommendation for a specific weight loss method or program exists. 			BMI (calculated from height and weight)
Opioid Use	<p>Recommended approach:</p> <ul style="list-style-type: none"> • Evaluate patient's pre-operative opioid use by reviewing state prescription monitoring program databases and medical history. • Counsel patients on expected opioid use post surgery based on preoperative use. 			
Anemia	<p>Recommended approach:</p> <ul style="list-style-type: none"> • Each institution should establish hemoglobin level guidelines and recommendations for optimization of levels before surgery. • Consider evaluating and treating preoperative anemia with iron supplementation, either oral or intravenous based on clinical situation. 		Partner with primary care physicians to evaluate unexplained anemia.	Pre-operative Hematocrit
IMMEDIATE PREOPERATIVE				
Preoperative Bathing	<p>Recommended approach:</p> <ul style="list-style-type: none"> • At-home bathing at least the night before surgery with either antibacterial soap or antiseptic agent (either washcloths with chlorhexidine gluconate or soap with chlorhexidine gluconate, such as Hibiclens). • Develop process to screen for patients for of S. aureus carriage. • Develop decolonization regimen for patients found to be nasal carriers (e.g., 5 days of nasal mupirocin plus chlorhexidine bathing) 		Review protocols from other hospitals and develop a workflow that fits at your hospital. It can be tricky to coordinate screening and treatment in the outpatient setting. There are examples of protocols in the sharing library.	Preoperative Bathing

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Reduced Fasting	Choose your approach: <ol style="list-style-type: none"> NPO 2 hours before surgery Other duration: NPO ____ hours before surgery 		American Society of Anesthesiologists Practice Guidelines for Preoperative Fasting	
Carbohydrate Loading	Choose your approach: <ol style="list-style-type: none"> Volume: choose one: 8 oz., 12 oz., 16 oz., or 20 oz Drink: choose one: sports, nutritional or fruit drink Other: _____ 		TIP: Preoperative carbohydrate load is not recommended for diabetic patients.	
Multimodal Pre-Anesthesia Medication	<p>Recommended approach: If no contraindications, give all of the following analgesics, but choose the dosing:</p> <ol style="list-style-type: none"> Acetaminophen [500 mg, 650 mg or 1g] PO once Nonsteroidal anti-inflammatory drug [e.g., Celecoxib 200mg or 400mg] PO once <p>Anti-emetics and adjunct agents For nausea (choose one or both):</p> <ol style="list-style-type: none"> Scopolamine patch 1.5 mg once placed preoperatively, remove 24 to 72 hours after surgery [postoperative nausea and vomiting] Intraoperative antiemetic [e.g. ondansetron 4-8 mg and/or dexamethasone 4 mg IV] 		TIP: Engage with anesthesiology colleagues and preoperative area nurses involved to improve your compliance of preoperative medication bundle.	
INTRAOPERATIVE				
Glycemic Control	Recommended approach: <ul style="list-style-type: none"> Check serum glucose in preoperative area. 2017 Centers for Disease Control and Prevention guideline recommends target blood glucose levels less than 200 mg/dL. 		TIP: If your hospital chooses to implement a perioperative glucose protocol, look in the sharing library for examples from other hospitals. Also, make sure that you involve your hospital endocrinologists, anesthesiologists and	

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			perioperative nurses and preoperative evaluation clinic. Effective protocols are multidisciplinary and can be complex to implement.	
Prophylactic Antibiotics	<p>Recommended approach (see guideline for details):</p> <p>Choose your prophylactic antibiotics approach*:</p> <ol style="list-style-type: none"> 1. Cefazolin 2 g (patient <120 kg) or 3 g (patient \geq 120 kg) q4h during procedure 2. Vancomycin (weight-based dosing) or cefazolin plus vancomycin in institutions that have a high prevalence of Methicillin Resistant Staphylococcus aureus (MRSA) SSIs and for patient who are known to be colonized with MRSA. <p>Alternative agents for patients with beta-lactam allergy:</p> <ol style="list-style-type: none"> 1. Vancomycin (weight-based dosing) in institutions that have a high prevalence of MRSA SSIs and for patient who are known to be colonized with MRSA 2. Clindamycin <p>*First dose should be administered within 60 minutes before incision (120 minutes for vancomycin). Intraoperative redosing for longer cases and those with significant blood loss should be done as described in the Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery.</p>		<p>Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery</p> <p>TIP: For vancomycin, coordinate with anesthesia providers and pre-operative area nurses to ensure administration in ample time before incision</p>	
Skin Preparation	<p>Choose your approach (all regimens should be alcohol based):</p> <ol style="list-style-type: none"> 1. Chloraprep 2. Duraprep 3. Other: _____ 		TIP: Train nurses in operating room to do preparation to standardize.	

