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Estimating Budget Impact and Joint Replacement Avoidance by Implementing a Standardized Education and Exercise Therapy Program for Hip and Knee Osteoarthritis in a Publicly Insured Health Care System

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Objective. The study objective was to estimate the budget impact of funding a standardized education and exercise therapy program, Good Life with osteoArthritis in Denmark (GLA:D) for people with hip and knee osteoarthritis (OA) waiting for total joint replacement (TJR) consultation in a universal publicly insured health care system in Canada.

Methods. We built a budget impact analysis model to estimate the annual cost (Canadian dollars) of providing the GLA:D program to people waiting for a TJR consultation and then forecasted a three-year budget cycle. The base case assumes that 40% attend GLA:D sessions, that 11% avoid surgery, uniform care delivery, that training costs are incurred separately, and that the health care system has enough trained staff to meet demand. The population of people with hip and knee OA waiting for a TJR consultation was estimated with government statistics, peer-reviewed evidence, and routinely collected data from five orthopedic centralized intake clinics (serving 80% of people seeking TJR). Patient-level costs were collected prospectively. International published evidence informed the TJR avoidance estimates. A one-way sensitivity analysis of key parameters evaluated model robustness. Four scenarios were analyzed: public funding for everyone (base case), low-income, rural, and uninsured persons.

Results. Funding GLA:D would cost $4.3 million, serve 12,500 people, and save $8.5 million by avoiding 1,300 TJRs in year one. Savings grow to $8.8 and $8.7 million in years two and three. The number of TJRs performed annually produced the most uncertainty in budget impact (–$15.3 million, –$1.8 million). The most cautious parameter estimates still produce cost savings.

Conclusion. Publicly funding standardized education and exercise therapy programs for everyone waiting for a TJR consultation would avoid surgeries, improve access to evidence-based treatments, and save more than the program costs.

INTRODUCTION

Osteoarthritis (OA) is one of the most common chronic conditions globally.[1] Health care system resources are strained by an aging population, obesity, and high OA prevalence.[2,3] In Canada, $1.26 billion is spent annually performing over 100,000 total joint replacements (TJRs),[4] and demand is expected to increase.[2] Many publicly funded health care systems struggle with long wait times for TJR. Wait times have also worsened because surgery volumes were reduced during the COVID-19 pandemic to maintain hospital bed capacity.[5] National targets in Canada recommend that the 90th percentile of wait times for TJR surgery should be within 26 weeks after the orthopedic surgeon and patient agree surgery is necessary. However, the 90th percentile is currently being seen within 89.6 weeks for consultation and undergoing TJR surgery within 91.6 weeks.[6]

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SIGNIFICANCE & INNOVATIONS

- Universal publicly insured health care systems like Canada's could spend $4 million offering GLA:D to everyone waiting for a TJR consultation.
- Publicly funding a structured education and exercise program like GLA:D is an affordable solution that could help decision-makers improve access to evidence-based treatments.

Decision-makers have increased surgical capacity,[7] but long wait times persist. Alternative solutions are necessary to address the wait time crisis for TJR.

TJRs are appropriate and effective for end-stage OA after all other treatment options have been exhausted.[8] International clinical guidelines recommend that everyone with hip and knee OA receive education, exercise therapy, and weight management as first-line treatment with adjunctive pharmacological pain management as needed.[9–12] These guidelines have existed for 25 years,[13] but first-line treatments are consistently underused whereas medication and surgery are overused.[14–17] Almost 40% of people with knee OA did not attempt first-line treatments before having a TJR.[18] Standardized programs like Good Life with osteoArthritis in Denmark (GLA:D) were developed to implement high-quality hip and knee OA treatments into routine care.[19,20] GLA:D includes 2 education sessions and 12 supervised neuromuscular exercise sessions delivered twice per week.[19] Eighty-five thousand people in 10 countries have attended GLA:D,[21] with most paying out of pocket because many health care systems and reimbursement plans do not include standardized education and exercise therapy programs.[22] A randomized controlled trial (RCT) evaluating knee replacement reported that 68% of surgical candidates randomized to an education and exercise program had avoided surgery two years after the intervention.[23] Ensuring everyone undergoing TJR is end stage by optimizing nonsurgical care before surgery may help alleviate long wait times, but resource implications are an important consideration for decision-makers. We conducted a budget impact analysis (BIA) to assess the affordability of publicly funding a standardized education and exercise therapy program like GLA:D before TJR.

