National Association of Orthopaedic Nurses

Advancing the Art and Science of Orthopaedic Care

Best Practice Guideline
Total Knee Replacement (Arthroplasty)

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Disclaimer

This Best Practice Guideline (BPG) was developed by experts in clinical practice who work in Joint Commission Disease Specific Certified environments. The BPG was guided by the NAON Executive Board with oversight from NAON's Director of Education. It is provided as an educational tool based on an assessment of current scientific and clinical research information, as well as quantifiable best practices. The tool is not intended to replace a clinician's independent judgment and critical thinking, but to enhance the clinician's knowledge regarding the care and the needs of the total joint patient throughout the continuum of care.

Levels of Evidence

The evidence within this best practice guideline is rated to differentiate evidence of varying strengths and quality. "The underlying assumption is that recommendations from strong evidence of high quality would be more likely to represent best practices than evidence of lower strength and less quality" (Newhouse, 2007, p. 90). Refer to the Appendix for an explanation of the levels of evidence contained within this guideline.

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Introduction

In 2010, Kremers et al. (2015) found the prevalence of total knee replacements in the U.S. was 1.52%, corresponding to 4.7 million individuals. By 2030, total knee replacements are projected to grow by 673% compared with 2005 (Kurtz, Ong, Lau, Mowat, & Halpern, 2007). These increasing demands for total knee replacements are fueled by aging baby boomers, joint injuries, and physically active life styles (Wilson, Schneller, Montgomery, & Bozic, 2008).

Overall, total hip and total knee revisions are projected to grow by 137% and 601%, respectively, between 2005 and 2030. By 2040, an estimated 78 million, or 26% of United States adults ages 18 years or older, are projected to have doctor diagnosed arthritis (Hootman, Helmick, Barbour, Theis, & Boring, 2016). Around seven million Americans are living with a hip or knee replacement (Kremers et al., 2015) and that number is growing every year. The Centers for Medicare and Medicaid (CMS, 2015) estimates greater than $7 billion in hospitalization costs for inpatient total joint arthroplasties.

Purpose

The purpose of the Best Practice Guideline for Total Knee Replacement is to collate the current available literature to provide best practice information aimed at the continuum of nursing care for the patient undergoing a total knee replacement. This guideline will focus on standardizing and improving patient care pathways for total knee replacement.

Rationale for Guideline

The rationale for the guideline is to emphasize the importance of identifying standardized practice guidelines for the total knee replacement patient. Standardized guidelines have been shown to have a positive impact with patient outcomes.

Goal of Best Practice Guideline

The guideline offers an assessment of the benefits and harms of various care and practice options for the total knee replacement patient. This will assist and empower nurses to manage the acute care requirements of the total knee replacement patient effectively. The overarching goal of the Best Practice Guideline is to improve patient outcomes through the dissemination of relevant literature and proven best practices. Ultimately, adoption of recommended practices offer the potential for an enhanced patient experience and recovery.

Description

A total knee replacement, also known as knee replacement or arthroplasty, is a modern surgical procedure described as knee resurfacing (American Academy of Orthopaedic Surgeons [AAOS], 2015a). This surgery involves removing the diseased or damaged knee joint and repairing the weight-bearing joint with a metal/plastic or ceramic prosthetic.

Definition of the Problem

Due to the aging population and longer life expectancies, Go et al. (2013) found that the growing total joint replacement population has become as prevalent as several chronic diseases: stroke (6.8 million), myocardial infarction (7.6 million), and heart failure (5.1 million). These disease states have been heavily researched; however, total knee replacement has not. With the growing number of total knee replacements being performed, the health care community recognizes the need for standardization of evidence based guidelines on acute and chronic care of individuals with knee replacements. There is an increasing awareness of the need to develop effective models of care that facilitate acute care management and patient self-management. Research regarding the care of the total knee replacement needs to increase and expand.

Pathophysiology

The most common cause for the need of a knee replacement is arthritis: osteoarthritis, rheumatoid arthritis, or posttraumatic arthritis (AAOS, 2015a):

- Osteoarthritis is the most common form of arthritis (Centers for Disease Control and Prevention [CDC], 2015). The pathology of osteoarthritis includes radiographic changes such as joint space narrowing, osteophytes and bony sclerosis. Osteoarthritis can be described as progressive loss of hyaline cartilage.

- Rheumatoid arthritis is the most common autoimmune inflammatory arthritis (Singh et al., 2015). Rheumatoid arthritis is a systemic inflammatory disease that can affect multiple joints (Aggarwal et al., 2015). The pathogenesis of rheumatoid arthritis includes fibrosis, synovial cell proliferation, pannus formation and erosion of bone and cartilage. The inflammatory response manifests in the synovial membrane of joints causing hypertrophy and chronic joint inflammation. The overgrowth of the synovial cells and activation of endothelial cells then leads to erosions of the cartilage and bones.

- Posttraumatic arthritis is caused by a physical injury such as vehicle accident, fall, dislocation, or any source of blunt trauma (Lotz, 2010). These injuries damage the articular cartilage and the bone, changing the mechanics of the joint and accelerating the progression toward osteoarthritis. The pathogenesis of posttraumatic arthritis occurs with the injury and progresses over time. Initially there is cell necrosis, collagen rupture and hemarthrosis. Months later, there is apoptosis, leukocyte infiltration, and extracellular matrix degradation. Over the years, the joint tissue will remodel and chronic inflammation will be present.

Continuum of Care

Preoperative Care

Preoperative Patient Optimization

Organizations and programs that seek evidence-based approaches to enhance patient outcomes typically address preoperative optimization to include one or more of these areas:

1. Dental Issues
2. Sleep Apnea
3. Smoking
4. BMI
5. Anemia
6. Hypertension
7. Hyperglycemia
8. Nutrition/low albumin
9. Alcohol/Drug consumption
10. Catastrophizing (considered a serious risk on outcomes and should be potential grounds for cancellation or delay of surgery.)

Use of enhanced recovery programs are increasing in all types of surgery. In the past ten years, these programs have been well studied and documented in the literature. There are varying definitions of these programs including 'Accelerated Rehabilitation', 'Fast-track', and 'Rapid Recovery' (Berend, Lombardi, & Mallory, 2004; Jakobsen, Kehlet, Husted, Petersen, & Bandhom, 2014; White, Houghton-Clemmey & Marval, 2013). The purpose of this best practice guideline is not to state which term or definition is correct, but to provide the literature that supports these practices. The main goal of these programs is to improve patient outcomes and expedite recovery by optimizing the surgical care pathway prior to surgery. The outcomes related to these practices in a total knee replacement include shortened length of stay (Christelis et al., 2015; Isaac et al., 2005), improved patient experience (Jones et al., 2014 (Level III & IV); Machin, Phillips, Parker, Carrannante & Hearth, 2013) (Level IV), and enhanced clinical and functional outcomes overall.

The implementation of these programs begins preoperatively; however, interventions should continue throughout the operative experience. There are many key interventions that comprise the enhancement recovery program for total knee replacements (Ibrahim, Alazzawi, Nizam, & Haddad, 2013; Machin, Phillips, Parker, Carrannante, & Hearth, 2013; National Health Service (NHS), 2008; Stowers, Lemanu, Coleman, Hill, & Munro, 2014). One intervention is a thorough patient assessment including measures like weight, height and BMI, hemoglobin A1C, renal function, activity level and management of co-morbidities. The American Academy of Orthopaedic Surgeons (AAOS), Surgical Management of Osteoarthritis of the Knee Practice Guideline (2015b), shows strong evidence to support that obese total knee patients have less improvement in outcomes and moderate evidence to support that patients with diabetes are at higher risk for complications after a total knee replacement.

