

An Evaluation of Strategies to Reduce Waiting Times for Total Joint Replacement in Ontario

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Reprints

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Conflicts of Interest

No potential conflicts exist

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Running Head: Strategies to reduce waiting times for total joint replacement

An Evaluation of Strategies to Reduce Waiting Times for Total Joint Replacement in Ontario

Abstract

Background: In 2005, the median waiting time for total hip and knee joint replacements in Ontario was greater than 6 months, which is considered longer than clinically appropriate. Demand is expected to increase and exacerbate already long waiting times. Solutions are needed to reduce waiting times and improve waiting list management.

Methods: We developed a discrete event simulation model of the Ontario total joint replacement system to evaluate the effects of 4 management strategies on waiting times: (1) reductions in surgical demand; (2) formal clinical prioritization; (3) waiting time guarantees; and (4) common waiting list management.

Results: If the number of surgeries performed increases by less than 10% each year, then demand must be reduced by at least 15% to ensure that, within 10 years, 90% of patients receive surgery within their maximum recommended waiting time. Clinically prioritizing patients reduced waiting times for high-priority patients and increased the number of patients at all priority levels who received surgery each year within recommended maximum waiting times by 9.3%. A waiting time guarantee for all patients provided fewer surgeries within recommended waiting times. Common waiting list management improved efficiency and increased equity in waiting across regions.

Discussion: Dramatically increasing the supply of joint replacement surgeries or diverting demand for surgeries to other jurisdictions will reduce waiting times for total joint replacement surgery. Introducing a strictly adhered to patient prioritization scheme

will ensure that more patients receive surgery within severity-specific waiting time targets. Implementing a waiting time guarantee for all patients will not reduce waiting times—it will only shuffle waiting times from some patients to others. To reduce waiting times to clinically acceptable levels within 10 years, increases in the number of surgeries provided greater than those observed historically or reductions in demand are needed.

Key Words: queuing, waiting time guarantees, patient prioritization, waiting list management, total joint replacement

Long waiting times for elective surgical procedures, such as total joint replacement (TJR), are a health policy concern in many OECD countries.¹ Total hip and total knee replacement surgeries are clinically-effective and cost-effective interventions.²⁻⁵ Long waiting times for TJR affect quality of life^{6,7} and have many economic consequences.⁷⁻¹⁰ Several initiatives to reduce waiting times for TJR surgery have been attempted around the world with varying success. However, waiting list reduction programs are expensive and no clear solution has been identified.

In Ontario, Canada, waiting times for elective total hip and total knee replacements increased between 2001 and 2005.¹¹ In 2005, the median waiting time for total hip replacement was over 5 months and the median waiting time for total knee replacement was 8 months.¹¹ Median waiting times vary widely across the province: from 4 to 9 months for total hip replacement and from 6 to 11 months for total knee replacement.¹¹ Demand for TJR is expected to increase substantially due to changing demographics,^{2,12} socioeconomic factors,^{13,14} increasing rates of obesity,^{15,16} and arthritis,¹² expanded clinical criteria for eligibility,^{2,17,18} and patients' increased willingness to undergo surgery.^{13,19} Demand for revision surgery will likely increase as more TJR are performed on younger patients.^{17,18}

Widespread concern exists as to whether patients are able to access TJR within a clinically acceptable time frame.^{11,20-22} The current federal waiting time benchmark for TJR is 6 months from the date of decision to have surgery until the surgery is performed.²³ Several clinical organizations define the maximum recommended waiting times for high, intermediate, and low- priority patients as 1 month, 3 months, and 6 months from the decision to have surgery, respectively.^{20,24,25}

TJR is a publicly insured service in Ontario. The Ministry of Health and Long-Term Care determines the maximum number of surgeries that can be performed each year and allocates funding across the province. Between 1995 and 2004 the number of primary and revision TJR surgeries performed in Ontario increased by approximately 5.9% annually.¹¹ To reduce waiting times, the number of elective surgeries increased by 16.4% in 2005.¹¹ One study showed that if 16% increases could be maintained for several years then, within 7 years, 90% of patients would receive surgery within 6 months of their decision to have surgery.²⁶ However, human resource shortages in orthopedics,²⁷ anesthesiology,²⁸ and nursing²⁹ may prevent this high level of sustained growth.

