Rationing of hip and knee replacement: effect on the severity of patient-reported symptoms and the demand for surgery in Otago

David Gwynne-Jones, Ella Iosua

ABSTRACT

AIM: A key Government health target has been to increase access to elective surgery. Despite this, there is a growing concern about unmet demand and increasing numbers of patients are being declined elective surgery. This study aims to determine whether there has been an increase in the severity of osteoarthritis of the hip and knee in patients undergoing publicly-funded elective total joint replacement (TJR) and any increase in demand for TJR in Otago.

METHOD: Demographic details and preoperative patient reported outcome scores (Oxford hip or knee score (OHS,OKS) and a reduced Western Ontario and McMaster Osteoarthritis Index (WOMAC) score (RWS)) were collected prospectively in an historical cohort of patients undergoing total hip and knee replacement (THR, TKR) between 2006–2010. These were compared with all patients undergoing THR and TKR in the 12-month period commencing 1 November 2013, and all patients waitlisted during this period but returned to GP due to capacity issues. An estimate of current demand was made by adding all waitlisted public patients from the 12-month period to surgical numbers from private and those funded by ACC.

RESULTS: In the 2006–2010 group of 613 patients, the mean OHS was 13.6 (SD 6.7) and OKS 15.4 (SD 6.5) and RWS 30.5 (SD 8.0). Three hundred and sixty-seven patients who underwent surgery in 2013/4 had significantly poorer scores (OHS 9.9 (SD 4.9), OKS 10.6 (SD 3.8), RWS 34.8 (SD 6.7)). The scores of 194 patients returned to GP in 2013/4 were the same as the historical surgical group (OHS13.0 (SD 6.2, OKS 15.2 (SD 5.9), RWS 30.8 (SD 8.4)). Six hundred and eight patients were wait-listed for public surgery and 356 joints were performed in private or under ACC in the 12-month period. The current intervention rate in Otago is 371/100,000 per year, while the demand has risen from 417/10000 in 2010–12 to 494/100,000 per year. In 2014, the shortfall was 241 joints per year.

CONCLUSION: Patients undergoing primary elective total hip and knee replacement in Otago in 2014 are more severely disabled than between 2006–2010. Patients currently being returned to GP would have qualified for publicly funded surgery during that period. The demand for elective TJR in Otago has increased by 19% since 2012.

Hip and knee replacement are two of the most successful interventions in orthopaedic surgery. The population of New Zealand is both ageing and growing, and it is predicted that there will need to be a large increase in the numbers of joint replacements over the next 10 years.\textsuperscript{1,2} The public health system is under significant funding constraints, and joint replacements are relatively expensive to provide. However, in the long term they are highly cost effective.\textsuperscript{3,5} In New Zealand, the ‘Joint Initiative’ ran from 2004 to 2008, which led to a significant increase in the number of joint replacements performed nationally. From 2008 onwards, the funding was no longer ringfenced and was included in the orthopaedic volumes of District Health Boards (DHBs). An increase in funding for orthopaedic procedures including joint replacement was signalled in the 2015 budget.
DHBs are required to prioritise patients and operate on the most in need. However, they are also obliged to meet Elective Surgical Performance Indicators (ESPIs). These include ESPI 5 (time to surgery from a certainty decision). This target was initially 6 months but reduced to 5 months in June 2013, and to 4 months in December 2014. This target has resulted in the so called ‘financial threshold’ score. If a patient is judged to benefit from surgery but capacity constraints mean that they cannot have surgery within the ESPI target, then they can be placed on Active Review if just below the threshold or returned to General Practitioner (GP).

In our district we have had significant problems with excess demand over capacity. The problems are longstanding, and in 2006 there was a well-publicised ‘cull’ of patients who had waited too long for surgery. Between 2010 and 2012 we estimated that the demand for elective hip and knee replacement was 41.7/10,000 per year. The main drivers were the age of the population and a backlog of cases due to under-provision relative to demand.

