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# Dramatic Increase in Total Knee Replacement Utilization Rates Cannot Be Fully Explained by a Disproportionate Increase Among Younger Patients

JOSEPH BERNSTEIN, MD; PETER DERMAN, MD, MBA

## abstract

Full article available online at [Healio.com/Orthopedics](http://Healio.com/Orthopedics)

The incidence of total knee replacement in the United States more than doubled between 1999 and 2008, increasing from approximately 263,000 to 616,000 cases. The purpose of this study is to evaluate the claim that there has been a disproportionate increase in knee replacements among younger patients owing to expanding indications for the procedure in this group. Data on the US population for individuals 18 to 44 years old, 45 to 64 years old, and 65 years and older were obtained from census data; the number of total knee replacements performed annually in each age group was acquired from the Agency for Healthcare Research and Quality and per-capita incidence rates were calculated. Applying the 1999 rates to the 2008 population, the number of knee replacements anticipated on the basis of population growth for each cohort was determined and compared with the number observed, yielding the unexplained growth. The data revealed that in 2008, approximately 305,000 knee replacements were performed beyond the number predicted by population growth alone. The largest segment of growth (151,000 cases) was among patients 65 years and older; the per-capita growth rate was highest in this cohort as well, increasing from 5.2 to 9.1 procedures per 1,000 individuals. The data show conclusively that a disproportionate increase in knee replacements among younger patients is not a full explanation for the growth in utilization. In fact, it is not even the best among alternative explanations. The main locus of growth was among traditional patients 65 years and older.

*The authors are from the Department of Orthopaedic Surgery (JB), University of Pennsylvania, Philadelphia, Pennsylvania; and the Department of Orthopaedic Surgery (PD), Hospital for Special Surgery, New York, New York.*

*The authors have no relevant financial relationships to disclose.*

*Correspondence should be addressed to: Joseph Bernstein, MD, Department of Orthopaedic Surgery, University of Pennsylvania, 424 Stemmler Hall, Philadelphia, PA 19104-6081 (orthodoc@uphs.upenn.edu).*

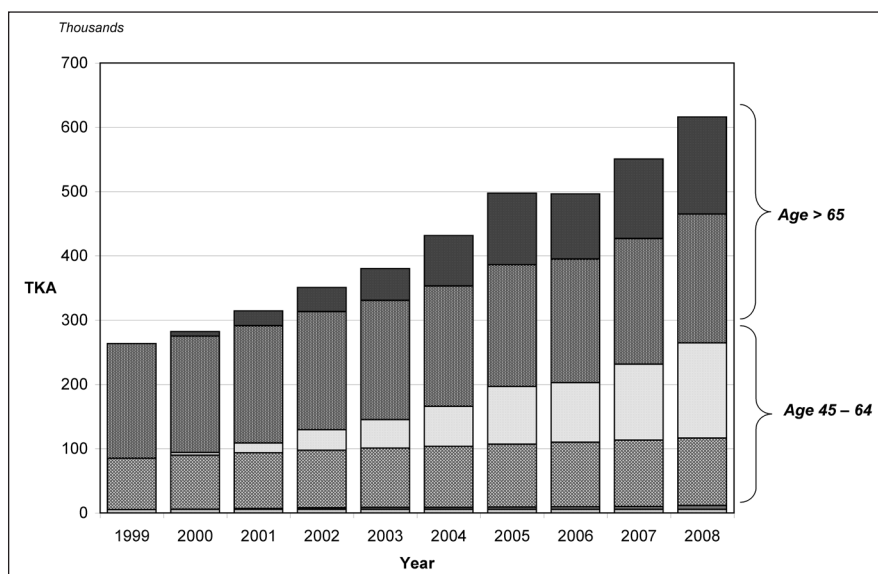
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The incidence of total knee replacement in the United States more than doubled from 1999 to 2008, increasing from approximately 263,000 to 616,000 total knee replacements.<sup>1</sup> According to one study, the demand for primary knee replacements is predicted to increase to 3.48 million procedures by the year 2030.<sup>2</sup> However, as noted by Losina et al,<sup>3</sup> “the reasons for the growing number of total knee replacements performed each year remain poorly understood.” They reported that “population growth and obesity cannot fully explain the rapid expansion of total knee replacements in the last decade, suggesting that other factors must also be involved.” They further stated that there was a “disproportionate increase in total knee replacements among younger patients. . .[owing to] expanding indications for the procedure.”<sup>3</sup>

The purpose of the current study is to evaluate the claimed disproportionate increase in total knee replacements among younger patients. An assessment of the number of knee replacements performed from 1999 to 2008, stratified by age and adjusted for population growth, allows for a more accurate characterization of the surplus. Specifically, by comparing the number of knee replacements anticipated on the basis of population growth to the quantity produced, one can identify the number of procedures that population growth fails to explain.

