Knee and Hip Replacements:
Changes in Healthcare Utilization and Costs from Pre- to Post-Surgery for Medicare Advantage Members

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Background

Introduction

From 1999-2008, the utilization rate of total knee replacements (TKR) in the US has more than doubled for the overall population, and tripled within the 45-64 year age-group.[1] Additional research has reported an increase in the rate of primary and revision knee replacements, as well as hip replacements.[2] Joint replacements are costly, but lower cost alternatives such as intra-articular corticosteroids or viscosupplementation are controversial, given the American Association of Orthopaedic Surgeon's (AAOS) recent recommendation against such procedures.[3] This study followed health insurance members who received knee or hip replacements relative to intra-articular injection categories to determine if one of these approaches resulted in fewer visits and treatments, and lower downstream OA-related healthcare costs.

Objectives

- To measure the healthcare utilization and cost of members receiving 1) knee replacements or 2) hip replacements, relative to 3) intra-articular injections into the knee or hip (controls) to determine if one of these approaches resulted in lower healthcare utilization and costs, after recovery from the procedure.

Methods

- Members aged 45 years or older, diagnosed with osteoarthritis (OA), and with primary knee or hip replacement surgery 7/1/2007 – 6/30/2012 were identified for this study. The date of joint replacement surgery was considered the index date. For the comparison cohort, the index date was 180 days post-injection of the first intra-articular injection observed.
- The following categories of medical and pharmacy claims for members with knee or hip replacements were examined longitudinally in 90-day increments from 180 days pre-index until 360 days post-index, relative to claims of the comparison cohort:
  - Physical therapy visits (in-home and out of home)
  - All other outpatient visits
  - Emergency Room (ER) visits
  - Inpatient stays
  - Pain medications
- Difference-in-difference (DID) analyses compared the change in OA-related healthcare costs, post- vs. pre-surgery, for the knee and hip replacement cohorts relative to the comparison cohort.
- The DID models included variables for depression, anxiety, fibromyalgia and coexisting pain conditions. The pain conditions were included given that patients having coexisting conditions of pain with central sensitization may experience persistent pain post-surgery,[4,5] and consequently incur higher healthcare utilization and cost.
- Time to event analyses were used to measure the following secondary outcomes for members with knee or hip replacements:
  - Post-surgical readmissions
  - Infections related to the joint prosthesis
  - Revision surgeries
  - Venous thromboembolic events (VTEs)

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Results

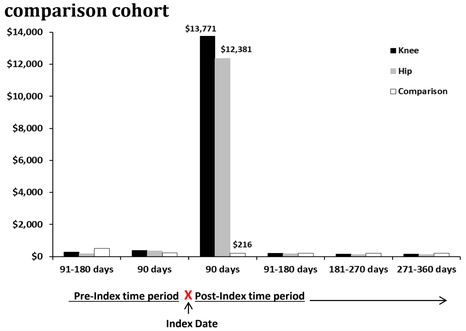
Table 1. Demographic and Clinical Characteristics of Members with Knee Replacements, Members with Hip Replacements, and the Comparison Cohort

Measure	Members with Knee Replacement n = 17,864	Members with Hip Replacement n = 7,317	Comparison Cohort n = 64,484
Age, years (mean [SD])	70.7 (± 7.3)**	71.7 (± 7.7)**	71.1 (± 8.7)
Gender, female (%)	11,642 (65.2)**	4,444 (60.7)**	43,280 (67.1)
Race/Ethnicity, White (%)	15,291 (85.6)**	6,443 (88.1)**	53,616 (83.1)
Geographic Region, South (%)	10,282 (57.6)**	3,848 (52.6)**	38,708 (60.0)
Plan Type (n, %)			
LIS Status Only	876 (4.9)**	332 (4.5)**	3,678 (5.7)
Dual Eligibility Only	125 (0.7)**	52 (0.7)**	643 (1.0)
LIS Status and Dual Eligibility	2,092 (11.7)**	713 (9.7)**	8,898 (13.8)
RxRisk-V Comorbidity Score, mean (SD)	4.7 (± 2.9)**	4.4 (± 2.9)**	4.8 (± 3.1)
Deyo Charlson Comorbidity Score, mean [SD]	0.7 (± 1.0)	0.6 (± 1.0)**	0.7 (± 1.2)
Comorbidity (n, %)			
Anxiety	1,054 (5.9)**	399 (5.5)**	4,673 (7.2)
COPD	1,556 (8.7%)**	818 (11.2%)**	6,384 (9.9%)
Depression	1,462 (8.2%)**	530 (7.2%)**	6,273 (9.7%)
Diabetes	5,409 (29.0%)	1,565 (21.4%)**	18,887 (29.3%)
Heart Failure	810 (4.5%)**	386 (5.3%)**	4,078 (6.3%)
Low Back Pain	2,323 (13.0%)**	1,810 (24.7%)**	12,203 (18.9%)
Neuropathic Pain	193 (1.1%)**	82 (1.1%)**	1,138 (1.8%)
Osteoporosis	2,695 (15.1%)**	1,723 (23.5%)**	11,172 (17.3%)
Rheumatoid Arthritis	762 (4.3%)**	318 (4.3%)**	4,139 (6.4%)
Venous Thromboembolism	244 (1.4%)	94 (1.3%)	860 (1.3%)
Pre-Index OA-related Healthcare Costs			
mean [SD]	$609.99 (± $869.13)**	$522.61 (± $676.99)**	$717.16 (± $1,805.53)
median [range]	$364 [$0 - $33,560]	$333 [$0 - $13,119]	$340 [$0 - $107,595]