The documentation of a complete and thorough assessment can facilitate the healthcare team to effectively care for and educate the patient throughout the continuum. The table below was constructed based on the literature for Enhanced Recovery After Surgery (ERAS) for total hip and total knee replacements. Outlined below are the optimal times, interventions, and outcomes of an enhanced recovery program. These options have been utilized successfully for improved outcomes.

Table 1-1: (ERAS) Strategies through the Care Continuum

Optimal Timing	Intervention	Outcome
Preoperative Care	– Thorough assessment by qualified MD, NP, or PA – VTE prophylaxis risk assessment and planning – Education – Anesthesia consultation – Case management consultation – Nutrition assessment – Minimal fasting time – Neuromuscular electrical stimulation – PreHab – HgbA1C – Multimodal analgesia pre and post op – Staph prophylaxis, nares	– Optimize general health and co-morbidities – Manage expectations and decrease anxieties about stay – Meet discharge requirements – Optimized preoperative care – Improved wound healing – Improved glycemic control
Intraoperative Care	– Warming systems – Tranexamic acid – Avoid drains – Minimally invasive surgery techniques – Optimized anesthetic techniques	
Postoperative Comfort Needs	– Pulsed electromagnetic fields – Local anesthetic around joints – Regular and effective analgesia – Prophylaxis for nausea	– Reduced pain and allow for earlier mobilization – Enhanced comfort
Postoperative Care		– Reduced VTE – Speed recovery – Optimize independence – Optimized postoperative care

Many of the interventions, such as nutrition assessment, fasting times, tranexamic acid, and avoiding drains have extensive literature and practice guidelines to support implementation. It is highly recommended that

these interventions be researched and clear guidelines followed when implementing. Some of these interventions may defy an organization's traditional practices, and implementation can be challenging. Nurses have an integral role in patient care and can have a direct influence on optimization of care for total knee replacement patients.

Some programs have found success in risk stratification tools, such as:

- Risk Assessment and Prediction Tool (RAPT) (Oldmeadow, McBurney, & Robertson, 2003),
- Predicting Location after Replacement Nomogram (PLAN) (Barsoum et al., 2010),
- Morbidity and Mortality Acute Predictor for Arthroplasty (arthro-MAP) (Wuerz, Kent, Malchau, & Rubash, 2014),
- Penn Arthroplasty Risk Score (PARS) (Courtney, Whitaker, Gutsche, Hume, & Lee, 2014).

Nutrition Screening

Nutrition screening prior to surgery is simply assessing the patient for nutrition deficiencies. Clinical malnutrition is associated with increased surgical complications, morbidity and mortality, prolongs rehabilitation (Husted, Holm, & Jacobsen, 2008), raises infection rates (Gottschalk, Johnson, Sadlack, & Mitchell, 2014), and delays wound healing (Pedersen & Pedersen, 1992; Pratt, Veitch, & McRoberts, 1981). Preoperative nutritional depletion occurs in 30% of elective surgery patients (Nicholson, Dowrick, & Liew, 2012). Huang, Greenky, Kerr, Austin, & Parvizi (2013) found malnutrition to be common in total joint replacement patients greater than 55 years of age. Enhanced Recovery After Surgery (ERAS) protocols recommend nutrition screening in all surgical patients.

There is not a consensus on a single best tool to assess nutrition status (van Bokhorst-de van der Schueren, Guaitoli, Jansma, & de Vet, 2014); however, a tool can aid in obtaining a quick and easy snapshot of the patient's nutritional status. Well known examples, include

- Malnutrition Screening Tool (MST) (Ferguson, Capra, Bauer, & Banks, 1999),
- Short Nutritional Assessment Questionnaire (SNAQ) (Kruizenga, Seidell, de Vet, Wierdsma, & Van Bokhorst-de Van der Schueren, 2005),
- Nutrition Risk Index (NRI) (Wolinsky et al., 1990), and
- Malnutrition Universal Screening Tool (MUST) (Elia, 2003).

Any positive indicator of high nutritional risk will need further evaluation by a professional to get a more complete picture of the severity and nature of the nutritional deficit (van Bokhorst-de van der Schueren, Guaitoli, & Jansma, de Vet, 2014). The MST, when compared with other screening tools (PG-SGA and NRS-2002), had a fair validity in determining malnutrition in hospitalized adults and elderly and scored fair in orthopaedic elderly (van Bokhorst-de van der Schueren, Guaitoli, Jansma, & de Vet, 2014) (Level I). More research is needed comparing different tools with one specific population such as total knee replacements.

Joint Coach (Care Partner) Selection

Social support is an important part of the overall recovery from a total knee replacement and can contribute to improved physical and cognitive functioning (Lange-Collette, 2002). Social support has an influence on health behaviors, prevention and treatment and on how a person recuperates from numerous diseases (Hurdle, 2001). Informal support can help patients with the untoward effects of the operation; filling a gap when support from health professionals is not indicated (Johnson, Horwood, & Gooberman-Hill, 2015).

Best practices state that the care partner or coach should be knowledgeable about the surgery including preparation needed before surgery, the rehabilitation needed after surgery, and general expectations and goals for total knee replacement. The care partner/coach should play an active role throughout the surgery and recovery. He or she should attend a preoperative educational class with the patient, take part in physical and occupational therapy, and should be willing and open to learning discharge needs or utilize other resources that can assist with questions and concerns (online, one-on-one, over the telephone). Discharge needs may include planning to stay with the patient at home for a few days, filling prescriptions, maintaining awareness of physical precautions, and transporting to therapy and other postoperative appointments.

Planning for Postoperative Destination

Discharge planning must begin early in the continuum, preferably before the day of surgery. Conversations with the patient and family members regarding the likely discharge destination should be initiated by each provider (i.e. surgeon, nurse navigator, pre-surgical optimization clinic staff, case manager) at the initial contact. Discharge destinations for patients after total knee replacement are variable. Patients may be discharged home with or without homecare. They may also be discharged to another inpatient facility. Inpatient facilities are either acute inpatient rehab facilities or skilled nursing facilities. Although insurance coverage for the discharge destination may influence patient decisions about post-surgical care, this should not be the determining factor when choosing care after surgery (Radcliff, Cote, Olson, & Liebrecht, 2012).

Inpatient rehabilitation does not reduce complication and infection rates. In fact, patients experience similar or improved outcomes when discharged home rather than to an inpatient facility. Nationally, home is the desired discharge plan for total knee replacement patients. Patient education about discharge should include the support person and should aim at helping patients and coaches to anticipate challenges with their transition home (Mitchell, 2015). Consistent communication among the healthcare team, involving the patient and support person, is critical to a successful transition after discharge. The patient should be following the agreed upon care path despite discharge destination (Pearson, 2001).

Mandatory Preoperative Education

A literature review was completed that included twenty-five studies addressing preoperative education. Six of those studies reported statistical significance in relation to preoperative education reducing length of stay, falls, complications and financial charges (Bergin et al., 2014; Clarke, Timm, Goldberg, & Hattrup, 2012; Huang, Chen, & Chou, 2012; Jones et al., 2011; Lin et al., 2011; Yoon et al., 2010). Jones and colleagues (2011) identified total knee replacement patients were 2.6 times more likely to have a shorter length of stay after

comprehensive preoperative patient education than a control group (Level III). Contradictory to the 2004 Cochrane review on written, audiovisual or a combination of both, preoperative education, several studies found structured preoperative teaching can shorten length of stay (Bergin et al., 2014; Huang et al., 2012; Jones et al., 2011; Yoon et al., 2010). Yoon and colleagues (2010) found one-on-one education significantly reduced the length of stay by approximately one day. One-on-one education may not be financially or operationally ideal; however, the personal nature of the education allows for open communication and provides a comforting environment for the patient to ask difficult or personal health related questions.