Despite using each new scoring system, we found that the mismatch between supply and demand drove the financial threshold up in order to ensure ESPI compliance. Increasingly, this is being seen in other centres in New Zealand. The drive for shorter wait times for elective surgery has not been matched by any significant increase in joint replacement numbers in our region. In turn, we have noticed an increase in the severity of disease of those patients who do qualify for surgery.

In response to concerns around capacity and unmet demand, a programme funded by the National Health Board was developed to address patient flow. It was decided that all scoring for joint replacement surgery in our hospital would be by a single experienced orthopaedic nurse, the prioritisation nurse (PN), to ensure consistency and avoid accusations of surgeons ‘gaming the system’.

The purpose of this study is to compare patient reported scores from a historical cohort of patients undergoing primary elective THR or TKR from 2006–2010 with patients undergoing surgery in 2013–2014, and those waitlisted but returned to GP for being below the financial threshold during the same period. A secondary goal was to determine whether the current level of demand in our local population for elective THR and TKR had increased since our previous report looking at the years 2010–2012.

**Methods**

In October 2013, prior to the programme commencing, the threshold for hip and knee replacement in our hospital was 80 points using the New Zealand Orthopaedic Association hip and knee prioritisation tool (NZOA score). This tool was developed by the Orthopaedic Working Group of the National Waiting Times Project and introduced in 2008. There were 106 patients with certainty, 83 on active review and 181 other patients had been listed for joint replacement but returned to GP. After analysis of the waiting list figures, capacity, contracted volumes, and ESPI compliance, the financial threshold was set at 71 points commencing 1 November 2013. Active review would no longer be used and all patients falling below threshold would be returned to their GP. All patients were to be scored by the prioritisation nurse using the NZOA tool. Criteria for the use of the five components of the score, especially the consequence of delay, were agreed and policed.

Data were retrieved from our department database of patients who had undergone primary hip or knee replacement (including unicompartmental knee replacement (UKR)) between 2006 and 2010. Patient details, including pre-operative scores, had been prospectively recorded in our departmental database. The patient completed a pre-operative Oxford hip or knee score (OHKS) and a reduced Western Ontario and McMaster Osteoarthritis Index (WOMAC) score (RWS). The modified Oxford score (0–48, where 0 is worst and 48 best) was used. The reduced WOMAC score (RWS) uses 5 pain questions and 7 function questions (scored 0–4, where 0 is best) giving a worst score of 48. Preoperative scores were available on 613 of 945 patients on the database.

Details of all patients undergoing elective primary total hip or knee replacement

**ARTICLE**

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(including UKR) between 1 November 2013 to 31 October 2014 were collected. This included age, gender, NZOA score, OHKS and RWS scores. Numbers and scores of patients waitlisted for surgery during the same period and their outcomes were also collected prospectively. This included details and scores of patients returned to GP care.

The historical group, study group and return to GP group were then compared by age, gender, OHKS and RWS. Independent sample t-tests were used to compare means, and the test for a difference in proportions was used to estimate differences between the 3 cohorts (2006–2010, 2013/2014 Surgery, and 2013/2014 Return to GP). The two-sided significance level $\alpha=0.05$ was specified for all statistical tests. Stata software version 13.1 was used for all statistical analyses.

Demand was calculated as in our previous paper by including all publicly funded patients listed for the 12-month study period and adding those performed under ACC, plus all primary joints performed at Mercy Hospital, Dunedin. Hip replacements for fracture were excluded. Unicompartmental knee replacement was included. Bilateral simultaneous procedures were counted as two joints. The population of Otago less Queenstown was taken as 194,800 at June 2013. The New Zealand intervention rate was calculated from Joint Registry data using the New Zealand population as 4,442,100, based on 2013 census data. Unicompartmental knee replacements comprised only 5–9% of knee replacements across the whole study period and so were not analysed separately.

Ethics approval was given by the University of Otago Ethics Committee (Health) for this study.