*p < .05; **p < .01; SD=standard deviation.

- Despite statistically significant differences, demographic and clinical characteristics were relatively similar in magnitude between the three cohorts (**Table 1**). Exceptions were observed in the percentage with specific comorbidities: diabetes (hip 21.4% vs. comparison 29.3%; p<.01), low back pain (knee 13.0%, hip 24.7% vs. comparison 18.9%; p<.01 for both comparisons), and osteoporosis (knee 15.1%, hip 23.5% vs. comparison 17.3%; p<.01 for both comparisons).
- Pre-index healthcare costs were highest for the comparison cohort at $717.16 versus $609.99 for knee and $522.61 for hip ($p$<.01 for both comparisons). However, median cost values were similar (knee $364, hip $333, and comparison $340, **Table 1**).

Figure 1 Healthcare costs for members with a knee replacement, members with a hip replacement, and comparison cohort



- Mean OA-related healthcare costs are shown in **Figure 1**. As expected, there was a spike at the time of joint replacement surgery for those respective cohorts, with healthcare costs falling below pre-index levels by the end of follow-up.
- For the comparison cohort, costs were highest during days 91–180 pre-index when the member received a glucocorticoid or viscosupplementation injection. Healthcare costs of the comparison cohort also decreased through follow-up (**Figure 1**).

Table 3 Difference-in-Difference GLM Analysis of Healthcare Costs (Knee and Hip Replacements relative to Comparison Cohort)

	Knee Replacement vs. Comparison Cohort		Hip Replacement vs. Comparison Cohort	
Parameter	Parameter Estimate	Pr > |Z|	Parameter Estimate	Pr > |Z|
Joint Replacement Surgery (vs. Comparison)	-0.165	<.001	-0.276	<.001
Time (Last 180 Days vs. 180 Days before index date)	-1.233	<.001	-1.236	<.001
Joint Replacement*Time (DID Effect)	-0.603	<.001	-0.438	<.001
Gender (Female vs. Male)	-0.063	0.294	-0.068	0.271
Age	-0.010	<.001	-0.005	0.057
Race (White vs. Non-white)	0.181	0.005	0.116	0.096
LIS/Dual Eligibility	0.075	0.273	0.069	0.419
Geographic Region (West vs. Midwest)	-0.088	0.364	0.121	0.341
Geographic Region (South vs. Midwest)	-0.243	<.001	-0.188	0.005
Deyo-Charlson Score	0.020	0.445	0.024	0.360
RxRisk-V Score	0.066	<.001	0.080	<.001
COPD	-0.033	0.685	-0.215	0.002
Diabetes	-0.095	0.159	-0.133	0.068
Dyslipidemia	0.053	0.352	-0.027	0.636
Heart Failure	-0.043	0.711	-0.057	0.473
Fibromyalgia	0.184	0.064	0.128	0.125
Depression	0.167	0.050	0.150	0.096
Anxiety	0.088	0.372	0.042	0.694
Coexisting Pain Condition	0.032	0.757	0.244	0.087

Note to Tables 3 & 4: Coexisting pain condition was defined by the following ICD9-CM codes: 346.xx Migraine; 564.1 Irritable Bowel Syndrome; 388.3 Tinnitus; 780.71 Chronic Fatigue Syndrome.

