This care process model (CPM) was created by the Musculoskeletal Clinical Program to maintain Intermountain Healthcare’s leading edge in joint replacement surgery and improve patient outcomes by enhancing best practices, promoting patient safety, improving patient satisfaction, and assuring cost accountability and regulatory compliance.

The CPM follows the sequential processes and expert advice for the perioperative management of total joint replacement surgeries (total knee arthroplasty, total hip arthroplasty) and summarizes current medical literature and national practice guidelines. Intermountain’s care management system for total joint replacement also includes:

- Education materials and programs for providers and patients
- Data systems that help providers and facilities gauge their success in patient outcomes
- Multidisciplinary coordination of perioperative patient care

**Why Focus ON TOTAL JOINT REPLACEMENT SURGERY?**

- Joint replacement is an increasingly common and high-cost procedure. Knee and hip replacement surgeries performed in the U.S. more than doubled between 2000 and 2010, to over 671,000 knee replacements and over 300,000 hip replacements annually.\(^1\)The Utah average price for each procedure is just over $36,700 for knees and $34,400 for hips;\(^2\) surgical complications further add to these costs.

- Medical facilities are under scrutiny for procedural costs and outcomes. The Centers for Medicare and Medicaid Services (CMS) will begin a bundled payment program in 2016 that will reward and penalize selected facilities for quality and cost outcomes for joint replacements. Several Intermountain hospitals will be required to participate. In addition, the general public and providers are increasingly aware of hospital performance ratings, patient outcomes, and publicly reported measures.

- Collaboration and communication between perioperative teams and care specialists ensure all patients system-wide get the best evidenced-based care. This CPM promotes optimal patient outcomes through consistent care based on expert consensus and evidence-based best practices.

- Patient engagement is critical to improving satisfaction and meeting patient expectations. Patients who participate in preoperative education have better functional outcomes.\(^3\)Patient education should stress pain management, early mobility and physical therapy compliance, and preparing for discharge to home, which has been linked to reduced hospital readmissions.\(^4\) As a result, providers and patients should partner to ensure appropriate care utilization, including setting realistic expectations for discharge at multiple points in the care process and the importance of a health coach.

**Where this CPM fits in the care pathway**

**What’s Inside?**

**Algorithms**
- Pre-admission
- Surgical and Post-operative Management
- Discharge Disposition

**Pre-operative Patient/Coach Education**

**Complications Risk Management**

**Post-operative Physical Therapy**

**Pain Management**

**Provider Resources**

**Patient Education Resources**

**Medications**

**References**

**Goals and Measurements**

As a result of implementing this CPM, Intermountain aims to:

- **Improve** patient safety and decrease complications related to morbidity and mortality (blood use, infections, DVTs/PEs, medication errors, skin integrity, and falls)
- **Reduce:**
  - Unplanned readmissions within 30 days
  - Variations in cost and quality of care (via transparent data reporting)
- **Increase:**
  - Number of patients/health coaches receiving optimized pre-operative education
  - Number of patients discharged to home (via measuring discharge outcomes)
  - Patient early mobility and functionality in less than 6 hours after leaving PACU
  - Patient satisfaction, meeting or exceeding 75th percentile for HCAHPS
- **Ensure** regulatory compliance in terms of medical necessity/appropriate use criteria, VBP

Throughout this CPM, the icon at right indicates an Intermountain measure.
(a) Medical necessity criteria

- Medical records should contain detailed information to support reimbursement as reasonable and necessary (see Orthopedic Surgeon Documentation of Medical Necessity for Total Joint Replacement).

- Neurological documentation should demonstrate that one or more of the following criteria for advanced joint disease have been met:
  - Radiculopathic evidence
  - Pain or functional disability

- Demonstrated history of unsuccessful conservative therapy in the patient’s pre-procedure record.

- If conservative therapy is not appropriate, the medical record must clearly document why such approach is not reasonable.

(b) Pre-op physical therapy

- Pre-operative physical therapy offers a variety of benefits for optimizing patient surgical and rehabilitation outcomes. It is important to share with patients these benefits of pre-operative physical therapy.

- Documented pre-operative exercises — Research indicates a link between strengthening exercises prior to surgery and decreased risk of discharge to rehab as well as a positive impact on post-surgical function.

- Losing weight — Each pound of weight loss reduces pressure on the knee by 4 pounds. Thus, a patient who loses 10 pounds before surgery experiences a decrease of 40 pounds of pressure on the joint, which improves sound healing time and decreases the risk of bed sores.

- Getting minimum recommended aerobic exercise — Exercising 150 minutes a week (swimming, water aerobics, walking, etc.) improves a patient’s aerobic capacity, which will make it easier to come out of anesthesia and reduce the need for supplemental oxygen. Counsel patients that this 150 minutes equals to 30 minutes (not all at once) a day for 5 days a week (plus hikers exercising for as little as 10 minutes 3 times during the day).

- For information on specific home exercises, access the Intermountain Home Exercise Program database.

### ALGORITHM 1: PRE-ADMISSION

**Patient to be scheduled for surgery**

- Patient meets criteria for medical necessity

  **VALIDATE medical necessity**

  - Use history and physical (see Patient History and Patient Exam forms)
  - Refer to CMS guidance on medical necessity documentation (a)
  - Submit required paperwork

  **CONDUCT pre-admission assessment**

  - Order Labs, EKG, clearances.
  - Consider screening for MRSA.
  - Reconcile medications.
  - Determine infection prevention measures, skin prep protocols, discharge transition plan.
  - Assess VTE risk and select VTE thromboembolic prophylaxis measures.

- Patient meets pre-admission criteria for surgery?

  - No: Refer to specialist for comorbidity management
  - Yes: SCHEDULE surgery and notify patient of admission time and location.

- Verify skin preparation

- Make pre-surgery call to inform/remind patient about pre-op instructions: No food or drink after 11:00 p.m. (unless otherwise instructed)

- Initiate medication history

### PRE-OPERATIVE PATIENT / COACH EDUCATION

It is very important to help the patient plan ahead for their surgery and life after surgery. Review the available patient education materials (see page 11) and resources for using teach-back strategies (at right and in the Teach Back Best Practice flash card).

