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# Risk Factors Associated With Health Care Utilization and Costs of Patients Undergoing Lower Extremity Joint Replacement

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## Abstract

**Background:** The Comprehensive Care for Joint Replacement program implemented by the Centers for Medicare and Medicaid Services did not incorporate risk adjustment for lower extremity joint replacement (LEJR). Lack of adjustment places hospitals at financial risk and creates incentives for adverse patient selection.
**Objective:** To identify patient-level risk factors associated with health care utilization and costs of patients undergoing LEJR.
**Methods:** A comprehensive search of research databases from January 1, 1990, through January 31, 2016, was conducted. The databases included Ovid MEDLINE In-Process & Other Non-Indexed Citations, Ovid MEDLINE, Ovid EMBASE, Ovid Cochrane Central Register of Controlled Trials, Ovid Cochrane Database of Systematic Reviews, and SCOPUS and is reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement. The search identified 2020 studies. Eligible studies focused on primary unilateral and bilateral LEJR. Independent reviewers determined study eligibility and extracted utilization and cost data.
**Results:** Seventy-nine of 330 studies (24%) were included and were abstracted for analysis. Comorbidities, age, disease severity, and obesity were associated with increased costs. Increased number of comorbidities and age, presence of specific comorbidities, lower socioeconomic status, and female sex had evidence of increased length of stay. We found no significant association between indication for surgery and the likelihood of readmission.
**Conclusion:** Developing a risk adjustment model for LEJR that incorporates clinical variables may serve to reduce the likelihood of adverse patient selection and enhance appropriate reimbursement aligned with procedural complexity.

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Recent projections suggest that the number of total hip arthroplasties and total knee arthroplasties performed in the United States may more than double from 2005 to 2030.[1] Data from the voluntary Bundled Payments for Care Improvement project introduced by the Centers for Medicare and Medicaid Services (CMS) suggest that bundled payments reduce costs.[2] The CMS implemented the Comprehensive Care for Joint Replacement (CJR) program, which dramatically transformed payment design for lower extremity joint replacement (LEJR). Although variation exists in patient and procedural complexity for LEJR, CMS-paid hospitals set episode prices with limited consideration for patient-level complexity. Due to the absence of a validated risk adjustment model in this context, the CJR program adjusted target pricing for joint replacement due to hip fracture only.[3] The CMS did include protection for providers from monetary loss during the course of a single performance year, including patient exclusions for conditions such as end-stage renal disease, service exclusions for use of clotting factors, and graduated stop-loss (and conversely stop-gain) provisions.[4]

Despite considerations in the CJR program to shield providers from excessive cost, a potential unintended consequence of the bundled payment strategy is preferential marketing to and selection of patients who are less likely to develop medical complications. Conversely, surgeons and health care systems will have incentive to delay or decline surgeries for higher-risk patients or to refer these patients to public or tertiary care centers.[5-7] Risk-adjusted payments have been proposed as a solution to remove disincentives for providing care to higher-risk patients.[8]

The primary aim of this systematic review was to identify patient-level risk factors potentially associated with increased health care utilization and costs for patients undergoing LEJR. Results inform an ongoing empirical analysis focused on examining the implications of including these factors in CJR program target price setting methods.

## METHODS

This systematic review was conducted according to guidance from the Cochrane Collaboration and is reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement.

### Inclusion Criteria

We sought to replicate the bundle of services included in the LEJR bundle.[9] The episode for the LEJR bundle of care begins with the index hospitalization that results in discharge under Medicare Severity Diagnosis Related Group 469 (major joint replacement or reattachment of lower extremity with major complications or comorbidities) or 470 (major joint replacement or reattachment of lower extremity without major complications or comorbidities) and ends 90 days after discharge. As such, we included studies of primary unilateral or bilateral LEJR (hip, knee, or ankle) with health care utilization and cost outcomes reported for the index hospitalization, including 3 days before admission and 90 days after discharge.

We excluded studies reporting no patient-level outcomes, including those reporting only hospital- or surgeon-level characteristics, such as hospital/surgeon volume, partial vs total joint replacement, hospital ward staffing or design, surgical approach, and provision of anticoagulation or antianemia medications. We also excluded studies for the following reasons: (1) language other than English, (2) full text not available through our library or interlibrary loan, (3) published as abstracts only, (4) focused solely on a pediatric population, (5) reported revision surgeries and primary surgeries together, and (6) reported only outcome timeframes greater than 90 days after surgery.

### Search Strategy and Criteria

A comprehensive search of research databases from January 1, 1990, through January 31, 2016, was conducted. The databases included Ovid MEDLINE In-Process & Other Non-Indexed Citations, Ovid MEDLINE, Ovid EMBASE, Ovid Cochrane Central Register of Controlled Trials, Ovid Cochrane Database of Systematic Reviews, and SCOPUS. The search strategy used controlled vocabulary to search for health care utilization, expenditures, and costs (Supplemental Appendix 1, available online at http://www.mcpiqojournal.org). We used search terms focusing on (1) patients with LEJR (knee, hip, or ankle), (2) resource expenditure including cost or utilization, and (3) the period after surgery, up to 90 days or 13 weeks. All abstracts retrieved by the search were evaluated independently by 2 reviewers according to aforementioned criteria (M.A.K., M.M.J., L.M.P., S.M.). Studies identified for possible inclusion by either reviewer were assessed in full text by 2 reviewers (M.A.K., M.M.J., L.M.P., J.A., B.J.B., M.H.M., A.N.L.). A third reviewer resolved discrepancies in full-text screening (M.A.K., M.M.J., J.A.). Data were abstracted by 1 of 4 abstracters (M.A.K., M.M.J., J.A., A.N.L.). Ten percent of studies were double abstracted and discrepancies corrected (M.M.J.).

The methodological quality of the studies was judged based on items selected to address risk-of-bias domains in observational studies. Quality of evidence was categorized as high, medium, or low based on domains from the GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach,[10] including the methodological limitations of the studies, the statistically significant effect size (relative association measure >2.0 considered a large effect), sample size (<200, 200-999, ≥1000), inconsistency