We used a discrete event simulation model of the Ontario TJR system to evaluate several strategies for reducing waiting times including: (1) reductions in demand for surgery; (2) patient prioritization; (3) waiting time guarantees; and (4) common waiting list management.

Methods

We used a discrete event simulation model which has been described in detail elsewhere²⁶ Surgeons in Ontario were grouped into 25 service providing regions: 11 teaching hospitals and 14 groups of community hospitals organized on the basis of Ontario's 14 Local Health Integration Networks.³⁰

The Ontario Joint Replacement Registry (OJRR) was a clinical registry that collected demographic, medical, surgical, and outcomes information on patients who received TJR in Ontario from 1999 to 2006. We used data from the OJRR to estimate the number of patients waiting for surgery in each region, the number of new patients joining the waiting lists of

each region each month and the travel patterns of patients, as well as patient acuity and demographic information.

The simulation model started on March 31, 2005 with 26,583 patients waiting across the province and progressed in 1-month intervals for 10 years. Each month the following actions occurred in sequence in each region: (1) the number of patients who decided to have surgery and the amount of surgical capacity available in each region was determined; (2) new patients were added to the end of each region's waiting list; (3) patients on each list were sorted based on clinical severity and length of wait; and (4) patients at the top of each list were removed. The waiting time was the number of months between joining the waiting list for surgery and receiving the surgery. Each scenario was simulated 100 times.

Results

Reducing Demand and Increasing Supply

To assess the impact of demand reduction policies we reduced total demand projected each year and estimated the amount of time required to reduce waiting times enough that 90% of patients received surgery within their recommended maximum waiting time (Table 1). With no reduction in demand and the number of elective surgeries available growing at 14% annually, it would take 9.5 years to meet this target. When demand was reduced by 5% and 10%, the timelines were reduced by approximately 1 and 2 years, respectively. When demand was reduced by 15%, 20%, and 25%, the timelines for achieving the target were reduced by 2 to 5 years depending on the rate at which the number of elective surgeries available increased. Even when demand was reduced by 25%

and the number of surgeries available each year grew by 16%, a minimum of 4.5 years was required to achieve the 90% target.

Patient Prioritization

We compared 2 methods of prioritizing patients within each region: status quo, defined as a mixture of clinical prioritization and time already waited; and strict clinical prioritization, in which higher priority patients always received surgery before lower priority patients and patients with equal clinical priority received surgery on a first-come first served basis (Fig. 1).

In the first 5 years after the implementation of strict clinical prioritization, the average number of high- and intermediate-priority patients who received surgery within their maximum recommended waiting time increased, whereas the average number of low-priority patients who received surgery within 6 months decreased. The net effect of changing from the status quo to a clinical prioritization policy was that, on average, 9.3% more patients received surgery within their maximum recommended waiting time each year (Table 2).

Waiting Time Guarantees

We compared the base case, with no waiting time guarantee, to 3 scenarios in which waiting time guarantees were implemented at the end of the third year (Fig. 2). The waiting time guarantees evaluated were (1) “high-priority patients must receive surgery within 3 months”; (2) “high- and intermediate-priority patients must receive surgery within 3 months”; and (3) “all patients must receive surgery within 6 months.” We assumed that all surgeries would continue to be provided in Ontario and that the total number of surgeries available for the year would not change as a result of the guarantee.

With guarantee 1 or 2, waiting times decreased for the targeted population, but increased for the remaining patient population. During the first 5 years after implementation, the net effect of changing from the status quo to guarantee 1 was that 0.6% fewer patients overall received surgery within their maximum recommended waiting time on average each year (Table 2). However, implementing guarantee 2 resulted in 6.1% more patients receiving surgery within their maximum recommended waiting time annually, averaged over the first 5 years of the guarantee.