**Key points to stress in care provider conversations with patients appear in the checklist below** (details about each checklist item can be found in the patient education toolkit, Your Guide to Joint Replacement).

- Arrange for a recovery coach and caregiver for a week or two (could be the same person)
- Set up your home for accessibility and comfort:
  - Use a bed on the floor (avoid stairs).
  - Allow plenty of space around furniture to move around easily with a walker or crutches.
  - Place a chair with arms within reach of a table (not a recliner).
  - Make seating easy to get into and out of (add pillows as necessary).
  - Prepare the bathroom to prevent falls (see Bathroom Safety fact sheet).
  - Remove household tripping hazards (throw rugs, loose carpet/flooring, electrical cords, clutter).
  - Allow for small pets (put a bell on the collar to know when the pet is underfoot or keep in a separate area of the house for a week or two).

- Keep from overdoing

  - Stock up on meals and supplies to avoid turning errands during recovery.
  - Make sure your home is clean and orderly before you go to the hospital so that cleaning won’t be necessary while you’re recovering.
  - Store kitchen and bath items so that you don’t bend below the waist, reach, or lift.

- Work with your healthcare providers to prepare for a safe surgery and recovery

  **Things to do a few weeks before surgery**

  - Attend a pre-surgery class — and bring your recovery coach.
  - Register with the hospital.
  - Have a physical exam and pre-admission tests.
  - Discuss all your medications, both prescribed and over the counter, with your healthcare providers.
  - Complete your advance directive — and share it with the hospital or your doctor (for more information, see the Advance Care Planning booklet and Advance Health Care Directive card).

  **Things to do in the week before surgery**

  - Give the hospital your health history information.
  - Review your insurance coverage, including co-pay, covered expenses, and hospital required payments due prior to surgery; contact insurance company and hospital staff with questions and concerns.
  - Expect a pre-surgery phone call — for your annual time and last minute instructions (discuss special needs).
  - Prevent constipation.
  - Do not shave the area of your body where your surgery will be performed for 5 days before surgery to avoid infection.

  **Things to do the day before surgery**

  - Shower in the morning and the evening using the soap or cleanser your doctor has recommended (wash thoroughly; do not scrub; dry gently; do not use lotion, cream, or powder).
  - Do not shave the area of your body where the surgery will be performed.
  - Pack a small suitcase of personal items.
  - Take only those medications recommended by your doctor for before surgery. Do NOT take any blood-thinning medications.
  - Do NOT eat or drink anything after 11:00 p.m. the night before surgery (unless otherwise instructed).

  **Things to do the morning of your surgery**

  - Shower in the manner described above.
  - Take ONLY the medications your doctor or nurse instructed you to take the day of surgery.
  - Arrive at the hospital at the scheduled time.

### USING TEACH-BACK STRATEGIES

**What is teach-back?** — Teach-back is a way to confirm that patients understand what we tell them using open-ended questions that invite the patient and family to “teach back” the information to us. It’s not a test of the patient’s knowledge — it’s a test of how well we explained something.

**Why is it important?** — Not understanding medical information is a common reason for readmissions. Teach-back is a proven tool for improving patient understanding.

**Who can use it?** — Everyone who explains anything to a patient or family.

**When can I use it?** — Use early in the care process and at each decision point or transition, especially when families or caregivers are present. Make sure caregivers participate in the teach-back process to ensure they understand key information.

**What are the steps?**

1. Explain or demonstrate a concept, using simple lay language.

2. Ask the patient/caregiver to repeat the information in their own words or demonstrate the process.

3. Confirm the responsibility (“I want to see whether I explained this well”). Ask the patient to tell you how he or she would explain the information to a spouse or family member. Avoid yes/no questions.

4. Identify and correct misunderstandings. Tips: Show empathy and caring as you correct. Avoid making the patient feel that they’ve failed a “test.” Don’t repeat the entire explanation or demonstration again unless it’s necessary — just focus on areas that need clarification.

5. Ask the patient/caregiver to explain or demonstrate again, to show improved understanding.

6. Continue this loop until you’re convinced the patient/caregiver understands the concept.

7. Tips: The patient — this process is worth the time it takes. Continue to be gracious in the process — patients can worry about judgment or waiting your time.
**Algorithm 2: Surgical and Post-Operative Management**

### Patient Admitted for Surgery
- **Patient Identified with Pre-admission Process**
  - Yes: **MEDICATE Patient-Specific Issues**
  - No: **Move Patient to Pre-op**

### Move Patient to Pre-op
- **Complete Universal Protocol Checklist (c) and Surgical Care Improvement Process (SCIP) (d).**

### Move Patient to Surgery
- **Perform Surgery According to:**
  - Order Sets (in CenTrak) (e) — SCIP measures (d)
  - Anesthesia Requirements
  - Physician Preferences
- **Administer Interoperative Medications** (see medication tables pages 12–15).

### After Surgery, Move Patient to PACU and Perform Post-anesthesia Care
- USE Ortho Hip or Knee Replacement Peri-op Order Set/ANES adult peri-operative order set in CenTrak — Key Points:
  - Pain Management: Use Intermountain/THS Pain Scale (see page 10); administer post-op PACU medications (see pages 12–15).
  - Monitoring: Follow the Modified Aldrete Scoring System; monitor core temperature, HR, BP; assess for respiratory distress (see page 6); monitor risks associated with blood transfusion, if indicated (see page 6).
  - Imaging: X-ray to confirm implant placement.
  - Criteria for transition to surgical floor: Follow the Modified Aldrete Scoring System; active PSO; order durable medical equipment (DME) in CenTrak.
  - Patient must be classified as in-patient for full reimbursement, even if discharged the same day.

### Manage Pain
- Set realistic pain management goals: Use Intermountain/THS Pain Scale (pages 9–10); administer post-op floor medications (pages 12–15).
- Review care plan with patient/recall coach.
- Use appropriate interventions: Medications, repositioning, king elevation, etc. (see Chronic Non-Cancer Pain CFR).
- Assess and reassess: See Chronic Non-Cancer Pain CFR.