We used the publicly insured health care system in Alberta, Canada, as an example in our BIA because the public health care provider Alberta Health Services (AHS) has supported GLA:D implementation since 2017. In Canada, the federal government provides co-funding for each province to deliver 100% publicly insured coverage for medically necessary doctor and hospital-based services. The Ministry of Health (MOH) in each province provides additional co-funding and decides how to deliver health care to the population. The province of Alberta spends $24.5 billion annually[24] delivering health care to a population of 4.4 million. Community-based services like GLA:D are funded by a complex mixture of public and private insurance or out-of-pocket payment. Patient-level costs were also recently collected in Alberta for a cost-effectiveness analysis comparing persons receiving GLA:D versus usual care (defined as any community-based service people used to manage their OA symptoms before a TJR). Collecting patient-level costs for a standardized OA program and usual care presents an opportunity to estimate the budget impact and assess the affordability of these programs from the health care systems perspective.

METHODS

We followed the International Society for Pharmacoeconomics and Outcomes Research BIA guidelines to transparently report the parameters and methods used when estimating the budget impact (Canadian dollars) of adopting a new intervention in a health care system.[25]

Model design. Following standard practice, we programmed a cost calculator in Microsoft Excel to estimate the public health care system's (Alberta, Canada) annual budget spent delivering care to people waiting for a TJR consultation

$$\boldsymbol{Annual\ Budget} = \big((\boldsymbol{A} - \boldsymbol{B} + \boldsymbol{C}) * \boldsymbol{D}\big) + (\boldsymbol{E} * \boldsymbol{F}) - (\boldsymbol{C} * \boldsymbol{G}) + (\boldsymbol{B} * \boldsymbol{G})$$

Where:
A = Number of people waiting for TJR consultation annually
B = Number of TJRs annually
C = Number of TJRs avoided annually
D = Cost of community management annually
E = Number of people waiting for TJR consultation who participate in GLA:D® annually
F = Cost of GLA:D (per person)
G =Cost of TJR (per person)

Figure 1. Budget impact analysis formula. GLA:D, Good Life with osteoArthritis in Denmark; TJR, total joint replacement.

(Figure 1). Our model takes the MOH perspective because it includes all publicly funded health care costs and is considered the reference case in Canada.[26] Costs were extrapolated over a three-year time horizon to be consistent with MOH budget forecasts and were calculated in 2022 Canadian dollars to reflect when our cost estimates were collected. We assumed the following: (1) a proportion of people waiting for a TJR consultation will participate in GLA:D regardless of prior treatment, (2) the cost of training clinicians in GLA:D delivery will be funded by employers' professional development budgets, (3) GLA:D delivered in person or virtually is uniform across all locations, (4) each GLA:D class has six participants, (5) the health care system has reached a steady state by training enough staff to meet demand for the program, and (6) half of surgical volumes are total knee replacements and half are total hip replacements because this reflects the case mix in Alberta over five fiscal years (2017/2018 to 2021/2022).[4] Infections, revisions, delaying TJR, bilateral TJR, and TJR for a different joint were excluded from our BIA model because we assumed that GLA:D participation would not change the costs related to these clinical characteristics.

Data sources. Model inputs were estimated from peer-reviewed research, gray literature, local administrative data, and expert clinical opinion, as described below (Table 1).

Population estimates. *Population waiting for TJR consultation.* The population waiting for a TJR consultation was estimated from routinely collected data at five orthopedic centralized intake clinics that provide access to approximately 80% of TJRs throughout Alberta. We assumed that the population of people waiting for a TJR consultation would increase at the same rate as those with OA in Alberta. The population of people with OA was estimated by multiplying population growth, mortality rates, and OA prevalence in Alberta.[27–29]

Forecasted demand for TJR. The Alberta Bone & Joint Health Institute, an independent charitable organization focused on turning knowledge into better care for people with bone and joint conditions, forecasts that demand for TJRs will grow in Alberta from 13,867 to 15,028 surgeries annually over the study period.[30]

GLA:D participation rates. We extracted participation rates from peer-reviewed research evaluating exercise therapy in people with hip and knee OA and then asked experts their opinion. Eighty percent of patients eligible for TJR consented to participate in RCTs of exercise therapy,[31] but clinical experts thought participation may be lower in the real world. We conservatively estimated that participation rates would be half of what were observed in peer-reviewed research (40%) when people were invited to participate in GLA:D if it was publicly funded while they wait for a TJR consultation.