Under guarantee 3, waiting times were reduced for low-priority patients at the expense of waiting times for the higher priority patient groups. During the first 5 years of this policy, the average effect of this guarantee was that 1.1% fewer patients received surgery within their maximum recommended waiting time each year.

Common Waiting Lists

We compared the base case with 25 regional queues to a scenario in which there was one common waiting list for the entire province (Fig. 3). In the common waiting list system, there was a short-term reduction in the proportion of patients who received surgery within their maximum recommended waiting time. During this period, the regional variation in waiting times was reduced. In the long-term, 90% of patients received surgery within their maximum recommended waiting time approximately 1 year earlier.

Sensitivity Analysis

We varied the length of the initial waiting list by $\pm 20\%$ (from 21,235 to 31,489) and varied the annual increase in demand from 4% to 14%. Waiting time targets were met sooner with either a shorter initial waiting list or a lower rate of new patient arrivals to the

waiting list, and later with either a longer initial waiting list or a higher rate of new patient arrivals.

We repeated the clinical priority and waiting time guarantee analyses using alternate distributions of patient severity. Holding the proportion of intermediate priority patients constant at 35%, we varied the proportion of high priority patients between 10% and 22% (base case = 16.0%) and varied the proportion of low priority patients between 55% and 43% (base case = 49%). We observed a relationship between the size of the group targeted to receive priority service, the benefits for that group, and the consequences for the nonpriority service group. When the size of group receiving priority service increased (decreased), the average waiting time benefit in that group decreased (increased) and the waiting time penalty for everyone else increased (decreased).

Discussion

Reducing Demand and Increasing Supply

We predict that the number of TJR surgeries provided in Ontario must increase by at least 12% annually to reduce waiting times enough that, within 10 years, 90% of patients will receive surgery within the federal benchmark of 6 months. If the timeline for achieving this benchmark is shorter or the ability of regions to perform more surgeries is limited then substantial demand reduction or diversion to other jurisdictions must take place. Until the waiting time guarantee applied to an individual patient, the patient's position on the list was determined using the status quo method. Thus, in a scenario in which no patient waited longer than the guaranteed period, patients would be seen in the same order as a scenario in which there was no guarantee policy.

Demand for TJR can be reduced in many different ways although none is perfect. Primary prevention, such as reducing rates of obesity, may provide reductions in demand, but only in the long-term. Explicit rationing based on clinical criteria could reduce demand. However, the population eligible for TJR is constantly being expanded by new clinical evidence.¹⁸ Regardless of how demand is reduced, our results suggest that the reduction will need to be large and sustained for several years to have any long-term impact on waiting times.

Permitting patients to obtain third-party insurance for TJR in a private setting may divert some patients out of the public system. However, this may exacerbate human resource shortages by also diverting orthopedic surgeons, anesthesiologists, and nurses out of the public service.²⁷⁻²⁹ Diversion of patients to other jurisdictions with excess capacity has been used in Ontario³¹ and British Columbia³² for other medical treatments and surgical procedures. Since all Canadian provinces currently have long waiting times for TJR any diversion would likely be to the United States. It is not known if primary TJR for Canadian patients, performed in the United States, would be cost effective. However, several US studies have found TJR to be cost effective^{4,5,32} and 1 Canadian study found that reducing waiting times for revision hip surgery can be cost saving.³⁴

Patient Prioritization

Clinical prioritization guidelines are available but they are not strictly adhered to in practice for several reasons including accommodating patient preferences and caregiving obligations, variation in interpretations of the guidelines, variations in case-mix, and preferential treatment of some patients over others.^{20,24,25,35-38} We compared a strictly

adhered to prioritization policy versus the status quo, in which each surgeon interprets and applies the prioritization guidelines independently. Compared with waiting time guarantees and common waiting list approaches, strict adherence to patient prioritization yielded the greatest improvement in waiting times for high and intermediate priority patients.

