The Uneven Distribution of High-Volume Revision Arthroplasty Centers Across the U.S. Produces Geographic Disparities in Access to Care

Ari Samuel Hilibrand, Nicholas Sauder, Michael Booth, Hayden N Box, Kyle Alpaugh, Anoop Prasad, Christopher Michael Melnic, Hany S Bedair

INTRODUCTION:

Revision joint arthroplasties (RJAs) are more complicated than primary procedures. Thus, some patients seek RJA surgeries at higher volume surgical centers far from their homes. This trend has led to the phenomenon of “Revision Centers” which attract patients from broad catchment areas. The importance of such centers is highlighted by findings that high volume revision surgeons have lower rates of re-revision. Since Medicare patients have been shown to travel further for RJA than commercially insured patients, Medicare records are an informative dataset from which to identify these “Revision Centers.” The current study seeks to identify the high volume revision centers (HVRCs) within the Medicare population and quantify the geographic distribution and accessibility of these centers.

METHODS:

The Medicare Inpatient Hospitals database was queried for all Medicare inpatient revision hip and knee arthroplasty procedures from 2013-2022 (270,848 arthroplasties). Patient/third-party payments were calculated as the portion of total payment not covered by Medicare. The U.S. Census Bureau Gazetteer Files and 2020 Decennial Census data were utilized to extract the geographic coordinates and population of every ZIP code. Distances from ZIP codes to revision centers were calculated as Haversine Great-Circle Distances. Z-Score analyses compared individual hospitals with the distribution of all hospitals performing Medicare RJAs. Analyses of variance were utilized.

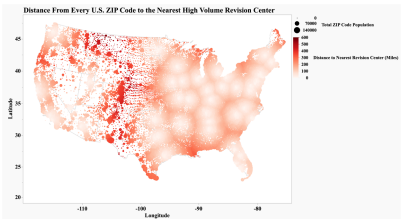
RESULTS:

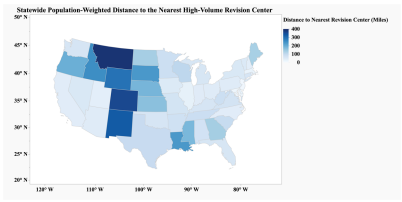
Across 2013-2022, 1,239 hospitals performed RJAs on Medicare patients, representing less than half of the 2,917 hospitals that performed primary inpatient Medicare arthroplasties over the same period. RJA volume varied widely across U.S. hospitals between the minimum of 11, the median of 113, and the maximum of 4382 RJAs. This distribution results from a large number of centers with close to U.S. median RJA volumes and a small number of HVRCs. To identify these centers, an outlier cutoff of more than two standard deviations from the mean RJA volume ($Z>2$) was applied, yielding 57 outlier HVRCs. Only eight of these centers were in the western United States. Interestingly, the cost to patients of revision arthroplasty at twenty-six of these HVRCs was lower than the U.S. average ($3652.6).

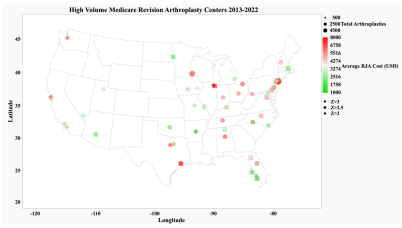
To quantify the impact of this non-uniform distribution on patient access to high quality care, the U.S. population distribution must be considered. Calculating distances from every ZIP code to the nearest HVRC revealed substantial maldistribution such that many populous ZIP codes remained quite far from an HVRC. ZIP code population-weighted mean distances to nearest revision centers for each contiguous U.S. state and Washington D.C. were calculated. This revealed large, statistically significant disparities in geographic access to HVRCs ($p<0.0001$). At the extremes, the nearest revision center was an average of 12.4 miles away from Washington D.C. residents, 19.0 miles away from NJ residents, and 391.9 miles away from Montana residents. Residents of the Mountain West states, North/Central Plains states, Oregon, Louisiana, and Mississippi experienced the most significant disparities. Maine and Georgia were also somewhat underserved.

DISCUSSION AND CONCLUSION:

Inpatient Medicare RJA procedures are non-uniformly distributed across hospitals in the U.S. Most of the hospitals that perform RJAs perform relatively few, while a small number maintain orders of magnitude higher surgical volume. The geographic maldistribution of these high volume revision centers limits access for patients in certain regions of the country. This places a financial and logistical burden on patients who may decide to travel to an HVRC for RJA care. In addition, this burden accentuates existing healthcare disparities whereby disadvantaged and underserved patients may be unable to afford the travel and care costs at an HVRC. Efforts must be made to support the development of HVRCs in underserved regions such as the Mountain West and North/Central Plains states, Oregon, Louisiana, and Mississippi to expand access and limit disparities.


Distance From Every U.S. ZIP Code to the Nearest High Volume Revision Center
0
70000
140000
Total ZIP Code Population
600
500
400
300
200
100
0
Distance to Nearest Revision Center (Miles)
Latitude
45
40
35
30
25
20
-110
-100
-90
-80
Longitude


Statewide Population-Weighted Distance to the Nearest High-Volume Revision Center
Distance to Nearest Revision Center (Miles)
400
300
200
100
0
50° N
45° N
40° N
35° N
30° N
25° N
20° N
120° W
110° W
100° W
90° W
80° W


High Volume Medicare Revision Arthroplasty Centers 2013-2022
500
2500 Total Arthroplasties
4500
8000
6750
5516
4274
3274
2516
1750
1000
Z> 3
Z>2.5
Z>2
Average RJA Cost (USD)
Latitude
45
40
35
30
25
20
-120
-110
-100
-90
-80
Longitude