Alberta Hip and Knee Replacement Pilot Project

Scientific Evaluation Report

June 2007
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1.0 BACKGROUND

Hip and knee replacements are among the most successful surgical procedures. They are a proven method of alleviating pain and restoring function and mobility. It has been suggested they are the best example of how medical science can return quality of life and re-establish independence. Their success rate is as high as 95% after 10 years and 90% after 20 years, and they are among the most cost-effective interventions in the medical world, despite their significant use of health care resources.

At the same time, there are excessively long waiting times to see an orthopaedic surgeon followed by even longer waiting times for surgery to occur. Both of these waiting periods delay hip and knee replacement surgery beyond the optimal time frame for the majority of patients in Alberta. The care given to hip and knee replacement patients is variable, influenced by such factors as socio-economic status, age and geographic location. Furthermore, treatment is provided in an atmosphere of spiralling public health care costs that are putting pressure on resources and constraining the ability of the public system to meet a growing need for hip and knee replacements.

The Alberta Orthopaedic Society (AOS) undertook in 2003/04 an initial comprehensive analysis and redesign of the continuum of care for hip and knee replacement in an effort to reduce lengthy waiting times for consultation and surgery and to improve care for patients. The work comprised all components of the continuum, including referral, patient assessment, patient optimization, surgery, in-patient care, sub-acute care, recovery at home and ongoing monitoring. The AOS then worked in partnership with the Regional Health Authorities and Alberta Health and Wellness to refine the newly designed continuum of care. This work was completed in early 2004 and presented to the Capital and Calgary Regional Health Authorities and Alberta Health and Wellness, resulting in a decision to move forward with a pilot to compare the new continuum with the conventional approach to hip and knee replacement. The partners chose to conduct the pilot in the Capital, Calgary and David Thompson health regions on the basis that a province-wide rollout of the new continuum of care would follow if the pilot proved successful. Alberta Health and Wellness provided $20 million to the three regions for the infrastructure and services required to conduct the pilot, and Alberta Bone and Joint Health Institute (ABJHI) invested more than $4 million to design and support the new continuum of care and conduct the pilot research and evaluation. The Regional Health Authorities and AOS formed a Provincial Working Group to oversee the pilot and refine the new continuum, and ABJHI provided overall project management.

The pilot, which was conducted over a 12-month period, was completed in spring 2006 and involved 1,125 patients who received a total hip or knee replacement under the new continuum and 513 who received a total hip or knee replacement under the conventional method of service delivery.

This report provides the results of ABJHI’s evaluation of the pilot. It includes the results of patient follow-up at three months after surgery.
The Alberta Quality Matrix for Health was used as an evaluation guide. Results were mapped to the six discrete service quality areas that comprise the matrix, including accessibility, efficiency, acceptability, effectiveness, safety and appropriateness.

The three Regional Health Authorities involved in the pilot are adopting the new continuum as their standard of care for hip and knee replacement. They are now planning to work with ABJHI to fine-tune the design and conduct ongoing evaluation in an effort to continuously improve access to care, the quality of care and the efficiency with which care is delivered to hip and knee replacement patients.

Based on the initial agreement for province-wide rollout following a successful pilot, Alberta’s remaining six Regional Health Authorities and the orthopaedic surgeons who practice in these six health regions want to implement the new approach for their patients and health care providers.

The new continuum of care is being introduced as demographic projections point to increasing need for bone and joint health care services. A recently released Alberta government study shows life expectancy in the province has increased by 20 years since the early 1930s and by about six months since 2000. Life expectancy at birth is now 82.3 years for women and 77.5 years for men. There will be almost three seniors (65 and older) for every 10 working-age Albertans by 2033. The prevalence of bone and joint conditions generally increases with age, and as both the number and proportion of older people in Alberta’s population grow, the incidence of these conditions and the need for treatment and care will also rise. Already, one in three Albertans require medical care for a bone and joint condition every year and there are approximately 1.7 million family physician visits annually for musculoskeletal reasons.

Growing obesity rates in children are also an omen of increased need for bone and joint health care. Obese people have an estimated nine-fold greater risk of osteoarthritis – the leading cause of joint degeneration. Almost one-quarter of Albertans aged two to 17 are overweight or obese. They are at increased risk of premature joint degeneration.
2.0 SCIENTIFIC APPROACH

A randomized, controlled study with an intention-to-treat analysis was the evaluation methodology chosen for the pilot. Under this method, individuals with similar conditions are allocated randomly to two or more treatment groups, and the outcomes of the groups are compared after sufficient follow-up time (Figure 1). Allocating subjects at random enables researchers to have different treatment groups that are statistically equivalent. This method of study is considered to result in evidence of the highest grade because it protects against the effects of potential confounding factors and minimizes opportunity for bias. It also provides a fair and equitable method of assigning patients to the study groups.

Figure 1. Patient recruitment process

Randomization was stratified by physician and joint type to eliminate the opportunity for these factors to create a patient advantage or disadvantage. In addition, all patients were invited to participate in the pilot, regardless of whether they were waiting for surgery prior to the start of the pilot or referred for a consultation during the pilot period.