Waiting Time Guarantees

Waiting time guarantees were proposed in the Kirby report³⁹ and have since been widely debated.⁴⁰⁻⁴⁴ Our analysis demonstrated that clinical prioritization may be sacrificed when a guarantee policy targets all patient groups. This is because providing surgery within the guaranteed time to low-priority patients causes delays for high-priority patients. By sacrificing clinical prioritization for the waiting time guarantee policy, fewer patients overall received care within their maximum recommended waiting time. Our observations are consistent with observed outcomes when waiting time guarantees have been implemented. Surgeons in Sweden abandoned the mandated waiting time guarantee to ensure that they could prioritize on a clinical basis when simultaneously faced with a waiting time guarantee and volume constraints⁴⁵ In addition, concerns have been raised in the U.K. that in an effort to meet waiting time targets surgeons were no longer able to schedule patients in the order indicated by clinical priority⁴⁶ Although the number of long-waiting patients declined, it came at the expense of the health of more urgent patients.⁴⁶

Common Waiting Lists

The use of common waiting lists was recommended by the federal advisor on waiting times.⁴¹ We found that common waiting lists resulted in increased efficiency, increased equity in waiting times across regions, and reduced waiting times in the long

term. In the regional waiting list system, large variation in waiting times across regions persisted, whereas in the common waiting list system, variation in waiting times across regions was minimized resulting in similar severity-specific waiting time distributions across regions. Once the variation across regions was diminished, waiting times were reduced in all regions simultaneously. Common waiting list management resulted in achieving waiting time targets 1 year earlier, and thus had approximately the same effect as reducing demand by 5% each year. This occurred because there were fewer instances of an allocated surgery not being used.

Independently managed lists result in instances of patients with lesser need receiving care faster than patients with greater need due to the case mix and prioritization practice of different surgeons and may contribute to the appearance of inequity. We did not have sufficiently detailed information to model at the level of the individual surgeon, even though this is the level at which waiting lists are maintained. However, we would expect benefits from any degree of waiting list sharing, such as from physicians to groups of physicians within the same hospital, within the same region, or in geographically close regions. Common waiting list management may lead to reductions in the inequities across practices and reductions in waiting times for patients in the highest clinical priority groups.

Limitations and Conclusions

Our model has limitations. It is a high-level simplification of a complex system. We did not model the behaviors of individual patients and surgeons nor the specific capacity limitations faced by each hospital and each region. Instead we simulated at the regional level and used statistical rather than behavioral models of patient actions and surgeon waiting list management strategies. We did this because reporting by surgeons to the OJRR

was voluntary and completion rates varied widely. We adjusted volumes in under-reported regions according to submission rates and sought external validation for inputs whenever available. To mitigate the weaknesses of the OJRR dataset, we performed sensitivity analysis on parameters generated from the OJRR. In addition, we did not consider the possibility that the condition of patients who joined the waiting list in a low-priority group would eventually deteriorate causing them to become high- priority patients.

Two of the strategies evaluated—waiting time guarantees and clinical prioritization—only change the order in which patients are seen. However, they do not change and should not be expected to change average waiting times for all patients. According to basic queuing theory, this should only occur if capacity increases, demand decreases, or uncertainty around capacity or demand decreases.⁴⁷ Common management of waiting lists also does not change capacity. The gains observed when waiting lists are shared is due to a better match between supply and demand at all times. This gives the appearance of increased capacity but the reduction in waiting times is actually the result of increased system efficiency caused by less unused capacity.