## Results

### Demographics

The historical cohort from 2006–10 comprised 613 patients (355 hips (58%) and 258 knees (42%)). It was well matched with respect to age, gender and proportion of hips to knees with the study period (Table 1).

During the study period in 2013/4, 367 primary elective hip and knee replacements were performed. There were 204 hip (56%) and 163 knee (44%) replacements. The mean age was 69.3 years, with hips a little younger than knees (68.5 years vs 70.3 years). The mean NZOA score was 78.8 (hip 79.8, knee 77.7).

A consultant scored 137 patients (37%) who had been given certainty before the start of nurse prioritisation. The PN had scored 230 (63%). There were no significant differences between those scored by nurse or surgeon with respect to age, gender, proportion of hips or knees, NZOA score, Oxford or RWS.

### Table 1: Comparison of demographic characteristics between 2006-10 surgery group, 2013/4 surgery group and 2013/4 return to GP group.

<table>
<thead>
<tr>
<th></th>
<th>2006–10</th>
<th>2013/4</th>
<th>2013/4 Return to GP</th>
<th>Difference (95% CI)</th>
<th>p</th>
<th>Difference (95% CI)</th>
<th>p</th>
<th>Difference (95% CI)</th>
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<tr>
<td></td>
<td>surgery</td>
<td>surgery</td>
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<tr>
<td>Male (%)</td>
<td>260 (42.4)</td>
<td>166 (45.2)</td>
<td>91 (46.9)</td>
<td>-2.8 (-9.2, 3.6)</td>
<td>0.389</td>
<td>-4.5 (-12.5, 3.5)</td>
<td>0.271</td>
<td>-1.7 (-10.3, 7.0)</td>
<td>0.705</td>
</tr>
<tr>
<td>Age (SD)</td>
<td>69.3 (10.1)</td>
<td>69.3 (10.4)</td>
<td>67.3 (9.0)</td>
<td>-0.0 (-1.3, 1.3)</td>
<td>0.979</td>
<td>1.9 (0.4, 3.5)</td>
<td>0.016</td>
<td>2.0 (0.2, 3.7)</td>
<td>0.027</td>
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<tr>
<td>Hips n= 355 n= 204 n=84</td>
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<tr>
<td>Hips %</td>
<td>57.9</td>
<td>55.6</td>
<td>43.3</td>
<td>2.3 (-4.1, 8.7)</td>
<td>0.477</td>
<td>14.6 (6.6,22.6)</td>
<td>&lt;0.001</td>
<td>12.3 (3.7,20.9)</td>
<td>0.006</td>
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<tr>
<td>Male (%)</td>
<td>153 (43.1)</td>
<td>90 (44.1)</td>
<td>39 (46.4)</td>
<td>-1.0 (-9.6, 7.5)</td>
<td>0.815</td>
<td>-3.3 (-15.2, 8.5)</td>
<td>0.580</td>
<td>-2.3 (-15.0, 10.3)</td>
<td>0.720</td>
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<tr>
<td>Age (SD)</td>
<td>68.1 (10.8)</td>
<td>68.5 (10.9)</td>
<td>66.0 (10.6)</td>
<td>-0.4 (-2.3, 1.5)</td>
<td>0.668</td>
<td>2.1 (-0.5, 4.7)</td>
<td>0.107</td>
<td>2.5 (-0.2, 5.3)</td>
<td>0.073</td>
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<tr>
<td>Knees n= 258 n= 163 n= 110</td>
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<tr>
<td>Knees %</td>
<td>42.1</td>
<td>44.4</td>
<td>56.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Male (%)</td>
<td>107 (41.5)</td>
<td>76 (46.6)</td>
<td>52 (47.3)</td>
<td>-5.2 (-14.9, 4.6)</td>
<td>0.299</td>
<td>-5.8 (-16.9, 5.3)</td>
<td>0.304</td>
<td>-0.6 (-12.7, 11.4)</td>
<td>0.916</td>
</tr>
<tr>
<td>Age (SD)</td>
<td>70.9 (8.6)</td>
<td>70.3 (9.6)</td>
<td>68.4 (7.4)</td>
<td>0.6 (-1.1, 2.4)</td>
<td>0.487</td>
<td>2.5 (0.7, 4.4)</td>
<td>0.007</td>
<td>1.9 (-0.2, 4.0)</td>
<td>0.078</td>
</tr>
</tbody>
</table>
During the study period, 608 patients were waitlisted for primary THR or TKR. Four hundred and fourteen (68%) were given certainty for surgery and 194 (32%) were returned to GP care. The return to GP group was younger by 2 years \( (p=0.027) \) and had a significantly higher proportion of knee (57%) than the two surgical groups \( (Table 1) \). Of the 194 returned to GP, 50 were re-referred and given certainty within the 12-month study period (mean 5 months).

