PHYSICAL THERAPIST MANAGEMENT OF TOTAL KNEE ARTHROPLASTY

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Disclaimer

This clinical practice guideline was developed by an American Physical Therapy (APTA) volunteer guideline development group that consisted of physical therapists, an orthopedic surgeon, a nurse, and a consumer. It was based on systematic reviews of current scientific and clinical information and accepted approaches to management of total knee arthroplasty. This clinical practice guideline is not intended to be a fixed protocol, as some patients may require more or less treatment or different means of diagnosis. Clinical patients may not necessarily be the same as those found in a clinical trial. Patient care and treatment always should be based on a clinician’s independent medical judgment, given the individual patient’s clinical circumstances.

Disclosure Requirement

In accordance with APTA policy, all individuals whose names appear as authors or contributors to this clinical practice guideline filed a disclosure statement as part of the submission process. All panel members provided full disclosure of potential conflicts of interest prior to voting on the recommendations contained within this clinical practice guideline.

Funding Source

This clinical practice guideline was funded exclusively by APTA, which received no funding from outside commercial sources to support its development.

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SUMMARY OF RECOMMENDATIONS

PREOPERATIVE EXERCISE PROGRAM
Physical therapists should design preoperative exercise programs and teach patients undergoing total knee arthroplasty (TKA) to implement strengthening and flexibility exercises.

PREOPERATIVE EDUCATION
It is the consensus of the work group that physical therapists or other team members should provide preoperative education of patients undergoing TKA, including at a minimum hospitalization and discharge protocol, postoperative rehabilitation program, safe transferring techniques, use of assistive devices, and fall prevention.

CONTINUOUS PASSIVE MOVEMENT DEVICE (CPM) USE FOR MOBILIZATION
Physical therapists should NOT use CPMs for patients who have undergone primary, uncomplicated TKA.

CRYOTHERAPY
Physical therapists should teach use of cryotherapy and encourage its use for early postoperative pain management for patients who have undergone TKA.

PHYSICAL ACTIVITY
It is the consensus of the work group that physical therapists should develop and teach the patient who has undergone TKA regarding appropriate progression of physical activity, based on safety, functional tolerance, and physiological response.

MOTOR FUNCTION TRAINING (BALANCE, WALKING, MOVEMENT SYMMETRY)
Physical therapists should include motor function training (e.g. balance, walking, movement symmetry) for patients who have undergone TKA.

POST-OPERATIVE KNEE RANGE OF MOTION EXERCISE
It is the consensus of the work group that physical therapists should engage and teach patients to implement passive, active assistive, and active range of motion exercises for the involved knee following TKA.

IMMEDIATE POST-OPERATIVE KNEE FLEXION DURING REST FOR BLOOD LOSS AND SWELLING
To reduce immediate post-operative blood loss and swelling in the first 7 days, physical therapists or other team members may teach patients to position the operated knee in some degree of flexion, while resting, (i.e., within the first week after surgery) to minimize blood loss and swelling.

NEUROMUSCULAR ELECTRICAL STIMULATION (NMES)
Physical therapists should use neuromuscular electrical stimulation (NMES) for patients who have undergone TKA to improve quadriceps strength, gait performance, performance-based outcomes, and patient-reported outcomes.

RESISTANCE AND INTENSITY OF STRENGTHENING EXERCISE
Physical therapists should design, implement, teach and progress the patient in high-intensity strength training and exercise programs during the early post acute period (i.e., within the first week after surgery) for patients who have undergone TKA to improve function, strength, and range of motion.
PROGNOSTIC FACTORS: BMI; DEPRESSION; PREOPERATIVE RANGE OF MOTION (ROM), PHYSICAL FUNCTION, AND STRENGTH; AGE; DIABETES; NUMBER OF COMORBIDITIES; AND SEX

Physical therapist management should take into consideration the following factors when determining prognosis, treatment, and informed decision-making and expectation-setting with patients undergoing TKA:

a) Higher BMI is associated with more postoperative complications and worse postoperative outcomes.
b) Depression is associated with worse postoperative outcomes.
c) Preoperative ROM is positively associated with postoperative ROM but has minimal, if any, effect on physical function and quality of life.
d) Preoperative physical function is positively associated with postoperative physical function.
e) Preoperative strength is positively associated with postoperative physical function.
f) Older age is associated with worse patient-reported, performance-based, and impairment-based outcomes.
g) Diabetes is not associated with worse functional outcomes.
h) A greater degree of comorbidity is associated with worse patient-reported outcomes.
i) Sex is associated with both positive and negative effects on postoperative outcomes.

PROGNOSTIC FACTORS: TOBACCO AND PATIENT SUPPORT

It is the consensus of the work group that active tobacco use and lack of patient support (i.e., environmental factors including, but not limited to, support and relationships) should be considered as prognostic/risk factors associated with less than optimal functional outcomes.

POSTOPERATIVE PHYSICAL THERAPY SUPERVISION

Supervised physical therapist management should be provided following TKA. The optimal setting should be determined by the patients’ safety, mobility, environmental, and personal factors.

GROUP VS INDIVIDUAL-BASED THERAPY

Physical therapists may use group-based or individual-based physical therapy sessions after TKA.

PHYSICAL THERAPY POSTOPERATIVE TIMING

Physical therapist management should start within 24 hours of surgery and prior to discharge for patients who have undergone TKA.

PHYSICAL THERAPY DISCHARGE PLANNING

Physical therapists should provide guidance to the care team, patient, and caregivers on patient functional status, assistive equipment, and services needed to support a safe discharge to home with scheduled therapy follow-up.
DEVELOPMENT GROUP ROSTER (VOTING MEMBERS)

Blinded for Peer Review
NONVOTING MEMBERS

Blinded for Peer Review
INTRODUCTION

OVERVIEW

This clinical practice guideline is based on a systematic review of published studies with regard to the physical therapist management of patients undergoing total knee arthroplasty. In addition to providing practice recommendations, this guideline also highlights limitations in the literature, areas that require future research, intentional vagueness, and quality-improvement activities.

This guideline is intended to be used by all qualified and appropriately trained physical therapists involved in the management of patients undergoing total knee arthroplasty (TKA). It is also intended to serve as an information resource for decision makers and developers of practice guidelines and recommendations.

GOALS AND RATIONALE

The purpose of this clinical practice guideline is to help improve treatment based on the current best evidence. Current evidence-based medicine standards demand that clinicians use the best available evidence in their clinical decision making, incorporate clinical expertise, and consider the patient’s values. To assist clinicians, this guideline consists of a systematic review of the available literature regarding the management of patients undergoing TKA. The systematic review detailed herein was conducted on studies published between 1995 and 2018 and demonstrates where there is good evidence, where evidence is lacking, and what topics future research must target in order to improve the management of patients undergoing TKA. APTA staff and the guideline development group systematically reviewed the available literature and subsequently wrote the following recommendations based on a rigorous, standardized process.

Musculoskeletal care is provided in many different settings by many different providers. This guideline is an educational tool to guide qualified clinicians through a series of treatment decisions in an effort to improve the quality and efficiency and reduce unwarranted variation of care. Recommendations are part of evidence-based practice and the patients wants and needs must be considered in the clinical decision making process. This guideline should not be construed as including all proper methods of care or excluding methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment must be made in light of all circumstances presented by the patient, including their preferences, safety and post-operative time period, as well as the needs and resources particular to the locality or institution.

INTENDED USERS

This guideline is intended to be used by physical therapists for the management of patients that will or have received a TKA. Physical therapists are health care professionals who help individuals maintain, restore, and improve movement, activity, and functioning, thereby enabling optimal performance and enhancing health, well-being, and quality of life. Typically, the physical therapist is a graduate of a physical therapist education program accredited by the Commission on Accreditation in Physical Therapy Education and is licensed to practice physical therapy. This guideline is not intended for use as a benefits determination document. Orthopedic surgeons, adult primary care clinicians, geriatricians, hospital-based adult medicine specialists, physiatrists, occupational therapists, nurse practitioners, physician assistants, emergency clinicians, and other health care professionals who routinely see this type of patient in various practice settings may also benefit from this guideline.

Care for individuals undergoing TKA is based on decisions made by them in consultation with their health care providers. Health care providers comprise a team, which may include physicians, surgeons, nurses and physical and occupational therapists. Care includes conservative management approaches and
Consideration of clinical practice guidelines such as the American Academy of Orthopaedic Surgeons’ Evidence-Based Clinical Practice Guideline on the Surgical Management of Osteoarthritis of the Knee.¹

Once the individual (and/or advocate) has been informed of the nature of the available therapies, their rationale, duration, benefits and risks, and has discussed the options with their health care provider, an informed and shared decision can be made.

PATIENT POPULATION
This guideline addresses the management of adult patients with knee osteoarthritis undergoing primary TKA. It is not intended to address management of revision or partial TKA, pediatric patients or patients with rheumatoid arthritis. In addition, this guideline is not intended to address nonoperative management of patients with osteoarthritis.

BURDEN OF DISEASE
Chronic knee pain is a leading cause of musculoskeletal disability in the United States. This often leads to TKA, also known as total knee replacement, which is the most commonly performed orthopedic surgery in the lower extremity. In 2013, 662,545 TKAs were performed, a steady increase in the number of procedures since 1992. While the length of stay has declined during the same time period, from 8.9 days to 3.4 days (67%), hospital charges have steadily increased. In 2013 the total hospital charges for TKA were $36.64 billion.² Additionally, the number of TKAs performed annually in the United States is expected to increase by 855% between 2012 and 2050, equating to 2,854 procedures per 100,000 US citizens over 40 years of age.³ In 2010, in North America, the prevalence of knee OA was 3.1% and globally the prevalence was 3.8%. The prevalence was higher in women. Prevalence peaked at around 50 years of age. Globally hip and knee OA was ranked as the 11th highest contributor to disability among almost 300 health conditions.⁴

ETIOLOGY
TKA consists of resection of the diseased or degenerative articular surfaces of the knee, replacing the surface with metal and polyethylene prosthetic components. The disease or degeneration is a result of destruction of the joint cartilage from osteoarthritis, rheumatoid arthritis, posttraumatic degenerative joint disease, or other pathologic conditions accounting for more than 95% of TKA surgeries.⁵

RISK FACTORS
Both treatable or modifiable risk factors and non-modifiable risk factors will impact the outcomes after TKA.