The intention-to-treat analysis is based on the initial intention of the treatment, rather than on the treatment eventually administered. It assumes that, as in real life, some patients in a study will not receive the treatment they were initially intended to receive.


2.1 Fairness and Equitability

The study method used in the Hip and Knee Replacement Pilot was chosen to ensure patients were treated fairly by allocating them at random to one of two groups: 1) an intervention group, whose members received a hip or knee replacement under the new continuum of care, and 2) a control group, whose members received a hip or knee replacement under the conventional method of delivering service. This 'lottery' approach ensured there was only a limited statistical difference in patient characteristics between the two groups and eliminated any opportunity to skew results by assigning specific patients to one group or the other.

The methodology used in the Hip and Knee Replacement Pilot was submitted for ethics approval in each of the three health regions where the pilot was conducted. Ethics approval was given by the University of Alberta for Capital Health, the University of Calgary for the Calgary Health Region, and the College of Physicians and Surgeons of Alberta for the David Thompson Health Region.

Approximately 15% of the patients in the Hip and Knee Replacement Pilot received some degree of treatment in the patient group to which they were not allocated initially. However, under the intention-to-treat methodology, these patients’ results were analyzed in the group to which they were allocated initially so that there was no opportunity to influence outcomes by reallocating patient results. For example, the results of patients who were allocated to the intervention group but received all or a portion of their care in the conventional approach were included in the analysis of the intervention group. This approach lent additional validity to the randomized, controlled trial as it continued to limit bias. However, a sensitivity analysis indicated that it also had a tendency in some areas of the Quality Matrix to improve the overall results for patients in the conventional approach and to diminish overall results for patients in the new continuum.

2.2 Patients

Approximately 3,400 patients were recruited to the Hip and Knee Replacement Pilot. These included patients who, prior to the start of the pilot, were waiting for a surgery date, patients who were waiting for a consultation with an orthopaedic surgeon due to hip or knee problems, and patients newly referred by their family physician for a consultation.

The recruited patient group was divided evenly, with approximately 1,700 patients allocated to hip or knee replacement under the new continuum of care (intervention patients) and approximately 1,700 allocated to surgery under the conventional method of delivering service (control patients).

Among the intervention patients, 752 were recruited in Calgary Health Region, 695 in Capital Health and 272 in David Thompson Health Region. Control patients were distributed in similar proportion, with 743 in Calgary, 699 in Capital and 267 in David Thompson.

The pilot concluded in 2006 on the following dates: March 31 in Capital, April 30 in Calgary and June 30 in David Thompson.
The 1,700 patients allocated to the intervention group received a consultation with a surgeon within the pilot period and were identified as requiring or not requiring surgery. At the pilot’s conclusion, 1,125 patients had received surgery through the new continuum of care. Among those assigned to the intervention group through the randomization process, the surgical yield was 66.5%. The remaining 33.5% were deemed non-surgical following their consultation or decided to not proceed with surgery.

It is not yet known how many of the 1,700 patients allocated to the control group received a consultation with a surgeon within the pilot period. However, it is known that 513 control patients received a hip or knee replacement during the pilot period through the conventional approach. The surgical yield among the control group will be known once all control patients have had a consultation.

ABJHI will follow all patients for a 12-month period from the pilot’s conclusion. A report on results of this follow-up is expected to be completed in December 2007.

Overall, the randomized, controlled study methodology, intention-to-treat analysis and patient recruitment and allocation processes were highly effective in ensuring there were limited or no statistically significant differences in baseline characteristics between the intervention and control patient groups (Table 1). Characteristics in which there were no statistically significant differences included:

- Age;
- Sex;
- Body mass index (BMI), a ratio of weight to height;
- Pre-surgery health condition; and
- Socio-economic factors such as work status (retired, employed, unemployed), income level, and living arrangement (single, cohabitating, requiring assistance).
Table 1. Patient characteristics – intervention group vs. control group*

<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Intervention</th>
<th>Control</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean years)</td>
<td>69.00</td>
<td>69.00</td>
<td>0.998</td>
</tr>
<tr>
<td>BMI (mean, kg/m²)</td>
<td>29.69</td>
<td>29.33</td>
<td>0.233</td>
</tr>
<tr>
<td>% Female</td>
<td>60.40</td>
<td>59.90</td>
<td>0.869</td>
</tr>
<tr>
<td>% Knee/% Hip</td>
<td>57.60 / 42.40</td>
<td>55.20 / 44.80</td>
<td>0.354</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Co-morbidity</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Concurrent Health Condition**</td>
<td>3140.80</td>
<td>3177.40</td>
<td>0.675</td>
</tr>
<tr>
<td>% Obese (≥30kg/m²)</td>
<td>41.30</td>
<td>37.30</td>
<td>0.128</td>
</tr>
<tr>
<td>% Anaesthesiology risk score ≥3</td>
<td>21.60</td>
<td>24.20</td>
<td>0.257</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Socio-economic</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>% Retired</td>
<td>45.90</td>
<td>45.40</td>
<td>0.857</td>
</tr>
<tr>
<td>% Employed (FT/PT)</td>
<td>29.50</td>
<td>29.50</td>
<td>0.970</td>
</tr>
<tr>
<td>% Low Household Income</td>
<td>64.70</td>
<td>60.90</td>
<td>0.130</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Living Status</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>% Rural</td>
<td>15.20</td>
<td>19.80</td>
<td>0.021</td>
</tr>
<tr>
<td>% Married</td>
<td>48.80</td>
<td>51.40</td>
<td>0.343</td>
</tr>
<tr>
<td>% Assisted with Daily Living</td>
<td>29.60</td>
<td>30.80</td>
<td>0.646</td>
</tr>
</tbody>
</table>

* There were 4% more rural patients in the control group than in the intervention group. This distribution was considered in all analyses.