### Facilitate Mobilization
- Optimize early mobilization via:
  - Patient getting out of bed within 6 hours after arriving at ICU;
  - PT assessment scheduled within 24 hours post-op (page 8).
  - Daily PT therapy sessions held 2 post-op days (page 4).
  - OT evaluation and treatment, as indicated.

### Educate/Plan Care Transition
- Use the Discharge Destination Algorithm (page 7c)
- Sign patient choice and durable medical equipment (DME) forms.
- Ensure ADL teaching (OT/RN/PT).
- Use in-room TV for exercise and education reminders.

### Monitor Other Risks
- Evaluate labs, including PT/INR if patient taking warfarin (Coumadin®) and renal function if taking a direct oral anticoagulant (e.g., apixaban, rivaroxaban).
- Assess for respiratory distress/other complications (see page 6).
- Conduct respiratory incentive spirometry and teaching (Incentive Spirometry Pediatric, Adult Procedure)

### Treat/Refer
- As needed

### Algorithm Notes
- **(SCIP Core Measures)**
  - Core measures for reducing surgical complications include (remember as ABCS):
    - **ABCS**
      - Antibiotics
      - Blood transfusion
      - Clotting
      - Surgery

- **Ortho Joint Replacement Peri-op Order Set (c) in CenTrak — Key Points**
  - **Medications:** Prophylactic antibiotics, VTE prophylaxis, antiembolism, local anesthetics (see pages 12–15 for medication details).
  - **Blood Utilization:** May or may not reduce the need for transfusion or Cell Saver. Do not use for all patients (see page 6).
  - **Anticoagulation Protocols:** Based on risk stratification, using the VTE computerized risk alert tool, which identifies VTE risk factors and assigns a weighted score (in points) for calculating VTE risk scores. Any score of > 4 points indicates that a patient is at high risk for VTE. (See info at right and User’s Guide: VTE Computerized Risk Assessment Tool).
  - **Anesthesia:** The ORTHO Knee Replacement and/or ORTHO Hip Replacement powerplans in Powerchart in CenTrak for guidance on pain management/nerve block, anesthesia type/medication choice and dosage. Regional anesthesia whenever appropriate.
  - **Tranexamic Acid (TXA):** Use weight-based dosing (10 mg/kg) vs. standard dose. For high-risk patients (e.g., personal or family history of DVT or PE) inject 2 mg intra-articularly. See the ORTHO Knee Replacement and/or ORTHO Hip Replacement powerplans in Powerchart in CenTrak.
  - **OR Efficiency:** Turnover time, anesthesia time.

- **VTE Risk Factors — (Points) High risk = >4 points**
  - Cancer
  - Prior VTE (VTE code) — (2)
  - Hypercoagulability (Factor V Leiden, etc.) — (3)
  - Major surgery (60+ minutes) — (2)
  - Bed rest (nurse charting) — (1)
  - Obesity (BMI >29 kg/m²) — (1)
  - Hormone replacement therapy or oral contraceptives — (1)
**COMPILATIONS RISK MANAGEMENT**

**Rapid response for respiratory distress**
Most patients experience sedation at the beginning of opioid therapy and whenever dose is increased significantly. Clinically significant respiratory depression is a risk factor for all patients receiving opioids for the first time and typically occurs when there is a decrease in rate and depth of respirations from baseline. Respiratory distress can be prevented by careful opioid titration and close monitoring of sedation and respiratory status.

**Monitoring for unintentional opioid oversedation**
Assess heart rate, respiratory rate/effort, blood flow, level of consciousness, pupil size, oxygen saturation, and gastrointestinal status. Watch for arrhythmia, seizure, or inadequate ventilation and need for bag mask ventilation. Using the NAMDU Scale (see table 2 below), the goal is to maintain a level of sedation of N or A. Notify physician or licensed independent practitioner when NAMDU goal is not met OR when patient experiences:
- Oversedation
- Respiratory rate outside designated parameters, decrease in respiratory effort
- Pinpoint pupils
- Bradycardia, apnea, desaturations
- Deteriorating patient status despite interventions (e.g., verbal or physical stimulation)

**Patient care management for respiratory distress**
Implement patient arousal measures and administering oxygen and a reversal agent such as naloxone (Narcan®). CAUTION: Rapid administration, excessive dosage, or the use of naloxone in opioid-dependent patients can cause hypertension, seizure, tachycardia, ventricular arrhythmias, pulmonary edema, or cardiac arrest. For more information, see Intermountain’s Unintentional Opioid Oversedation Newborn Pediatric Adult Protocol for assessment, reportable conditions, patient care management, education, safety, and complications.

**Transfusion Risk**
Risks associated with red blood cell (RBC) transfusions are a major consideration and are proportionally related to the volume of blood given. The most serious risks are Transfusion-Related Acute Lung Injury (TRALI), ABO-incompatible transfusions, and bacterial contamination of blood products (planted high risks).

As a result, RBC transfusion thresholds have become more restrictive. Table 1 is left details Intermountain’s recommended transfusion guidelines. Consider using autologous blood transfusions (Cell Saver®) to minimize associated risks. If unavailable, consider blood bank/donor transfusions.