An understanding and appreciation of the risk factors will help inform care and determine prognosis. The guideline development group (GDG) identified aspects of the relationship between risk factors and outcomes in this patient population and made specific searches and recommendations. Refer to the specific recommendations below for details.

POTENTIAL BENEFITS, RISK, HARMs, AND COST
The potential benefits, risk, harms, and cost are provided for each recommendation within this document.

FUTURE RESEARCH
Consideration for future research is provided for each recommendation within this document.
METHODS

The methods used to create this clinical practice guideline were employed to minimize bias and enhance transparency in the selection, appraisal, and analysis of the available evidence. These processes are vital to the development of reliable, transparent, and accurate clinical recommendations for management of patients undergoing TKA. To view the full APTA clinical practice guideline methodology, visit the APTA Clinical Practice Guideline Process Manual published in 2018. Any variation will be documented below.

This clinical practice guideline evaluates the effectiveness of approaches in the management of patients undergoing TKA. APTA sought out the expertise of the American Academy of Orthopaedic Surgeons (AAOS) Evidence-Based Medicine Unit as consultants to assist in the creation of this CPG. The GDG consists of members from APTA and its representative sections, AAOS, the National Association of Orthopaedic Nurses, and a patient safety activist from Consumers United for Evidence-Based Healthcare. All GDG members, staff, and methodologists were free of potential conflicts of interest relevant to the topic under study, as recommended by clinical practice guideline development experts.

This clinical practice guideline was prepared by the APTA GDG with the assistance of APTA staff and the AAOS Clinical Quality and Value Department (staff evidence-based medicine methodologists). To develop this guideline, the GDG held an introductory meeting on September 22, 2017, to establish the scope of the clinical practice guideline. The GDG defined the scope of the guideline by creating PICOT questions (i.e., population, intervention, comparison, outcome, and time) that directed the literature search. The medical librarian created and executed the searches (see eAppendix 1 for search strategies).

BEST-EVIDENCE SYNTHESIS

The guideline includes only the best available evidence for any given outcome addressing a recommendation. Accordingly, the highest-quality evidence for any given outcome is included first, if it was available. In the absence of 2 or more occurrences of an outcome based on the highest-quality evidence, outcomes based on the next level of quality were considered until at least 2 or more occurrences of an outcome had been acquired. For example, if there were 2 “moderate”-quality occurrences of an outcome that addressed a recommendation, the recommendation does not include “low”-quality occurrences of evidence for this outcome. A summary of excluded articles, as well as the data findings for each recommendation, can be viewed in eAppendix 2.

LITERATURE SEARCHES

The medical librarian conducted a comprehensive search of MEDLINE, Embase, and the Cochrane Central Register of Controlled Trials based on key terms and concepts from the PICOT questions. Retrospective non-comparative case series, medical records review, meeting abstracts, meta-analyses, systematic reviews, historical articles, editorials, letters, and commentaries were excluded. Bibliographies of relevant systematic reviews were hand searched for additional references. All databases were last searched on July 13, 2018, and searches were limited to publication dates from 1995 to 2018 and in the English language.

DEFINING THE STRENGTH OF THE RECOMMENDATIONS

Judging the strength of evidence is only a steppingstone toward arriving at the strength of a clinical practice guideline recommendation. The operational definitions for the quality of evidence are listed in Table 1, and rating of magnitude of benefits versus risk, harms, and cost is listed in Table 2. The strength of recommendation, listed in Table 3, takes into account the quality, quantity, and trade-off between the benefits and harms of a treatment, the magnitude of a treatment’s effect, and whether there are data on critical outcomes. Table 4 addresses how to link the assigned grade with the level of obligation of each recommendation.
VOTING ON THE RECOMMENDATIONS
GDG members voted on the recommendations and their strength at a final in-person meeting resulting in consensus (100% approval) on every recommendation for this guideline.

INTERPRETING THE STRENGTH OF EVIDENCE

TABLE 1. RATING QUALITY OF EVIDENCE

<table>
<thead>
<tr>
<th>RATING OF OVERALL QUALITY OF EVIDENCE</th>
<th>DEFINITION</th>
</tr>
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<tbody>
<tr>
<td><strong>High</strong></td>
<td>Preponderance of Level 1 or 2 evidence with at least 1 Level I study. Indicates a high level of certainty that further research is not likely to change outcomes of the combined evidence.</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>Preponderance of Level 2 evidence. Indicates a moderate level of certainty that further research is not likely to change the outcomes direction of the combined evidence; however, further evidence may impact the magnitude of the outcome.</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>A moderate level of certainty of slight benefit, harm, or cost, or a low level of certainty for moderate-to-substantial benefit, harm, or cost. Based on Level II thru V evidence. Indicates that there is some but not enough evidence to be confident of the true outcomes of the study and that future research may change the direction of the outcome and/or impact magnitude of the outcome.</td>
</tr>
<tr>
<td><strong>Insufficient</strong></td>
<td>Based on Level II thru V evidence. Indicates minimal or conflicting evidence to support the true direction and/or magnitude of the outcome. Future research may inform the recommendation.</td>
</tr>
</tbody>
</table>
### Table 2. Magnitude of Benefit, Risk, Harm, Cost

<table>
<thead>
<tr>
<th>Rating of Magnitude</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantial</td>
<td>The balance of the benefits versus risk, harms, or cost overwhelmingly supports a specified direction.</td>
</tr>
<tr>
<td>Moderate</td>
<td>The balance of the benefits versus risk, harms, or cost supports a specified direction.</td>
</tr>
<tr>
<td>Slight</td>
<td>The balance of the benefits versus risk, harms, or cost demonstrates a small support in a specified direction.</td>
</tr>
</tbody>
</table>

### Table 3. Strength of Recommendations

<table>
<thead>
<tr>
<th>Strength</th>
<th>Strength Visual</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong</td>
<td>🔵🔵🔵🔵</td>
<td>A high level of certainty of moderate-to-substantial benefit, harm, or cost, or a moderate level of certainty for substantial benefit, harm, or cost (based on a preponderance of Level 1 or 2 evidence with at least 1 Level 1 study).</td>
</tr>
<tr>
<td>Moderate</td>
<td>🔵🔵🔵</td>
<td>A high level of certainty of slight-to-moderate benefit, harm, or cost, or a moderate level of certainty for a moderate level of benefit, harm, or cost (based on a preponderance of Level 2 evidence, or a single high-quality RCT).</td>
</tr>
<tr>
<td>Weak</td>
<td>🔵🔵</td>
<td>A moderate level of certainty of slight benefit, harm, or cost, or a low level of certainty for moderate-to-substantial benefit, harm, or cost (based on Level 2 thru 5 evidence).</td>
</tr>
<tr>
<td>Theoretical/ foundational</td>
<td>🔵</td>
<td>A preponderance of evidence from animal or cadaver studies, from conceptual/theoretical models/principles, or from basic science/bench research; or published expert opinion in peer-reviewed journals that supports the recommendation.</td>
</tr>
<tr>
<td>Best Practice</td>
<td></td>
<td>Recommended practice based on current clinical practice norms; exceptional situations in which validating studies have not or cannot be performed yet there is a clear benefit, harm, or cost; or expert opinion.</td>
</tr>
<tr>
<td>Research</td>
<td></td>
<td>An absence of research on the topic or disagreement among conclusions from higher-quality studies on the topic.</td>
</tr>
</tbody>
</table>

### Table 4. Linking Strength of Recommendation, Quality of Evidence, Rating of Magnitude, and Preponderance of Risk vs Harm to the Language of Obligation

<table>
<thead>
<tr>
<th>Recommendation Strength</th>
<th>Quality of Evidence and Rating of Magnitude</th>
<th>Preponderance of Benefit or Risk, Harm, or Cost</th>
<th>Strength Visual</th>
<th>Level of Obligation to Follow the Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong</td>
<td>High quality and moderate-to-substantial magnitude or Moderate quality and substantial magnitude</td>
<td>Benefit</td>
<td>🔵🔵🔵🔵</td>
<td>Must or Should</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk, harms, or cost</td>
<td>🔵🔵🔵</td>
<td>Must not or Should not</td>
</tr>
<tr>
<td>Moderate</td>
<td>High quality and slight-to-moderate magnitude or</td>
<td>Benefit</td>
<td>🔵🔵🔴</td>
<td>Should</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk, harms, or cost</td>
<td>🔵🔵</td>
<td>Should not</td>
</tr>
<tr>
<td>Weak</td>
<td>Moderate quality and slight magnitude or Low quality and moderate-to-substantial magnitude</td>
<td>Benefit</td>
<td>May</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------------------------------------------------------------------------</td>
<td>---------</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>Theoretical/ foundational</td>
<td>N/A</td>
<td>Benefit</td>
<td>May</td>
<td></td>
</tr>
<tr>
<td>Best Practice</td>
<td>Insufficient quality and clear magnitude</td>
<td>Benefit</td>
<td>Should or May</td>
<td></td>
</tr>
<tr>
<td>Research</td>
<td>Insufficient quality and unclear magnitude or Conflicting high-to-moderate quality and conflicting magnitude</td>
<td>Varies</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

**PEER REVIEW**
Following the formation of a final draft, the CPG review draft was subjected to a 4-week peer review for additional input from external content experts and stakeholders. Comments were collected via an electronic structured review form. All peer reviewers were required to disclose any conflicts of interest.
(see details in eAppendix XX)

**PUBLIC COMMENTARY**
After modifying the draft in response to peer review, the clinical practice guideline was subjected to a 2-week public comment period. Commenters consisted of members of the APTA Board of Directors (Board), the APTA Scientific and Practice Affairs Committee (SPAC), all relevant APTA sections, stakeholder organizations, and the APTA member community at large. (Guidelines automatically are sent to members of the APTA Board and the SPAC for review and comment prior to considering the guideline for approval; see “The APTA Clinical Practice Guideline Approval Process” below.) More than XXX people had the opportunity to comment on the guideline. To view comments, visit the CPG Peer Review and Public Comment View background material in the [location TBD].