** Concurrent health condition is defined as chronic disease score.
### 3.0 RESULTS OF THE PILOT

ABJHI has analyzed and evaluated the Hip and Knee Replacement Pilot using the Alberta Quality Matrix for Health as an evaluation guide (Table 2). The results, based on follow-up with patients three months after surgery, were grouped according to the six dimensions of the Quality Matrix, including accessibility, efficiency, acceptability, effectiveness, safety and appropriateness.

**Table 2. Six dimensions of the Alberta Quality Matrix for Health**

<table>
<thead>
<tr>
<th>Dimensions of Quality</th>
<th>Current Approach</th>
<th>New Continuum of Care</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accessibility</strong></td>
<td>Referral to seen - 145 days&lt;br&gt;Seen to surgery - 58 weeks</td>
<td>Referral to seen - 21 days&lt;br&gt;Seen to surgery - 7.5 weeks</td>
</tr>
<tr>
<td><strong>Efficiency</strong></td>
<td>Surgery time - 119 minutes&lt;br&gt;Acute LOS - 6 days&lt;br&gt;Cost change - toward new</td>
<td>Surgery time - 109 minutes&lt;br&gt;Acute LOS - 4.7 days&lt;br&gt;Cost change ↓15% hospital&lt;br&gt;↓2% overall</td>
</tr>
<tr>
<td><strong>Acceptability</strong></td>
<td>Long waits = decreased quality of life and increased cost</td>
<td>Reduced wait = minimal decrease in quality of life and cost&lt;br&gt;More personal and more intense</td>
</tr>
<tr>
<td><strong>Effectiveness</strong></td>
<td>Improved physical and social function and reduced pain</td>
<td>Even greater increase in physical and social function and pain reduction</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>4.8 joint-related adverse events per 100 patients &lt;30 days after surgery&lt;br&gt;2.2 joint-related adverse events per 100 patients ≥30 days after surgery</td>
<td>4.1 joint-related adverse events per 100 patients &lt;30 days after surgery&lt;br&gt;1.2 joint-related adverse events per 100 patients ≥30 days after surgery</td>
</tr>
<tr>
<td><strong>Appropriateness</strong></td>
<td>31% mobilized day of 75% spinals&lt;br&gt;Discharge change - toward new</td>
<td>85% mobilized day of 82% spinals&lt;br&gt;Reduced use of surgical wound drains</td>
</tr>
</tbody>
</table>

No difference in patient age, sex, BMI, health status, socio-economic factors.
3.1 Accessibility

The Health Quality Council of Alberta defines accessibility as health services being obtained in the most suitable setting in a reasonable time and distance.

The pilot was evaluated in two discrete areas of accessibility: 1) waiting time for a consultation with an orthopaedic surgeon, beginning at the time of referral; and 2) waiting time for surgery, beginning when a decision is made to have a hip or knee replacement.

The pilot found that all patients in the new continuum of care had significantly faster access to consultation with an orthopaedic surgeon and to surgery. The degree of improvement was the same whether patients required a hip or a knee replacement. Furthermore, there was no statistical association between length of wait and age, joint type, physician, BMI or co-morbidity (concurrent health conditions).

Waiting time for consultation

Patients who had a hip or knee replacement through the new continuum of care waited an average of 21 working days for a consultation with an orthopaedic surgeon, compared with an average wait of 145 working days for patients who had a hip or knee replacement under the current approach to service delivery. Furthermore, results of the pilot suggest that the new continuum can achieve a standard for consultation waiting time of 17 working days or less on average by eliminating the backlog of patients and providing sufficient central intake resources.

The pilot found no statistical association between length of wait for a consultation and the health region in which the consultation took place.

Waiting time for surgery

The 1,125 patients who had surgery through the new continuum of care waited an average of 7.5 weeks, beginning when the decision was made to have a hip or knee replacement. While only 513 patients received surgery through the conventional method during the study time frame, these patients waited an average of 58 weeks for surgery. The significantly longer average wait for these patients was caused by a backlog of surgeries and a lack of resources dedicated to hip and knee replacement care. At the pilot's conclusion, 1,187 patients in the conventional approach were still waiting for their first consultation, were waiting for surgery, or were seen and determined to be non-surgical. This suggests that actual average waiting time in the conventional approach is longer than stated in this report.

Results of the pilot provide scientific proof that Alberta can achieve significantly higher standards in wait times in the two major components of access – consultation and surgery – through improved processes and better allocation of health care resources.
3.2 Effectiveness

The Health Quality Council of Alberta defines effectiveness as health services being provided based on scientific knowledge to achieve desired outcomes.