---

**TABLE 1. Transfusion Guidelines**

<table>
<thead>
<tr>
<th>Transfusion indications</th>
<th>Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hct &lt;21% / Hgb &lt;7 g/dl</td>
<td>All age groups</td>
</tr>
<tr>
<td>Hct &lt;26% / Hgb &lt;8 g/dl</td>
<td>Any of the following, with no explanation other than anemia</td>
</tr>
</tbody>
</table>
- Tachycardia or tachypnea
- Shortness of breath or orthopnea
- Orthostasis and syncope
| Hct <27% / Hgb <8 g/dl | Neonate |
| Hct <30% / Hgb <10 g/dl | To reduce cardiac stress in severe CHF |

---

**TABLE 2. NAMDU Newborn Pediatric Adult Tool**

<table>
<thead>
<tr>
<th>Score</th>
<th>Degree</th>
<th>Assessment Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no sedative</td>
<td>awake and responsive; requires no stimulation</td>
</tr>
<tr>
<td>1</td>
<td>minimal sedation</td>
<td>drowsy, sleeping; response to verbal / environmental stimulation; (e.g., patient opens eyes when you enter the room), cognition / coordination may be impaired</td>
</tr>
<tr>
<td>2</td>
<td>moderate sedation</td>
<td>responds purposefully to verbal / physical stimulus; sleep and return to sleep without stimulus, unable to maintain conversation / may be skimming words</td>
</tr>
<tr>
<td>3</td>
<td>conscious sedation</td>
<td>responds purposefully to verbal / physical stimulus; sleep and return to sleep without stimulus, unable to maintain conversation / may be skimming words</td>
</tr>
<tr>
<td>4</td>
<td>deep sedation</td>
<td>drowsy, sleeping; response to verbal / environmental stimulation; (e.g., patient opens eyes when you enter the room), cognition / coordination may be impaired</td>
</tr>
<tr>
<td>5</td>
<td>unconscious, requires intervention</td>
<td>drowsy, sleeping; response to verbal / environmental stimulation; (e.g., patient opens eyes when you enter the room), cognition / coordination may be impaired</td>
</tr>
</tbody>
</table>

* CAUTION: Deep sedation is an indicator of impending respiratory depression or arrest.

**ALGORITHM: DISCHARGE DESTINATION**

Intermountain Healthcare’s goal for most patients is to discharge to a safe and supportive home environment, which is associated with lower post-operative complications and hospital readmission rates.\(^{12,13}\) Patient education and standardization of rehabilitation protocols may shape patient expectations and aid in this transition of care from hospital to home.

**ALGORITHM NOTES**

(a) **Alternate transition planning strategies**
Explore other safe transitions that may or may not be covered by the patient’s insurance, such as:
- 24/7 sits
- Custodial care
- Assisted living/facility for non-skilled care

(b) **Homebound Patients**

- Are confined to home due to a medical condition
- Are heavily dependent on another person to be able to leave the residence
- May require home only occasionally for short durations or for necessary health care visits

- Are confined to home due to a medical condition
- Are heavily dependent on another person to be able to leave the residence
- May require home only occasionally for short durations or for necessary health care visits

**TABLE 1. Transfusion Guidelines**

<table>
<thead>
<tr>
<th>Transfusion indications</th>
<th>Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hct &lt;21% / Hgb &lt;7 g/dl</td>
<td>All age groups</td>
</tr>
<tr>
<td>Hct &lt;26% / Hgb &lt;8 g/dl</td>
<td>Any of the following, with no explanation other than anemia</td>
</tr>
</tbody>
</table>
- Tachycardia or tachypnea
- Shortness of breath or orthopnea
- Orthostasis and syncope
| Hct <27% / Hgb <8 g/dl | Neonate |
| Hct <30% / Hgb <10 g/dl | To reduce cardiac stress in severe CHF |

---

**TABLE 2. NAMDU Newborn Pediatric Adult Tool**

<table>
<thead>
<tr>
<th>Score</th>
<th>Degree</th>
<th>Assessment Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no sedative</td>
<td>awake and responsive; requires no stimulation</td>
</tr>
<tr>
<td>1</td>
<td>minimal sedation</td>
<td>drowsy, sleeping; response to verbal / environmental stimulation; (e.g., patient opens eyes when you enter the room), cognition / coordination may be impaired</td>
</tr>
<tr>
<td>2</td>
<td>moderate sedation</td>
<td>responds purposefully to verbal / physical stimulus; sleep and return to sleep without stimulus, unable to maintain conversation / may be skimming words</td>
</tr>
<tr>
<td>3</td>
<td>conscious sedation</td>
<td>responds purposefully to verbal / physical stimulus; sleep and return to sleep without stimulus, unable to maintain conversation / may be skimming words</td>
</tr>
<tr>
<td>4</td>
<td>deep sedation</td>
<td>drowsy, sleeping; response to verbal / environmental stimulation; (e.g., patient opens eyes when you enter the room), cognition / coordination may be impaired</td>
</tr>
<tr>
<td>5</td>
<td>unconscious, requires intervention</td>
<td>drowsy, sleeping; response to verbal / environmental stimulation; (e.g., patient opens eyes when you enter the room), cognition / coordination may be impaired</td>
</tr>
</tbody>
</table>

* CAUTION: Deep sedation is an indicator of impending respiratory depression or arrest.
POST-SURGICAL PHYSICAL THERAPY

Inpatient occupational and physical therapy consults

Following surgery (typically during 24 hours post-op), a physical therapist will meet with the patient to conduct an initial assessment and create a post-op physical therapy (PT) plan. Patients who have had a spinal block should have full return of sensation and motor control for 30 minutes prior to initiation of PT assessment/intervention. The PT assessment typically includes:

- Reviewing medical history
- Identifying patient discharge disposition goals (see ambulation guidelines in the Discharge Destination algorithm on page 7)
- Conducting lower extremity strength testing, such as:
  - For knees: weight-bearing heel raise, knee flexion and extension
  - For hips: hip flexion, extension, abduction, adduction, internal and external rotation; quad, hamstring
- Assessing balance and fall risk (via single-leg stance test, comparing operative vs. non-operative side)
- Analyzing gait (walking with and without assistive device); daily ambulation goals are typically >100 feet by end of post-operative day 1 and >200 feet by end of post-operative day 2.
- Conducting functional testing (e.g., timed up-and-go test which correlates fall risk as well as stair climb test and 5 repetitions of sitting to standing)
- Assessing range of motion, such as:
  - For knees: lower extremity range of motion; dorsiflexion, knee flexion and extension
  - For hips: hip flexion, extension, abduction, adduction, internal rotation and external rotation (IF NOT an anterior hip surgery)

The resulting plan will focus primarily on achieving optimum discharge disposition goals, particularly those associated with discharge to home. In daily visits during the hospital stay, the physical therapist will guide the patient to do range-of-motion and strengthening exercises as well as to use TED hose, and do ADLs, such as getting in and out of chairs and bed as well as a car, dressing, showering, and using stairs (if required at home). The goal of these PT sessions is to help the patient transition to home and outpatient physical therapy, if indicated.