In addition to decreased length of stay, Bergin and colleagues (2014) found preoperative incentive spirometry patient education decreased postoperative complications compared to a control group. Decreased financial charges were also found in those patients who had received preoperative patient education (Bergin et al., 2014; Huang et al., 2012). While most of these studies focused on length of stay, one study was noted to reduce postoperative falls in patients who participated in a one-on-one nurse led preoperative education program (Clarke, Timm, Goldberg, & Hattrup, 2012).

Further research is needed on the appropriate timing of preoperative education. Preoperative education timing has ranged from the day before surgery to four weeks prior to surgery (Jones et al., 2011; Yoon et al., 2010). In addition, content of the structured education sessions has not been clearly defined nor has the length of time the education should last. Despite these limitations, formalized and comprehensive preoperative patient education encourages the patient to be an active participant in their care (Hass, Jaekel, & Nesbitt, 2015). A few topics were found repeatedly in the literature, which could be used as a basis for best practice preoperative education:

- multidisciplinary approach
- preoperative educational booklet which is given to the patient and reviewed during educational sessions
- care pathway from pre-admission to post-discharge
- preparation for surgery: preadmission assessment, smoking cessation, nutrition, clearances if needed, preoperative lab work, preparation of the home and what to bring to the hospital
- intraoperative care: anesthesia
- postoperative care: pain control, wound care, hand hygiene
- physical and occupational therapy
- mobility
- venous thromboembolism (VTE) prevention
- discharge needs and goals
- exercises following discharge (see ‘Prehab’)
- durable medical equipment or DME
- discharge to home environment
- infection prevention

Blood Transfusions Prevention

Knee replacements require extensive soft tissue release and bone incisions, which may result in significant blood loss. Reducing blood loss has a positive clinical impact on the patient's recovery, including reducing the need for blood transfusions and minimizing the additional risks associated with blood transfusions (Bierbaum et al., 1999). Many practices have been tested and associated with reduced blood loss in total joint replacements:

1. Tourniquet use during surgery (Yi, Tan, Chen, Chen, & Huang, 2014; Li et al., 2014) (Level II),
2. Drain placement protocols (Stucinskas et al., 2009),
3. Fibrin sealants (Li et al., 2015) (Level II),
4. Tranexamic acid (AAOS, 2015b) (strong evidence); Kedi et al., 2016 (Level III); Zhao-Yu, Yan, Wei, Yuejv, & Ying-Ze, 2013), and
5. Postoperative knee flexion (Liu, Li, Cao, & Wang, 2015).

The pros and cons of all these interventions need to be weighed against overall patient benefit. For example, tourniquet use can cause increased postoperative pain (AAOS, 2015b (strong evidence); Tai et al., 2012) and clamped drains may lead to hematoma, delayed wound healing and deep venous thrombosis (Yamada, Imaizumi, Uemura, Takada, & Kim, 2001).

No clear guidelines of any one approach can be made based on the current evidence due to low quality (Li et al., 2014). No study was found comparing all techniques in regards to efficacy. A multimodal approach using pharmacologic agents and topical techniques can be an appropriate method to limit the amount of bleeding. Benefits and side effects of all approaches will need to be considered with each patient. Preoperative optimization labs should be drawn within a timeframe that allows corrective action to be taken if needed. Many programs suggest ordering and drawing labs four to six weeks preoperatively, which allows time for treatment of hemoglobin/hematocrit issues and achievement of acceptable values prior to the surgical procedure.

"PreHab"

Topp, Ditmyer, King, Doherty, & Hornyak (2002) define preoperative rehabilitation or "prehab" as the "process of enhancing functional capacity of the individual to enable him or her to withstand the stressor of inactivity" (p. 268). The overall goals of prehab initially were to prevent functional decline until surgery and provide a quicker functional recovery post-surgery (Carli & Zavorsky, 2005; Ditmyer, Topp, & Pifer, 2002; Topp, Ditmyer, King, Doherty, & Hornyak, 2002). Some programs use prehab as a method to help determine a patient's preoperative readiness and the length of stay goal for that patient (i.e. same day discharge versus overnight stay). With the growing trend toward shorter length of stay and outpatient total knee replacement, prehab has extended to teaching and the patient demonstrating the exercises needed after discharge. The need for patient mastery of the exercise protocol is even higher if the planned destination is home. It is very important to validate the patient's and coach's understanding of the exercises (teach back, return demonstration).

Overall, in the literature, prehab did not show improvement in long-term patient outcomes. Cabilan, Hines, & Munday (2016) conducted a systematic review evaluating the evidence on the effectiveness of prehab on functional status, healthcare utilization, quality of life, and pain compared to a usual care group (Level II). Based on their review, prehab does not improve functional outcomes. For self-reported functional status, utilizing the Western Ontario and McMaster Universities Arthritis Index (WOMAC) osteoarthritis index, there were no statistically significant improvements. Prehab was not found to significantly benefit quality of life or pain scores. Contrary to these findings, Beaupre, Lier, Davies, & Johnston (2004) found a statistically significant benefit of prehab in reducing admission to acute rehabilitation for total knee replacement patients; however, prehab did not significantly reduce readmission rates. In light of current trends with shortened acute care stays, research regarding the role and contributions of prehab is necessary.

Pain Management Plan before Surgery

Mental health, preoperative knee pain, pain at other sites, and pain catastrophizing are all predictors of obstinate pain after a total knee replacement (Lewis, Rice, McNair, & Kluger, 2014) (Level I). Mental exhaustion before surgery is a risk factor of post-operative pain (Lavand'homme & Thienpont, 2015). Stress overload can lead to anxiety, panic attacks, depression alcoholism and other substance abuse (Montero-Marin, Prado-Abril, Demaizo, Gascon, & Garcia-Campayo, 2014). Patients with chronic pain often suffer from insomnia, exhaustion, and depression, all of which are indicators of preoperative stress, thus putting the patient at high risk for post-operative pain (Ayers, Franklin, Ploutz-Snyder, & Boisvert, 2005). The long-term use of opioid medication preoperatively also will increase the risk of a more painful and extended recovery time (Zywiel, Stroh, Lee, Bonutti, & Mont, 2011). AAOS clinical practice guidelines (2015b) stated that total knee patients with select chronic pain conditions have less improvement in patient reported outcomes. Pain catastrophizing, the strongest predictor of postoperative pain, is associated with acute and chronic pain severity (Forsythe, Dunbar, Hennigar, Sullivan, & Gross, 2008), altered central nociceptive processing (Goodin et al., 2009), disability (Forsythe, Dunbar, Hennigar, Sullivan, & Gross, 2008), and functional decline (Keefe et al., 2000).

A pain management plan before surgery is a key component to a positive patient experience post-surgery. A discussion with the patient prior to surgery should include determination of the patient pain goal, before the patient is medicated. Approaches to address pain management prior to surgery may include enhancing the preoperative education to include an outline of the surgical procedure and expected outcomes, enabling the patient to participate in decisions, and ensuring consistent information from all healthcare professionals across the continuum. Some patients may benefit from earlier surgical intervention and a more intensive analgesic (Lewis, Rice, McNair, & Kluger, 2014) (Level I). Valid screening tests would augment pain management and enhance individualized risk stratification for consistent postoperative pain. Those with neuropathic pain, and long term opioid use, may benefit from specific preoperative or perioperative antihyperalgesic medications (Lavand'homme & Thienpont, 2015). Overall, a multimodal approach, including non-pharmacologic approaches such as ice and distraction, is necessary.