Population avoiding TJR. RCTs have demonstrated that 44%[32] to 68%[23] of people with hip and knee OA avoided TJR after being randomized to exercise therapy. However, there might be selection bias in these samples. Only 9% (127 of 1,475) of those screened were eligible to participate in the study by Skou et al,[31] and 79% (100 of 127) of eligible patients were willing to be randomized. We used real-world data from the GLA:D Canada database to estimate that 11% of participants would avoid a TJR.[33] GLA:D participants were asked, "Are you so troubled by your knee/hip problems that you want surgery?" with "yes" or "no" as possible answers. Participants who responded "yes" before the GLA:D program and then "no" at 12 months were used to estimate the percentage of the population who

Table 1. Parameters used in the budget impact analysis model*

Parameter (Alberta specific)	Value	Source
Total population, n	4.44M	Government of Alberta[33]
Annual population growth rate, %	1.5	Government of Alberta[33]
All-cause mortality rate, %	0.6	Government of Alberta[34]
OA prevalence, %	8.0	A Rowe, MSc, Alberta Health Services, personal communication (email), January 19, 2023 to T. Wasylak
OA incidence (annual), %	0.9	A Rowe, MSc, Alberta Health Services, personal communication (email), January 19, 2023 to T. Wasylak
OA population waiting for TJR consultation, n	31,227	Alberta Bone & Joint Health Institute[35]
Forecasted number of TJRs annually (2021/2022 to 2024/2025)	13,867–15,028	Alberta Bone & Joint Health Institute[36]
Per-person cost of GLA:D at private clinics, $CAD	400	GLA:D clinics
Per-person cost of GLA:D at public clinics, $CAD	304	Expert opinion
Annual cost per person to manage OA with UC, $CAD	653	Mazzei et al[30]
Average cost per TJR, $CAD	10,116	AHS[37]
Implementation, $CAD	211,920	AHS[38]
Percentage avoiding TJR, %	11	GLA:D Canada[39]
GLA:D participation rate from population waiting for a TJR, %	40	Expert opinion

* Estimates are in 2022 Canadian dollars (CAD). AHS, Alberta Health Services; GLA:D, Good Life with osteoArthritis in Denmark; M, million; OA, osteoarthritis; TJR, total joint replacement; UC, usual care.

would avoid TJR for the three-year budget cycle. This estimate is comparable to the 12% of people who reported undergoing a TJR within 12 months of participating in GLA:D although we feel unwillingness is a better predictor of avoidance than people who actually proceeded to surgery.[34]

Cost estimates. *Community management.* The cost of managing OA in the community was estimated from administrative data in a cohort of participants receiving usual care in Alberta, Canada. The average cost was applied to each person in the population of people waiting for a TJR.

GLA:D. The price to attend GLA:D ranges from $375 to $450 at private clinics in Alberta. We assumed the average price was $400 because only 1 of 68 clinics charged $450 when the study was conducted. Public facility costs were estimated by taking an average physiotherapist salary ($43.48 hourly plus 20% for benefits) multiplied by 2.5 hours per class (30-minute preparation, 60-minute class, 30-minute take-down, and 30-minute charting) for 14 classes, producing an estimated cost of $1,826 per class. Assuming six participants per class produced a per-person cost of $304. Public facility cost estimates do not include facility costs such as electricity and maintenance because these costs are incurred in a separate part of the budget whether GLA:D is delivered or not. We assumed clinics already had the necessary equipment because GLA:D was designed to use minimal equipment, and resistance bands would often be purchased by the patient for a nominal fee.