Outpatient physical therapy (as indicated)

During an initial outpatient physical therapy session, patient evaluation will build on the assessment and planning done during the patient’s hospital stay, focusing on the patient’s ultimate activity goals (active sports vs. activities of daily living/occupational goals). The physical therapist works with the patient to set interim goals, which will be reevaluated and reset every 30 days. At each subsequent visit, the physical therapist re-evaluates at least one therapy component (e.g., ROM, strength, balance, etc.) and prioritizes, personalizing activities for the patient’s goals and progress.

Release criteria for patients participating in outpatient physical therapy includes independent gain for length of time/distance established in initial goals and a facilitated transition to a long-term exercise situation (gym membership, walking group, recreation center classes, home exercise plan, etc.)

When outpatient physical therapy is indicated, emphasize home exercise compliance by delineating with the patient what to do daily at home versus at an outpatient clinic. Compliance is key to reducing outpatient visits and improving outcomes.

PAIN MANAGEMENT

There are a number of pain management issues related to post-operative recovery, including setting realistic pain management goals and using caution with older adults.

Discuss pain management goals with each patient in terms of ADLs and physical therapy, long-term activity goals (e.g., skiing vs. walking the dog), and level of comfort that optimizes healing.

For geriatric patients, consider avoiding NSAIDS and certain anticoagulants (due to issues with creatinine clearance) and avoid muscle relaxants. Additionally, delirium can result from either over- or undertreatment of pain in older adults. Refer to the medications tables on pages 12–15 for prescribing information about pain medications.

Using the booklet, Managing Your Pain with an Orthopedic Procedure, be sure to talk with patients about:

- Safely taking pain relief medications (see guidelines at right)
- Dealing with potential side-effects of pain medications (constipation, drowsiness, confusion, and difficulty breathing)
- Managing pain without medication (heat/cold therapy, relaxation or meditation, massage, spiritual or emotional counseling)
- Avoiding addiction

For more information, see Management of Chronic Non-Cancer Pain CPM  and the Tapering Opioid Pain Medication Clinical Guideline.
**BEST PRACTICE FLASH CARDS**

Providers can now access flash cards for:

- Joint Replacement Surgery (covers perioperative management)
- Discharge Planning

Best practice flash cards:

- Provide brief decision advice or quick reference information
- Contain algorithms or tables that aid in decision making for diagnosis, treatment, and management
- Link to the CPM or guideline they support

The Flashcard App

This app is available as part of the Physician Container App, which can be downloaded from the App store on your phone (or via iTunes from an Apple device). Just search for “Intermountain Healthcare,” and scroll down to “Intermountain Physician” and “Get” the app.

Be sure you have your username and password.

Printed Flashcards

At iPrintStore.org, providers can order packs of 10 flash cards (all the same topic, on 4-inch by 6-inch cardstock printed on both sides). Cost is a little more than $2 per pack.

**PROVIDER RESOURCES**

To find this CPM, clinicians can go to intermountainphysician.org/clinical/musculoskeletalPages/home.aspx and select the CPM listed under the heading, “Care Process Models” as shown below.

There are a number of other CPMs and clinical guidelines that may be informative for care providers in relationship to total joint replacement surgery and patient postsurgical care. These resources include:

- Management of Chronic Non-Cancer Pain CPM
- Substance Use Disorder CPM
- Tapering Opioid Pain Medication Clinical Guideline
- Choosing a Direct Oral Anticoagulant (DOAC) Clinical Guideline
- Clinical Recommendations for Prescribing Naloxone Clinical Guideline

**PATIENT EDUCATION**

Patient education is a critical element in joint replacement surgery associated with enhanced patient outcomes and satisfaction. Patients need to know the goals of the program, understand its steps and what they need to do, and feel motivated to participate. Several patient education resources are available to help you educate patients about knee and hip replacement.

**Intermountain patient resources**

Clinicians can order Intermountain patient education booklets and fact sheets for distribution to their patients from Intermountain’s online library and print store at iPrintStore.org.

Intermountain's patient education toolkit, Your Guide to Total Joint Replacement, is an interactive guide that helps prepare patients and families for surgery. The toolkit includes patient education materials, such as patient education booklets, fact sheets, and other educational tools.

Current pre-operative classes held throughout Utah reflect the standardized content of the toolkit. These classes are free to the public. Patients can see a full calendar of classes offered and register online at intermountainhealthcare.org/JoinReplacementClass.

**Krames patient resources**

In addition, Krames StayWell offers some brief Health Sheets on orthopedic surgeries. Access these using the Krames On Demand link on the Intermountain Patient Education Library page and in the Cerner EMR patient education library.

To find and print Krames Health Sheets at your desktop:

1. Open the Patient Education Library page by typing PEN in your address bar (within the firewall).
2. Click the Krames On-Demand button.
3. Type “Total Joint Replacement” in the search bar. The applicable materials appear.

Pertinent Krames materials will also appear in the Cerner EMR.

© 2016 INTERTMOUNTAIN HEALTHCARE. ALL RIGHTS RESERVED.
This section gives detailed information on medication—including oral agents and non-insulin injectables—for the surgical management of patients undergoing total hip replacement surgery. *AAOS, ASAM, DAL, EAL, JAC, MOC*

**NOTE**: Table 3 (below) details those medications that should only be administered in the operating room. Table 4 (below and continued on pages 13–15) details all other oral agents and non-insulin injectable medications used throughout the patient’s continuum of care for total joint replacement surgery. For all tables, the legend for tier and cost information appears on page 15.

