

PREDICTING THE BURDEN OF KNEE ARTHROPLASTY REVISION OVER A 20-YEAR HORIZON

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BACKGROUND AND OBJECTIVE

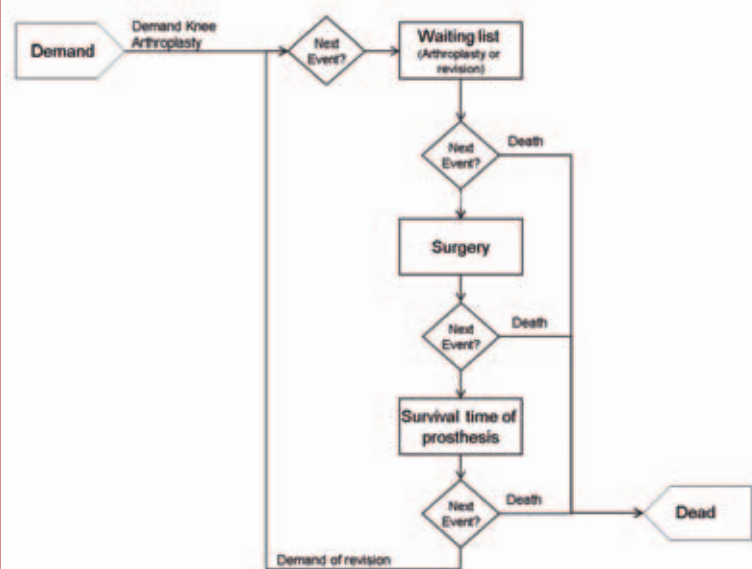
Knee osteoarthritis is a frequent cause of musculoskeletal pain in older adults and may result in decreased mobility and quality of life. When the disease is severe and the conservative treatment fails, primary knee arthroplasty is a highly efficacious and cost-effective procedure. In recent years, rates of knee arthroplasty have increased in most Western countries because of ageing, reduced surgical risk and broader criteria for surgery. A key point to assess effectiveness is the survival of knee prostheses, as revision knee arthroplasty, to substitute totally or partially the prosthesis, is a more complex and resource consuming procedure. Thus, it is important to take into account the future burden of revision knee arthroplasties and its impact on the availability of resources for primary knee arthroplasties in the coming years.

The aim of this study was to estimate future scenarios of revision knee arthroplasty utilization in the Spanish National Health System at the short and long term and its impact on primary knee arthroplasty (KA) utilization.

METHODS

A discrete event simulation model was built to represent the utilization of primary and revision KA for 20 years (2011-2031) in the Spanish National Health System, according to different scenarios of utilization and prostheses survival. The model was built to represent the process from a primary KA to a revision or death. New patients in the model represent demand of primary KA, have their own characteristics such as age and sex and are included in a waiting list. Surgery applies to patients in the waiting list according to the daily surgery capacity of the system. Each patient operated of primary arthroplasty was assigned a survival time of the prostheses. If survival of the prostheses was shorter than lifetime, the patient returned to the waiting list with the highest priority (Figure 1).

Figure 1: Conceptual model.



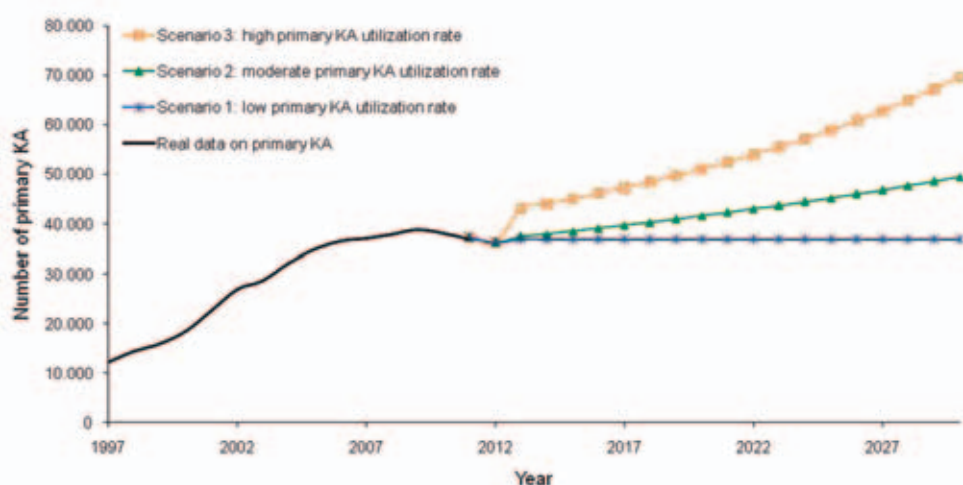
Data on KA utilization from 1997 to 2011 was obtained from the Minimum Data Set of the National Health System. In order to simulate future utilization of primary knee arthroplasty, three scenarios under different assumptions were considered. In the “**Scenario 1: low primary KA utilization rate**” the resources were considered constant from 2011 to 2031, and therefore, the number of surgeries per year wasn’t changed during the period. In the “**Scenario 2: moderate primary KA utilization rate**” the number of surgeries was projected for the years 2012 to 2031 considering 2011 age and sex specific KA rates on the long-term projections of the Spanish population (2012-2051). Finally, in the “**Scenario 3: high primary KA utilization rate**” the number of primary KA was linearly projected based on the linear relationship between population number and number of primary KA for the group of 75 years or more (methodology in Bashinskaya et al., *ISRN Orthop* 2012).