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Standard Intraoperative Anesthesia Pathway	<p>Recommended approaches: Below are <u>three elements</u> which you should consider when building your protocol:</p> <p>A. Type of anesthesia to allow rapid awakening, return of function and minimize opioids:</p> <ol style="list-style-type: none"> 1. Regional anesthesia [e.g. neuraxial (epidural, spinal); peripheral nerve blocks/catheters; intrathecal morphine], when available, is preferred over general anesthesia 2. General anesthesia [e.g. Propofol /total intravenous anesthesia] <p>B. Non-opioid analgesia adjuncts (consider one or more of the following)*:</p> <ol style="list-style-type: none"> 1. IV Lidocaine 2. Ketamine 3. Other: _____ <i>*Consensus dosing recommendations not available. Confer with local anesthesia providers and pharmacists to develop standardized approach</i> <p>C. Postoperative nausea and vomiting prophylaxis:</p> <ol style="list-style-type: none"> 1. Ondansetron 4–8 mg IV 2. Dexamethasone 4 mg IV 3. Other: _____ 		See recommended doses in ISCR CJR Anesthesia Evidence Reviews	<p>Use of Regional Anesthesia</p> <p>Use of Anti-emetic Prophylaxis</p>
Tranexamic acid	<p>Recommended approach:</p> <ul style="list-style-type: none"> • Consider for intraoperative bleeding or high bleeding risk patients on an individual basis. 			Tranexamic Acid (TXA) Use
Ventilation	<p>Recommended option:</p> <ul style="list-style-type: none"> • Intraoperative tidal volume 6-8 mL/kg predicted body weight 			

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Normothermia	Choose your approach: <ol style="list-style-type: none"> 1. Forced air warmer in preoperative area and operating room 2. Warmed intravenous fluids in the operating room 3. Other: _____ 		TIP: Place blanket warmers in prep area and include in order set/policy. Let all know that blanket warmers also increase patient experience with surgery.	
Euolemia	Recommended approach: <ul style="list-style-type: none"> • Intraoperative fluid management should be individualized to minimize fluid and maintain euolemia 			
Avoid Drains	Recommended approach: <ul style="list-style-type: none"> • No routine use of drains at end of procedure 			
Intra-articular, Local Infiltration and Peri-articular Injection	Recommended approach: <ul style="list-style-type: none"> • Consider when regional analgesia is not available 			
POSTOPERATIVE (INPATIENT)				
VTE Prophylaxis	Recommended approach: <ul style="list-style-type: none"> • Patients should receive VTE prophylaxis with an appropriate regimen for an extended duration (e.g. >28 days total) • Options include low molecular weight heparin, vitamin K antagonists, direct oral anticoagulants or aspirin (at least 325 mg a day) 		TIP: Include VTE prophylaxis in admission order sets and have policy in place to prescribe VTE prophylaxis for a total of 28 days after surgery if that is indicated by the patient's diagnoses and operation. Patient education should be done about risks and benefits of post discharge prophylaxis.	Medical DVT Prophylaxis Continued 28 Days Postoperatively

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Multimodal Pain Management	<p>Recommended approaches:</p> <p>If local expertise or resources are available, use:</p> <ol style="list-style-type: none"> 1. Regional analgesia using a local anesthetic regimen [minimize opioids] <p>Non-opioid analgesics</p> <p>Scheduled (pick at least 2 if no contraindications):</p> <ol style="list-style-type: none"> 1. Acetaminophen [3-4g PO per day divided q6 hr or q8 hr] 2. Nonsteroidal anti-inflammatory drug (e.g. Ibuprofen [400–600mg PO q6 hr], ketorolac [15–30 mg IV q6 hr]) <p>If available, adjuncts to consider:</p> <ol style="list-style-type: none"> 1. Lidocaine topical patch (4% or 5%) placed for up to 12 hours in a 24-hour period 2. NMDA antagonists (e.g., dextromethorphan 20-30 mg q6 hr or q8 hr) <p>PRN (or as needed dosing):</p> <ol style="list-style-type: none"> 1. Tramadol [can be given 25–50 mg PO q 4-6 hrs as needed]. Try before giving opioids. 2. Opioids (IV for breakthrough pain, PO for when tolerating liquids). May give as a last option for analgesia if other analgesics are insufficient 		<p>Example Electronic Health Record Order Sets</p> <p>TIP: Standardize multi-modal medications in order sets and have timing of medications conducive to patient sleep patterns. Ensure physicians, nurses and patients are educated about benefits of pre-emptive analgesia and around the clock multimodal medications.</p>	Use of Multimodal Pain Management
Early Alimentation	<p>Choose your approach:</p> <ol style="list-style-type: none"> 1. Clears POD 0 2. Regular diet POD 0 3. Other: _____ 			
Early Ambulation/ Weight Bearing As Tolerated	<p>Choose your approach:</p> <ol style="list-style-type: none"> 1. OOB to chair on POD 0 2. Ambulate WBAT on POD 0 3. Ambulate WBAT on POD 1 4. Other: _____ 		TIP: This is a component of the Joint Commission Center of Excellence for Joint Replacement.	Weight Bearing As Tolerated (WBAT) on POD 1

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Early Urinary Bladder Catheter Removal	Choose your approach: 1. DC Foley on POD 0 2. DC Foley on POD 1 3. Other: _____		TIP: Consider either not using foley catheters or removing in at the end of the operation.	Foley Removal
Discharge Planning	Recommended approach: <ul style="list-style-type: none"> Multi-disciplinary approach to discharge planning should begin before admission 		TIP: Patients do better if they are discharged to home – plan early to ensure the right resources are in place for them to succeed in recovery at home.	

Abbreviations:

DC = discontinue; DVT = Deep vein thrombosis; IV = intravenous; OOB = out of bed; POD = postoperative day; PO=by mouth; hrs=hours; NMDA = N-methyl-D-aspartate; WBAT = weight bearing as tolerated ; MRSA = Methicillin-resistant Staphylococcus aureus