The pilot used the following tools to measure the effectiveness of the new continuum versus the conventional approach to hip and knee replacement before surgery and at three months after surgery:

1) WOMAC – the Western Ontario and McMaster Universities Arthritis Index for measuring the severity of osteoarthritis of the hip or knee and the impact of the condition on the patient. Using a questionnaire, patients are asked to assess their symptoms of pain, stiffness and physical function before and after surgery.
2) Short-form 36 – a general health survey designed to enable patients to assess their physical function, social function, mental health, emotional state, and pain level before and after surgery.

Both WOMAC and Short-form 36 are widely used measures of patient outcomes. They have been used in diverse clinical and interventional environments and are considered valid, reliable and responsive outcome measures.

Using these measurement tools, patients in both pilot groups – the new continuum of care and the conventional approach – improved. Overall, however, the degree of improvement among patients in the new continuum of care exceeded that of patients in the conventional approach.

WOMAC results

Patients in the new continuum of care had a 36% improvement in their average WOMAC score, compared with a 31% improvement for patients in the conventional approach. The five-percentage-point difference has small-to-moderate clinical significance as determined by effect-size analysis, which measures the magnitude of a treatment effect independent of sample size. A small-to-moderate effect size is clinically relevant, indicating that the new continuum led to significantly better patient-perceived outcomes than the conventional approach at three months post-surgery.

The pilot found that age, sex, tobacco use, socio-economic status and location (rural versus urban) did not directly influence the WOMAC score for patients in the new continuum or in the conventional approach.

However, patients in both the new continuum and the conventional approach who had concurrent osteoarthritis in another joint experienced less improvement in their WOMAC score following surgery. Hip replacement patients in the new continuum and in the conventional approach had a greater degree of improvement at three months post-surgery than knee replacement patients, who typically have a longer recovery period.

Pre-surgery condition associated with the replaced joint also influenced the degree of change in the WOMAC score. Patients with severe osteoarthritis, high levels of pain and stiffness and low physical function prior to surgery experienced the most improvement at three months after surgery.
Short-form 36 results

The Short-form 36 tool, using effect-size analysis, measured patient outcomes in five key areas, including physical function, mental health, emotional state, pain, and social function. There was significant improvement in all of these areas among hip and knee replacement patients in the new continuum of care and in the conventional approach.

Factors that influenced patient outcomes using the Short-form 36 tool were similar to those identified in WOMAC. In both groups – the new continuum and the conventional approach – patients who had concurrent osteoarthritis in another joint experienced less improvement following surgery. Hip replacement patients had better outcomes than knee replacement patients. Patients with poorer general health condition prior to surgery also had less improvement after surgery than patients in better health. However, patients in poor general health experienced a higher degree of relative improvement following surgery.

Unlike results using the WOMAC tool, patient sex and age were identified by the Short-form 36 tool as determining factors in outcomes across both patient groups. The degree of improvement was higher among younger patients, and males tended to experience greater improvement than females.

Results based on the five areas of measurement are:

*Physical function* – patients in the new continuum had a 28% improvement, compared with 23% in patients in the conventional approach.

*Pain* – patients in the new continuum experienced a 34% improvement, compared with 29% in patients in the conventional approach. Most significantly, patients who had high levels of pain prior to surgery reported the greatest degree of improvement following surgery.

*Social function* – patients in the new continuum had a 21% improvement, compared with 17% in patients in the conventional approach. The level of improvement diminished with advanced age and in patients suffering from depression.

In the areas of mental health and emotional state, there was no significant difference in the degree of improvement between patients in the new continuum and those in the conventional approach.
3.3 Efficiency

The Health Quality Council of Alberta defines efficiency as resources being used optimally in achieving desired outcomes.

Among the key drivers of efficiency are operating room utilization, length of stay in acute and sub-acute hospitals, and cost. Results of the pilot show the new continuum of care is more efficient in all of these efficiency drivers.

Operating room efficiency

Operating room time, measured from when a patient enters to when the patient leaves, was an average of 109 minutes for patients who were treated under the new continuum of care. This compares with 119 minutes for patients treated under the conventional approach.

The improvement was similar for both hip and knee replacement surgeries, with hip replacement patients spending an average of approximately one additional minute in the operating room.

Within operating room time, surgical incision to wound closure averaged 66 minutes for both hip and knee replacement patients in the new continuum of care – statistically significantly more efficient than the standard of 71 minutes per case required to achieve four surgeries per operating room per day.

Results of the pilot established no statistical association between patient sex and operating room time. However, several other patient factors significantly influenced operating room efficiency, including BMI, American Society of Anesthesiologists (ASA) score, and age.

Time in the operating room increases in direct proportion to patient BMI largely because the incision to access the joint is more difficult and time-consuming as BMI rises.

The pilot found a statistical correlation between patient surgical risk and operating room time. Patients who were rated three or greater on the ASA score, a measure of risk associated with health factors such as cardiovascular disease and diabetes, had longer surgery time.

Prosthesis complexity also influences surgery time. Since the simplest prostheses are used in older joint replacement patients, the operating room time for these patients was shorter in the new continuum.