Patient-reported scores
The Oxford scores and RWS scores were significantly worse for both hips and knees in 2013/4 compared with the historical cohort. The difference in Oxford score of 3.7 for hips and 4.7 for knees and RWS (hip 3.4, 11% change from baseline, and knee 5.4, 19% change from baseline) is likely to reflect a clinically important difference.\(^{12,17,18}\)

The Oxford and RWS scores of those patients returned to GP in 2013/4 were the same as for those receiving surgery in 2006-10 \( (Table 2) \).

Demand
During the 12-month study period, 608 patients were waitlisted, 464 patients were given certainty and 367 patients had undergone surgery. The number of patients waiting with certainty had increased from 106 to 164 and the numbers on Active Review had fallen from 83 to 23. Demand was 241 (67%) in excess of supply. Even after sending back 194 patients, the imbalance was 47 joints (13% excess), which rose to 97 (26% excess) when those re-referred and given certainty were included.

During the same period, an additional 8 hip replacements were performed in the hospital under ACC, and 348 hip and knee replacements were performed in the private sector, giving a total of 723 joints performed during the year. The current intervention rate for primary hip and knee replacement in Otago is 371/100,000. The demand, assuming no unmet need in private, is now approximately 495/100,000.

In New Zealand, 16,104 hip and knee replacements, including unicompartmental replacement of knee, were performed in 2014, after excluding those for acute fracture.\(^{16}\) This gives a New Zealand intervention rate of 363/100,000 for 2014.

### Discussion
There will always be excess demand in the public sector leading to the need for some form of prioritisation or rationing. This paper shows that prioritisation is being implemented effectively. Patients undergoing surgery have mean scores that are poorer than those returned to GP. We have previously reported that nurse scoring is as effective as consultant scoring.\(^{11}\) It removes inconsistencies and accusations of attempts to ‘game’ the system. However, there are problems around the threshold score.\(^{11}\)

The patient-derived scores were significantly worse for the study period when

### Table 2: Comparison of preoperative Oxford and reduced WOMAC scores (RWS) between surgery 2006-10, surgery 2013/4 and return to GP group 2013/14.