VTE Prophylaxis Plan

The risk of developing blood clots in either a deep vein in the lower extremity (deep vein thrombosis or DVT) or the lung (pulmonary embolism or PE) after joint replacement is high. Following orthopedic surgery, the incidence can be 40% to 60% (Cohen et al., 2012). The risk for fatal PE is 0.2% to 0.3%. Deep vein thrombosis can cause pain, swelling, and erythema. Pulmonary emboli can present with shortness of breath, pain on inspiration, and tachycardia. If not treated, PE can result in circulatory collapse and death (Forster & Stewart, 2015). Risk factors associated with VTE include inactivity, dehydration, hospitalization, trauma, clotting disorders with previous clot, varicose veins with phlebitis, pregnancy, oral hormonal contraceptives, malignancy, obesity, smoking, and age (National Institute for Health and Care Excellence [NICE], 2010). VTE prophylaxis treatment ideally should be modified to match the risk level for the individual patient; at the current time, all patients undergoing total knee replacements are considered in the high-risk category. Studies are underway that hope to show improved outcomes using assessment tools that identify levels of risk and implementing correlating treatment protocols. Currently, there is no validated tool to do this for total knee replacement patients.

Patients on anticoagulation therapy before surgery should discontinue anticoagulation/antiplatelet therapy before surgery. The amount of time of interruption in therapy varies by drug and the individual patient assessment. Timing for resuming anticoagulation therapy may also vary if neuraxial anesthesia is planned (Benzon, Avram, Green, & Bonow, 2013). Average risk patients should receive pharmacological anticoagulation therapy and mechanical VTE prophylaxis therapy after surgery. Relevant anticoagulants include low molecular weight heparin, fondaparinux, apixaban, dabigatran, rivaroxaban, low-dose unfractionated heparin, adjusted dose warfarin, and aspirin. Choice of anticoagulants is a debated issue, while the use of them is standard practice (Adam, McDuffie, Lahiewicz, Ortel, & Williams Jr., 2013). Pharmacological VTE prophylaxis should start within the medication specific timeframe, usually within 24 hours of surgery; timeframes vary by drug and recommendations. Pharmacologic prophylaxis should be continued for at least 14 days; newer recommendations propose these medications may be useful for up to 35 days (Forster & Stewart, 2015). Mechanical VTE prophylaxis such as compression stockings or sequential compression devices should be implemented upon admission, prior to surgery, and continued until full mobility is returned after discharge from the inpatient setting (Yi, Hui, Jian, & Yixin, 2014). Take care when issuing compression stockings to patients. Patients must receive education about proper use and the risks of poorly fitting stockings. This information should include when to put on and remove, how to apply, how to assess skin for problems, and what to do if problems occur (Lim & Davies, 2014)

Patients should mobilize early and at frequent intervals (AAOS, 2014; AAOS, 2011b). Early mobilization and routine mobilization is critical to achieve personal outcomes and prevent many complications including VTE (AAOS, 2011b). There is moderate evidence supporting neuraxial anesthesia is preferred to general anesthesia to prevent VTE (Khatod, Inacio, Bini, & Paxton, 2012).

Patients and their support person(s) should be educated about VTE prophylaxis (Mazaleski, 2011). Education topics for patients and family members should include, risk factors for VTE, pharmacological VTE prophylaxis, mechanical VTE prophylaxis, signs and symptoms of VTE, and how to get help if VTE is suspected or if the

patient is unable to adhere to prophylaxis program (NICE, 2010). Special consideration should be taken with teaching patients the risks of medications, including bleeding, and risks of compression stocking use, including skin damage (NICE, 2010).

Preoperative Surgical Skin and Nares Preparation

The impact of surgical site infections (SSI) is well known and reported in the literature. Surgical site infections double readmission rates (Whitehouse, Friedman, Kirkland, Richardson, & Sexton, 2002), prolong length of stay (de Lissovoy et al., 2009; Kurtz et al., 2008; Whitehouse, Friedman, Kirkland, Richardson, & Sexton, 2002) and increase financial costs for the patient and also hospitals (de Lissovoy et al., 2009; Kurtz et al., 2008; Rao et al., 2011; Whitehouse, Friedman, Kirkland, Richardson, & Sexton, 2002). Understanding the impact of SSIs can enhance the implementation of evidence-based interventions. Numerous studies have been conducted to show that implementation of a decolonizing protocol can decrease the rate of SSIs in total joint replacements (Illingworth et al., 2013). However, there are mixed results on what a decolonization protocol should entail. Some studies suggest treating all those who are at high risk for infection (Weiser, Eng, & Moucha, 2015). Others suggest screening the nares for colonization and treating those who are positive (Buehlmann et al., 2008) (Level IV); (Kim et al, 2010) (Level III); (Roa et al., 2011) (Level IV).

Implementation of a decolonization protocol is the first step in preventing SSI. There is significant literature supporting implementation of a decolonization protocol; however, further research on efficacy of protocol treatments and cost effectiveness is necessary. The use of a decolonization protocol in total joint replacement patients has the potential to eliminate SSIs, thus preventing unwanted complications, emotional stress and financial burdens.

The following are evidence-based steps for a decolonization protocol:

- Screen for colonization of the nares of Staphylococcus aureas (SA) two to four weeks prior to surgery (Rao et al., 2011) (Level IV),
- Educate the patient on the importance of decolonization (Rao et al., 2011) (Level IV); (Bebko, Green, & Awad, 2015) (Level IV),
- For those patients who screen positive for SA, beginning one week prior to surgery instruct the patient to use nasal mupirocin twice a day and to bathe and/or shower using chlorhexadine soap once a day (Rao et al., 2011) (Level IV); (Kim et al., 2010) (Level III); (Buehlmann et al., 2008) (Level IV), and
- Assess for patient compliance day of surgery.

Treatment of all patients with mupirocin ointment prior to total joint replacement, or use of a screen-and-treat strategy, is a simple, safe, and cost-effective intervention that can reduce the risk of SSI. A study by Courville et al., (2012) found treatment of mupirocin ointment for every patient prior to total joint replacement had lower cost and greater benefit. Three study groups of patients preparing for total joint replacements were compared for cost and benefit over a one-year period. In one group, all received the mupirocin treatment (treat all). The second group all received screening and those who were positive for SA

were treated (screen and treat). The third group received no decolonization intervention. The two groups who received treatment demonstrated better outcomes than the group without treatment (Level II).

Infection disease practitioners, pharmacists and surgeons are key players when implementing a decolonization protocol. Nurses also play an important part in mitigating SSI by educating their total knee replacement patients about their role in infection prevention (Mori, 2015). In addition to sharing the importance of a decolonization protocol, education could include bathing before surgery, putting on clean clothes after bathing, sleeping on clean linen and limiting pets in the bed.

Skin Antisepsis

Regardless of screening, chlorhexadine bathing is recommended (Bebko, Green, & Award, 2015) (Level IV). Some programs have started to focus on screening and treatment preoperatively while others utilize a body wash combined with an intranasal swab for anyone that is colonized although not screened. Skin antisepsis is a key component in decreasing risk of infection. The research continues to encourage preoperative 'full body' cleansing; however, there is no current consensus on which specific protocol is superior. The solution chlorhexidine gluconate (CHG) applied to the skin preoperatively via impregnated cloths is one form of cleansing that is convenient for the patient. The patient applies the cloths to the front and back of their trunk, arms and legs. Two cloth applications are considered a reasonable protocol in light of the current lack of a single standard: (1) the night before the scheduled surgery and (2) the morning of the surgery. Instruct patients not to bathe or use creams, lotions, or powders after the application. Further studies and research are needed to make a strong recommendation for one particular method.

Intraoperative Care

Skin Antisepsis

Surgical site prep for antisepsis on the day of surgery is a painting with a solution of Iodine povacrylex, Isopropyl alcohol, and/or chlorhexidine. The consensus is that there is no clear difference between various skin preparation agents. There is some evidence that combinations of antiseptic agents with alcohol may be important for skin antisepsis (Blaha, Mont, & Sancheti, 2014).