**THE APTA CLINICAL PRACTICE GUIDELINE APPROVAL PROCESS**
This final clinical practice guideline draft must be approved by the APTA Board and the SPAC. These decision-making bodies are described in eAppendix 1. Their charge is to approve or reject publication of the guideline by majority vote.

**REVISION/REAFFIRMATION PLANS**
This clinical practice guideline represents a cross-sectional view of current treatment and may become outdated as new evidence becomes available. It will be reviewed in 5 years and either updated in accordance with new evidence, changing practice, rapidly emerging treatment options, and new technology; reaffirmed; or withdrawn.
SYSTEMATIC LITERATURE REVIEW DISSEMINATION PLANS

The primary purpose of this clinical practice guideline is to provide interested readers with full documentation of the best available evidence for various procedures associated with TKA. Publication of this guideline is announced by press release and published in *PTJ (Physical Therapy)*, the journal of the American Physical Therapy Association.

Education and awareness about this clinical practice guideline will be disseminated via online resources, such as webinars and continuing education courses, at professional annual meetings, and via social media.
STUDY ATTRITION FLOWCHART

7,826 abstracts reviewed via primary search performed on July 13, 2018

6,568 articles excluded from title and abstract review

1,258 articles recalled for full text review

1,066 articles excluded after full text review for not meeting the a priori inclusion criteria or failing to be best available evidence

192 articles included after full text review and quality analysis

View background material in eAppendix 1
View data summaries in eAppendix 2
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RECOMMENDATIONS

PREOPERATIVE EXERCISE PROGRAM

Physical therapists should design preoperative exercise programs and teach patients undergoing total knee arthroplasty (TKA) to implement strengthening and flexibility exercises. Evidence Quality: High, Recommendation Strength: Moderate]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: 4 high-quality studies\(^7-10\) and 2 moderate-quality studies\(^11,12\)

RATIONALE

Four high-quality studies,\(^7-10\) and 2 moderate-quality studies,\(^11,12\) support the use of preoperative physical therapy training/exercise programs for patients undergoing TKA and are associated with better postoperative functional outcomes. A summary of the outcomes measured and length of follow-up are listed below:

- Total WOMAC, subscales included function, pain and stiffness and the SF 36 Physical Function scores improved at 1 and 3 months post-op with pre-op training.\(^7\)
- Modified WOMAC, subscales included function and stiffness and the pain VAS improved at 1 and 3 months post-op with pre-op quadriceps exercise.\(^11\)
- SF 36 physical component score improved at 12 weeks post-op with pre-op lower extremity exercise.\(^10\)
- KOOS ADL improved at 6 weeks and 3 months post-op with pre-op physical therapy.\(^12\)
- KOOS ADL, KOOS pain, and EQ5D -VAS improved at 6 weeks post-op with pre-op neuromuscular exercise program and standard education.\(^13\)
- Iowa Level of Assistance Scale total score improved at 3 days post-op with pre-op physical therapy.\(^8\)
- Hospital for Special Surgery Knee Rating improved at 12 weeks post-op with pre-op cardiovascular conditioning.\(^14\)
- Length of stay was reduced with pre-op training.\(^7\)
- Stair Test improved at 1 and 3 months post-op with pre-op training.\(^7\)
- TUG improved at 1 and 3 months post-op with pre-op training.\(^7\)
- Biodex overall stability index score improved at 6 weeks post op with pre-op training.\(^15\)
- Knee flexion ROM improved at 3 months post-op with pre-op training.\(^7\)
- Knee extension ROM improved at 1 and 3 months post-op with pre-op training.\(^7\)
- Quadriceps strength improved at 1 and 3 months post-op with pre-op quadriceps training.\(^11\)
- Isometric hip abduction improved at 1 and 3 months post-op with pre-op training.\(^7\)
- Isometric knee flexion improved at 1 and 3 months post-op with pre-op training.\(^7\)
- Isometric knee extension improved at 3 months post-op with pre-op training.\(^7\)
- Post-op number of days to reach 90 degrees flexion improved with pre-op exercise.\(^9\)

BENEFITS, RISKS, AND HARMs OF IMPLEMENTING THIS RECOMMENDATION

Benefits:

- Improved activities and performance
- Improved pain
- Improved balance
- Improved knee flexion
- Improved knee extension

View background material in eAppendix 1
View data summaries in eAppendix 2
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• Improved isometric strength
• Improved report of quality of life (e.g. as measured by SF-36)
• Reduced length of stay
• Decreased stiffness

**Risk, Harm, and/or Cost:**
• No reported harms were associated with implementing this recommendation.
• While costs were not reported in studies, there may be an expected associated expense.

**Benefit-Harm Assessment:** With no reported risk or harm in the studies, there is a preponderance of evidence-supported benefit for this recommendation.

**FUTURE RESEARCH**
Additional research on the effects of preoperative exercise programs is required. This research should examine specific regimens or recommendations for type, frequency, duration and progression, and consider patient preferences. Outcomes related to length of stay, discharge to home, patient satisfaction and return to activities and participation should be included.

**ADDITIONAL COMPONENTS**

**Value Judgments:** None were identified.

**Intentional Vagueness:** Specific exercise priorities are identified based on the individual patient. The preoperative examination and evaluation guide the discussions for appropriate interventions included in the plan of care.

**Exclusions:** None were identified.

**Quality Improvement:**
• Organizations may use the completion of a preoperative visit to physical therapy that includes preoperative strengthening and flexibility instruction as a performance indicator.

**Implementation and Audit:**
• Organizations may audit the rate of occurrence of preoperative physical therapy visits that includes preoperative strengthening and flexibility instructions for patients that receive a TKA.
PREOPERATIVE EDUCATION

It is the consensus of the work group that physical therapists or other team members should provide preoperative education of patients undergoing TKA, including at a minimum hospitalization and discharge protocol, postoperative rehabilitation program, safe transferring techniques, use of assistive devices, and fall prevention. [Evidence Quality: Insufficient, Recommendation Strength: Best Practice]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: There was one study of moderate quality that supported the use of preoperative education to shorten LOS and decrease medical expenses.72

RATIONALE

In light of limited evidence, the GDG, (physical therapists, nurse, orthopedic surgeon, and patient) felt this supports best practice and were in consensus with this recommendation.

POTENTIAL BENEFITS, RISKS, AND HARMs OF IMPLEMENTING THIS RECOMMENDATION

Benefits:
- Improved patient adherence
- Decreased postsurgical complication

Risk, Harm, and/or Cost:
- No expected risk or harms were associated with this recommendation.
- There may be an expected associated expense for the visit.

Benefit-Harm Assessment: There is a preponderance of benefit for this recommendation.

FUTURE RESEARCH

Additional research on physical therapist or other team member led patient preoperative education is required. This research should evaluate the method and frequency of the education delivered. In addition, outcomes such as patient anxiety, health literacy, and satisfaction should be considered when evaluating the benefits of preoperative education.

ADDITIONAL COMPONENTS

Value Judgments: Although there was not a preponderance of high-quality evidence, the GDG felt compelled to make a recommendation to support the use of preoperative education for patients undergoing TKA. This was felt to be associated with better postoperative functional outcomes.

Intentional Vagueness: Not applicable

Exclusions: None were identified.

Quality Improvement:
- Organizations may use the completion of a preoperative visit to physical therapy that includes education as a performance indicator.

Implementation and Audit:
- Organizations may audit the rate of occurrence of preoperative physical therapy visits that include education for patients that receive a TKA.
CONTINUOUS PASSIVE MOVEMENT DEVICE (CPM) USE FOR MOBILIZATION

Physical therapists should NOT use CPMs for patients who have undergone primary, uncomplicated TKA. [Evidence Quality: High, Recommendation Strength: Moderate]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: Four high-quality studies, 16-19, 6 moderate-quality studies, 20-25, and 2 low-quality studies 26,27

RATIONALE

Four high-quality studies, 16-19, 6 moderate-quality studies, 20-25, and 2 low-quality studies 26,27 examined the effect of CPM use. Findings from 2 moderate-quality studies 24,25, and 2 low-quality studies 26,27 reported some significant statistical effects; however, these findings were contradicted by nonsignificant statistical findings in higher-quality studies or showed effects favoring both CPM and no CPM, depending on the outcome measured. The outcomes measured included knee flexion and extension range of motion as well as need for manipulation under anesthesia. Additionally, meta-analyses for the outcomes of function (SMD= 0.14 (-1.10, 0.39)) and hospital length of stay (WMD= -0.15 (-0.60, 0.30)) showed nonsignificant results.

BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION

Benefits:
- Results for outcomes in function were nonsignificant.
- Results in hospital length of stay were nonsignificant.

Risk, Harm, and/or Cost:
- Bed rest may be prolonged with CPM use.
- There is an inconvenience of use.
- While costs were not reported in studies, there is an expected associated expense.

Benefit-Harm Assessment: There is a preponderance of evidence to support there is increased risk, harm, and/or cost related to use of CPM for uncomplicated TKA.

FUTURE RESEARCH

Some subpopulations may benefit from CPM, and this could be explored with studies large enough to allow subgroup analyses or by narrowing inclusion criteria. Examples may be those with TKA revisions or those with particularly poor preoperative range of motion.

ADDITIONAL COMPONENTS

Value Judgments: None were identified.

Intentional Vagueness: The nature of an uncomplicated TKA is not explicit in most studies. Only one study implied a definition of uncomplicated by exclusions of patients with “concurrent intervention during surgery that could interfere with outcomes (e.g., collateral ligament repair), infection of the affected knee, and any major health complication during the hospital stay (e.g., pulmonary embolism, heart attack, problems with scar healing).” 19

Exclusions: None were identified.