### Table 3. OR-Use Only: Oral Agents and Non-insulin Injectable Medications

<table>
<thead>
<tr>
<th>Class</th>
<th>Medication name: generic (Brand)</th>
<th>Usual dosing</th>
<th>Tier*, Cost†</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antihistamines, OTC Meds</td>
<td>phenelzine (Nardil) ▪ diphenhydramine (Benadryl) ▪ decongestant ▪ chlorpheniramine (Chlor-Trimeton) ▪ cetirizine (Zyrtec, Aller-Act) ▪ loratadine (Claritin) ▪ diphenhydramine (Benadryl) ▪ ranitidine (Zantac) ▪ famotidine (Pepcid) ▪ omeprazole (Prilosec) ▪ lansoprazole (Prevacid) ▪ esomeprazole (Nexium)</td>
<td>5–10 mg every 4–6 hours (Max) ▪ 25–50 mg every 6 hours ▪ 325–1000 mg every 6 hours ▪ 15–30 mL four times daily ▪ 15–30 mL four times daily ▪ 20 mg twice daily ▪ 20 mg twice daily ▪ 40 mg twice daily ▪ 40 mg twice daily</td>
<td>Generic: Tier 1, $</td>
<td>• Anticholinergic effects may be enhanced in elderly population • Use with caution in patients with chronic kidney disease or liver disease • Not recommended in patients with chronic renal disease or liver disease • May impair bone healing</td>
</tr>
<tr>
<td>Antihistamines, Schedule IV</td>
<td>hydroxyzine (Atarax, Vistaril) ▪ acrivastine (Fexofenadine HCl) ▪ cetirizine (Zyrtec) ▪ loratadine (Claritin) ▪ fexofenadine (Allegra) ▪ cetirizine (Zyrtec) ▪ desloratadine (Allegra) ▪ levocetirizine (Xyzal) ▪ loratadine (Claritin) ▪ fexofenadine (Allegra) ▪ cetirizine (Zyrtec) ▪ desloratadine (Allegra) ▪ levocetirizine (Xyzal) ▪ levocetirizine (Xyzal) ▪ levocetirizine (Xyzal)</td>
<td>10 mg every 4 hours ▪ 25–100 mg every 6 hours ▪ 10–30 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25–100 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours</td>
<td>Generic: Tier 1, $</td>
<td>• Anticholinergic effects may be enhanced in elderly population • Use with caution in patients with chronic kidney disease or liver disease • May impair bone healing</td>
</tr>
<tr>
<td>Muscle Relaxants, Schedule IV</td>
<td>dantrolene (Dantrium) ▪ metoclopramide (Reglan) ▪ aminophylline (Aminophylline) ▪ dantrolene (Dantrium) ▪ metoclopramide (Reglan) ▪ aminophylline (Aminophylline) ▪ dantrolene (Dantrium) ▪ metoclopramide (Reglan) ▪ aminophylline (Aminophylline)</td>
<td>25–100 mg every 6 hours (Max) ▪ 2–5 mg every 4 hours ▪ 50–200 mg every 6 hours (Max)</td>
<td>Generic: Tier 1, $</td>
<td>• Anticholinergic effects may be enhanced in elderly population • Use with caution in patients with chronic kidney disease or liver disease • May impair bone healing</td>
</tr>
</tbody>
</table>

### Table 4. Oral Agents and Non-insulin Injectable Medications

<table>
<thead>
<tr>
<th>Class</th>
<th>Medication name: generic (Brand)</th>
<th>Usual dosing</th>
<th>Tier*, Cost†</th>
<th>Benefits and Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antihistamines, OTC Meds</td>
<td>phenelzine (Nardil) ▪ diphenhydramine (Benadryl) ▪ decongestant ▪ chlorpheniramine (Chlor-Trimeton) ▪ cetirizine (Zyrtec, Aller-Act) ▪ loratadine (Claritin) ▪ diphenhydramine (Benadryl) ▪ ranitidine (Zantac) ▪ famotidine (Pepcid) ▪ omeprazole (Prilosec) ▪ lansoprazole (Prevacid) ▪ esomeprazole (Nexium)</td>
<td>5–10 mg every 4–6 hours (Max) ▪ 25–50 mg every 6 hours ▪ 325–1000 mg every 6 hours ▪ 15–30 mL four times daily ▪ 15–30 mL four times daily ▪ 20 mg twice daily ▪ 20 mg twice daily ▪ 40 mg twice daily ▪ 40 mg twice daily</td>
<td>Generic: Tier 1, $</td>
<td>• Anticholinergic effects may be enhanced in elderly population • Use with caution in patients with chronic kidney disease or liver disease • May impair bone healing</td>
</tr>
<tr>
<td>Antihistamines, Schedule IV</td>
<td>hydroxyzine (Atarax, Vistaril) ▪ acrivastine (Fexofenadine HCl) ▪ cetirizine (Zyrtec) ▪ loratadine (Claritin) ▪ fexofenadine (Allegra) ▪ cetirizine (Zyrtec) ▪ desloratadine (Allegra) ▪ levocetirizine (Xyzal) ▪ loratadine (Claritin) ▪ fexofenadine (Allegra) ▪ cetirizine (Zyrtec) ▪ desloratadine (Allegra) ▪ levocetirizine (Xyzal) ▪ levocetirizine (Xyzal) ▪ levocetirizine (Xyzal)</td>
<td>10 mg every 4 hours ▪ 25–100 mg every 6 hours ▪ 10–30 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25–100 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours</td>
<td>Generic: Tier 1, $</td>
<td>• Anticholinergic effects may be enhanced in elderly population • Use with caution in patients with chronic kidney disease or liver disease • May impair bone healing</td>
</tr>
<tr>
<td>Muscle Relaxants, Schedule IV</td>
<td>dantrolene (Dantrium) ▪ metoclopramide (Reglan) ▪ aminophylline (Aminophylline) ▪ dantrolene (Dantrium) ▪ metoclopramide (Reglan) ▪ aminophylline (Aminophylline) ▪ dantrolene (Dantrium) ▪ metoclopramide (Reglan) ▪ aminophylline (Aminophylline)</td>
<td>25–100 mg every 6 hours (Max) ▪ 2–5 mg every 4 hours ▪ 50–200 mg every 6 hours (Max)</td>
<td>Generic: Tier 1, $</td>
<td>• Anticholinergic effects may be enhanced in elderly population • Use with caution in patients with chronic kidney disease or liver disease • May impair bone healing</td>
</tr>
</tbody>
</table>