Anesthesia

Approaches to anesthesia have evolved in the effort to provide the best possible outcomes and in light of the significant increase in total knee replacement surgeries. Anesthesia has become a key component in the reduction of post-operative pain. What is currently considered best practice with Disease Specific Certification programs is that the pain goal is set with the patient, the morning of surgery before any medication has been administered. This also allows for education to occur just before the patient is medicated. This goal then needs to be documented and shared with providers at each handoff until discharge.

Total joint replacement procedures can be performed after induction of general anesthesia or neuraxial anesthesia, which can be an epidural or spinal block. Neuraxial anesthesia falls under the broader category of

regional anesthesia, which also includes other lower extremity blocks, truncal blocks and upper extremity blocks (American Society of Regional Anesthesia and Pain Medicine [ASRA], 2018). Helwani et al. (2015) and Memtsoudis et al. (2013) found in large national database studies the majority of total joint replacement patients receive general anesthesia. However, these reviews also concluded that compared with general anesthesia, regional anesthesia approaches for total joint replacement were associated with a reduction in various negative outcomes. According to the AAOS Surgical Management of Osteoarthritis of the Knee Guideline (2015b), there is moderate evidence to support that neuraxial anesthesia could be used to improve select perioperative outcomes and complication rates compared to general anesthesia. While there is significant evidence from dozens of studies supporting the use of neuraxial anesthesia for total knee replacement surgeries, the continued use of general anesthesia may be due to inconsistent or conflicting study results, lack of resources and/or limited number of large multi-institutional trials with significant data (Turnbull, Sastow, Giambrone, & Tedore, 2017).

Regional anesthesia offers advantages of decreased deep vein thrombosis, pulmonary embolus and intraoperative bleeding (Jaffe, Samuels, Schmiesing, & Golianu, 2004). In addition to these outcomes, Rodgers et al. (2000) cited a decrease in pneumonia and respiratory depression in a large systematic review of epidural, and spinal anesthesia. Difficulties with regional anesthesia come with the positioning requirements with the induction, which is sometimes uncomfortable for patients with limited mobility. General anesthesia may be offered to supplement regional anesthesia as needed. The circulating nurse will perform all the necessary duties outside of the sterile field. The nurse will help position the patient correctly on the operating room table and assist the anesthetist with hooking up monitors and connecting other necessary suction and cauterization equipment.

Accidental vascular injection during a regional anesthesia block procedure is rare, but can lead to central nervous system and/or cardiac toxicity very quickly, and become life threatening. Local Anesthetic Systemic Toxicity (LAST) symptoms can begin within the first minute following injection or as long as 30 minutes following injection (Neal et al., 2010). Seizure is the most common symptom and may be preceded by tinnitus, metallic taste in the mouth, agitation or CNS depression. Cardiac toxicity may be exhibited by a prolonged PR interval, hypotension, and lead to cardiac arrest. The severity of this adverse effect is influenced by the amount of local anesthetic administered as well as patient comorbidities such as underlying cardiac, neurologic, or metabolic disease, diabetes, or renal failure. The treatment regimen for an acute LAST situation, recommended by the American Society of Regional Anesthesia (ASRA), includes airway management to prevent hypoxia and/or acidosis, both of which would worsen the symptoms. Seizure treatment and circulatory support are also priorities. Depending on the severity of the effect, lipid emulsion infusion may be administered to draw the content of lipid-soluble local anesthetics from within cardiac tissue, thereby improving cardiac function (Neal et al., 2010). ASRA strongly recommends a 'toxicity kit' with treatment supplies, and posted instructions for its use be maintained in areas where local anesthetics are administered in doses high enough to cause a severe toxic response if accidentally injected into the vascular system. Nursing considerations for vascular absorption of a local anesthetic include patient education prior to the procedure regarding awareness and reporting of unusual symptoms, monitoring closely for side effects for up

to 30 minutes following the regional anesthesia procedure, rapid notification and intervention in the event of symptoms, and assuring resources such as a Toxicity kit are readily available.

The intraoperative phase of care may include strategies that carry into the postoperative phase, especially related to multimodal pain management. For example, the AAOS Surgical Management of Osteoarthritis of the Knee Guideline (2015b) indicates there is a strong level of evidence to support the use of periarticular local anesthetic infiltration compared to placebo during the total knee replacement procedure to decrease pain and opioid use. This guideline also found strong evidence supporting peripheral nerve blockades acting to decrease postoperative pain and opioid requirements; because of their impact on postoperative pain, these blocks are discussed in more detail in the postoperative phase of this guideline.

Antibiotic Prophylaxis

Antibiotic prophylaxis for a total knee replacement is utilized to reduce surgical site infections. Appropriate antibiotic/antimicrobial agent and timing of administration of this prophylaxis are significant. Infusion of the first antimicrobial dose should begin within 60 minutes prior to incision, if using fluoroquinolone or vancomycin the infusion should begin 120 minutes before incision to prevent antibiotic-associated reactions. For knee replacement, the antimicrobial should completely infuse if using a proximal tourniquet, prior to inflation of the tourniquet. Dosing should be based on weight and should be repeated intraoperatively if the operation continues longer than two half-lives after the first dose. This ensures adequate antimicrobial levels until wound closure. This also allows for prophylaxis with adequate concentration during the entire time the wound is open and at risk for bacterial contamination (Bratzler et al., 2013).

For patients undergoing hip or knee replacement the preferred antimicrobial is either cefazolin or cefuroxime. If a patient has a beta-lactam allergy, vancomycin or clindamycin may be used. For patients carrying methicillin-resistant Staphylococcus aureus, Vancomycin is indicated. It is recommended that antimicrobial prophylaxis be discontinued within 24 hours after the end of the operation.

SCD and/or Compression Stockings

Venous thromboembolic disease (VTED) is a serious post-operative complication after lower extremity total joint replacement (Pierce et al., 2015). Non-pharmacological preventative measures for patients undergoing replacement may include compression stockings and/or the use of sequential compression devices (SCD), with application as early as in the preoperative holding area and continuing through the operative procedure. Compression stockings apply a constant pressure to the lower extremities. This subsequently decreases the amount of venous stasis. SCD's work to increase the velocity of venous blood flow and stimulate the release of endothelial-derived relaxing factors that may decrease clot formation. Portable compression devices are becoming available and could be worn all the time, even when the patient is mobile. When making VTE prophylaxis decisions, most orthopaedic surgeons reference either clinical practice guidelines on this topic from the American Academy of Orthopaedic Surgeons (2011b) and/or the American College of Chest Physicians (ACCP) (Falck-Ytter et al., 2012). Non-pharmacologic measures are often combined with

pharmacologic agents, which have anticoagulant effects (Odeh et. al., 2016).

Traffic Patterns

Airborne bacterial contamination is an alarming concern in the operating room, where the potential of periprosthetic joint infection is considered a strong correlation (Panahi, Stroh, Casper, Parvizi, & Austin, 2012). Transmission of organisms decreases when the number of personnel entering and exiting the active OR room is limited as well as movement minimized in the room while surgery is in progress. Process improvements such as storage of instruments and implants in the operating room are recommended. Additionally, planned education and active involvement of OR personnel are required to reduce door openings in the OR (Hamilton, Balkam, Purcell, Parks, & Holdsworth, 2018). Maintaining closure of the OR door allows for decreased mixing of OR air with corridor air, which in turn decreases the bacterial count in the room. Organizations have displayed innovations in finding practices and strategies to impact door opening during joint replacement surgery. One example is the use of hook and loop tape strips (such as VELCRO®) to serve as an audible alert and reminder when the door is being opened; this is difficult to keep clean, and large signage may be just as effective with less risk for bacterial compromise.