Quality Improvement:
- When CPM is used, there should be documented complications associated with TKA that justify its use.
Implementation and Audit:

- Organizations may audit the use of CPM after TKA and discourage its use unless justified by documented complications associated with the procedure.
CRYOTHERAPY

Physical therapists should teach use of cryotherapy and encourage its use for early postoperative pain management for patients who have undergone TKA. Evidence Quality: High, Recommendation Strength: Moderate]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: Six high-quality studies\textsuperscript{28-33} and 4 moderate-quality studies\textsuperscript{34-37} 

RATIONALE

Six high-quality studies,\textsuperscript{28-33} and 4 moderate-quality studies,\textsuperscript{34-37} examined the use of cryotherapy after TKA. One high-quality study\textsuperscript{28} and 1 low-quality study\textsuperscript{38} favored cryotherapy over control for pain management, and 1 high-quality study found no difference. Findings from 1 high-quality study\textsuperscript{28} found improvement in pain management (VAS pain) with the use of ethyl chloride spray (applied during exercise for about 40 seconds at a distance of about 10 cm) versus control 4 weeks after TKA, and 1 high-quality study\textsuperscript{29} found no difference at 30 days after TKA in pain management (VAS pain) comparing 45 degree versus 75 degree (Fahrenheit) cryotherapy. One low-quality study\textsuperscript{38} found improved pain (VAS pain) at 30 days after surgery with the use of continuous-flow cooling device versus no cooling device. One high-quality study\textsuperscript{29} and 1 low-quality study\textsuperscript{38} found no increased complications with cryotherapy versus controls. Findings from 2 high-quality studies\textsuperscript{30,31} and 2 moderate-quality studies\textsuperscript{35,36} found no increased complications between cryotherapy modalities. A meta-analysis of 3 studies\textsuperscript{32,33,36} evaluated cryotherapy devices versus standard cold packs for pain management and found no statistically significant difference.

BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION

Benefits:
- Improvement in pain management
- Low cost and relatively easy to apply in all setting

Risk, Harm, and/or Cost:
- There were no increased complications between cryotherapy modalities used.
- There is a risk of skin irritation, burns, and frostbite; however, risk or harms are not expected when prescribed and monitored appropriately. Appropriately prescribing includes ensuring intact sensation.

Benefit-Harm Assessment: A preponderance of evidence supports the use of cryotherapy for pain management. There were no reported risk or harm to patients using cryotherapy. As with all treatments, it is advised that the patient be instructed on the use of the delivery system (e.g., cooling devices, ethyl chloride spray, ice packs). Furthermore, the therapist and patient should discuss any barriers to using cryotherapy (e.g., cost, lack of adequate storage, physical disability) in choosing the appropriate delivery system.

FUTURE RESEARCH

Future research focused on frequency of use and the length of time cryotherapy is used after surgery would further inform use.

ADDITIONAL COMPONENTS

Value Judgments: None were identified.
Intentional Vagueness: Although no one application method was shown to be superior, using cryotherapy is supported in managing post-op pain. There was not sufficient evidence to provide a prescriptive time frame for the application after surgery. In addition, there was insufficient evidence to identify how many days post-surgery cryotherapy should be continued.

Exclusions: None were identified.

Quality Improvement:
- Organizations may use documentation of the use of cryotherapy after TKA as a performance indicator.

Implementation and Audit:
- Organizations may audit occurrence of documentation of use of cryotherapy after TKA to assist in the management of pain.
PHYSICAL ACTIVITY

It is the consensus of the work group that physical therapists should develop and teach the patient who has undergone TKA regarding appropriate progression of physical activity, based on safety, functional tolerance, and physiological response. [Evidence Quality: Insufficient, Recommendation Strength: Best Practice]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: No high-quality studies related to physical activity for patients undergoing TKA

RATIONALE

The work group members, GDG, (physical therapists, nurse, orthopedic surgeon, and patient) were in consensus with this recommendation that physical activity is an important aspect in recovery and the progression of activities and participation. The 2nd edition of the US Department of Health and Human Services Physical Activity Guidelines provides evidence that routine physical activity, including moderate to vigorous aerobic and muscle-strengthening exercises, results in substantial health benefits.39 The recommendations include weight bearing exercises for bone health, balance activities, and flexibility activities. Furthermore, the Guidelines note that people with chronic conditions or disabilities (e.g., from osteoarthritis of the knee or TKA) benefit from engaging in physical activity to the extent they are able. There is a long list of known health benefits of physical activity, including lowering risk of all-cause mortality, heart disease and its risk factors, and certain types of cancer. According to the Guidelines, benefits of physical activity generally outweigh the risk of injuries. One study of physical activity 1 year following TKA reported that 42% of participants did not meet recommendations for levels of physical activity that promote health.40 In an observational study women who were inactive prior to TKA had increased odds of having mobility limitations and dying by age 85.41 Studies of specific types of exercise regimens (Pilates,42 Tai chi chuan43) following TKA have shown effects on a variety of outcomes, including health-related quality of life, walking distance, balance, and physical function. One study examining a resistance exercise regimen 4 years following TKA, demonstrated benefits of increased strength as well as walking speed and physical function.44 Amount of physical activity has also been shown to be positively associated with improvements in gait function following TKA.45,46 Furthermore, a dose-response relationship between exercise intensity and gait function has been demonstrated following TKA.47

POTENTIAL BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION

- **Benefits**: Improved gait function, walking distance, balance, physical function and health-related quality of life
- Improved activities and participation (e.g. mobility; self-care; and domestic life)

**Risk, Harm, and/or Cost:**
- No expected risk or harms are expected when progression is monitored and prescribed appropriately.

-**Benefit-Harm Assessment**: There is a preponderance of benefit for this recommendation.

FUTURE RESEARCH

Additional research on the effects of progressive physical activity is required. This research should examine specific regimens or recommendations for physical activity type, frequency, duration and progression, and report patient preferences and safety. Outcomes related to functions of cardiovascular,
neurological and musculoskeletal systems, as well as patients’ activities and participation should be included.

**ADDITIONAL COMPONENTS**

**Value Judgments:** Expert opinion and low-quality evidence supports the use of progressive physical activity for patients after TKA for better postoperative functional outcomes. The individualization of physical activity progression to match the patient’s goals, abilities, and physiological response should include documentation of objective baseline data, patient’s goals, and plan of care (interventions, dosage, frequency, and duration) as well as appropriate outcomes to demonstrate patients’ response to the specific approach.

**Intentional Vagueness:** Not applicable.

**Exclusions:** None were identified.

**Quality Improvement:**

Organizations may use the documentation of plan of care and progression of physical activity that include items such as patient preferences, safety, functional tolerance, and physiological response as a performance indicator.

**Implementation and Audit:**

Organizations may audit occurrence of documentation of plan of care and progression of physical activity during the physical therapy visits for patients who undergo TKA.
MOTOR FUNCTIONAL TRAINING (BALANCE, WALKING, MOVEMENT SYMMETRY)

Physical therapists should include motor function training (e.g. balance, walking, movement symmetry) for patients who have undergone TKA. [Evidence Quality: High, Recommendation Strength: Moderate]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: 5 high quality studies\(^{48-52}\) and 1 moderate quality study\(^{53}\)

RATIONALE

Five high-quality studies\(^{48-52}\) and 1 moderate-quality study\(^{53}\) addressed different aspects of movement retraining after TKA. These studies varied in the types of interventions but included dynamic balance training,\(^{48,50}\) robot-assisted gait retraining,\(^{53}\) movement training with visual biofeedback to promote weight-bearing symmetry,\(^{49}\) or motor functional training.\(^{51}\)

The studies that included balance training\(^{48,50}\) found that the balance interventions improved walking function as measured by gait speed, stair-climbing time, and the Timed Up and Go Test 32 weeks after training\(^{50}\) and by the Six-Minute Walk Test 9 months after training.\(^{48}\) Self-reported function was also better in the balance groups on the Self-Efficacy and Sports and Recreation subscales of the KOOS\(^{48}\) and Physical Function subscale on the WOMAC.\(^{50}\) Liao 2015 also found that balance training improved reaching and single-leg standing tests of balance.\(^{50}\)

The single study that evaluated 2-week robot-assisted gait training\(^{53}\) found better outcomes in the experimental group for balance using the Berg Balance Scale and walking ability measured with the Six-Minute Walk Test. Knee proprioception was also better than the control group.

The single study that evaluated feedback on weight-bearing symmetry\(^{53}\) found that subjects in the experimental group had better sagittal plane knee moments 26 weeks after surgery and better times for the Five Times Sit-to-Stand Test 6 and 26 weeks after surgery, but no other differences.

The single study that evaluated functional training,\(^{52}\) warm-up exercise, chair rise, walking, and leg lifts while standing did not find any benefit to the functional training protocol, but the retraining was performed in an unsupervised home setting and there was a large loss to follow-up (>50%), and the authors concluded they were underpowered to detect potential differences.

BENEFITS, RISKS, AND HARMs OF IMPLEMENTING THIS RECOMMENDATION

Benefits:

- Improvement in balance
- Improvement in walking function
- Improvement in activities and participation (i.e. getting in and out of car, shopping, household duties)

Risk, Harm, and/or Cost:

- No expected risk or harms are associated with this recommendation.
- Some of the more advanced training programs that include weight-bearing biofeedback or robot-assisted gait training may be cost- and resource-prohibitive for most clinical settings.

Benefit-Harm Assessment: A preponderance of evidence supports including motor function training. The individualization of progression to match the patient’s goals, abilities, and physiological response should include documentation of objective baseline data, patient’s goals, and plan of care (interventions,
dosage, frequency, and duration). This includes the use of appropriate outcomes to demonstrate patient response to the specific approach.

**FUTURE RESEARCH**

The long-term impact of normalizing movement patterns or improving balance after TKA remains unknown. Future research should determine if improving movement symmetry reduces long-term sequelae on the surgical and nonsurgical limbs, and whether improving balance after TKA reduces fall prevalence and reduces long-term morbidity. As technology improves, the use of biofeedback-based movement interventions may become more applicable for this patient population. Future research is warranted to determine the feasibility of such systems and long-term impact.

**ADDITIONAL COMPONENTS**

**Value Judgments:** None were identified.

**Intentional Vagueness:** Given the varied nature of the study interventions, we cannot recommend a single postoperative movement training program. However, exercises that promote dynamic balance and movement symmetry appear to be appropriate.