In addition, or as an alternative to the hypothesis that a disproportionate increase in knee replacements among younger patients exists, the authors may find that increased utilization among traditional patients (ie, those not “young”) may have contributed significantly to overall growth. In turn, this phenomenon may suggest that traditional means of expanding utilization, such as increased access, broadened indications, and greater patient willingness to undergo surgery, are also important explanations (if not more important).



**Figure 1:** Bar graph showing the number of total knee replacements output by year. Each bar, representing the output for the given year, has 6 components: for each of the 3 age groups, the hatched area shows the output predicted by population growth and the solid area above that shows the excess above that which population growth would predict. Abbreviation: TKA, total knee arthroplasty.

**MATERIALS AND METHODS**

Data for 3 age groups of the US population—18 to 44, 45 to 64, and 65 years and older—were obtained from government census data<sup>4</sup> for years 1999 to 2008. The number of total knee replacements performed annually in each of the aforementioned age groups from 1999 to 2008 was acquired from the Healthcare Cost and Utilization Project’s Nationwide Inpatient Sample.<sup>1</sup> Per capita rates of total knee replacements per 100,000 individuals in the 3 groups were derived from the population and incidence data.

By applying the 1999 rates to the population for each subsequent year, the authors were able to determine the number of procedures anticipated on the basis of population growth for each cohort. Subtracting that number from the actual number of surgeries performed identified the surplus—or unexplained growth.

**RESULTS**

The US population increased from approximately 273 million in 1999 to more than 304 million in 2008, a 25% increase. In that decade, the cohort 45 to 64 years

old expanded the most, from 59 to 78 million. The cohort 65 years and older increased from 35 to 39 million.

Approximately 264,000 total knee replacements were performed in 1999 and approximately 616,000 in 2008, a 234% increase. Fewer than 48,000 of the 353,000 additional procedures performed in 2008 can be explained based on population growth (Figure 1).

The annual per capita rates of knee replacements among patients 65 years and older compared to the rates among patients 45 to 64 years old is shown in Figure 2. In 1999, there were 5.2 procedures performed for every 1000 individuals 65 years and older vs 9.1 in 2008. For those 45 to 64 years old, the rates were 1.4 and 3.3, respectively. Approximately 151,000 more procedures were performed for those 65 years and older and 148,000 more for those 45 to 64 years old.

**DISCUSSION**

The incidence of total knee replacements in the United States from 1999 to 2008 increased at an annual rate of more than 9%, from 264,000 in 1999 to approx-

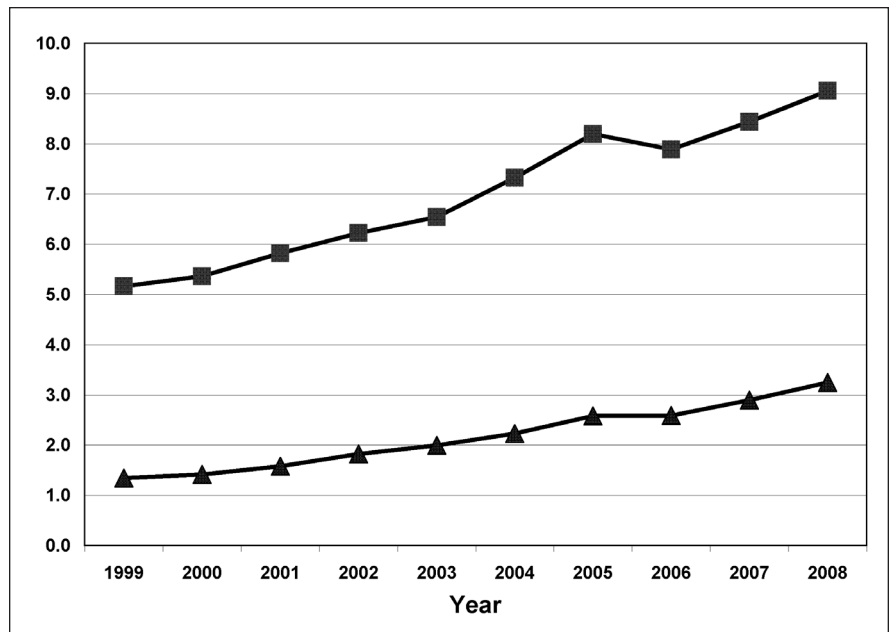
imately 616,000 in 2008. Only approximately 13% of the 353,000 additional procedures can be explained by population growth.