TJR surgery. In 2022, AHS estimated that the average TJR costs $10,116 (A Rowe, MSc, Alberta Health Services, personal communication (email), January 19, 2023 to T. Wasylak). Surgical costs include physician compensation, materials, staff time, and bed days in hospital. This estimate does not include rehabilitation because these costs are predominantly incurred out of pocket in Canada.[35]

Implementation. Implementation costs were estimated by the AHS Bone and Joint Health (BJH) Strategic Clinical Network (SCN), which began piloting GLA:D in 2017. SCNs are the innovation arm of Alberta's publicly funded health care system. SCNs bring together clinical experts, operational leaders, patients, and researchers to produce transformative solutions to improve health care delivery. The BJH SCN supported GLA:D implementation by taking on administrative duties as well as offering annual clinician training classes, hosting regular community of practice meetings for clinicians to learn from one another, and fidelity checks during the pilot phase. GLA:D was implemented at 45 privately funded community rehabilitation clinics, 5 of 40 primary care networks, and 18 of 106 AHS facilities.[36] The BJH SCN hired one additional staff member to support GLA:D implementation, and other team members contributed a portion of their time. Implementation costs include staff time, research grants, travel, training sessions, and event-related costs.

Sensitivity analysis. Parameter uncertainty was evaluated using one-way sensitivity analysis. The estimates are shown in Supplementary Table 1. Each parameter was varied with a high and low estimate to evaluate how variability surrounding each parameter would change the budget impact results. One standard deviation was used for parameters with distributions. The highest and lowest reported price to attend GLA:D at a private facility in Alberta was used to show how price will change the budget impact. GLA:D Denmark and GLA:D Australia ask the same question about wanting surgery before participating in GLA:D and at 12 months, so we used real-world data from these databases as high and low estimates for the percentage of people who would avoid TJR.[21,37] Standard deviations or confidence intervals did not exist in the literature to estimate parameter uncertainty for all other parameters. Therefore, parameters were varied using expert opinion with input from a senior biostatistician, a health care executive, and two clinician-scientists in the research field. Parameter uncertainty ranged from 5% to 50% based on the research team's confidence with each parameter. Results were visualized in a tornado diagram in which parameters were ordered from most to least impact on the primary results.[38]

Scenario analysis. Decision-makers may choose to publicly fund GLA:D for various subpopulations based on costs, expected benefits, clinical characteristics, or equity considerations. Operational leaders within the BJH SCN helped us select four scenarios that were relevant to decision-makers to assess how publicly funding GLA:D for different subpopulations would impact affordability: (1) low-income people to reduce economic inequities, (2) people in rural communities where there are publicly funded hospitals to reduce geographic inequities, (3) high-risk subpopulations for whom TJR surgical risks outweigh the potential benefits (eg, contraindications to general anesthetic), and (4) people who do not have private health insurance that covers allied health professional (eg, rehabilitation) visits because people with private health insurance could use these resources to access a program like GLA:D (Supplementary Table 2).

RESULTS

Base case analysis. We estimate that the MOH will spend $155.4 million in the first year delivering OA care to people waiting for a TJR consultation, and publicly funding GLA:D would reduce the annual budget to $146.7 million (Figure 2). In the first year, it would cost $4.3 million to publicly fund GLA:D, and 1,374 people would avoid surgery, producing net savings of approximately $8.5 million by reducing demand for TJR. This return of investment equals approximately $2 saved for every $1 investment. Over three years, the population waiting for a TJR consultation is expected to grow from 31,227 to 32,817 people. The number of people participating in GLA:D and avoiding TJR would also grow.