Maintain Normothermia to Avoid Hypothermia

Neuraxial anesthesia combined with cold stress of the low degree of temperature of an operating room can affect a patient, potentially leading to hypothermia. Hypothermia has been associated with increased risk of infection, increased risk of cardiac events, as well as an increase of intraoperative blood loss (Allen & Jacofsky, 2017). Patients with lower BMI are more at risk for hypothermia (Williams & El-Houdiri, 2018). Each phase of the perioperative experience should be examined for the capacity to maintain patient normothermia. Simpson et al. (2018) found the largest drop in core body temperature occurred between preoperative holding and the induction of anesthesia; recommendations included preoperative holding protocols that decrease the time from operating room entry to incision, as well as increasing ambient room temperature. Prevention of hypothermia and maintaining normothermia can be achieved by use of forced air heaters attached to blankets that can be placed on the patient intra-operatively as well as post-operatively as the patient recovers.

Postoperative Care

Multimodal Pain Management Plan

Historically, opioids were the most effective medicines for moderate to severe pain, especially for managing short-term pain after surgery. These drugs work by attaching to certain opioid receptors and blocking the transmission of pain messages to the brain (AAOS, 2011a). Controversies with opioids include,

- For more than a decade, there has been a growing challenge balancing between assuring that pain control is a priority and the realization that opioid pain medications have become among the most prescribed drugs in the United States (Kuehn, 2007).

- Growing abuse of these powerful medications became a concern of physicians, policy makers and scientists working to develop strategies to thwart abuse while still treating pain effectively. Strategies and practices minimizing primary reliance on opioids to manage post-operative pain evolved.
- In 2015, the AAOS issued a call for a comprehensive opioid program to decrease opioid use and to include education prescribers, caregivers, and patients in the research for effective alternative pain management and coping strategies. More effective opioid abuse treatment programs were also supported.
- The 2016 age-adjusted rate of drug overdose deaths in the United States was reported at more than three times the rate of drug overdose deaths in 1999 (Hedegaard, Warner, & Miniño, 2017).
- Multimodal analgesia refers to the use of more than one agent from different pharmacologic analgesic classes that target different mechanisms of pain (Arnstein, 2011). Different protocols and organizations have achieved effective pain management from multimodal analgesia.

Non-steroidal anti-inflammatory drugs (NSAIDs) reduce swelling and are often used alone for mild to moderate pain or in conjunction with opioids for managing moderate to severe pain. NSAIDs work by preventing an enzyme, called cyclooxygenase (COX-1 or COX-2) from making too much prostaglandin, which causes pain and swelling (AAOS, 2011a).

Use of Acetaminophen and/or NSAIDs as part of a multimodal analgesia for postoperative pain in total joint patients without contraindications, is associated with less postoperative pain and opioid consumption (Chou et al., 2016) (Level IV).

A preoperative dose of oral Celecoxib for total joint patients without complications, has shown to reduce opioid requirements after surgery (Chou et al., 2016) (Level IV).

With consideration of the patient history and state of health, as well as organizational resources and protocols, peripheral nerve blocks are increasing in use as a component of multimodal pain management following a total knee replacement. Fewer opioid-related side effects as well as shorter hospital stay are proven benefits. A review conducted by Bauer, Pogatzki-Zahn, & Zahn (2014) found femoral nerve blocks to be the most effective analgesia approach with total knee replacements. More recently, in light of efforts to mobilize patients as soon as possible following surgery, the adductor canal block has gained interest. This block targets mainly sensory nerves; research studies with this block reflect the quadriceps muscle maintains it strength for ambulation better, and lessens the risk of falling (Grevstad et al., 2015; Kwofie et al., 2013; Jaeger et al., 2013).

Implications for nursing care following a peripheral nerve block or infusion include the following considerations:

- Best practice entails standardized nursing guidelines for care and monitoring of patients with peripheral nerve blocks. Patient education should include rationale for use, potential side effects, and

the important contribution of nerve blocks to multimodal pain management. Use of adjunct analgesia, if available, will help control pain levels.

- A complete assessment including sensory, vascular, and motor function is a requirement, and it will help differentiate between paresthesia related to the block and potential nerve compromise or ischemic pain. The frequency of assessments is determined at the organizational level and typically follows similar timeframes for postoperative vital signs.
- Careful attention to motor function is imperative in the care for those who receive blockades. Motor ability returns before sensation. Patients are able to move their limbs before they can feel them, which puts them at a high risk for injury. A sensory assessment should be done throughout the postoperative period until sensation returns.
- In particular, the femoral nerve block has demonstrated reduced quadriceps muscle strength, impacting early mobilization postoperatively, and creating increased risk for fall (Jaeger et al, 2013). High-level alert to patient safety to prevent fall or injury is warranted.
- If a continuous infusion is utilized, bilateral heel checks are needed, as this site is the most vulnerable to skin breakdown. With a continuous infusion, patients should be able to move the foot during sensory numbness

Monitoring for potential complications following a peripheral nerve block (PNB) is essential.

- Complications associated with peripheral nerve blockade include postoperative motor weakness, neural injury (Liu et al., 2009), hematoma and infection (Capdevila, Bringuier, & Borgeat, 2009).
- Persistent quadriceps weakness postoperatively suggests neural injury caused by direct nerve trauma from the needle, injection or compressive ischemic injury caused by a hematoma.
- If a patient is prone to bleeding, hematoma can occur at the catheter insertion site. Severe bleeding can contribute to development of compartment syndrome. Assessment of bleeding at the insertion site will prevent undue complications.
- With any type of invasive procedure, infection can be a risk. Frequent assessment for infection at the insertion site is needed.
- It is rare for patients in the postoperative phase of recovery to experience complications secondary to local anesthetic administration, such as a peripheral nerve block. However, adverse events do occur. Local anesthesia effects can spread to adjacent tissue or unintended muscle groups and impact function and recovery. This localized absorption generally causes mild temporary side effects related to muscle function, loss of sensation and impaired movement. Nursing implications in this situation include monitoring for adverse effects, fall prevention strategies to maintain safety, and minimizing delays in patient mobilization to the extent possible (Neal et al., 2010). A toxic dose of local anesthetic systemically mandates immediate attention; refer to the Intraoperative phase, anesthesia topic for details regarding Local Anesthetic Systemic Toxicity (LAST) on pg. 17 of this guideline.

Other innovative pain reducing measures and resources may include an acute pain management service, acupuncture, massage therapy, guided imagery, acupressure and aromatherapy. Hence, a multimodal pain

management plan that best fits within the context of the organization's program is warranted. Multimodal pain management plans can prevent pain, decrease complications, and improve overall patient outcomes.

Postoperative Incisional Care

Incision healing begins within hours after surgery and continues for two to seven days post-operatively (Yu, Alfieri, Bartucci, Holzmeister, & Rees, 2016). Wound closure can be done with staples, sutures, or adhesive. There is some evidence that staples are more effective than sutures at reducing incision complications; however, more research is needed about adhesive closures after knee replacement (Newman et al., 2011). Dressings used after total knee replacement may vary but they have three major functions: a dressing should protect the wound from microorganisms, optimize healing, and collect any wound drainage (Dobbelaere, Schuermans, Smet, van der Straeten, & Victor, 2015). Some moisture is necessary for wound healing, decreasing infections, and less pain, but too much moisture may cause skin damage and/or bacterial infiltration of the wound (Zarghooni et al., 2015). The initial dressing should stay on as long as possible to reduce risk of bacterial contamination and promote cellular wound healing (McGuiness, Vella, & Harrison, 2004; Ousey, Gillibrand, & Stephenson, 2013). Cost effectiveness should be taken into consideration when choosing the appropriate dressing, without compromising the purpose of the dressing. Nursing staff should assure that dressings are used according to manufacturer directions. Patients should be assessed for reaction to their dressing including sensitivity and skin irritation. When choosing a dressing, patient feedback should be taken into consideration for ease of use, comfort of dressing, and freedom of movement while wearing the dressing (Dobbelaere et al., 2015).