Losina and Katz<sup>5</sup> proposed that obesity (as a precursor of arthritis) might be the primary explanation of this phenomenon. However, based on their data review, they ultimately concluded that obesity can “explain no more than a small portion of the increased utilization rates.” They then proposed that an increased incidence of knee replacements in younger patients may be responsible.<sup>6</sup>

The authors’ study offers some support for that claim. For one thing, the number of knee replacements in patients younger than 65 years more than tripled—from fewer than 80,000 in 1999 to more than 250,000 in 2008; moreover, the rate of surgery per person increased from 1.4 to 3.3 procedures for every 1000 individuals in that same time span. Nonetheless, expansion of utilization among younger patients cannot be held as the primary explanation of the growth in knee replacements overall.

Rather, the data demonstrate that the single largest source of growth was expansion among patients 65 years and older. In 2008, population growth based on the 1999 levels should have produced approximately 200,000 procedures in patients 65 years and older. However, more than 350,000 knee replacements were performed in that cohort in 2008. The net growth for the cohort 45 to 64 years old was smaller—approximately 148,000 cases. Moreover, the per capita rate of surgery in patients 65 years and older increased from 5.2 to 9.1 knee replacements performed per 1000 individuals. The net increase in the rate, 3.9 per 1000 individuals, was more than twice the net increase seen in patients 45 to 64 years old.

The growth in utilization among older patients is even more telling when, for example, one considers that a 64 year old who received a primary knee replacement in 2005 was not going to be a 65 year old



**Figure 2:** Line graph showing the rate of knee replacements per 1000 people in the 45 to 64 years (triangles) and 65 years and older (squares) cohorts.

who received a knee replacement in 2006. That is, the observed growth was seen despite the “diversion” of some of the expected production.

The current results echo those of Culliford et al,<sup>6</sup> who found that, despite increasing utilization rates in the United Kingdom for knee replacements, “the perception that the mean age for [this operation] has decreased over time is not supported.”

Unless a change in the prevalence of arthritis (a phenomenon for which there is no radiographic evidence<sup>7</sup>) was observed, there is a “traditional” patient (older than 65 years) whose burden of disease would have prompted a total knee replacement using the 2008 standards but would have been managed nonoperatively in 1999.

The increased incidence of surgery does not mean that indications for surgery have changed. Three alternative explanations might also apply: changes in patient awareness,<sup>8</sup> changes in patient attitudes,<sup>9,10</sup> and changes in surgeon manpower.<sup>11</sup> That is to say that perhaps more patients were aware of their surgical options and thus more people presented for

care; that perhaps patients might have been more willing to have surgery based on perceived improvements in the operation; or that perhaps there are simply more surgeons willing or able to meet demand in 2008 than there were in 1999.

It must be stressed that this study makes no claim about the correct rate of surgery. Although a doubling in the incidence of total knee replacements from 1999 to 2008 may suggest that too much surgery was performed in 2008, it is equally possible that the 1999 rate represents vast underservice. In addition, even if one were certain that one rate or the other is the appropriate one, population data offer no hint as to whether the number of people who had surgery were the most appropriate recipients. Similarly, the authors have no opinion as to whether the choice made by orthopedic surgeons to perform more knee replacements, either by supplanting other activities or by adding to their prior workload, was the correct one. In short, observational studies such as this one make no statements about what should be.

The data show conclusively that the growth in surgery in younger patients is

not a full explanation for the growth in utilization. In fact, it is not even the best among alternative explanations. The main locus of growth was among patients 65 years and older.

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