### Table 4. Oral Agents and Non-insulin Injectable Medications (continued)

<table>
<thead>
<tr>
<th>Class</th>
<th>Medication name: generic (Brand)</th>
<th>Usual dosing</th>
<th>Tier*, Cost†</th>
<th>Benefits and Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antihistamines, OTC Meds</td>
<td>phenelzine (Nardil) ▪ diphenhydramine (Benadryl) ▪ decongestant ▪ chlorpheniramine (Chlor-Trimeton) ▪ cetirizine (Zyrtec, Aller-Act) ▪ loratadine (Claritin) ▪ diphenhydramine (Benadryl) ▪ ranitidine (Zantac) ▪ famotidine (Pepcid) ▪ omeprazole (Prilosec) ▪ lansoprazole (Prevacid) ▪ esomeprazole (Nexium)</td>
<td>5–10 mg every 4–6 hours (Max) ▪ 25–50 mg every 6 hours ▪ 325–1000 mg every 6 hours ▪ 15–30 mL four times daily ▪ 15–30 mL four times daily ▪ 20 mg twice daily ▪ 20 mg twice daily ▪ 40 mg twice daily ▪ 40 mg twice daily</td>
<td>Generic: Tier 1, $</td>
<td>• Anticholinergic effects may be enhanced in elderly population • Use with caution in patients with chronic kidney disease or liver disease • May impair bone healing</td>
</tr>
<tr>
<td>Antihistamines, Schedule IV</td>
<td>hydroxyzine (Atarax, Vistaril) ▪ acrivastine (Fexofenadine HCl) ▪ cetirizine (Zyrtec) ▪ loratadine (Claritin) ▪ fexofenadine (Allegra) ▪ cetirizine (Zyrtec) ▪ desloratadine (Allegra) ▪ levocetirizine (Xyzal) ▪ loratadine (Claritin) ▪ fexofenadine (Allegra) ▪ cetirizine (Zyrtec) ▪ desloratadine (Allegra) ▪ levocetirizine (Xyzal) ▪ levocetirizine (Xyzal) ▪ levocetirizine (Xyzal)</td>
<td>10 mg every 4 hours ▪ 25–100 mg every 6 hours ▪ 10–30 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25–100 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours ▪ 25 mg every 6 hours</td>
<td>Generic: Tier 1, $</td>
<td>• Anticholinergic effects may be enhanced in elderly population • Use with caution in patients with chronic kidney disease or liver disease • May impair bone healing</td>
</tr>
<tr>
<td>Muscle Relaxants, Schedule IV</td>
<td>dantrolene (Dantrium) ▪ metoclopramide (Reglan) ▪ aminophylline (Aminophylline) ▪ dantrolene (Dantrium) ▪ metoclopramide (Reglan) ▪ aminophylline (Aminophylline) ▪ dantrolene (Dantrium) ▪ metoclopramide (Reglan) ▪ aminophylline (Aminophylline)</td>
<td>25–100 mg every 6 hours (Max) ▪ 2–5 mg every 4 hours ▪ 50–200 mg every 6 hours (Max)</td>
<td>Generic: Tier 1, $</td>
<td>• Anticholinergic effects may be enhanced in elderly population • Use with caution in patients with chronic kidney disease or liver disease • May impair bone healing</td>
</tr>
</tbody>
</table>

©2016 INTERMOUNTAIN HEALTHCARE. ALL RIGHTS RESERVED.
### TABLE 4. Oral Agents and Non-insulin Injectable Medications (continued)

<table>
<thead>
<tr>
<th>Class</th>
<th>Medication name: generic (Brand)</th>
<th>Usual dosing</th>
<th>Tier*, Cost</th>
<th>Benefits and Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Acting Opioids</td>
<td>Hydrocodone (Hycodan)</td>
<td>2.5 mg to 20 mg every 6 hours (max)</td>
<td>Tier 1, $</td>
<td>• Caution when using with products containing acetaminophen (DNP 4 g/day) • Use with caution in elderly patient or in hepatic or renal dysfunction • Schedule II Controlled Substance</td>
</tr>
<tr>
<td></td>
<td>Hydromorphone (Dilaudid)</td>
<td>0.5 mg to 1 mg every 15 minutes to 1 hour PO: 2 mg to 4 mg every 6 hours</td>
<td>Tier 1, $</td>
<td>• Less histamine release (lactal) as compared to morphine • Use with caution in elderly patient or in hepatic dysfunction – high risk of accumulation and respiratory depression • Schedule II Controlled Substance</td>
</tr>
<tr>
<td></td>
<td>Morphine/ Morphinex/ Astamorph</td>
<td>0.2 mg to 10 mg every 1–4 hours Spinal: 0.2 mg to 0.5 mg pre-op intra-op</td>
<td>Tier 1, $</td>
<td>• Use with caution in elderly patient or in hepatic or renal dysfunction • Higher risk of histamine release (lactal) than other opioids • Schedule II Controlled Substance</td>
</tr>
<tr>
<td></td>
<td>Oxycodone — with or without APAP</td>
<td>2.5 mg to 20 mg every 6 hours (max)</td>
<td>Tier 1, $</td>
<td>• Use with caution in elderly patient or in hepatic or renal dysfunction • Caution when using with products containing acetaminophen (DNP 4 g/day) • Schedule II Controlled Substance</td>
</tr>
<tr>
<td></td>
<td>tramadol — with or without APAP (Ultram/ Ultracet)</td>
<td>25 mg to 100 mg every 6 hours (max)</td>
<td>Tier 1, $</td>
<td>• Use with caution in elderly patient or in hepatic or renal dysfunction • Can increase seizure risk when used in combination with other products that decrease seizure threshold • Can increase risk of serotonin syndrome, especially in patients taking antidepressants • Schedule II Controlled Substance</td>
</tr>
<tr>
<td>Long Acting Opioids</td>
<td>Morphine (MS Contin)</td>
<td>15 mg to 30 mg pre-op 15 mg to 45 mg every 6 hours to 12 hours</td>
<td>Tier 1, $</td>
<td>• Not recommended for chronic use in orthopedic population • Use with caution in elderly patient or in hepatic or renal dysfunction • Bleeding reversed by Vitamin K • Wound and bone healing</td>
</tr>
<tr>
<td></td>
<td>Oxycodone (Oxycet)</td>
<td>10 mg to 20 mg pre-op 10 mg to 30 mg every 6 hours to 12 hours</td>
<td>Tier 1, $</td>
<td>• Not recommended for chronic use in orthopedic population • Use with caution in elderly patient or in hepatic or renal dysfunction • Bleeding reversed by Vitamin K • Wound and bone healing</td>
</tr>
</tbody>
</table>