The results shown here are not precise predictions of the future. Instead they highlight the differences between strategies. Significant reductions in demand or diversion to other jurisdictions were needed to have a noticeable impact on the time required to meet waiting time goals. Strict clinical prioritization resulted in the greatest improvement in the number of patients receiving surgery within maximum recommended waiting times. Waiting time guarantees for all patients, a politically popular strategy, had a small overall waiting time benefit that came at the expense of the highest priority patients. Common waiting lists reduced variation in waiting times between regions and reduced waiting times

in the long run. If the objective of policy-makers is to maximize the number of patients who receive surgery within their recommended maximum waiting time, then diversion of patients to jurisdictions with excess capacity and enhanced use of prioritization tools are likely to be more effective than waiting time guarantees.

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Figure Legends

Figure 1. The proportion of TJR patients who received surgery within the maximum recommended waiting time for each level of clinical severity. The 2 scenarios differ in the method of choosing which patient on the list will receive the next surgery: status quo (◆); clinical severity at the time of decision (○). In both scenarios, the number of elective surgeries available to be performed increased by 16% each year. A, The proportion of high priority patients.

Figure 2. The proportion of TJR patients who received surgery within the maximum recommended waiting time for each level of clinical severity. The scenarios differ in the presence and characteristics of the waiting time guarantee implemented: no guarantee (status quo, ◆); guarantee (1), "all high priority patients must receive surgery within 3 months" (A); guarantee (2), "All high and intermediate priority patients must receive surgery within 3 months" (□); guarantee (3), "All patients must receive surgery within 6 months" (X). In all 4 scenarios, the number of elective surgeries available to be performed increased by 16% each year. Column 1, panels A, B, and C: Guarantee 1 vs. the status quo. Column 2, panels D, E, and F: Guarantee 2 vs. the status quo. Column 3, panels G, H, and I: Guarantee 3 vs. the status quo. Row 1, panels A, D, and G: The proportion of high priority patients who received surgery within 1 month. Row 2, panels B, E, and H: The proportion of intermediate priority patients who received surgery within 3 months. Row 3, panels C, F, and I: The proportion of low priority patients who received surgery within 6 months, comparing each guarantee to the status quo across the row.

Figure 3. The proportion of all TJR patients who received surgery within the maximum recommended waiting time for each level of clinical severity. The scenarios differ in the level of waiting list sharing: regionally organized (♦); provincially organized (X). In both scenarios, the number of elective surgeries available to be performed increased by 16% each year. A, The proportion of high priority patients who received surgery within 1 month. B, The proportion of intermediate priority patients who received surgery within 3 months. C, The proportion of low priority patients who received surgery within 6 months.

Figure 1.

