Prevalence and Projections for Upper Extremity Arthroplasty in the United States
+1,2Day, J S; 1Lau, E; 1Ong, K L; 1Williams, G R; 1Ramsey, M L; 1Kurtz, S M
+1Drexel University, Philadelphia, PA; 1Exponent, Inc., Philadelphia, PA; 1Exponent, Inc., Menlo Park, CA; 1Rothman Institute, Philadelphia, PA
Senior author jdav@exponent.com

INTRODUCTION:

Over the past decade, the demand for hip and knee arthroplasty has grown substantially with expected growth rates of up to more than 600% by the year 2030 [Kurtz, 2007]. The purpose of this study was to use the Nationwide Inpatient Sample (NIS) to examine trends in upper extremity arthroplasty in the United States. Procedure rates for upper extremity arthroplasty were analyzed including gender, age and race related effects. Trends were analyzed and projections were made up until 2015.

METHODS:

The Nationwide Inpatient Sample (1993-2006) was used in conjunction with U.S. Census Bureau data to quantify primary arthroplasty rates as a function of age, race, and gender. Surgical procedures were identified from the discharge records using the 9th Revision of the International Classification of Diseases (ICD-9-CM). Total and partial (hemi) shoulder replacements were identified by the codes 81.80 (TSA) and 81.81 (HSA). Total elbow arthroplasty (TEA) was identified by the code 81.84. Revision of an upper extremity joint replacement was identified by code 81.97. During this time period, the ICD-9-CM codes for these procedures have been consistent, thereby allowing the analysis of longitudinal trends in data.

The annual prevalence of arthroplasty surgery was modeled using a Poisson regression with age, gender, race/ethnicity, census region, and calendar year as covariates to account for differences in prevalence among population subgroups as well as changes over time. Age was categorized into eight subgroups (<45, 45-54, 55-65, 65-74, 75-79, 80-84, and 85+ years), while race/ethnicity was grouped into two categories (White, Non-white). Four census regions (Northeast, South, Midwest, and West) and the two genders were also categorical covariates in the analysis. Two-way interactions between age, gender, race, census region, and calendar year were included in the regression model. Surgery prevalence was calculated by dividing the number of procedures estimated from the NIS for each population subgroup by the corresponding population from the Census Bureau. The projected number of procedures was estimated by applying the surgery prevalence estimated from the regression model to the projected population data for each subgroup. The projected national total was the sum of the projected number of procedures from each subpopulation. Independent models were used for each type of shoulder and elbow arthroplasty. Length of stay and hospital charges were also analyzed for each procedure type.

RESULTS:

The number of all procedures as well as the procedure rates increased between 1993 and 2006. Overall, the number of primary procedures increased by between 262% (TEA) and 318% (TSA) while the procedure rates increased by between 230% (TEA) and 277% (TSA) in the same period. Revision procedures and rates increased by 436% and 385% respectively over the same period (Figures 1&2). This corresponds to growth rates of approximately 6 to 14% per year.

Projected procedures were predicted to increase by a further 212% (HSA) to 450% (Revision) of 2006 levels by the year 2015. This corresponds to an increase in procedure rate of between 196% (HSA) to 450% (Revision) of 2006 levels by the year 2015. This corresponds to an increase in procedure rate of between 196% (HSA) to 450% (Revision) of 2006 levels by the year 2015.

1). Procedure rate was lower for non-whites than whites and peaked in the 65 to 84 year age groups.

During the period studied, the reported length of hospital stay decreased by approximately 2 days for TSA and HSA (p<0.05). Length of stay in 2006 varied from 2.4 (TSA) to 3.9 days (TEA). Charges, in 2007 CPI adjusted dollars, increased for all four procedure types at rates that varied between $900 (TSA) and $1700 (TEA; p<0.05). Average charges ranged from $38,000 to $47,000 (TEA).

The proportion of procedures charged to Medicare/Medicaid varied from 51% (TEA) to 70% (TSA).

Table 1. Risk Ratios by gender, race and age.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
<th>White</th>
<th>Non-White</th>
<th>0-44 y.o.</th>
<th>45-54 y.o.</th>
<th>55-64 y.o.</th>
<th>65-74 y.o.</th>
<th>75-84 y.o.</th>
<th>85-99 y.o.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSA</td>
<td>1.0</td>
<td>1.22</td>
<td>1.0</td>
<td>0.45</td>
<td>1.0</td>
<td>1.0</td>
<td>0.9</td>
<td>0.89</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>HSA</td>
<td>1.0</td>
<td>1.65</td>
<td>1.0</td>
<td>0.48</td>
<td>1.0</td>
<td>7.6</td>
<td>35.9</td>
<td>78.6</td>
<td>86.8</td>
<td>32.0</td>
</tr>
<tr>
<td>TEA</td>
<td>1.0</td>
<td>2.33</td>
<td>1.0</td>
<td>0.69</td>
<td>1.0</td>
<td>7.6</td>
<td>19.7</td>
<td>41.7</td>
<td>57.7</td>
<td>35.8</td>
</tr>
<tr>
<td>Revision</td>
<td>1.0</td>
<td>1.42</td>
<td>1.0</td>
<td>0.50</td>
<td>1.0</td>
<td>4.1</td>
<td>5.6</td>
<td>8.2</td>
<td>7.4</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Figure 1: The number of total procedures increased steadily over the period studied.

Figure 2: Procedure rates increased steadily over the period studied.

DISCUSSION:

Our data indicate that there has been a steady increase in both the number and incidence rate for upper extremity arthroplasty during the time period analyzed. Our procedure rates are similar to those reported by the AAOS from the National Hospital Discharge Survey and similar to those reported using NIS data from 1990 to 2000 [Jain et al., 2006].

There was a degree of both gender and race disparity in the data examined. While gender disparity could be explained by higher rates of arthritis and osteoporosis in females, this may not be the case for race disparity, and may reflect access to health care. While the current data indicates that the length of stay has decreased during period studied, charges have increased. This is of particular concern considering the growing disparity between charges and reimbursements for orthopaedic procedures. The rapid increase in upper extremity arthroplasty may place increasing economic burden on the healthcare system.