Results of the pilot indicate the new continuum can achieve a standard operating room time of 98 minutes on average with further improvement in processes and patient optimization.
**Patient length of stay in acute care**

Patients who received care under the new continuum had a mean length of stay of 4.7 days in an acute care hospital, compared with a mean of 6.0 days for patients who were treated under the conventional approach. This could be due to adherence to the new continuum’s target length of stay, to improved patient optimization prior to surgery, or to a combination of these two factors.

Length of stay in acute care increased with advanced patient age, an ASA score of three or higher, and the existence of other medical conditions. This increase occurred in hip and knee replacement patients in the new continuum and in the conventional approach.

Married patients had on average a 12% shorter stay in hospital. The reduction was the same for patients regardless of whether they had a hip or knee replacement in the new continuum or in the conventional approach.

The pilot found no statistical correlation between length of stay in acute care and patient socio-economic status, tobacco use, joint type, or severity of joint deterioration prior to surgery. Furthermore, there was no difference in acute-care length of stay between patients discharged directly home and those discharged to a sub-acute care facility.

Results of the pilot suggest that with further refinement of processes and improved patient optimization, length of stay can be reduced to a standard of 4.0 days for patients discharged directly home and 3.0 days for patients transferred to sub-acute care. Overall, results indicate the new continuum can achieve a standard length of stay in acute care of 3.8 days.

**Patient length of stay in sub-acute care**

The new continuum of care produced a significantly greater reduction in length of stay in sub-acute care than in acute care. Patients stay in sub-acute care averaged 8.6 days, compared with 13.2 days for patients who received care under the conventional approach.

Hip replacement patients in the new continuum and in the conventional approach spent significantly more time in sub-acute care than knee replacement patients. However, the gap was less than two days for patients in the new continuum, compared with more than four days for patients in the conventional approach.

Results of the pilot suggest the new continuum can achieve a standard length of stay in sub-acute care of 5.0 to 7.0 days.
Cost

The total cost to the public health system was calculated using a standardized model that captured hospital, community-based services and prosthesis costs, as well as professional fees. Total cost was 2% lower in the new continuum, compared with the conventional approach.

Hospital cost, which includes the cost of the operating room, the prosthesis and in-patient stay, was reduced by 15% in the new continuum, compared with the conventional approach.

It is more expensive to replace a hip than a knee, whether in the new continuum or the conventional approach, due to the higher cost of the hip prosthesis. The pilot identified a correlation between patient wait time and overall case cost as longer waits result in more services required of health care providers to help patients manage symptoms such as pain and diminished physical function. Other factors than influence costs include:

- Patient age – costs are higher for younger patients, likely due to the use of more expensive prostheses.
- Obesity – costs escalate as BMI rises, reflecting increased operating room time.
- ASA score – costs rise as patient health risk increases, reflecting the greater complexity of care and increased operating room time and longer hospital stay.
- Analgesic – prolonged use drives up cost.
- Pre-surgery joint deterioration – costs rise with the severity of deterioration as patients seek help from providers to manage symptoms and use analgesics to control pain.
- Marital status – the cost to treat married people is lower as these patients typically return home sooner, reducing their hospital stay.

The lower total cost to public health care together with improved patient outcomes indicate the new continuum is more cost-effective than the conventional approach to hip and knee replacement.
3.4 Acceptability

The Health Quality Council of Alberta defines acceptability as health services being respectful of and responsive to user needs, preferences and expectations.

Patients were surveyed following surgery to identify their view of services on the basis of acceptability.

On the issue of waiting time for surgery, survey results indicated that patients’ desires were influenced by their experiences. Overall, patients said 9.5 weeks was a desirable waiting time for surgery. However, patients who waited more than 12 weeks for surgery had a desired waiting time of 10.3 weeks, compared with 8.3 weeks desired by patients who waited less than 6 weeks.

A similar influence was evident when patients were asked to identify an ideal waiting time. Overall, patients said they would wait 5.7 weeks for surgery if circumstances were ideal. However, patients who waited longer than 12 weeks for surgery selected 6.8 weeks as their ideal waiting time, compared with 5.6 weeks for patients who waited less than 6 weeks.

Not surprisingly, quality of life was associated with waiting time. Overall, 51.5% of patients felt their quality of life worsened while they waited for surgery. The result was only slightly better – 47.3% – among patients who experienced a wait of less than 6 weeks. More than two thirds – 68% – of patients who waited more than 12 weeks for surgery said their quality of life had diminished while waiting.

Generally, patients who were surveyed reported that waiting time is a major determinant of acceptability and fairness of treatment.

The influence of compassion on acceptability was also measured. Patients were asked whether they would allow another patient to jump ahead in the queue if that person had more pain, less physical function and was incurring more personal costs than they were while waiting. Pain was a major driver of compassion. Most hip replacement patients – 87.0% – and most knee replacement patients – 88.0% – agreed to let a patient with more pain jump ahead of them.

Personal costs incurred while waiting was the next major grounds for compassionate queue jumping. The majority of hip replacement patients – 58.5% – and more than two-thirds of knee replacement patients – 67.6% – agreed to step aside under this circumstance.