**Exclusions:** None were identified.

**Quality Improvement:**

- Organizations may use documentation of the use of motor functional training (balance, gait, posture) after TKA as a performance indicator.

**Implementation and Audit:**

- Organizations may audit occurrence of documentation of use of motor functional training after a TKA to assist in the management of pain.
POST-OPERATIVE KNEE RANGE OF MOTION EXERCISE

It is the consensus of the work group that physical therapists should engage and teach patients to implement passive, active assistive, and active range of motion exercises for the involved knee following TKA. [Evidence Quality: Insufficient, Recommendation Strength: Best Practice]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: Because range of motion (ROM) exercises are considered a standard of care, there have been no studies examining patients who received ROM exercises compared to those who did not.

RATIONALE

The work group members, GDG, (physical therapists, nurse, orthopedic surgeon, and patient) were in consensus with this recommendation.

POTENTIAL BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION

Benefits:
- Improved range of motion of the knee
- Decreased postsurgical complication
- Improved functional outcomes

Risk, Harm, and/or Cost:
- No expected risk or harms were associated with this recommendation.

Benefit-Harm Assessment: There is a preponderance of benefit for this recommendation.

FUTURE RESEARCH

Additional research is unlikely given that a true control group without range of motion exercise is unlikely to be approved in any trial.

ADDITIONAL COMPONENTS

Value Judgments: Although there was a lack of high-quality evidence the GDG felt compelled to make a strong recommendation to support the use of ROM exercises. However, other factors besides ROM substantially contribute to successful post-operative outcomes; therefore, strategies targeting ROM should be complemented with other interventions.

Intentional Vagueness: Not applicable

Exclusions: None were identified.

Quality Improvement:
- Organizations may use the application of post-operative range of motion exercises as a quality indicator.

Implementation and Audit:
- Organizations may audit the rate of occurrence of post-operative physical therapy visits that include range of motion exercises for patients that receive a TKA.
IMMEDIATE POST-OPERATIVE KNEE FLEXION DURING REST FOR BLOOD LOSS AND
SWELLING
To reduce immediate post-operative blood loss and swelling in the first 7 days, physical therapists or
other team members may teach patients to position the operated knee in some degree of flexion, while
resting, (i.e., within the first week after surgery) to minimize blood loss and swelling.

[Evidence Quality: High, Recommendation Strength: Weak]

ACTION STATEMENT PROFILE
Aggregate Evidence Quality: Four high-quality studies\textsuperscript{54-57} and 1 moderate-quality\textsuperscript{58} study

RATIONALE
Four high-quality studies\textsuperscript{54-57} and 1 moderate-quality\textsuperscript{58} study evaluated knee positioning during the
immediate postoperative period and its effect of blood loss, swelling, edema management, and range of
motion (ROM). One high-quality study\textsuperscript{54} found decreased blood loss, knee circumference and improved
knee flexion ROM comparing the resting position of 30 degrees of hip flexion and 30 degrees of knee
flexion compared to 30 degrees of hip flexion and full knee extension at 3 and 7 days after TKA. The
study did not indicate if ROM was measured passively or actively and extension ROM was not measured.
There was no difference between groups in flexion ROM at 6 weeks. One high-quality study\textsuperscript{55} found
decreased knee blood loss, circumference comparing mild flexion (leg elevated 25cm at the ankle over
backing pad with a 20cm backing pad behind the upper calf to bend the knee mildly) and
extension (leg elevated 25 cm at the ankle over a backing pad with full extension of the knee) at 7 days
after surgery. The knee positioned in mild flexion, from postoperative days 1-7, had greater venous
return, less postoperative blood loss and knee swelling and greater knee flexion ROM. There were no
differences in knee flexion ROM at 6 weeks follow up. Extension ROM was not measured. One high-
quality study\textsuperscript{56} found decreased blood loss and knee circumference at 7 days after surgery in a group of
patients with the knee positioned in 45 degrees of hip flexion and knee flexion at 90 degrees compared to
a second group with the knee positioned in full extension. These positions were maintained for the first 6
hours post operatively. There were not statistical differences in knee flexion ROM at 7 days between
groups. Extension ROM was not measured. One high-quality study\textsuperscript{57} compared patients with the knee
positioned in 60 degrees of hip flexion and 60 degrees of knee flexion to a group of patients positioned in
full knee extension. These positions were maintained for the first 48 hours after surgery. The results
showed decreased blood loss, shorter hospital length of stay by 1.9 days, less knee circumference, and
greater flexion ROM at 6 weeks post op (105 vs 98 degrees) in the group with the knee resting in flexion.
Overall length of stay for both groups averaged over 10 days in these Chinese hospitals. There were no
differences in knee flexion ROM at 6 months follow up. One moderate-quality study\textsuperscript{58} found no
difference in knee blood loss, circumference or flexion ROM comparing high flexion (70 degrees) vs mild
flexion (30 degrees) at 7 days after surgery. The mean length of stay in this Italian hospital was 8 days.

These findings further support the meta-analysis by Jiang et al that assessed the impact of flexion versus
extension of knee position on outcomes after TKA.\textsuperscript{59} This later study concluded that positioning the knee
in flexion in the early postoperative stage was associated with significantly lesser total calculated blood
loss, lesser hidden blood loss, decreased requirement for blood transfusion and better ROM at least in the
early postoperative period, which may contribute to early rehabilitation. Important, no significant
difference was found in ROM at 6 weeks.

BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION

Benefits:
- Decrease in blood loss associated with TKA surgery
- Decrease in swelling in the first 7 days post operatively

View background material in eAppendix 1
View data summaries in eAppendix 2
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Improvement in short term flexion range of motion

Risk, Harm, and/or Cost:
- There is a potential risk of developing limited extension ROM with this recommendation. Knee extension ROM was not measured in these studies. Limited knee extension could be a risk factor with patients being placed in a knee flexion resting position post operatively.

Benefit-Harm Assessment: There is benefit in reducing blood loss and swelling in the first 7 days from this recommendation. Improved flexion ROM is not long term with only one study showing improvement after 6 weeks, none after 6 months. The impact on extension ROM is not known. Most of these studies had a length of stay greater than 7 days or the length of stay was unreported. There is a question about the generalizability of the results of these studies to post-operative care due to the length of stay.

FUTURE RESEARCH
Continued comparative studies, with larger sample sizes, between positioning the knee at different degrees of flexion during the immediate postoperative period after TKA may further clarify the use of this approach to minimize swelling and edema. Furthermore, the optimal degrees of flexion are still to be determined as is the minimal timing required to obtain the reported effect. Future studies should include outcomes related to knee extension ROM.

ADDITIONAL COMPONENTS
Value Judgments: Given the potential for short term reduced blood loss and swelling, we recommend knee flexion during rest immediately post surgery.

Intentional Vagueness: Given the varied nature of the study interventions, we cannot recommend a specific length of time or degree of flexion after the surgery; however, most studies looked at a time frame of 7 days and knee flexion between 30 and 90 degrees. It was unclear the amount of time per day that the knee was in flexion.

Exclusions: None were identified.

Quality Improvement:
- Organizations may use documentation of patient and/or caregiver education for patient resting knee flexion for the immediate postoperative period after TKA as a performance indicator of reduced blood loss and swelling.

Implementation and Audit:
- Organizations may audit occurrence of documentation of patient and/or caregiver education for patient resting knee flexion for the immediate postoperative period after a TKA to assist in the management of blood loss and swelling.
Physical therapists should use neuromuscular electrical stimulation (NMES) for patients who have undergone TKA to improve quadriceps strength, gait performance, performance-based outcomes, and patient-reported outcomes. [Evidence Quality: High, Recommendation Strength: Moderate]

**Rationale**

Four high-quality studies and 1 moderate-quality study compared the use of neuromuscular electrical stimulation (NMES) with no NMES use in the treatment of patients after TKA. Two high quality studies found that NMES improved quadriceps and hamstrings maximum voluntary isometric contractions from 2 to 52 weeks after TKA. Four high-quality studies reported greater improvement in walking, stair climbing performance, and patient-reported outcomes with NMES use compared with no NMES from 2 to 52 weeks after TKA. Postoperative range of motion with NMES use was not different from no NMES use from 2 to 52 weeks after TKA. Earlier NMES (as early as postoperative day 2) and more frequent (5-7x daily) application with longer cumulative time at maximal patient tolerance improved outcomes. Patients after TKA who would most likely benefit are those with quadriceps muscle activation deficits, often measured in terms of a quadriceps extensor lag or quadriceps activation battery. NMES should be applied for at least a minimum of 3 weeks.

**Benefits, Risks, and Harms of Implementing This Recommendation**

**Benefits:**
- Improvement in quadriceps and hamstrings maximum voluntary isometric contractions from 2 to 52 weeks after TKA
- Improvement in walking, stair-climbing performance, and patient-reported outcomes

**Risk, Harm, and/or Cost:**
- The financial cost of using NMES and its availability to patients may be prohibitive for patients.
- Pain/discomfort with use
- Decreased tolerance

**Benefit-Harm Assessment:** There is a preponderance of benefit for this recommendation.

**Future Research**

While current evidence supports the use of NMES after TKA, additional research might continue to refine NMES benefits by understanding the best patient factors for NMES use, optimal dosage, stimulation parameters, application with and without concurrent muscle contraction, mechanisms explaining NMES efficacy, adjuncts to NMES (e.g., nutritional supplementation), and when to discontinue NMES.

**Additional Components**

**Value Judgments:** Independent application (placement) of electrodes and implementation of the appropriate parameters of NMES by the patient may lead to less optimal outcomes; however, preoperative education improves the quality of implementation.

**Intentional Vagueness:** Given the varied nature of the study interventions, we cannot recommend a specific setting for NMES; however, studies consistently used parameters that allow for tetanic quadriceps muscle contractions with stronger contractions leading to greater quadriceps strength.
Exclusions: None were identified.

Quality Improvement:
- Organizations may use documentation of use of NMES after TKA as a performance indicator.

