Health Benchmarks®
Clinical Quality Indicator Specification 2008

Client: HEALTH BENCHMARKS, INC. STANDARD ALGORITHM
Implemented for Blue Cross Blue Shield of Illinois

Measure Title: RISK-ADJUSTED COMPLICATIONS POST PRIMARY TOTAL KNEE REPLACEMENT (TKR) SURGERY

Disease State: Knee Arthroplasty

Strength of Recommendation: Not applicable. Not a key recommendation for clinicians regarding diagnosis or treatment.

Organizations Providing Recommendation:
- American College of Chest Physicians
- National Surgical Infection Prevention Project

Clinical Intent: To assess the complication rate for primary total knee replacement surgery. Note that this measure is risk adjusted.

Physician Specialties: Surgery-Orthopedic, Mixed Specialty

Background: Disease Burden

- According to the National Center for Health Statistics (NCHS) 2004 National Hospital Discharge Survey, there were over 478,000 knee replacements.[1]
- From 1995 to 2004, the rate of knee replacements in the elderly has increased by 70% from 47.2 per 10,000 population to 80.3 per 10,000 population.[1]
- Post-operative complications:
  - One study examining 9,367 joint replacement procedures (both hip and knee) from 1996 through 2001 found complications from pulmonary embolism at 0.4% and deep vein thrombosis at 1.4%.[2]
  - Another study of 222,684 patients that underwent TKR from 1999 to 2001 found an infection rate of 0.71% and pulmonary embolism at 0.41%.[3]
  - Furthermore, the American College of Chest Physicians guidelines estimates that the incidence of PE is around 4-10% and for deep-vein thrombosis within 20-80% for calf or proximal diagnoses. Approximately 10% of all hospital deaths are due to pulmonary embolism.[4]
  - Patellofemoral disorders, including patellar instability, loosening of the patellar components, patellar component failure, patella fracture, patella clunk syndrome, and rupture of the extensor mechanism, are the most common complications after knee
arthroplasty.[5, 6]

Reason for Indicated Intervention or Treatment
- The inter-institutional and provider-level variation in the incidence of risk-adjusted complications after primary total knee replacement surgery suggests that differences in care may have an impact on these rates.

Evidence Supporting Intervention or Treatment
- Risk reductions of up to 40% in the frequency of thrombosis after knee replacement surgery have been achieved with the use of thromboprophylaxis such as low molecular weight heparin.[7-9]
- Prophylactic administration of antibiotics can decrease postoperative morbidity, shorten hospitalization, and reduce the overall costs attributable to infections.[10-13]

Clinical Recommendations
- **Venous Thromboembolic Disease:**
  - The ACCP recommends thromboprophylaxis regimens based on these risk categories: For moderate risk patients, either low-dose unfractionated heparin (LDUH) (5,000 U bid) or low-molecular-weight heparin (LMWH) (≤3,400 U once daily) is recommended (Strength of evidence: 1A). For higher risk patients who have multiple risk factors, it is recommended that they receive LDUH (5,000 U bid) or LMWH (>3,400 U daily) (Strength of evidence: 1A). As for high risk patients, it is recommended that this group receive combination therapy-LDUH three times a day or LMWH (>3,400 U daily) with graduated compression stocking and/or intermittent pneumatic compression devices (Strength of evidence: 1C).[4]

- **Infection:**
  - The National Surgical Infection Prevention Project recommends that preoperative antimicrobial prophylaxis should be standard for all patients undergoing joint replacement. It recommends cefazolin or cefuroxime as first-line agents for prophylaxis. If the patient is allergic to B-lactams, then it is recommended that they use vancomycin or clindamycin.[10]

Source
Health Benchmarks, Inc.:

Items adapted from other sources:

Denominator Definition
Continuously enrolled members who underwent primary knee replacement surgery during the 1 year period starting 150 days prior to the measurement year.
Denominator Codes

<table>
<thead>
<tr>
<th>Total knee replacement</th>
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<tbody>
<tr>
<td>CPT-4 code(s): 27447</td>
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<tr>
<td>ICD-9 surgical proc code(s): 81.54</td>
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Denominator Exclusion Definition

Members with evidence of the following conditions: patella fracture, conversion of previous knee surgery, complications from a previous TKR 0-2 days prior to the index date (inclusive of the index date), or members diagnosed with arthropathy associated with infection, knee arthrotomy for infection with drainage on the index date, or members with metastatic cancer or bone cancer 365 days prior through 4 days after the index date (inclusive of the index date).

Denominator Exclusion Codes

- **Patellar fracture**
  - ICD-9 diagnosis code(s): 822.xx
  - CPT-4 code(s): 27520-27524

- **Evidence of conversion of previous knee surgery**
  - CPT-4 code(s): 27486, 27487

- **Complication of previous TKR**
  - ICD-9 diagnosis code(s): 996.4x, 996.60, 996.66, 996.70, 996.77, 996.78, V54.0x
  - ICD-9 surgical proc code(s): 78.66, 80.06, 81.55
  - CPT-4 code(s): 20680, 27488

- **Bone infections**
  - ICD-9 diagnosis code(s): 711.x6, 730.06, 730.16, 730.26, 730.96, 996.60, 996.66, 996.67