There is an emerging body of research on negative pressure wound therapy (NPWT) that suggests it can decrease wound complications such as dehiscence, infection, seroma, and hematoma for high-risk patients. High-risk patients are those that have potential for higher amounts of drainage or those that may have difficulty with wound approximation (Manoharan et al., 2016). Surgeons may elect for this therapy and can place the therapy system bandage at the conclusion of the procedure or during the postoperative period.

The patient and support person(s) should be educated about dressing care specific to the dressing applied. That education should include timing of dressing removal if necessary. Patients should know how to keep the incision clean and dry, when to bathe, and how to spot and report signs and symptoms of infection (AAOS, 2015a).

Rapid Recovery and Early Mobility

Rapid recovery protocols are loosely defined as protocols that streamline care so patients can be discharged on postop day zero or postop day one. The goals of rapid recovery include reducing costs to maximize efficiency while optimizing patient outcomes. These goals are achieved by using a mix of individual care plans and standardized protocols (Walters, Sayeed, El-Othmani, & Saleh, 2016). Critical elements to these protocols are patient selection, patient optimization, pain management, early mobilization and aggressive exercise protocols.

Patient selection for rapid recovery program starts at the time of decision for surgery. There is some evidence that patients with history of myocardial infarction or pulmonary embolism, chronic anticoagulation therapy, large body mass index, three or more comorbidities, and inability to be discharged home fail rapid recovery programs at a higher rate (Callaghan et al., 2015). Younger independent patients, with friend or family support at home, have better outcomes with faster recovery (Walters et al., 2016). There is also some evidence that healthcare system support that increases patient 'touches', like those that have been implemented for chronic disease management in the cardiac field, improve patient outcomes. Touches are defined as clinical staff having contact with patients or families. The type and amount of post discharge touches needs further study (Edwards, Levine, Cullinan, Newbern, & Barnes, 2015).

Preoperative optimization for rapid recovery should include at least one preoperative therapy session to review transfer activities and preoperative education to set expectations for after surgery. It is important for patients to understand discharge criteria and anticipated length of stay (Callaghan et al., 2015). Rapid recovery protocols require aggressive inpatient and outpatient therapy or exercise protocols as well as comprehensive pain management protocols. The interdisciplinary care team's involvement of these protocols is critical to the success to the patient in a rapid recovery setting. Although the number of therapy sessions after surgery does not seem to effect readiness for discharge, patients participating in therapy on the day of surgery does decrease their length of stay (Pua & Ong, 2014). Exercise is critical for patients to achieve their personal goals after surgery, though there is inconclusive evidence that a home exercise program is preferred to home physical therapy or outpatient physical therapy after discharge (Flores-Garcia et al., 2016). Proper pain control is critical to patient's success with exercise or therapy. Multimodal pain control using oral medication, local infiltrate, and nerve block is useful for pain control (Perlas et al., 2013). Using ice or cryotherapy as well as compression can reduce symptoms of pain (Su et al., 2012).

Urinary Catheter and Hemovac Removal

The need for indwelling urinary catheters and hemovacs has greatly decreased over the years. In fact, neither of these are considered best practice any longer and should be used only in rare circumstances. Most orthopaedic programs are no longer using these devices due to the risks they issue. If an indwelling urinary catheter is placed, then the use of a nurse driven removal protocol to reduce the incidence and duration of urinary catheterization is imperative to prevent catheter associated urinary tract infections (Mori, 2014). Regardless of type of anesthesia, the routine use of urinary catheters is not recommended for patients undergoing total knee replacement surgery (Huang, Ma, Shen, & Pei, 2015; Tischler et al., 2015).

Patients who are male, older, have a higher American Society of Anesthesiologists grade, history of benign prostatic hypertrophy, large volume intravenous fluid infused, and long surgical time may be more at risk for post-operative urinary incontinence (POUR). There is some evidence that patients with up to 800ml of urine postoperatively may not need catheterization but current recommendations indicate catheterization only if the bladder contains 500ml to 600ml of urine postoperatively (Bjerregaard et al., 2016). When a urinary catheter is necessary, the indwelling catheter should be removed within 24 to 48 hours after insertion to reduce the risk of POUR and catheter associated urinary tract infections (Zhang et al., 2015). Patients and their

support person(s) should be educated about the risks of using urinary catheters and the signs and symptoms of POUR as well as urinary tract infections.

Drain Removal

As noted above, drains are no longer best practice and should only be used in rare circumstances. Intra-articular drains are used to avoid internal fluid collection and may be continuous suction or intermittent. Limiting fluid collections in and around the wound could accelerate healing, promote tissue approximation, lower risk for infection, and decrease pain (Tsang et al., 2016). The use of drains is also associated with increased blood loss, which may result in blood transfusion (Bjerke-Kroll et al., 2014). A review of randomized controlled trials by Quinn, Bowe, Galvin, Dawson, & O'Byrne (2014) found that using drains had no clinical benefits to patient outcomes. If a drain is placed, the nurse is responsible for observing and recording output. There are some studies that suggest that drainage of more than 100ml per hour requires clamping of the drain and drainage of less than 70ml over eight hours requires the drain to be removed (Tsang, 2015).

Constipation Prevention

Constipation is a complication that can occur after a total knee replacement. This occurs due to a decrease in activity, decreased fluid intake, and medications such as opioids. Patient education is extremely important to educate and engage patients and families to prevent this complication. The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) recommends that risk of constipation in post-surgical patients can be decreased with an increased intake of fluids and fiber, early mobilization, and a decrease in opioid medications (niddk.nih.gov, 2014) (Level V). Nurses play an instrumental role in providing education at discharge to help patients prevent and manage constipation at home. Nurses should educate patients on non-pharmacological management of constipation and provide medication teaching on any prescribed laxatives (Hunter, 2014).

Prevention of Readmissions

Preventing readmissions following a total knee replacement has become an important priority related to quality and value within healthcare; healthcare outcomes have increasing financial implications. Studies have shown there is a cost burden to the healthcare system caused by readmissions (Saucedo et al., 2014; Bosco et al., 2014). Performance and quality improvement strategies to improve patient outcomes are an important contributor for any program and organization seeking to decrease readmissions.

Pugely, Callaghan, Martin, Cram, & Gao (2013) utilized the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database to analyze risk factors, complications and 30-day readmission rates for nearly 12,000 total knee replacement patients. In this review, overall 30-day readmission rates were 4.6% for this population. The most common complications associated with readmission were surgical site infections (SSI), thromboembolic disorders (such as DVT, stroke) and systemic infections such as sepsis and pneumonia. Higher occurrence of readmissions was found in patients with advanced age, male gender and comorbidities such as COPD, CHF, and Diabetes. Additional risk factors found in the data analysis

included elevated ASA class and history of a bleeding disorder. Minimizing modifiable risk factors (pre-surgical optimization) and a careful balance of DVT prophylaxis versus the risk of bleeding were both stressed as potential improvement opportunities (Pugely, Callaghan, Martin, Cram, & Gao, 2013). Current best practices to reduce readmissions include a preoperative risk stratification process and responsive interventions, in the physician office, or a dedicated Optimization Clinic. A variety of strategies related to optimization and risk reduction prior to surgery are detailed in the preoperative section of this Best Practice Guideline. Coordination of the entire interprofessional team is essential to communicate patient status and actions taken to all providers. A Collaborative Care Model (CCM) facilitates Interprofessional communication, coordination of care, and positively affects patient outcomes (Arana, Harper, Qin, & Mabrey, 2017). The EMR is the most likely database for patient information through the continuum of care to make information available to all.