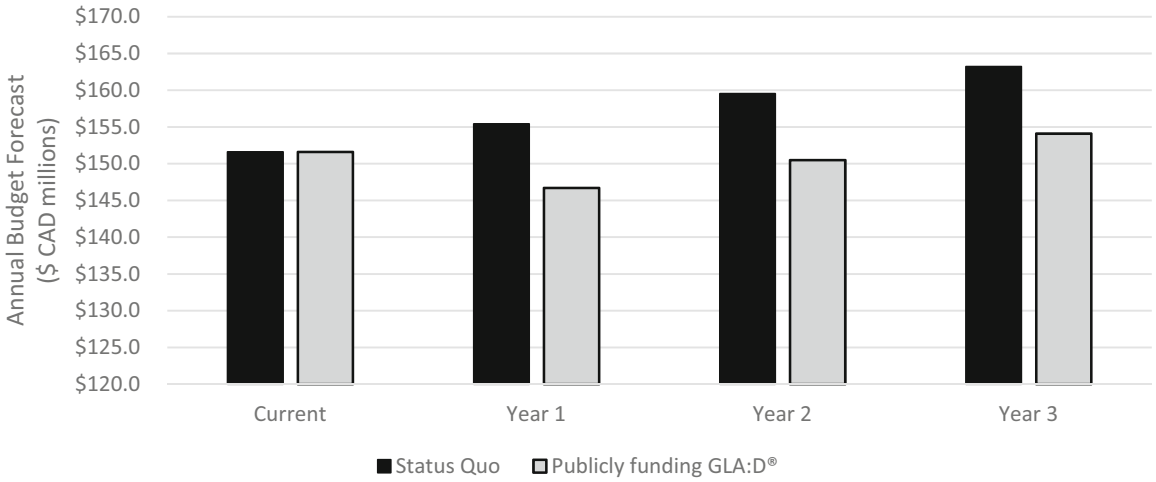

Figure 2. Annual budget forecast of publicly funding GLA:D compared to status quo. Budget impact is the difference in annual budget forecast between status quo and publicly funding GLA:D in each year. CAD, Canadian dollars; GLA:D, Good Life with osteoArthritis in Denmark.

The total budget impact would be –$8.5 million, –$8.8 million, and –$8.7 million in year 1, 2, and 3 respectively (Table 2).

Sensitivity analysis. Parameter uncertainty is shown in Figure 3. All estimates produced cost savings as shown by negative budget impacts. The annual number of TJRs produces the most uncertainty, causing the budget impact in year 1 to range from –$15.3 million if there are 5% fewer TJRs than what was forecasted to –$1.8 million if there are 5% more TJRs than what was forecasted in the base case. The budget impact ranges from –$13.8 to –$4.7 million if the percentage of people avoiding surgery changes from 15.5% to 7.8%. The budget impact will be –$12.9 million if the participation rate is 60% or –$4.7 million with participation rates of 20%. No estimates pass the breakeven point (budget impact of $0), where cost savings are less than the budget to deliver GLA:D.

Scenario analysis. All scenarios would save more than the budget needed to publicly fund GLA:D for the identified subpopulations. Publicly funding GLA:D for low-income, high-surgical-risk, rural, and uninsured subpopulations would cost $0.4 million, $0.6 million, $0.9 million, and $1.3 million while saving $0.5 million, $1.0 million, $1.5 million, and $2.4 million, respectively (Table 3). Publicly funding GLA:D for everyone saves more than when GLA:D is publicly funded for smaller subpopulations.

DISCUSSION

Investing $4.3 million will allow 12,491 people awaiting a hip and knee TJR consultation to participate in GLA:D free of charge and save the MOH approximately $8.5 million in the first year by avoiding 1,374 TJRs. A total of 4,161 TJRs will be avoided over

Table 2. Budget impact for publicly funding GLA:D*

	Current	Year 1	Year 2	Year 3
OA population waiting for TJR consultation, n	31,227	31,227	31,521	32,817
Status quo				
Total annual budget for managing OA population waiting for TJR consultation with status quo, $CAD	151.6	155.4	159.5	163.0
Forecasted number of TJRs annually	13,867	14,267	14,657	15,028
Cost to manage OA without surgery, $CAD	11.3	11.1	11.0	11.0
Publicly funding GLA:D				
Population who attend GLA:D in publicly funded scenario, n	739	12,491	12,608	12,727
Avoided TJRs, n	0	1,374	1,387	1,400
Cost of publicly funding GLA:D, $CAD	0	4.3	4.3	4.4
Cost of avoided TJRs, $CAD	0	−13.9	−14.0	−14.2
Implementation costs	—	$0.2	$0.2	$0.2
Total annual budget for managing OA population waiting for TJR consultation with publicly funding GLA:D	$151.6	$146.7	$150.5	$154.1
Budget impact, $CAD	—	−8.5	−8.8	−8.7
Budget impact (percentage of status quo annual budget), %	—	−5.5	−5.5	−5.3

* Dollar figures are in millions (2022 Canadian dollars [CAD]) and rounded to the nearest decimal so rows may not add. Negative costs indicate cost savings. GLA:D, Good Life with osteoArthritis in Denmark; OA, osteoarthritis; TJR, total joint replacement.