There was dramatically less compassion on the basis of physical function. Just 13.7% of hip replacement patients and 11.5% of knee replacement patients agreed to allow someone with less physical function to have surgery ahead of them.
3.5 Safety

The Health Quality Council of Alberta defines safety as mitigating risks to avoid unintended or harmful results.

Comparative safety data from the pilot was generated from hospital and clinic charts, administrative data, and patient response to a questionnaire three months after surgery. Outcomes were submitted to a Safety Review Committee, which conducted a blinded review of all adverse events.

There were four in-hospital patient mortalities in the intervention group, compared with none in the control group. From a scientific evaluation perspective, the small number of in-patient mortalities and the higher number of surgeries – more than twice as many in the new continuum as in the conventional approach – present a significant challenge when attempting to establish an association between these events and the treatment method used, random variation or other factors and circumstances outside the scope of treatment. Study of these outcomes is continuing.

Overall, there were no significant differences in the rates of other major complications whether undergoing a hip or a knee replacement in the new continuum or under the conventional approach.

There were 4.13 joint-related adverse events – such as a fall, surgical wound infection, fracture or pulmonary embolism – per 100 patients in the new continuum within 30 days of surgery. This compares with 4.76 adverse events per 100 patients who had surgery under the conventional approach.

The rate of joint-related adverse events at 30 days or longer following surgery was 1.22 per 100 patients in the new continuum, compared with 2.18 per 100 in the conventional approach.

There were 6.57 non-joint-related adverse events per 100 patients within 30 days of surgery among patients in the new continuum, compared with 5.36 per 100 patients in the conventional approach. These include events such as urinary tract and gastro-intestinal infections and minor heart attack.

Despite significantly earlier mobilization of patients in the new continuum, there was no significant difference in the number of patient-reported falls while in hospital. Overall, 2.9% of patients in the new continuum experienced a fall after surgery, compared with 3.3% of patients in the conventional approach.

The results indicate that significantly improved access to services as well as standardized approaches to care can be achieved without increasing patient risk. At the same time, it is critical that existing safety processes and records of patient safety, particularly related to mildly or moderately severe events, are reported consistently and completely. In the course of collecting data, the pilot discovered that these events are not currently reported on a consistent or complete basis.
3.6 Appropriateness

The Health Quality Council of Alberta defines appropriateness as health services being relevant to user needs and based on accepted or evidence-based practice.

The pilot was evaluated in seven key indicators of appropriateness:

- Use of medical screening;
- Use of spinal anaesthesia;
- Use of surgical wound drains;
- Patient mobilization;
- Patient discharge home without home care;
- Patient discharge home with home care; and
- Patient transfer to sub-acute care.

The new continuum of care proved more appropriate than the conventional approach to hip and knee replacement in all of these indicators.

Medical screening

The new continuum of care applied evidence-based criteria to screening patients for hip or knee replacement surgery. Under the conventional approach to hip and knee replacement, medical screening is left to the discretion of the surgeon and to individual health region guidelines and is not supported by agreed-upon provincial standards.

Evidence suggests patients who have hip or knee replacement surgery are at greater risk if they have ischemic heart disease, congestive heart failure, uncontrolled hypertension, restrictive lung disease or anaemia, or are insulin-dependent diabetic, anticoagulant or morbidly obese.

These conditions were added to establish a more standardized approach to clearing patients for hip or knee replacement surgery in the new continuum. While surgeon discretion and regional guidelines remained determining factors, the addition of specific criteria was intended to reduce non-evidence-based patient screening that is costly and consumes public health care resources.

Using these criteria, the most dramatic difference was in Capital Health, where 67.1% of patients in the new continuum were screened, compared with 84.5% in the conventional approach. In David Thompson Health Region, results were 32.6% and 42.2%, respectively.

The College of Physicians and Surgeons of Alberta requires screening for all patients who have surgery at the Health Resource Centre in the Calgary Health Region because the centre is not equipped to provide intensive care. Since screening generally occurs before patients are assigned to a particular facility for surgery, this requirement by the College results in almost all patients being screened. Furthermore, the requirement was not changed for the pilot, and the criteria-based approach to screening developed for the new continuum could not be applied. Consequently, there was little difference in the Calgary Health Region between the percentage of patients screened in the new
continuum and the percentage of patients screened in the conventional approach – 95.5% and 97.8%, respectively.

Furthermore, while the rate of screening is significantly higher in the Calgary Health Region than in the David Thompson and Capital regions, the relative concurrent health condition rates are similar in patients across the three health regions. This suggests the use of medical screening is not associated with the existence of concurrent health conditions.

**Spinal anaesthesia**

Evidence indicates that patients who have spinal anaesthesia for hip or knee replacement recover from surgery faster than patients who have general anaesthesia. They are able to become mobile sooner. Early mobilization is critical to shortening patient stay in hospital and, consequently, reducing consumption of public health care resources and lowering costs.

There are no standards for anaesthesia type in the conventional approach to hip and knee replacement surgery. The new continuum established an evidence-based standard of spinal anaesthesia use in 95% of patients.