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<tr>
<td></td>
<td>Oxford</td>
<td>RWS</td>
<td>Oxford</td>
<td>RWS</td>
<td>Oxford</td>
<td>RWS</td>
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<tr>
<td>Hips</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13.6 (6.7)</td>
<td>9.9 (4.9)</td>
<td>13.0 (6.2)</td>
<td>3.7 (2.4, 4.9)</td>
<td>&lt;0.001</td>
<td>0.6 (-1.5, 2.7)</td>
</tr>
<tr>
<td></td>
<td>15.4 (6.5)</td>
<td>10.6 (3.8)</td>
<td>15.2 (5.9)</td>
<td>4.7 (3.4, 6.1)</td>
<td>&lt;0.001</td>
<td>0.2 (-1.7, 2.1)</td>
</tr>
<tr>
<td></td>
<td>28.9 (7.8)</td>
<td>34.3 (6.3)</td>
<td>30.1 (8.2)</td>
<td>5.4 (7.1, 3.6)</td>
<td>&lt;0.001</td>
<td>-1.3 (-3.6, 1.1)</td>
</tr>
<tr>
<td></td>
<td>14.3 (6.7)</td>
<td>10.2 (4.5)</td>
<td>14.2 (6.1)</td>
<td>4.1 (3.2, 5.0)</td>
<td>&lt;0.001</td>
<td>0.1 (-1.3, 1.5)</td>
</tr>
<tr>
<td></td>
<td>30.5 (8.0)</td>
<td>34.8 (6.7)</td>
<td>30.8 (8.4)</td>
<td>4.3 (5.4, 3.1)</td>
<td>&lt;0.001</td>
<td>-0.3 (-2.0, 1.4)</td>
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</table>
compared with the historical cohort. The return to GP group were similar to those qualifying for surgery in the historical group. Knees were more likely to be returned to GP than hips. This reverses the ratio seen for those qualifying for surgery in both the historical and study group. In general, patients with hip OA are more disabled than knees. Knees in the historical group had better scores than hips, but that difference is now less.

The difference on Oxford score of 4.1 points (hips 3.7, knees 4.7) is comparable with the minimum clinical difference of 2 to 5 points reported for the Oxford score. Similarly, the change in RWS of 4.3 points (hips 3.4, knees 5.4) is greater than 6% of maximum (2.9 points) and the 12% change from baseline WOMAC (3.7 points), and therefore is likely to be clinically significant.

There is no absolute value of RWS or Oxford score that indicates the need for surgery. Large series from the UK show an average preoperative Oxford score of 18–20 points for knee replacement. A recent study on unicompartmental replacement showed a mean preoperative OKS of 24 points. The Oxford scores for hip replacement are a little lower (worse) at 16–19 points with public hospital patients scoring worse than private. In Canterbury, the mean preoperative OHS was 18 in a prospective observational study between 2009 and 2011 of 726 hips. The mean scores seen in all three groups in this paper are all significantly worse than these studies. They fall into the bottom three deciles for hip, and bottom two deciles for knee, by Oxford score. However, Singleton et al reported similar scores in both Māori (OHKS 10.1, WOMAC 76.2%) and non-Māori (11.26, 73.5%) in the Bay of Plenty between 2005 and 2009.

The mean scores seen in all three groups in this paper are all significantly worse than these studies. They fall into the bottom three deciles for hip, and bottom two deciles for knee, by Oxford score. We have not collected postoperative scores on the study group, but have reported postoperative scores similar to New Zealand Joint Registry averages in other studies, especially since introduction of ERAS protocols. We estimated the demand for primary THR and TKR in Otago to be 41.7/10,000 between 2010 and 2012, with 55% of TJR publicly funded. Using the same methodology, the demand in 2014 increased by 18.5% to 49.5/10,000, while both the total number of joint replacements and the intervention rate have fallen slightly.

This figure may still be an underestimate of the need in the community. Behaviour of both GPs and surgeons may have changed, and patients with less severe disease may be less likely to be referred or offered surgery. We introduced a physiotherapy and nurse-led clinic (Joint Clinic) in 2012 in which patients with less severe disease are managed nonoperatively. Approximately 50 patients with Oxford scores less than 20 points were under Joint Clinic care during the study period.

Nationally, the overall intervention rate (all funders) has climbed from 330/100,000 in 2011 to 363/100,000 in 2014. The raw overall intervention rate in Otago of 371/100,000 is similar to the national rate. However, population demographics mean that after age and ethnicity standardisation it is likely to be lower.