The preceding scenarios on primary KA utilization were combined with two scenarios on prosthesis survival time. The “**Scenario B: Better survival (RACat)**” function (five-year survival 96.5%) was based on the primary and revision KA registered in RACat between 2005 and 2011 (n=44,557). The “**Scenario W: Worse survival (AIAQS)**” function (five-year survival 91.5%) considered the survival function estimated within a retrospective cohort study on KA in 8 hospitals in Spain between 1995 and 2000 (n=2,000).

The model was programmed using ARENA version 14.0 (Rockwell Software). The simulation results were analyzed at the short (2015) and long-term (2030).

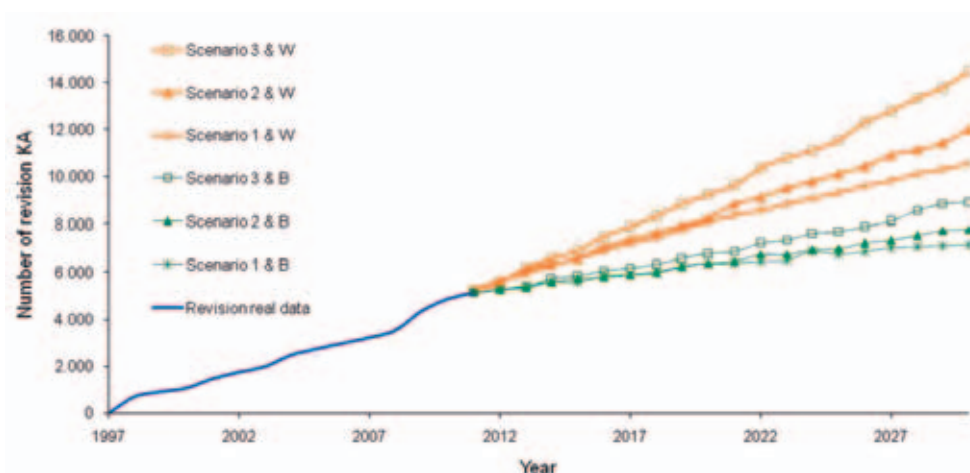
RESULTS

Figure 2: Evolution of the scenarios used for number of primary knee arthroplasties, 2012-2030.



KA: Knee Arthroplasty

Figure 3: Simulation results on revision knee arthroplasty according to scenarios, 2012-2030.



KA: Knee Arthroplasty. Scenarios for primary KA utilization: 1 low, 2 moderate, 3 high. Scenarios for prostheses survival: B better, W worse.

Variations in the number of revisions depended on both the primary utilization rate and the survival function applied, ranging from 8.3% to 31.6% increase at the short-term and from 38.3% to 176.9% at the long term, percentages corresponding to the combinations of scenario 1 (low primary utilization rate) and survival function B (better survival) versus scenario 3 (high primary utilization rate) and survival function W (worse survival), respectively. The prediction of increase on overall surgeries ranged from 0.1% to 22.3% at the short-term and from 3.7% to 98.2% at the long-term.

CONCLUSIONS

Projections of the burden of knee arthroplasty provide a quantitative basis for future policy decisions relating to concentration of high complexity procedures, the number of orthopaedic surgeons required to perform these procedures and the number of resources needed.