Results of the pilot indicate that the application of a standard is effective in increasing use of spinal anaesthesia. Overall, spinal anaesthesia was used in 81.6% of patients in the new continuum, compared with 74.7% of patients in the conventional approach to hip and knee replacement. The difference was most striking in the David Thompson Health Region, where 89.0% of patients in the new continuum had spinal anaesthesia, compared with 76.5% in the conventional approach. The difference was consistent in the Calgary and Capital health regions, where spinal anaesthesia use in the new continuum was 79.0% and 81.0%, respectively, compared with 74.2% and 74.6%, respectively, in the conventional approach.

**Surgical wound drains**

A review of medical literature indicates hip and knee replacement patients do not have improved outcomes as a result of draining excess blood from the surgical wound. Evidence suggests, therefore, that drain use consumes time and resources with little or no patient benefit.

Results of the pilot show that drains were used in 46.7% of patients who had a hip or knee replacement under the conventional approach. This declined to 38.3% of patients in the new continuum.

Results also show that use of drains varied dramatically across the three participating health regions. Drain use among patients in the conventional approach was 76.6% in Capital Health, 25.4% in Calgary, and 6.1% in David Thompson. Drain use among patients in the new continuum declined to 67.6% in Capital, 16.5% in Calgary, and 2.8% in David Thompson.
Patient mobilization

Patients who become mobile soon after their hip or knee replacement are known to have a faster recovery from surgery than patients whose mobilization is delayed. A faster recovery, in turn, shortens patient stay in hospital, reducing consumption of health care resources and the costs of care.

Overall, the percentage of patients mobilized on day of surgery was almost three times higher in the new continuum than in the conventional approach – 85.3%, compared with 30.8%. The incidence of patient falls indicates that early patient mobilization does not compromise safety. Just 2.9% of patients in the new continuum experienced a fall while in hospital, compared with 3.3% of patients in the conventional approach.

Both the percentage of and the increase in new-continuum patients mobilized on day of surgery, compared with patients in the conventional approach, were highest in the David Thompson Health Region. Just 13.3% of patients in the conventional approach were mobilized on day of surgery. This increased to 95.6% of patients in the new continuum.

The rate of increase was comparable in the Capital and Calgary health regions. In Capital, 88.2% of patients in the new continuum were mobilized on day of surgery, compared with 37.7% of patients in the conventional approach, while in Calgary the results were 77.7% and 29.8%, respectively.

Patient discharge home without home care

The new continuum applied evidence-based criteria to patient referral for home care following surgery. Under the conventional approach to hip and knee replacement, home care referral is left to the discretion of the surgeon and is not supported by agreed-upon provincial standards.

Patients in the new continuum were referred for home care when they required assistance with:

- Activities of daily living, such as bathing, walking, dressing, feeding, and getting on and off a toilet and into and out of bed;
- Administering medication;
- Changing a wound dressing and monitoring a draining wound; or
- Leaving their residence for required treatments, exercise or monitoring.

Overall, 67.7% of patients in the new continuum were discharged home without home care, compared with 66.3% of patients in the conventional approach. Results were similar when comparing hip replacement with knee replacement patients. In the new continuum, 68.8% of hip replacement patients and 66.9% of knee replacement patients were discharged home without home care, compared with 63.5% and 68.6%, respectively, of patients in the conventional approach.

Among the three participating health regions, only David Thompson had a lower percentage of patients in the new continuum discharged home without home care – 66.0%, compared with 88.5% of patients in the conventional approach.
In the Calgary Health Region, 85.2% of patients in the new continuum were discharged home without home care, compared with 79.4% of patients in the conventional approach. Capital Health results were 49.0% and 46.9%, respectively.

(It is important to note that 56.0% of patients in the conventional approach were discharged home without home care in the early stage of the pilot, compared with 66.3% over the entire pilot period. This result suggests that discharge practices in the conventional approach became similar to those in the new continuum as the pilot progressed.)

**Patient discharge home with home care**

Overall, 24.5% of patients in the new continuum were discharged home with home care, compared with 25.9% of patients in the conventional approach. Results were similar when comparing hip replacement with knee replacement patients. In the new continuum, 24.7% of hip replacement and 24.3% of knee replacement patients were discharged home with home care, compared with 28.9% and 23.3%, respectively, of patients in the conventional approach.

In the David Thompson Health Region, the percentage of patients discharged home with home care was three and a half times higher in the new continuum than in the conventional approach – 34.0%, compared with 9.8%.

In the Calgary and Capital health regions, the percentage of new-continuum patients discharged home with home care was lower than that of patients in the conventional approach – 11.3% compared with 18.3% in Calgary, and 36.3% compared with 38.0% in Capital.

**Patient transfer to sub-acute care**

Evidence-based criteria were applied when considering patient transfer to sub-acute care following surgery in the new continuum. Under the conventional approach to hip and knee replacement, transfer to sub-acute care is left to the discretion of the surgeon and is not subject to agreed-upon provincial standards.