ERAS protocols have been adopted as a means to expedite post-operative recovery, decrease complications and decrease hospital length of stay. ERAS begins well in advance of surgery and continues through the continuum, including post-discharge. Studies demonstrate ERAS can effect significant decreases in hospital length of stay without an increase in complications or readmissions (Sibia et al., 2017). Patient metrics for determining appropriate candidates for Enhanced Recovery programs include comorbidities and lifestyle indicators such as smoking and blood sugar levels (Callaghan et al., 2015). Patient engagement, education and management of expectations, standardized processes and coordinated team effort are essentials to success (Hozack & Matsen-Ko, 2015). Multiple ERAS approaches can be found throughout this guideline.

Transitions of Care, Discharge Processes and Patient Discharge Instructions are key to the success of a safe recovery after leaving the hospital, and avoiding readmissions. Patients and their caregivers are more likely to be successful when there is thorough preparation for discharge. The Clinical Pathway (CP) is a coordinated, team-based initiative addressing the patient care continuum phases from preoperative to post-discharge. The CP is typically developed at the organizational level although there are common characteristics for this population which are consistent. Evidence is clear that a well-developed and coordinated Clinical Pathway (CP) for the total joint replacement patient population can maximize patient outcomes and lower health delivery costs (Van Citters et al., 2014). A robust CP is also able to inform the team regarding opportunities for improvement, including the reduction of readmissions in the post-discharge phase. Patient support following discharge can be addressed in a variety of ways; the primary goal is an organized patient communication process that 'touches' the patient at regularly defined intervals (Edwards, Levine, Cullinan, Newbern, & Barnes, 2015). This can be accomplished with designated team members such as a nurse navigator or an advanced practice nurse, at established intervals. Technology can also be tapped with a patient management support system to improve post-discharge communication, with improved outcomes (Edwards, Levine, Cullinan, Newbern, & Barnes, 2015).

The authors and contributors to this guideline recommend the following resources and studies for those looking for strategies preparing patients for discharge that improve outcomes and minimize readmissions.

- Clinical pathway facilitators are key to improving coordination of the care processes and communication with patients and families (Vanhaecht, Panella, van Zelm, & Sermeus, 2010) (Level I).

- Care for comorbidities needs to be proactive, patient-oriented, and multidisciplinary (Williams, Dunning, & Manias, 2007) (Level III).
- Follow up telephone calls shown to reinforce discharge education and assist in decreasing readmissions of TJR (Green, Dearmon, & Taggart, 2015) (Level III).
- Standardized protocols, discharge coordinators, and home care programs have proven effective in decreasing 30 day readmissions (Kheir et al., 2014) (Level IV).
- Ensuring that care transitions smoothly to each new phase of care, with the patient as a contributing partner, has the potential to improve pain management and functional outcomes (Samuels & Woodward, 2015) (Level V).

Utilization of Clinical Quality Indicators

The Institute of Medicine has created a framework for healthcare quality that includes six aims for improvement (Institute of Medicine [IOM], 2001).

1. Patient safety protects patients from intended or unintended harm during care.
2. Effective care is based in scientific knowledge and provided only to those in need of care.
3. Patient-centered care is respectful of individual patient needs, values, and choices.
4. Patients should be included in all clinical decisions.
5. Care must be delivered in a timely and efficient manner.
6. Equitable care provides for all patients despite gender, ethnicity, geographic location, and socioeconomic status (IOM, 2001).

Quality improvement is a cycle that starts with the definition of a goal or problem and then a change to practice with an evaluation of the outcome. There are many systematic process improvement methods available. Despite the method employed, structure must be applied to any changes made to achieve the aims of healthcare quality (Wyszewianski, 2014). Quality indicators to improve the care of the total knee replacement patient may be aligned with the organization's goals and the overarching goals of the Institute of Medicine.

What Does the Future Hold for Total Hip/Knee Replacements?

- Telerehabilitiation may be a promising alternative to traditional face-to-face conventional rehabilitation. Many programs are going to same day discharge.
- LOS or same day discharge
- increasing number of surgeries performed at Ambulatory Surgery Centers
- preoperative optimization and patient selection
- insurance and reimbursement changes
- group therapy
- discharge class
- preoperative home site visit or home care phone call
- changes in rehab therapy needs

- VTE prophylaxis
- national standards and recommendations for outcomes
- younger more active patients

Becoming Joint Commission Disease Specific Certified

Joint Replacement programs can benefit from becoming certified by The Joint Commission under the Disease-Specific Care Certification. There are two types of Certification, Core Certification and Advanced. Core Certification is offered for Hip and Knee programs and can be one or both. Advanced certification is offered and must include both total hip and knee replacement. Advanced certification looks at the broader continuum of care from physician office through follow up after surgery and involves a much more rigorous on-site review (The Joint Commission, 2016). Certification by a national body validates a program of excellence by its use of evidenced based guidelines and adhering to and utilizing clinical practice standards (Mori, 2012). Applying for and maintaining certification holds a program accountable for commitment to quality care and continuous improvement that ultimately benefits the patient and the facility. Patients and competing health care facilities know a facility as a center of excellence when they achieve certification. These facilities demonstrate use of advanced technologies, efficiency in patient care, and have impetus and direction for a successful program. An increase in presurgical class attendance, an increase in patient satisfaction, improvement on postoperative documentation, and an increase of orthopaedic certified nurses were all process improvements one facility noted from seeking certification (Mori, 2012). McWilliam-Ross (2011) states the certification process is a demonstration of the program's commitment to unceasingly pursuing the best possible patient care.

Web Sites

Professionals:

- American Academy of Orthopaedic Surgeons: www.aaos.org
- National Association of Orthopaedic Nurses: www.orthonurse.org
- The Joint Commission: www.jointcommission.org
- The National Guidelines Clearinghouse: www.guideline.gov
- Orthopaedic Nurses Certification Board: www.oncb.org
- American Society of Anesthesiologisis: www.asahq.org
- National Guideline Clearinghouse: www.guideline.gov

Patient and Family:

- Bone Smart Knee Replacement & Hip Replacement Patient Advocacy & Online Community www.bonesmart.org
- John Hopkins Medicine: http://www.hopkinsmedicine.org/healthlibrary/test_procedures/orthopaedic/knee_replacement_surgery_procedure_92,P07673/

- Healthline Total Knee Replacement Surgery: http://www.healthline.com/health/total-knee-replacement-surgery

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Appendix: System for Rating the Strength of Evidence

System for Rating the Strength of Evidence	
Level I	High-quality randomized controlled trial with large sample and statistically significant difference or no statistically significant difference but narrow confidence intervals Evidence from a systematic review, a meta-analysis, or an evidence-based clinical practice guideline where only results from randomized controlled clinical trials were used.
Level II	Evidence from at least one well-designed randomized prospective comparative clinical trial. Systematic review of primarily Level II studies.
Level III	Evidence from well-designed case controlled trials without randomization, comparative studies and evidence from a systematic review, a meta-analysis, or an evidence-based clinical practice guideline where results from randomized clinical trials and controlled clinical trials were used. Systematic review of primarily Level III studies.
Level IV	Evidence from case series and cohort studies. Evidence from well-designed descriptive, qualitative, or psychometric studies. Evidence from a systematic review, a meta-analysis, or meta-synthesis of descriptive or qualitative studies.
Level V	Evidence from the opinion of authorities or experts.
Level VI	Common practice, as documented in clinical articles or nursing textbooks.
Modified from the Rating System for the Hierarchy of Evidence by Melnyk, B.M., & Fineout-Overholt, E. (2005). Evidence-based practice in nursing & healthcare: A guide to best practice (p.10). Philadelphia: Lippincott, Williams & Wilkins.	
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Modified from Centre for Evidence-Based Medicine, Oxford, UK. See www.cebm.net.	