Implementation and Audit:
- Audits of occurrence of documentation of use of NMES after a TKA to assist in quadriceps and hamstrings voluntary isometric contractions may be used.
RESISTANCE AND INTENSITY OF STRENGTHENING EXERCISE

Physical therapists should design, implement, teach and progress the patient in high-intensity strength training and exercise programs during the early post acute period (i.e., within the first week after surgery) for patients who have undergone TKA to improve function, strength, and range of motion. [Evidence Quality: High, Recommendation Strength: Moderate]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: Three high-quality studies\(^8,65,67\) and 1 moderate-quality study\(^66\)

RATIONALE

Three high-quality studies\(^8,65,67\) and 1 moderate-quality study\(^66\) support the benefits of land-based high-intensity resistance training on muscle function, functional performance, and balance. Evgeniadi found that postoperative resistance training (8 weeks) resulted in higher levels of functional mobility and better knee extension range of motion (ROM).\(^8\)

One additional high-quality study evaluated the safety of early high-intensity resistance training\(^67\) on knee ROM and adverse events and found that early high-intensity resistance training is as safe as low-intensity resistance training. Knee ROM (flexion or extension) was not compromised with early high-intensity resistance training initiated 72 hours after TKA. This study did not find improvements in muscle strength or physical function, but both groups demonstrated substantially better outcomes than have been previously reported. In particular, the control group may not have provided a true low-intensity comparison.

Effectiveness of high-intensity resistance training may be limited by arthrogenic muscular inhibition of the quadriceps (muscle activation deficits) in the early postoperative period.\(^67\) Patients with large muscle activation deficits may not experience sufficient muscle overload with resistance training to achieve comparable strength gains as those of patients without muscle activation deficits.

BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION

Benefits:

- Improvement in muscle strength
- Improvement in activities related to mobility (e.g. getting into and out of a chair)
- Improvement in balance
- Improvement in knee extension

Risk, Harm, and/or Cost:

- No harm or risks were reported with early postoperative high-intensity resistance training after TKA.

Benefit-Harm Assessment: There is a preponderance of benefit for this recommendation.

FUTURE RESEARCH

Future studies should evaluate the impact of muscle activation deficits on the effectiveness of early resistance exercise in terms of muscle strength gains and functional outcomes. Additional work should focus on the optimal timing of resistance training, potentially targeting later postoperative recovery when muscle activation deficits have resolved.
ADDITIONAL COMPONENTS

Value Judgments: None were identified.

Intentional Vagueness: High-intensity strength training should include the use of progression criteria such as described in Bade to tailor speed of progression with individual responses to exercise (e.g., excessive swelling following intervention). Given the varied nature of the study interventions, we cannot recommend a specific parameter for resistance and intensity; however, Yousefian found that 6 weeks of progressive resistance training 3 times per week starting the day after surgery resulted in better balance outcomes on the Sharpened Romberg, Star Excursion, and Berg. Husby found that resistance training 3 times per week for 8 weeks initiated 8 days after TKA resulted in better muscle strength, and gains persisted through 12 months after TKA.

Exclusions: None were identified.

Quality Improvement:
- Organizations may use documentation of use of high-intensity strength training and exercise programs after TKA as a performance indicator.

Implementation and Audit:
- Organizations may audit occurrence of use of high-intensity strength training and exercise programs after a TKA to assist in the management of pain.
PROGNOSTIC FACTORS: BMI; DEPRESSION; PREOPERATIVE RANGE OF MOTION (ROM), PHYSICAL FUNCTION, AND STRENGTH; AGE; DIABETES; COMORBIDITIES; AND SEX

Physical therapist management should take into consideration the following factors when determining prognosis, treatment, and informed decision-making and expectation-setting with patients undergoing TKA:

a) Higher BMI is associated with more postoperative complications and worse postoperative outcomes.

b) Depression is associated with worse postoperative outcomes.

c) Preoperative ROM is positively associated with postoperative ROM but has minimal, if any, effect on physical function and quality of life.

d) Preoperative physical function is positively associated with postoperative physical function.

e) Preoperative strength is positively associated with postoperative physical function.

f) Older age is associated with worse patient-reported, performance-based, and impairment-based outcomes.

g) Diabetes is not associated with worse functional outcomes.

h) A greater degree of comorbidity is associated with worse patient-reported outcomes.

i) Male and female sex may be related either positively and negatively to recovery after TKA depending on the outcomes measures studied.

[Evidence Quality: High, Recommendation Strength: Moderate]

ACTION STATEMENT PROFILE

RATIONALE

a) BMI: Five high-quality and 7 moderate-quality studies were included. Twenty-seven studies of low quality were not included. Five of the high- and moderate-quality studies support higher BMI as a factor related to worse patient outcomes, including patient-reported outcomes on the Oxford Knee Score, 68,69 SF-12, 69 Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) composite score, 70 and KSS function and impairment-based outcomes for range of knee flexion. 70,71 Physical therapists definitely should consider higher BMI as a risk factor for worse patient-reported and impairment-based outcomes of TKA. Adverse events that were associated with increased BMI included deep-vein thrombosis, joint infection, surgical complications, unplanned readmissions, and wound complications.

b) Depression: One high-quality 72 and 2 moderate-quality 73,74 study were included. Six studies of low quality were not included.

Of the high- and moderate-quality studies, 2 moderate-quality studies report depression as a factor related to worse patient-reported outcomes on the Oxford Knee Score. 73 The high-quality study 72 reports nonsignificant results for patient-reported outcomes on the WOMAC.
c) Preop ROM: Four high-quality studies generally suggest that preoperative ROM predicts postoperative ROM\textsuperscript{75-77} but that preoperative ROM does not predict functional outcomes of Timed Up and Go and Stair Climbing Test.\textsuperscript{78} One high-quality study indicated that patients with flexion contractures before surgery do just as well after surgery as do patients without flexion contractures.

Four studies provided moderate-quality evidence,\textsuperscript{70,79-81} with some limitations: Holm measured knee ROM only at hospital discharge.\textsuperscript{81} Park found only a weak correlation between postoperative maximum flexion and the pain, function, and quality of life 12 months after TKA.\textsuperscript{79} The study did not investigate how preoperative ROM predicts postoperative ROM.\textsuperscript{80} The most important factors that influenced knee ROM after arthroplasty were preoperative range of flexion and the body weight of the patient.

d) Preoperative Function: While there is mixed evidence in this area, most studies found that higher levels of preoperative function were associated with higher levels of postoperative function. Five high-quality studies, 12 moderate-quality studies, and 14 low-quality studies found correlations from preoperative function and postoperative outcomes. One high-quality study\textsuperscript{82} found a higher preoperative SF 12 to be associated with higher postoperative step count. A moderate-quality study\textsuperscript{70} found a higher preoperative WOMAC to be associated with better knee flexion postoperative. A moderate-quality study\textsuperscript{73} found a preoperative Timed Up and Go, 6-Minute Walk Test, Stair Climb Test, and SF 36 Physical Component Score to be associated with these same tests at 1, 3, and 6 months postoperative. Another moderate-quality study\textsuperscript{84} found preoperative scores below reference value significantly decreased the possibility to achieve the level of HRQoL of the general population at a 1-year follow-up. Jones found that preoperative WOMAC function and walking distance are significantly associated with better 6-month postoperative WOMAC function scores.\textsuperscript{85} Another moderate-quality study\textsuperscript{74} found that higher preoperative Oxford Knee Score (OKS) is associated with higher-postoperative OKS.

Four high-quality studies\textsuperscript{72,75,76,78} and 4 moderate-quality studies\textsuperscript{79,80,86,87} did not find significant correlations with preoperative function and postoperative outcomes.

e) Preoperative Strength: One moderate-quality study\textsuperscript{81} suggests that preoperative strength is associated with an increased percent change in 10-minute walking speed, and 1 moderate-quality study suggests no relationship between preoperative strength and SF-36 physical function score.\textsuperscript{87}

f) Age: Eight high-quality,\textsuperscript{68,72,75,76,78,88-90} 9 moderate-quality,\textsuperscript{79,81,84,88,91-93} and 33 low-quality studies investigated the association of age with outcome.

Of the 17 high- and moderate-quality studies, 3 report older age as a factor related to worse patient outcomes, including patient-reported outcomes from SF-12,\textsuperscript{89} KSS function,\textsuperscript{89} WOMAC function,\textsuperscript{72,89} and HRQoL,\textsuperscript{84} and impairment-level outcomes on gait speed\textsuperscript{90} and extension lag.\textsuperscript{89} One high-quality study\textsuperscript{72} reports nonsignificant differences for WOMAC. The remainder of studies report nonsignificant results for a variety of outcomes.

One moderate-quality study reports a greater fall rate with older age.\textsuperscript{92}

g) Diabetes: One moderate-quality study was included.\textsuperscript{74} Five studies were of low quality.\textsuperscript{71,74,84-86} Study results were nonsignificant for effects of diabetes on Oxford Knee Score.

h) Comorbid conditions: Two high-quality\textsuperscript{72,88} and 6 moderate-quality\textsuperscript{18,84} studies were included. Ten studies of low quality were not included. Of the included studies, 5 reported greater degree of
comorbidity as a factor related to worse patient-reported outcomes on WOMAC function,\textsuperscript{75,85,86} Oxford Knee Score,\textsuperscript{76} SF-12,\textsuperscript{93} KSS,\textsuperscript{95} and quality of life.\textsuperscript{85} 

One high-quality study reported a higher total complication rate with higher comorbidity.\textsuperscript{92} 

i) Sex: Five high-quality,\textsuperscript{68,72,75,76,89} and 9 moderate-quality,\textsuperscript{73,94,79-81,84-87} were included. 

j) Male and female sex may or may not be related either positively or negatively to recovery after TKA depending on the outcome measures studied; therefore, a general statement of the impact of sex on recovery cannot be made. 

Three high quality studies\textsuperscript{75,76,89} and 7 moderate quality studies\textsuperscript{73,79,80,81,85,88,94} reported no effect of sex on a variety of outcomes including ROM, walking speed, knee extension strength and measures of function. 