Patients in the new continuum were transferred to sub-acute care when they:

- Could not manage in their home environment because they did not have home support or because the structure of their residence made access to critical areas, such as the bathroom, bedroom or kitchen, difficult or dangerous;
- Were frail and elderly with concurrent health conditions;
- Did not have access or had only limited access to the rehabilitation services they required;
- Experienced post-operative complications; or
- Had bilateral joint surgery.

Results of the pilot show that the percentage of patients in the new continuum referred to sub-acute care is similar to that of patients in the conventional approach when examined on the basis of location and type of joint replaced.
Overall, 6.9% of patients in the new continuum and 6.9% of patients in the conventional approach were transferred to sub-acute care. Among hip replacement patients, 6.4% of those in the new continuum and 7.1% of those in the conventional approach were transferred to sub-acute care. Among knee replacement patients, 7.3% of those in the new continuum and 6.8% of those in the conventional approach were transferred to sub-acute care.

In the Calgary Health Region, just 0.5% of new-continuum patients were transferred to sub-acute care, compared with none of the patients in the conventional approach. In the David Thompson Health Region, 4.6% of new-continuum patients and 1.6% of patients in the conventional approach were transferred to sub-acute care. Transfers in Capital Health were 14.7% and 15.1%, respectively.

(It is important to note that 20% of patients in the conventional approach were transferred to sub-acute care in the early stage of the pilot, compared with 6.9% over the entire pilot period. This result suggests that sub-acute care transfer practices in the conventional approach became similar to those in the new continuum as the pilot progressed.)
4.0 SUMMARY

Access is a key influencer of other dimensions of health care quality. As waiting time increases, patient condition worsens, patient satisfaction decreases, and the cost to both the patient and the public health care system escalates.

Successfully managing the challenge of access through such means as eliminating the backlog of hip and knee replacement surgeries, meeting a steady rise in demand due to demographic, social and technological changes, and defining and adhering to criteria for appropriateness is a precursor to improving efficiency in the public health care system.

Efficiency, including improved access to health care resources and reduced cost of providing care, is enhanced by reallocating resources across the continuum of care. This is demonstrated by a 15% decrease in average hospital cost, with 13% being reallocated to the community. By reallocating resources, access to consultation is improved significantly without a negative impact on hospital cost.

As hospital care continues to represent the largest component of overall case cost, further gains in safety, increased operating room utilization and reduced length of stay in hospital generate increased patient capacity at a lower cost per case. In addition, efforts to expand evidence-based standards of appropriateness have a positive impact on cost.

As appropriateness, efficiency and access improve, both effectiveness and acceptability increase. Improved patient outcomes in the critical areas of physical function, social function and pain duration and level are linked to providing the right evidence-based intervention at the right time.

Satisfaction levels rise as patients receive access to evidence-based services and understand the care they are receiving is proven to produce positive outcomes and, therefore, is in their interest.

Patient outcomes, particularly with regard to safety, must always remain the primary consideration in any effort to improve the delivery of public health care services. Patient outcomes, including safety, can be improved continuously by enhancing access, appropriateness and efficiency and reinvesting some of the resulting savings to support ongoing comprehensive monitoring and evaluation of services.
5.0 ALBERTA HIP AND KNEE REPLACEMENT PROJECT CONCLUSIONS

The Alberta Hip and Knee Replacement Pilot Project is among the most extensive health services delivery evaluations ever undertaken in North America. ABJHI presents the following conclusions from its report:

It is possible to introduce innovative change to the public health care delivery system that generates value for all Albertans, including the people who need care, the professionals who provide the care, and the taxpayers who fund it. More specifically, access to services can be faster, patient outcomes can be improved, patient and provider satisfaction can be increased, and the utilization of expensive health care resources can be optimized. These gains can be made without compromising safety.

There were improvements in accessibility, efficiency, acceptability, effectiveness and appropriateness – five of the six dimensions that comprise the Alberta Quality Matrix for Health, as defined by the Health Quality Council of Alberta, an independent organization established to promote province-wide patient safety and health service quality. In the sixth dimension – safety – the risk of major complications in the new continuum of care was equal to that in the conventional method of service.

The model for developing, testing and evaluating an evidence-based approach to hip and knee replacement can be applied to all areas of bone and joint health care and may also be effective in other areas of medicine where multifaceted continuums of care and multidisciplinary services are needed.

Any new approach would ideally be evaluated against the conventional methodology to identify whether the changes being advanced are beneficial. Consequently, in evaluating health care services that include a major intervention such as a hip or knee replacement, a thorough and fair evaluation must include two patient groups, one that will experience the new approach and another that will experience the conventional approach. Best practice is to apply evaluation methodologies that ensure the groups have similar profiles, such as age, weight and general health condition. An evaluation of this kind requires proper resources, dedicated funding, a defined testing period, and a standardized measurement framework. Patients should understand that until the evaluation is complete, it will not be known whether their participation in one group or the other will be a disadvantage or an advantage.

Scientific results are a tool for advancing evidence-based change. Even with evidence, however, change will often be met with resistance, founded largely on fear of departing from the known. Advancing comprehensive and multi-level change in a sensitive area such as medical care where there are diverse interests, each with unique needs, expectations and responsibilities, is difficult but can be accomplished with diligent attention to each of the interests.
REFERENCES


FURTHER INFORMATION

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