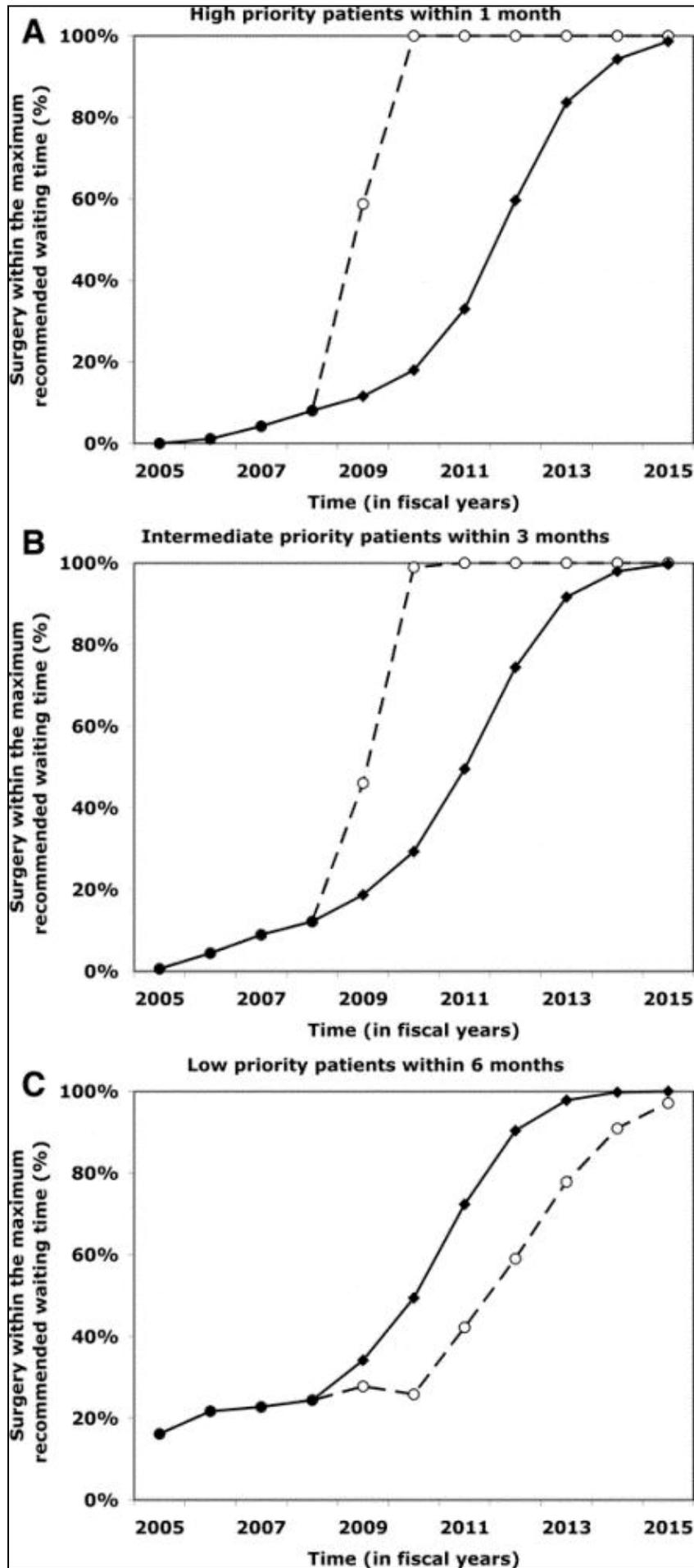


Figure 2.