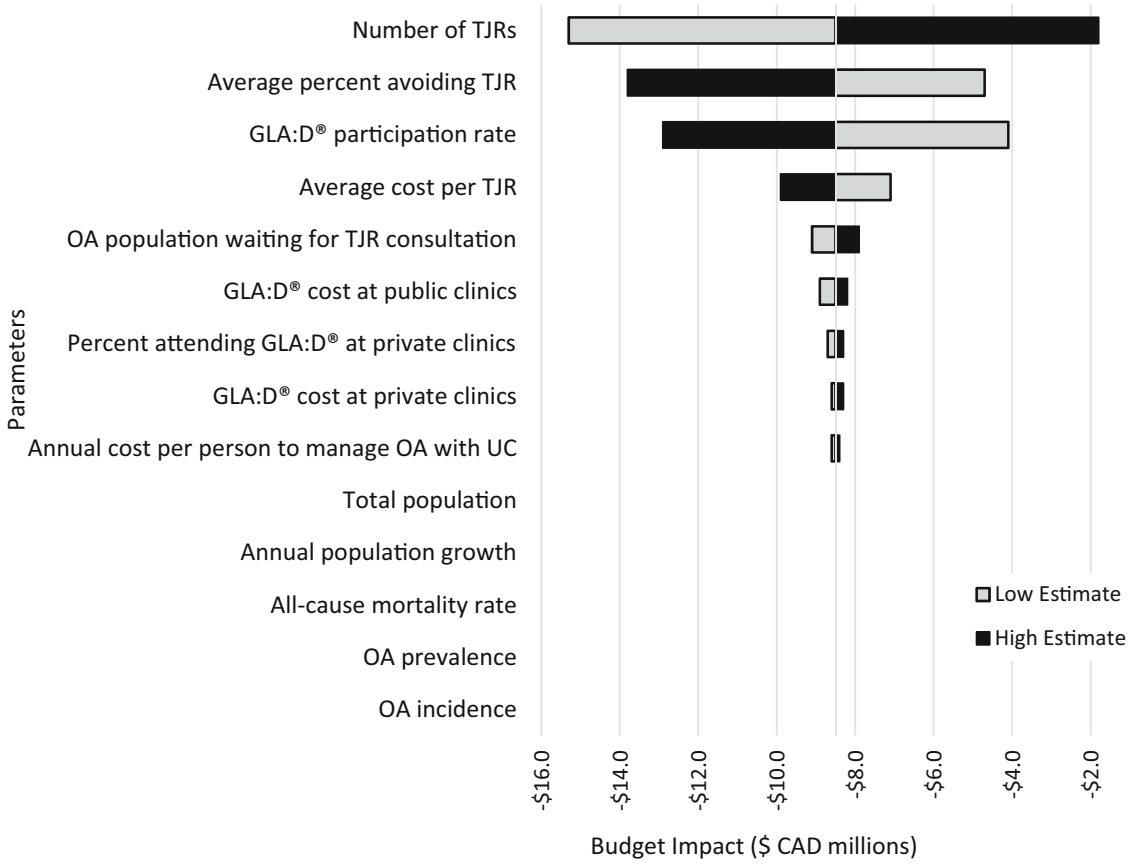

Figure 3. Change in budget impact estimates based on parameter uncertainty. Figure is centered around the Year 1 estimate (–$8.5 million) from the base case analysis. CAD, Canadian dollars; GLA:D, Good Life with osteoArthritis in Denmark; OA, osteoarthritis; TJR, total joint replacement; UC, usual care.

three years. By year three, cost savings will grow to $8.7 million annually as the population awaiting a TJR consultation grows.

We estimated that 40% of people would participate if GLA:D was offered free of charge and 11% of participants would avoid surgery. Parameter uncertainty changes the budget impact, but even pessimistic estimates for participation rates and the percentage of people who avoid surgery will still break even (shown by negative budget impacts). Based on our findings, publicly funding the GLA:D program would pay for itself if as few as 3% of people who participated in GLA:D or 1% of everyone waiting for a TJR consultation avoid surgery. Our scenario analysis showed that funding GLA:D for subpopulations instead of everyone would cost less but also produce less savings. A health care system will save more if more people participate in GLA:D. Providing universal public funding to a structured education and exercise therapy program like GLA:D ensures everyone has equitable access to evidence-based OA treatments, regardless of socioeconomic, geographic, or clinical characteristics.