- For both knee and hip replacement cohorts, OA-related costs were lower than for the comparison cohort (coefficient for knee replacement vs. comparison: -.165, p<.001; coefficient for hip replacement vs. comparison: -.276, p<.001, **Table 3**). Over time, OA-related costs for the joint replacement cohorts decreased more than for the comparison cohort (-1.233 for knee replacement, -1.236 for hip replacement; p<.001 vs. comparison for both).
- The interaction term (DID effect) was -.603 for knee replacement*time and -.438 for hip replacement*time (**Table 3**, p<.001 versus comparison for both). Exponentiating these coefficients (.547 for knee and .645 for hip vs. comparison) imply costs were 45.3% less for the knee replacement cohort and 35.5% less for the hip replacement cohort relative to the comparison cohort.

Table 4 Time to Event Analyses, Post-Joint Surgery

	Knee Replacement Cohort		Hip Replacement Cohort	
Secondary Outcome	n (%)	Time (days) to Event Mean (Median)	n (%)	Time (days) to Event Mean (Median)
OA Related Hospital Re-Admissions				
Event	56 (0.3%)	175.5 (168)	23 (0.3%)	179.8 (175)
Censored	17,809 (99.7%)	*	7,294 (99.7%)	*
Infections				
Event	258 (1.4%)	79.9 (36)	107 (1.5%)	62.9 (28)
Censored	17,607 (98.6%)	*	7,210 (98.5%)	*
Revision Surgeries				
Event	599 (3.4%)	133.6 (119)	328 (4.5%)	105.6 (44)
Censored	17,266 (96.7%)	*	6,989 (95.5%)	*
Venous Thromboembolic Events				
Event	1,009 (5.6%)	45.4 (13)	376 (5.1%)	49.5 (16)
Censored	16,856 (94.4%)	*	6,941 (94.9%)	*

* All members were censored after 360 days if the event did not occur.

- Time-to-event results were similar between the two cohorts, except for revision surgeries, with mean (median) days to revision surgery of 133.6 (119) days for the knee replacement cohort and 105.6 (44) days for the hip replacement cohort, respectively (**Table 4**).

Discussion

- Whereas prior studies have shown knee and hip replacements result in improved outcomes,[6,7] this is the first study to explicitly investigate a comparison cohort of members undergoing steroid or viscosupplementation injections.
- Members without significant comorbid conditions undergoing knee or hip replacement procedures had a greater decrease in OA-related healthcare resource utilization and costs once they recovered from surgery relative to pre-surgery, and relative to the comparison cohort of members with intraarticular injections.
- These results also suggest that, while initially generating lower cost, the alternative treatment of steroid and viscosupplementation injections may actually result in increased utilization and cost over time.
- Reported elsewhere to increase the risk of persistent pain,[5,8,9,10] the comorbid conditions of depression, anxiety, fibromyalgia and chronic pain could have resulted in increased costs despite a surgery conducted primarily to relieve pain. Patients with comorbid conditions were identified by a recorded diagnosis code on a medical claim, which is likely to be under-reported under normal medical practice.
- Under-representation due to lack of medical recording may result in reduced statistical power to show a significant effect. A prospective study would be required to more thoroughly investigate the potential effect of these comorbid conditions on costs following total joint replacement surgery.

Limitations

- Members of the comparison cohort may have been sicker and of lower socioeconomic status than members with joint replacements, as indicated by differences in demographic and clinical characteristics. While differences were small, these may have precluded some members of the comparison cohort from being considered for joint surgery.
- If OA was not documented on the claim, post-surgery healthcare utilization and costs may have been underestimated by not including the cost of thromboembolic events, nosocomial infections, or other potential consequences of the surgery and inpatient stays known to be higher with surgery.[11] Furthermore, restricting the study to members with continuous enrollment may have resulted in an underestimation of readmissions, infections, and thromboembolic events resulting in disenrollment due to death.

Conclusion

This comparative study suggests better outcomes among OA members with knee or hip replacements relative to OA members with steroid or viscosupplementation injections. However, high rates of VTE post-surgery highlight the potential need for increasing prophylactic therapy with anticoagulants as appropriate.

References

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Disclosures

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- **Conflicts of Interest:** Margaret Pasquale and Anthony Louder are employees of Comprehensive Health Insights, a wholly owned subsidiary of Humana Inc., who were paid consultants to Pfizer. Andrew Reiners is an employee of Humana Inc. Raymond Cheung, Jack Mardekian, and Veerainder Goli are employees and stockholders of Pfizer Inc. Robert Sanchez was an employee of Pfizer Inc. at the time of this study, and is a stockholder of Pfizer Inc.