- **Arthrotomy for infection**
  - CPT-4 code(s): 27310

- **Bone and Metastatic Cancer**
  - ICD-9 diagnosis code(s): 170.7x, 171.3x, 195.5x, 196.5, 198.5x, 238.9, 239.9, 733.10, 733.15, 733.16 CPT-4 code(s): 27327-27329

Numerator Definition

Members who DID NOT have evidence of the following complications related to TKR:

- Pulmonary embolism (PE), joint infection, deep vein thrombosis, in the 1-90 days after index date (exclusive of the index date)
- Dislocation in the 2-90 days after the index date (exclusive of the index date)
- Musculoskeletal readmission in the 8-90 days after the index date (exclusive of the index date)
- Expired in the 0-90 days after the index date (inclusive of the index date)

Numerator Codes

- **PE**
  - ICD-9 diagnosis code(s): 415.1x
Deep vein thrombosis
ICD-9 diagnosis code(s): 453.4x, 453.8x

Inpatient setting
CPT-4 code(s): 99221-99223, 99231-99233, 99238-99239, 99251-99255, 99261-99263, 99291-99300, 99356-99357, 99431-99440
UB revenue code(s): 0100-0114, 0117-0124, 0127-0134, 0137-0144, 0147-0154, 0157-0159, 0160-0169, 0190-0219, 0220-0229, 0720-0729, 0800-0809, 0987

Outpatient setting
CPT-4 code(s): 99201-99205, 99211-99215, 99241-99245, 99271-99275, 99301-99313, 99315-99316, 99318-99337, 99341-99350, 99354-99355, 99381-99387, 99391-99397, 99401-99429, 99450, 99455-99456
UB revenue code(s): 0500-0529, 0570-0599, 0770-0779, 0820-0859, 0882, 0982-0983

Prothrombin Time Test
CPT-4 code(s): 85610

Post TKR joint infection
CPT-4 code(s): 27310, 27360

Joint infection
ICD-9 diagnosis code(s): 711.00, 711.06, 711.60, 711.66, 711.90, 711.96, 730.00, 730.06, 730.10, 730.16, 730.20, 730.26, 730.90, 730.96, 996.60, 996.66, 996.67

Confirming procedures
ICD-9 surgical proc code(s): 78.60, 78.66, 78.67, 80.00, 80.06, 80.10, 80.16, 81.91
CPT-4 code(s): 20680, 27301, 27303, 27310, 27330, 27331, 27332-27335, 27360, 27488

Dislocation
ICD-9 surgical proc code(s): 79.76, 79.86
CPT-4 code(s): 27550-27566

Musculoskeletal Readmission
DRG code(s): 213, 216, 217, 501, 502, 503, 545

Physician Attribution
Description
Score only the physician who performed the index surgery.

References
6. Brick, G.W. and R.D. Scott, The patellofemoral component of total knee...
deriving the predicted rate for a provider

Statistical Methodology for TKR

Patient populations are inherently variable, ensuring that providers will treat an array of patients that are likely different in composition of risk compared to patient pools treated by other providers. This variability, particularly with regard to general health status, can account for a large proportion of the measured quality of care differences between providers and lead to incorrect findings and conclusions if not considered. To generate a meaningful statistic that reflects only differences in provider practice patterns, appropriate statistical method such as the conventional logistic regression is used to model the probability of occurrence of the TKR complication by controlling for a variety of patient mix and severity of illness factors such as demographics (age, gender) and comorbidities during a specific period.

Model specification

For j-th patient who received a TKR procedure from physician i, we modeled the complication indicator variable Yi (1 for complication and 0 otherwise) as follows:

\[
G(E(Y_{ij})) = \]
\[ \beta_0i \text{ (physician) } + \beta_1 \text{ age categories (0-35, 35-45, 45-55, 55-65, 65-75, and over 75 years old)} + \beta_2 \text{ gender} + \beta_3 \text{ Charlson Comorbidity Index} \]

\[ + \beta_4 \text{ Specific arthritis diagnosis, i.e., a flag for each of the following: rheumatoid arthritis, osteoarthritis, or avascular necrosis.} \]

Where \( E(Y_{ij}) \) is the expected value of \( Y_{ij} \) and \( G \) is a monotonic differentiable link function that describes how the expected value of \( Y_i \) is related to the predictors. A binomial distribution for \( Y \) and logit link function, i.e., logistic regression, will be applied to estimate the physician effect (indexed by \( \beta_0i \)) on the likelihood of developing a complication after surgical procedure, controlling for the patient level characteristics variables.

**Prediction**

Based on the parameter estimates of physician indicators from the above model, the average risk adjusted likelihood of complication for physician \( i \) was obtained using the following equation:

\[ P_i = \frac{\exp(\beta_0i + X\beta)}{1+\exp(\beta_0i + X\beta)} \]

Where,

- \( \text{Exp: exponential function; } \)
- \( \beta_0i: \text{ parameter estimates indexed physician effects; } \)

\( X\beta: \text{ the estimated regression coefficients from the model*mean values for each covariate. } \)

\( P_i \) can be interpreted as the expected complication rate physician \( i \) would have if he/she treated all TKR surgical procedures at his/her actual level of performance. Comparing risk adjusted TKR complication rates across physicians would measure physician \( i \)'s performance assuming that this provider encountered the typical or average case distribution experienced by his/her peers.