### TABLE 4. Oral Agents and Non-insulin Injectable Medications (continued)

<table>
<thead>
<tr>
<th>Class</th>
<th>Medication name: generic (Brand)</th>
<th>Usual dosing</th>
<th>Tier*, Cost</th>
<th>Benefits and Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticoagulants</td>
<td>warfarin (Coumadin)</td>
<td>1 mg to 12.5 mg daily x 10–35 days</td>
<td>Tier 1, $</td>
<td>• Predictable dose adjustments made through INR testing • Bleeding reversed by Vitamin K • Grade 1b CHEST Guidelines for VTE prevention • Multiple drug-drug and drug-food interactions • Patient subject to frequent INR testing</td>
</tr>
<tr>
<td></td>
<td>enoxaparin (Lovenox)</td>
<td>30 mg twice daily x 10–35 days (begin 12 hours before or after surgery)</td>
<td>Tier 1, $</td>
<td>• Grade 1b CHEST Guidelines for VTE prevention – PREVENTION AGENT • No laboratory testing required • Black Box Warning for epidural or spinal hematomas in patients anticoagulated with LMWH and receiving neuraxial anesthesia or spinal puncture</td>
</tr>
<tr>
<td></td>
<td>rivaroxaban (Xarelto)</td>
<td>10 mg daily x 10–35 days (begin 6–10 hours after surgery)</td>
<td>Tier 2, $</td>
<td>• Grade 1b CHEST Guidelines for VTE prevention • No laboratory testing required • No reliable reversal agent exists</td>
</tr>
<tr>
<td></td>
<td>apixaban (Eliquis)</td>
<td>2.5 mg twice daily x 10–35 days (begin 12 hours after surgery)</td>
<td>Tier 2, $</td>
<td>• Grade 1b CHEST Guidelines for VTE prevention • No laboratory testing required • No reliable reversal agent exists</td>
</tr>
<tr>
<td></td>
<td>aspirin (Ibexin/ Bayer)</td>
<td>325 mg twice daily</td>
<td>Tier 1, $</td>
<td>• Grade 1b CHEST Guidelines for VTE prevention • Available OTC without prescription</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>clofazimine (Keflex, Acuff)</td>
<td>2.0 g if ≤ 120 kg to 3.0 g if &gt; 120 kg pre-op and every 6 hours x 24 hours</td>
<td>Tier 1, $</td>
<td>• For patients with beta-lactam allergy • CMS will not pay for antibiotic unless documentation for beta-lactam allergy is noted</td>
</tr>
<tr>
<td></td>
<td>ciprofloxacin (Ciloxin)</td>
<td>900 mg pre-op and every 8 hours x 24 hours</td>
<td>Tier 1, $</td>
<td>• For patients with beta-lactam allergy AND MRSA colonization or high risk MRSA • CMS will not pay for antibiotic unless documentation for MRSA is noted</td>
</tr>
<tr>
<td></td>
<td>vancomycin</td>
<td>1 g if ≤ 100 kg, 1.25 g if &gt; 100 kg, but &lt; 150 kg, 1.5 g if &gt; 150 kg pre-op and every 12 hours x 24 hours</td>
<td>Tier 1, $</td>
<td>• For patients with beta-lactam allergy AND MRSA colonization or high risk MRSA • CMS will not pay for antibiotic unless documentation for MRSA is noted</td>
</tr>
</tbody>
</table>

* Tier 1: $5–$10 copay; Tier 2 = $30–$50 copay; Tier 3 = $50–$60 copay (based on typical SelectHealth 2010 RxSelect benefit design; some benefit designs may differ).
† Cost: Estimated monthly cost based on usual dose. $1–$25; $26–$75; $76–$150; $151–$300; $301–$600. Generic used for tier and price comparisons unless otherwise noted.
This CPM presents a model of best care based on the best available scientific evidence at the time of publication. It is not a prescription for every physician or every patient, nor does it replace clinical judgment. All statements, protocols, and recommendations herein are viewed as transitory and iterative. Although physicians are encouraged to follow the CPM to help focus on and measure quality, deviations are a means for discovering improvements in patient care and expanding the knowledge base. Send feedback to:

Joan Lelis, Operations Director
Musculoskeletal Clinical Program
Intermountain Healthcare
(Joan.Lelis@imail.org)

CPM DEVELOPMENT TEAM
MSKCP Total Joint Development Team

Medical Director: Nate Momboker, TOSH
Central Region: Jeremy Gilliland, LDSH
    Josh Hickman, LDSH
    Crystal Soverein, LDSH
    Keri Mcaffee, TOSH
    Adam King, IMC
North Region: Tom Calton, McKay-Dee
    Bryan King, Logan
    Allyssa Burt, Logan
    Evelyn Chapman, McKay-Dee
South Region: Adam Bergeson, UVH
    Terrell Winterton, UVH
    Jordan Falor, UVH
Southwest Region: Ed Prince, DRMC
    Emily Lowe, DRMC
PKMC-Heber: Charles Lind, PKMC
    Nicolle Miller, PKMC
    Jen Brown, PKMC

MSKCP Medical Director: Hugh West
MSKCP Operations Director: Joan Lelis
MSKCP Data Manager: Ben Layne
MSKCP Data Analyst: Jackie Lee
Medical Writer: Kathi Whitman, Patient and Provider Publications
MSKCP Administrative Assistant: Helen Messina

REFERENCES