New Zealand has a relatively high rate of provision compared with other developed countries. It is predicted to rise to around 600/100,000 by 2026. The increase in demand is less than anticipated in the US and it has been suggested that rather than reflecting over-servicing in New Zealand, it demonstrates a response by the health service to an identified area of high need. Since our original report there has been a lot more publicity about unmet demand for orthopaedic surgery across New Zealand. Nationally, increased numbers of TJR have been performed over this period, but age and ethnicity standardised rates of TJR vary widely across DHBs. We do not think that the situation in Otago is necessarily different from the rest of New Zealand, but we do appear to be several years ahead for a number of reasons. New Zealand has an ageing population, and Otago has a higher proportion of older patients than the New Zealand average. We have previously identified the backlog of patients awaiting surgery due to under-provision in previous years as a factor. Despite this, there has been no increase in publicly-funded
surgery in Otago between 2010 and 2014. We estimate 61–65% of TJR are publicly funded based on the National Minimum Data Set (NMDS) and Joint Registry figures. In contrast, only 51% of TJRs in Otago were publicly funded in 2014. This has fallen from 55% in 2010–12. We believe that this difference is due to under-provision in the public sector in Otago rather than over-servicing in private. Many of these patients have chosen to self-fund their procedure due to problems with access to the public sector.

Other centres in New Zealand have reported on unmet demand, with 33% of patients listed for TJR in Northland and 41% in Hawkes Bay declined due to threshold. The average NZOA score in Hawkes Bay for patients qualifying for surgery was 76.9 points, which is similar to ours (78.8), while in Northland it was 70.6 points. However, as no other outcome score was used and multiple consultants scored the patients, it is not clear whether the differences seen in their study are true differences in the incidence and severity of disease, or whether they reflect surgical capacity or different interpretations and use of the scoring tool.

A strength of this study is that all patients in the return to GP group had been prioritised by a single nurse to ensure consistency using the NZOA tool. Criteria for its use were agreed and policed. We have used patient-reported outcome scores to assess the severity of patient symptoms. These are validated scores in common usage. They were not designed as prioritisation tools and it is possible that patients have inflated their scores in an attempt to qualify for surgery. However, the Oxford or RWS does not directly influence the NZOA score which was used to determine qualification for surgery. There were still problems with access to TJR in 2006–2010 when we started using these scores and we had no reason to believe that patients were consistently attempting to game the system.

A weakness is that the historical cohort does not include all cases performed between 2006 and 2010. This may result in some bias. However, the historical cohort was well matched with respect to age, gender and proportion of hip to knee with the study period.

It has been predicted that the demand and projected numbers of hip and knee replacement will rise significantly. It is unclear how this can be funded. While the budget announcement of increased numbers of TJR from 2016 onward is welcome, the numbers are inadequate to match demand. The indicative increase of Southern DHB (including Southland) is provisionally for only 62 extra joints spread over 3 years. The onus therefore is on individual DHBs to decide the allocation of their scarce resources. If orthopaedic volumes are not increased, then other orthopaedic procedures will need to be cut if additional joint replacements are to be done. The alternative is to raise thresholds for TJR to an unacceptable level to achieve ESPI compliance.

Prioritisation and process change may help efficiency and allow more timely surgery. However, the 4-month target is artificial and by itself does nothing to increase capacity. The worst patients may be getting their surgery sooner, but there is no sign that the numbers of severely affected patients is decreasing.

The public needs to be given realistic expectations. There is explicit rationing and, although cost effective, public funding for hip and knee replacement will soon only be for the most severely affected. Others need to consider private insurance, or self-funding their surgery.

**Conclusion**

Patients undergoing primary elective total hip and knee replacement in Otago in 2014 are more severely disabled than between 2006–2010. Patients currently being returned to GP would have qualified for publicly-funded surgery during that period. The unmet demand for TJR in Otago has increased by 19% since 2012.

This paper confirms that the increasing demand that is not matched by an increase in supply leads to a recognisable and measurable increase in the severity of disease using validated patient-reported measures in patients qualifying for surgery. The problems we describe are likely to become increasingly widespread across New Zealand.
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Competing interests:
David Gwynne-Jones reports grants from the Ministry of Health during the conduct of the study, and grants from DEPuy NZ Ltd outside the submitted work.

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