Table 3. Scenario analysis for publicly funding GLA:D in select subpopulations*

Scenario[a]	Percentage of population	Number of annual GLA:D participants	Cost to deliver GLA:D, $CAD	Budget impact, $CAD
All (base case)	40	12,491	4.3	−8.5
Low income	8	1,024	0.4	−0.5
High surgical risk	14	1,749	0.6	−1.0
Rural	20	2,498	0.9	−1.5
Uninsured	30	3,747	1.3	−2.4

* Dollar figures are in millions (2022 Canadian dollars [$CAD]) and rounded to the nearest decimal. GLA:D, Good Life with osteoArthritis in Denmark; TJR, total joint replacement.
[a] Subpopulations waiting for TJR consultation. Low income is defined as the income situation below which families or persons would likely devote a higher proportion of their after-tax income than average to the necessities of food, shelter, and clothing. High surgical risk refers to subpopulations for whom TJR surgical risks outweigh the potential benefits. Rural refers to all areas outside of population centers. Uninsured is defined as people who do not have private health insurance that covers allied health professional services.

Our results align with other budget impact models evaluating standardized education and exercise therapy programs. Ackerman et al found that the Australian health care system could save $300 to $690 million if standardized education and exercise therapy programs were implemented nationally.[39] Their results showed more savings than ours because they assumed surgical avoidance and intervention costs from RCT data.[23] Populating our model with real-world data from people accessing OA care in the community is likely more generalizable to the policy options that decision-makers face. Smith et al showed that an exercise and diet intervention for OA would have a similar cost to other health promotion programs from the perspective of commercial insurance or Medicare Advantage plans in the United States.[40] Our results add to the evidence base by evaluating a standardized education and exercise therapy program from the perspective of a publicly insured health care system delivering universal access.

Other health care systems can learn from the implementation experience in Alberta, although some contexts are unique.[41] The implementation costs in our model were quite small because only one full-time equivalent staff member was hired to support implementation. The SCNs act as supportive infrastructure within AHS by providing teams and resources to support innovation. Academics and nonprofit organizations like Bone and Joint Canada also played an important role in setting up and maintaining routine data collection. Health care systems may incur additional implementation costs if innovation teams are not already embedded within their organization and partners do not offer in-kind support for common goals. Administrative costs were also not included because the GLA:D program and AHS do not have centralized referral pathways or patient navigation services for people with hip and knee OA. Our BIA model assumed that a ramp-up of training had already occurred and that the health care system has reached a steady state with enough capacity in GLA:D trained staff to deliver the program to 12,000 people annually in the first year of the program. This volume is feasible in a health care system like AHS, which has supported implementation of GLA:D for several years, but health care systems adopting a new program may have reduced volumes before reaching a steady state. We assumed that training costs were funded by employers' professional development budgets, which is common practice for allied health professionals across Canada, but other health care organizations may have to consider these costs. We estimate that it would cost $150,800 to train 260 staff ($580 per staff[42]) to meet the demand for the GLA:D program in our BIA model (assuming every clinician delivers GLA:D twice per quarter to an average of six participants, serving a total of 48 participants annually). Increasing the capacity of trained allied health professionals is a primary barrier during the initial stages of implementation. Training multiple providers at each clinic is important to deliver the program sustainably. Publicly funding a program like GLA:D may incentivize clinicians to take the training course faster than what occurred in Alberta. Program uptake was facilitated by a community of practice, prepackaged materials, and the ability to perform the exercise program without specialized equipment.[41] However, implementing GLA:D took longer than expected, with most clinicians delivering their first class three to four months after training.[41] Marketing the program is critical to increase patient uptake. Clinicians believed referral pathways would also remove barriers to the program. The GLA:D program was originally delivered in-person but was adapted to a virtual delivery model during the COVID-19 pandemic. Virtual delivery is an important option in countries with a large land mass like Canada, specifically for people in rural and remote communities. Our model shows that the difference in cost based on delivering GLA:D at private versus public clinics is marginal. When deciding the delivery location, health care systems should consider what is feasible to rapidly scale the program based on the local context of allied health professionals.