One high quality study reported women had worse scores than men on the Oxford knee score and men had worse terminal knee extension.\textsuperscript{68} Another high-quality study reported woman had more knee pain than men at 6 weeks following TKA.\textsuperscript{72} One moderate quality study reported men had less improvement in self-reported function than women.\textsuperscript{84} Another moderate quality study reported that women had longer rehabilitation hospital stays (25 days) than men (23 days).\textsuperscript{86} 

**BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION**

**Benefits:**

Patients and practitioners can analyze and discuss the potential effects of these factors on recovery after TKA.

**Risk, Harm, and/or Cost:**

- No expected risk or harms are associated with this recommendation.

**Benefit-Harm Assessment:** There is a preponderance of benefit for this recommendation.

**FUTURE RESEARCH**

Age and diabetes require more research regarding subgroups.

**ADDITIONAL COMPONENTS**

**Value Judgments:** Recognition of prognostic factors may modify decisions about dosage, rate of progression and duration of interventions.

**Intentional Vagueness:** Additional prognostic factors that haven’t been described may also influence outcomes.

**Exclusions:** None were identified.

**Quality Improvement:**

- Organizations may use documentation of risk factors with patient before TKA as a performance indicator.

**Implementation and Audit:**

- Organizations may audit occurrence of risk factors with a patient prior to patient undergoing a TKA.
PROGNOSTIC FACTORS: TOBACCO USE AND PATIENT SUPPORT

It is the consensus of the work group that active tobacco use and lack of patient support (e.g., environmental factors including, but not limited to, support and relationships) should be considered as prognostic/risk factors associated with less than optimal functional outcomes. [Evidence Quality: Insufficient, Recommendation Strength: Best Practice]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: There were no high-quality studies related to the association of tobacco use or lack of patient support associated with functional outcomes for patients undergoing TKA.

RATIONALE

Without strong evidence in research, it is the consensus of the group that tobacco use and lack of patient support are important aspects in recovery and functional outcomes associated with TKA. Support includes social structures, people, and relationships that help a person manage recovery. While there is not specific evidence to support the impact of tobacco use and patient support related to risk factors associated with TKA, there is significant evidence to support the impact to overall health.

POTENTIAL BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION

Benefits:
- Patients can make informed decisions about use of tobacco and analyze their availability of support systems in understanding the potential effects of these factors on recovery after TKA.

Risk, Harm, and/or Cost:
- No expected risk or harms are associated with this recommendation.

Benefit-Harm Assessment:
- There is a preponderance of benefit for this recommendation.

FUTURE RESEARCH

Additional research needed on the use of tobacco and the use of available support related to outcomes for patients undergoing TKA. Additionally, the GDG felt it is important to also study the impact of level of education and socioeconomic status as prognostic/risk factors for patients undergoing TKA.

ADDITIONAL COMPONENTS

Value Judgments: Tobacco use affects healing, which is an important component of TKA, leading to complications. Patients who undergo TKA should be tobacco-free or engaged in a tobacco cessation program prior to surgery.

Optimally patients benefit from support of family, friends, and/or community after TKA, especially on return to home, work or community participation.

Intentional Vagueness: Not applicable

Exclusions: None were identified.

Quality Improvement:
- Organizations may use documentation of prognostic factors with patient before TKA as a performance indicator.
Implementation and Audit:

- Organizations may audit occurrence of prognostic factors prior to patients undergoing TKA.
POSTOPERATIVE PHYSICAL THERAPY SUPERVISION

Supervised physical therapist management should be provided following TKA. The optimal setting should be determined by the patients’ safety, mobility, environmental, and personal factors.

[Evidence Quality: Moderate, Recommendation Strength: Moderate]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: One high-quality study and 1 moderate-quality study examined various aspects of the supervised versus less supervised physical therapy after TKA.

RATIONALe

This recommendation indicates there was limited supporting evidence for supervised physical therapy after TKA compared with home exercise-based approaches. One high-quality study allocated 40 subjects to either a home-based program or a supervised program and found the supervised program had better quality of life scores 3 and/or 6 months after surgery. One moderate-quality study randomized 40 individuals to either a supervised program that met 2 times a week for 1 month or a supervised program that met twice a month and performed home exercises. The more frequently supervised group had better self-reported outcomes, mobility scores, and balance at the end of the intervention compared with the less-supervised group.

BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION

Benefits:

- Approaches that include supervised physical therapy management may produce better outcomes than approaches with less supervision from a physical therapist.

- Given that most patients progress after TKA with respect to function, strength, and range of motion, supervised physical therapy may allow for more appropriate and safe exercise progression.

Risk, Harm, and/or Cost:

There were no reported risk or harms associated with providing supervised care from the physical therapist.

Benefit-Harm Assessment: There is a preponderance of benefit that supervised physical therapist management should be provided after TKA to address physical impairments and functional limitations that are commonplace after surgery.

FUTURE RESEARCH

Existing studies on this topic varied widely in their scope and methodology. Although there was limited evidence supporting supervised vs unsupervised physical therapy programs, there is a dearth of literature on this topic, perhaps due to ethical issues related to withholding supervised physical therapy after surgery. Studies that compare supervised physical therapy with a true non-active control or home-exercise program are warranted. Future work should include (1) randomized trials that evaluate patient outcomes after allocation and (2) prognostic studies that identify patient characteristics that make an individual better suited for less supervision after discharge from the hospital.

ADDITIONAL COMPONENTS

Value Judgments: Physical therapy supervision is warranted after TKA, although additional research may identify the individuals who may succeed with less structured supervised rehabilitation after discharge from the hospital.

Intentional Vagueness: Given the lack of experimental studies, we cannot recommend a specific level or amount of supervision for postoperative physical therapy. The choice of a singular ideal level is further...
complicated by heterogeneity in patient goals, needs, comorbidities, risk factors and level of function in this population.

**Exclusions:** None were identified.

**Quality Improvement:**
- Organizations may use documentation of justification of supervision level for postoperative TKA physical therapist management.

**Implementation and Audit:**
- Organizations may audit occurrence of documentation of supervision level for justification for postoperative physical therapist management of patients who undergo TKA.
GROUP- VS INDIVIDUAL-BASED THERAPY

Physical therapists may use group-based or individual-based physical therapy sessions after TKA. [Evidence Quality: Moderate, Recommendation Strength: Weak]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: One high-quality study97 and 2 moderate-quality studies98,99 examined group versus individual-based therapy after total knee arthroplasty

RATIONALE

There is limited evidence to support the benefit of individualized physical therapist management over group-based sessions. There was a trend among 1 high-quality,97 2 moderate-quality,98,99 and 1 low-quality100 studies that individualized therapy was neither superior nor inferior to group rehabilitation. Various patient functional outcomes improved over the course of the studies, regardless of participation in individual or group physical therapy sessions.

The evidence was limited, given differences in study populations, the timing of the programs post-surgery and differences in doses of the intervention between and within groups. In the only high-quality study,97 an eight-week group-based physical therapy was compared with usual care, in which 15% of patients in the usual care did not receive physical therapy at all. In the Kauppila 2010 study, a ten-day group-based therapy was implemented 2-4 months after surgery and compared to usual care, which resulted in a larger exposure in the group-based arm of the study.98 The Artz 2017 paper was a preliminary study and only included self-reported outcomes in 46 subjects.99 The low-quality study100 evaluated only the benefit of 2 additional group therapy sessions in the acute care environment. All studies compared the group-based management to usual care, which differs greatly among geographic locales and health care delivery systems.

BENEFITS, RISKS, AND HARMs OF IMPLEMENTING THIS RECOMMENDATION

Benefits:
- Individualized physical therapist management allows for a tailored plan of care for patients based on their physical and psychosocial needs.

Risk, Harm, and/or Cost:
- Group therapy may fail to provide enough progression of therapy for more advanced patients or to provide adequate engagement for patients with lower abilities or significant impairments.
- Group-based physical therapy management after TKA will require careful selection of patients based on physical therapist examination and patients’ progress should be monitored throughout their course of care.

Benefit-Harm Assessment: There is a preponderance of benefit for the use of group-based or individual-based physical therapy sessions after TKA.

FUTURE RESEARCH

Given the lack of evidence that directly compares balanced dosage of group-based physical therapist management with individualized sessions, additional comparative studies are warranted before a stronger recommendation can be made.

ADDITIONAL COMPONENTS

Value Judgments: Limitations in the existing research limited the ability to draw a conclusion about the superiority of either treatment approach, and the decision to use either may be based on a variety of institutional, therapist, and patient-related factors.
Intentional Vagueness: The lack of a clear, high-quality, comparative study that included dose-equivalent group and individual-based treatment plans precluded a preferential recommendation for either approach.

Exclusions: None were identified.

Quality Improvement:
- Organizations may use documentation of individual versus group therapy for patients with TKA to allow for future research in this area.

Implementation and Audit:
- Organizations may audit occurrence of documentation of the use of individual versus group therapy for patients with TKA to support future research.
PHYSICAL THERAPY POSTOPERATIVE TIMING

Physical therapist management should start within 24 hours of surgery and prior to discharge for patients who have undergone TKA. [Evidence Quality: Low, Recommendation Strength: Moderate]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: 2 low-quality studies

RATIONALE

Two low-quality studies examined postoperative timing to receiving physical therapist management after TKA and support the use of starting inpatient physical therapy earlier rather than later in hospital settings. One low-quality study compared a group that initiated rehabilitation within the first 24 hours post surgery with a group that received the same rehabilitation protocol but did not start rehabilitation until 48 to 72 hours post surgery. This study by Labraca had issues with randomization, incomplete outcome reporting, and confounding variables. The group that started earlier rehabilitation had a shorter hospital stay, reduced pain, and improved physical function (gait, balance, range of motion, and strength). The other low-quality study, a retrospective study, compared a group that began ambulation 1 day postoperative with a group that began ambulation 2 days postoperative. The early ambulation group had a shorter hospital stay, lower hospital costs, higher odds of achieving 90 degrees of knee flexion, and higher odds of requiring a walking aid with a smaller base of support (e.g., straight cane vs walker).

BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION

Benefits:
- Shortened inpatient hospital stay
- Reduced pain
- Improved physical function

Risk, Harm, and/or Cost:
No expected harms are expected with implementing this recommendation. The retrospective study reported no difference in 90-day readmission rate between the early-ambulation group and the later-ambulation group.

Benefit-Harm Assessment: There is a preponderance of moderate-to-substantial benefit for this recommendation that lead the group to upgrade the recommendation strength in the presence of low evidence quality.

FUTURE RESEARCH

As evolving management emphasizes shorter lengths of hospital stays, including discharge within 24 hours after surgery and surgery on an outpatient basis for some patients, additional high-quality research is needed to investigate the optimal timing of TKA rehabilitation for these management models.

ADDITIONAL COMPONENTS

Value Judgments: None were identified.

Intentional Vagueness: Given the limitations of the current evidence, the optimal timeframe within the first 24 hours to start rehabilitation is not yet known.

Exclusions: None were identified.

Quality Improvement:
• Organizations may use documentation of the timing of postoperative therapy for TKA patients as a performance indicator.

Implementation and Audit:
• Organizations may audit occurrence of documentation of the timing of postoperative therapy for TKA patients.
PHYSICAL THERAPY DISCHARGE PLANNING

It is the consensus of the work group that physical therapists should provide guidance to the care team and patient on safe and objective discharge planning, patient functional status, assistance equipment, and services needed to support a safe discharge from the acute care setting. [Evidence Quality: Low, Recommendation Strength: Moderate]

ACTION STATEMENT PROFILE

Aggregate Evidence Quality: No quality studies were found specific to the effectiveness of physical therapists being involved in objective (using standardized measures) discharge planning for the patient following TKA. After review of the available literature, the work group decided to include information from studies related to services available to patients as a result of discharge planning that were not included in other sections of this guideline. One moderate-quality study103 and 4 low-quality studies94–97 examined rehabilitation services for the patient to receive after TKA.

RATIONALE

One study103 compared usual care post discharge to usual care (home and outpatient PT) with health coaching and a financial incentive to improve physical activity. The health coaching consisted of phone calls to the patient focused on motivation interviewing. The financial incentive rewarded patients for increased physical activity measured by steps/day as recorded by a Fitbit. At 6-month follow up, steps/day increased significantly. A second study104 found no difference in Western Ontario and McMaster Universities Osteoarthritis Index function score (WOMAC) scores between groups receiving usual care and those receiving usual care and Care Navigation. Care Navigation was described as up to 10 phone calls by the “Navigator” trained in Motivation Interviewing to improve the patient’s functional status. McLawhorn et al105 analyzed over 100,000 TKA patients from the National Surgical Quality Improvement Data Base. Approximately 30% were discharged to skilled facilities. At 30 days post discharge, those who went to the skilled facilities compared to directly home had higher complications and readmission rates. Patients discharged to skilled facilities were older, had more co-morbidities, and were more likely to have been non-independent pre-operatively, suggesting a selection bias for those discharged to skilled care vs. home. The authors recommended patients who have undergone TKA be discharged directly home when possible. Padget106 concluded that patients can safely discharge home after TKA. They also reported that referral to inpatient rehabilitation facilities did not influence six-month reductions of complications, nor did it lead to functional differences at two-years when compared to those discharged directly home. Tribe et al107 found significant functional improvements in patients with TKA who were discharged home or were treated in an inpatient rehab facility. Physical therapy visits were similar in both groups and there were no differences in functional improvements.

The studies reviewed found inpatient rehabilitation for TKA to be no better than discharge directly home. In addition, Brennan108 found that less days from hospital discharge to start of outpatient therapy predicted improved patient reported pain and outcome in an outpatient setting. Patients in this study were covered by commercial insurance and younger (mean age 56.1).

Predicting discharge disposition to avoid ineffective services could save costs. Smith109 found physical therapists to make accurate and appropriate discharge recommendations. When physical therapists’ recommendations matched actual discharge setting, there was a lower probability of hospital readmissions than when they did not match. Similarly, Falvey110 and colleagues identified the contributions of physical therapists to the discharge planning team when preparing for care transitions and the potential to mitigate readmissions. Two studies have shown a measure of function, using a standardized tool administered on the first therapy visit, to have predictive value in discharge disposition from acute settings. These findings suggest benefits to the inclusion of physical therapy with interdisciplinary discharge planning early in the hospitalization. Jette111 evaluated all types of diagnoses and Mariano112 looked specifically at the discharge of joint replacement patients including TKA.
BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION

Benefits:
- Physical therapists can provide the care team with valuable information to assure the most appropriate discharge setting
- Involving physical therapists in discharge planning can prepare the patient for a more safe and independent transition to the home environment.
- Health coaching and financial incentives can improve patient functional performance
- Inpatient rehabilitation may not be more beneficial than discharge directly home

Risk, Harm, and/or Cost:
- No expected risks or harm are associated to implementing the recommendation.

Benefit-Harm Assessment:
- There is a preponderance of benefit for this recommendation that lead the group to upgrade the recommendation strength in the presence of low evidence quality (see table 3).

FUTURE RESEARCH
From the current research regarding care navigators/discharge planner and social support, we are left with far more questions than answers. Was the care navigator/discharge planner present from the beginning of the decision process? Did the care navigator actually go home with the patient and assist in personal care, safety, and home physical therapy? Did the care navigator provide the patient with home safety assessment, develop a personal home care plan, help secure assistive devices, and support pain management strategies? Likewise, the study of social support was narrowly focused on contact from provider to patient related to function. More research using a broader application of different types of social support from within patients’ larger communities is needed to assess the impact on patient safety in postoperative discharge to home, pain levels, and return to function.

Related to future research in the area of post-operative setting (or location), no high-quality studies were evaluated on this topic. There is a lack of studies evaluating measures or standard processes for objective discharge decision making. The current Medicare joint replacement bundle includes all costs incurred up to 90 days post op. Studies evaluating the outcome and cost of the timing and setting of post-acute care will become more and more important. Studies evaluating cost and outcome of patients discharged directly to an out-patient setting compared to a skilled nursing or home care setting prior to out-patient care need to be evaluated.

ADDITIONAL COMPONENTS
Value Judgments: Patients who participate in discharge planning have greater confidence in their ability to manage rehabilitation at home. Less stress in a safe, supportive environment creates a positive patient outlook and encouragement to fully participate in their own rehabilitation.

Intentional Vagueness: Given the need for more research using broader models of patient caregiver support, the recommendation is based on anticipated positive impact of coordinated, intentional discharge planning.

Exclusions: None were identified.

Quality Improvement:
• Organizations may use documentation of discharge planning with the patient and health services team as a performance indicator.

**Implementation and Audit:**

• Organizations may audit occurrence of documentation discharge planning with the patient and health services team.
OUTCOMES ASSESSMENT
It is the consensus of the work group that physical therapists should collect the Knee Injury Osteoarthritis Outcomes Survey Joint Replacement (KOOS JR) as a patient-reported outcome measure and both the 30-Second Sit-to-Stand and Timed Up and Go tests as performance-based outcomes to demonstrate the effectiveness of care provided. These measures should be collected at a minimum at the first visit and upon conclusion of care from each setting. [Evidence Quality: Insufficient, Recommendation Strength: Best Practice]

ACTION STATEMENT PROFILE
Aggregate Evidence Quality: No PICO was created to specifically look at this question, as such the search returned no studies addressing this topic

RATIONALE
The GDG discussed the psychometric properties, clinical utility, and importance to the patient of multiple tests and measures that have been used when describing outcomes for patients undergoing TKA. The group was in consensus with this recommendation. There is evidence for the validity of the use of the tools in TKA.

BENEFITS, RISKS, AND HARMS OF IMPLEMENTING THIS RECOMMENDATION
Benefits:
- Documentation of actual results of implementing the plan of care
- Consistent measures can standardize communication across the continuum of care.
- Minimal time to administer assessments
- Utilization of information that is understood by different health care providers for patients undergoing TKA

Risk, Harm, and/or Cost:
- No expected risk or harms are associated with this recommendation.
- There is an increase in time to perform these outcome measures.

Benefit-Harm Assessment: There is a preponderance of benefit for this recommendation.

FUTURE RESEARCH
Additional research on outcome measures used to measure outcome assessments is required. This should include validity and reliability studies.

ADDITIONAL COMPONENTS
Value Judgments: Expert opinion and low-quality evidence supports the use of identified outcome assessments. In addition, there are value-based incentive payment programs (e.g. Comprehensive Care for Joint Replacement Model) and regulatory mandate’s for Joint Commission Advanced Certification that require the use of KOOS JR assessment tool. There is need for consistency of outcomes to improve understanding of the effectiveness of care provided for patients undergoing TKA.

Intentional Vagueness: Not applicable

Exclusions: None were identified.

Quality Improvement:
- Organizations may use the completion of identified outcome measures at the initial visit and conclusion of care visit as a performance indicator.
Implementation and Audit:
Organizations may audit completion of identified outcome measures at the initial visit and conclusion of physical therapy visits for patients that receive a TKA.
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View background material in eAppendix 1
View data summaries in eAppendix 2
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### Score Predict Discharge Disposition After Total Hip and Knee Arthroplasties?


#### Excluded studies can be found in eAppendix I.


GUIDE DEVELOPMENT GROUP DISCLOSURES

Prior to the development of this clinical practice guideline, group members disclosed conflicts of interest in writing to the American Physical Therapy Association via a private online reporting database and also verbally at the recommendation approval meeting.

Disclosure Items: (n) = Respondent answered No to all items indicating no conflicts. 1 = Royalties from a company or supplier; 2 = Speakers bureau/paid presentations for a company or supplier; 3A = Paid employee for a company or supplier; 3B = Paid consultant for a company or supplier; 3C = Unpaid consultant for a company or supplier; 4 = Stock or stock options in a company or supplier; 5 = Research support from a company or supplier as a PI; 6 = Other financial or material support from a company or supplier; 7 = Royalties, financial or material support from publishers; 8 = Medical/Orthopaedic publications editorial/governing board; 9 = Board member/committee appointments for a society.

VOTING MEMBERS

Blinded for peer review