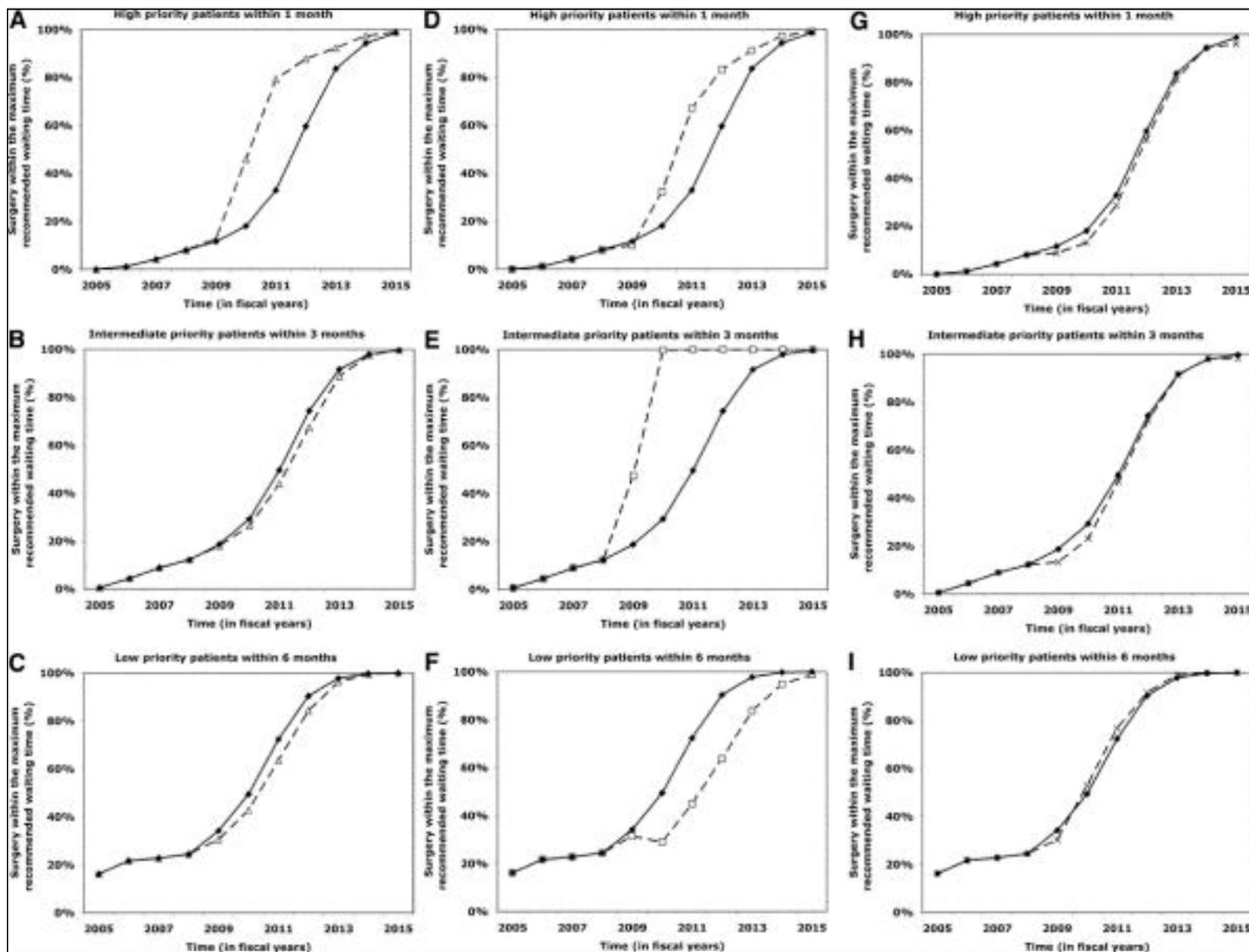


Figure 3

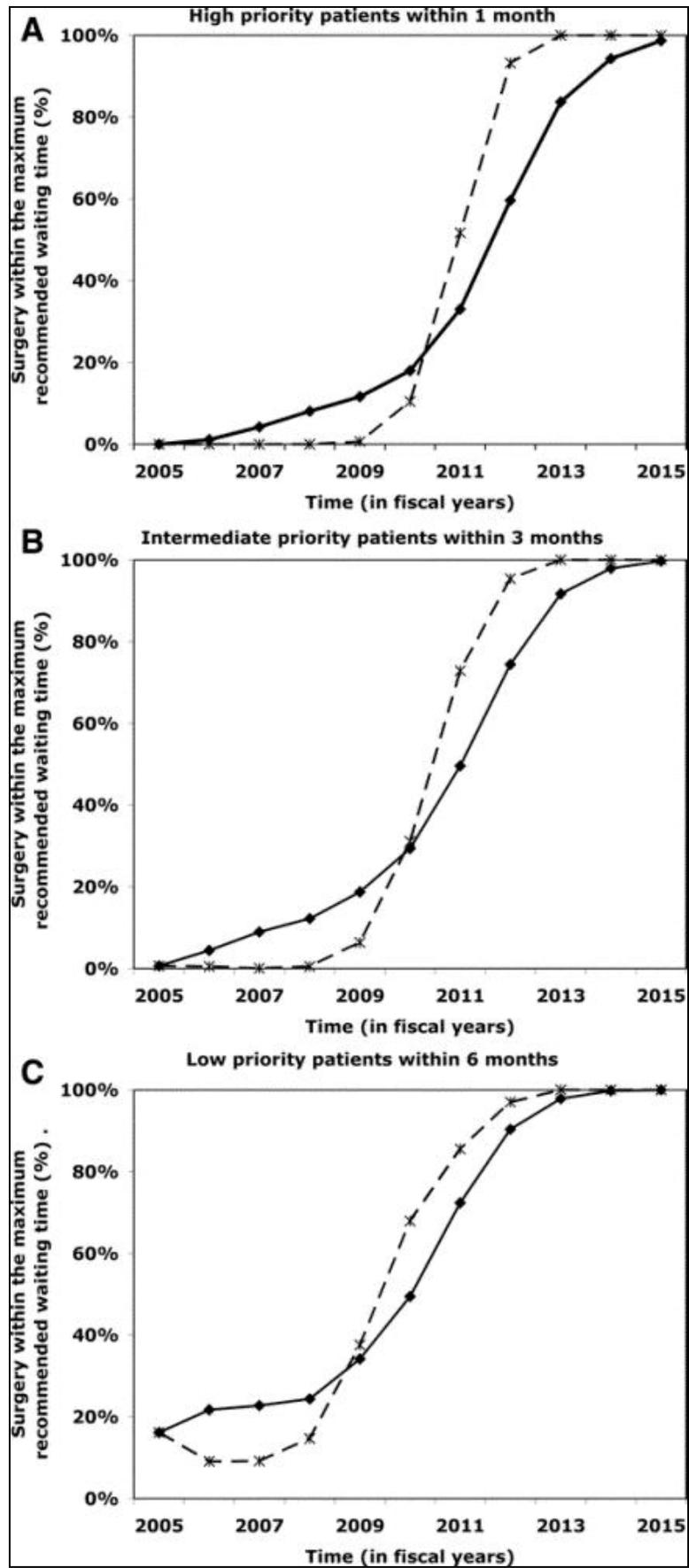


Table 1. The Approximate Number of Years Required Until 90% of Total Joint Replacement Surgeries are Provided Within the Priority-Specific Recommended Maximum Waiting Time.

Demand Reduction* (%)	Average Annual Demand Increase (%)	Annual Increase in Elective Surgeries Available			
		10%	12%	14%	16%
0	8.7	>10	>10	9.5	8
5	8.1	>10	>10	8.5	7
10	7.6	>10	10	7.5	6.5
15	7.0	>10	8	7	6
20	6.5	9	7	6	5
25	5.9	7.5	6	5	4.5

*Demand reductions were evenly distributed across all priority groups and across regions where patients sought care. Demand was calculated such that the projected total demand was first calculated, then total projected demand was reduced by the scenario specific rate.

Table 2 . Average Proportion of Patients by Priority Level Receiving Surgery Within Their Maximum Recommended Waiting Time Over the First 5 Years of Implementing the New Policy Under 5 Different Policy Options.

Policy Options	High-Priority Patients (%) (Within 1 Month)	Intermediate-Priority Patients (%) (Within 3 Months)	Low-Priority Patients (%) (Within 6 Months)	All Patients[†] (%) (Within Their Respective Maximum Recommended Waiting Times)
Status quo				
A mixture of clinical prioritization and time already waited	41.2	52.7	68.8	59.0
Clinical prioritization				
Patients are served in order of clinical priority regardless of time already waited	91.7	89.0	46.6	68.3
Waiting time guarantee policies [‡]				
1. High-priority patients must receive surgery within 3 mo	63.6	48.9	63.5	58.4
2. High- and intermediate-priority patients must receive surgery within 3 mo	56.7	89.4	50.6	65.1
3. All patients must receive surgery within 6 mo	37.5	49.3	70.1	57.9

^{*}The new policy was always implemented at the end of year 3. In all the scenarios presented, the number of elective surgeries available to be performed increased by 16% each year. Results presented are the average of years 4 through 8.

[†]Of all patients, 16.0% are high priority, 34.8% are intermediate priority, and 49.2% are low priority.

[‡]Until the waiting time guarantee applied to an individual patient, the patient's position on the list was determined using the status quo method. Thus, in a scenario in which no patient waited longer than the guaranteed period, patients would be seen in the same order as a scenario in which there was no guarantee policy.