Our budget impact results are complementary to the previously published economic evaluations showing that standardized OA programs are cost-effective in many health care systems. Cost-effectiveness helps decision-makers understand whether a new intervention generates more value (ie, health benefit) for money than an alternative intervention. However, it is possible for a new intervention to be cost-effective but not affordable if the price is high and a large percentage of the population uses the new intervention. We estimated that a standardized education and exercise therapy program like GLA:D is cost-effective and affordable because it may help people avoid TJRs, which cost 25 times more than the GLA:D program per person. Combining cost-effectiveness and affordability provides a comprehensive economic picture of implementing GLA:D into a publicly insured health care system.

Publicly insured health care systems use waitlists to control demand for finite resources like TJRs. This means cost savings in the real world would be observed as reduced wait times instead of budget reductions because another person would have the TJR that was avoided. Using queuing theory,[43] we estimate that the 90th percentile wait time for TJR would be reduced by 12.3 weeks if 11% of GLA:D participants avoided surgery. This means that a publicly insured health care system in Canada could reduce the 90th percentile wait time for TJR surgery from 91.6 weeks to 79.3 weeks. Health care systems could spend $4 million offering GLA:D to everyone waiting for a TJR consultation or $14 million increasing surgical volumes to achieve the same wait time reductions. However, increased surgical volumes also assume that there is operating room capacity and trained staff (eg, orthopedic surgeons, anesthesiologists, and nurses) to meet the increased surgical demand. Publicly funding a structured education and exercise program like GLA:D is an affordable solution that could help decision-makers reduce long wait times.

Our BIA model uses real-world costs and implementation experiences within a publicly insured health care system to

showcase the financial considerations of implementing standardized education and exercise therapy programs into a large publicly insured health care system. However, health care system benefits are likely underestimated because our model only considers the benefits for OA and ignores the additional health benefits that can be gained from exercise for 35 other chronic diseases.[44,45] Policy-makers in other jurisdictions must also recognize that our cost savings are underestimated because postoperative rehabilitation accounts for 39% of health care costs related to TJR,[35] but these costs were not considered in our model because most community rehabilitation services are not publicly funded in Alberta. Although the evidence is mixed, participating in a presurgical standardized education and exercise therapy program may also offer small postsurgical health benefits and reduced length of stay,[46] which are factors not considered in our BIA model. One-way sensitivity analysis is a less rigorous method to evaluate model uncertainty, but most parameters in our model lacked standard deviations, making probabilistic sensitivity analysis not feasible. Our model assessed funding a standardized education and exercise therapy program for people waiting for a TJR consultation because long waitlists are the most relevant problem for decision-makers; however, clinical guidelines recommend education and exercise therapy right after diagnosis. Future research will need to evaluate optimal timing of education and exercise therapy to maximize clinical benefits and health care system resources. We also assumed surgeries were avoided for the entire budget cycle whereas some people may delay but still go on to have a TJR. Skou et al showed that 26% of randomized patients proceeded to surgery at one year and 9% after two years, suggesting a diminishing percentage of people delaying surgery.[23,31] We expect that delayed surgery would be an insignificant cost compared to the total annual cost of managing everyone waiting for a hip and knee TJR consultation. Assessing whether standardized education and exercise therapy programs actually help people avoid TJR in the real world also has important implications. Lastly, implementation research can help health care systems reduce other barriers like misinformation, knowledge gaps, expectations, and referral patterns to increase participation rates.[47,48]

Our results suggest that providing GLA:D to everyone waiting for a TJR consultation would avoid surgeries and save more than the program costs in a universal publicly insured health care system like Canada's. Funding GLA:D prior to TJR consultation would be an affordable solution to reduce wait times in publicly funded health care systems.

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AUTHOR CONTRIBUTIONS

All authors contributed to at least one of the following manuscript preparation roles: conceptualization AND/OR methodology, software, investigation, formal analysis, data curation, visualization, and validation AND drafting or reviewing/editing the final draft. As corresponding author, Dr Marshall confirms that all authors have provided the final approval of the version to be published, and takes responsibility for the affirmations regarding article submission (eg, not under consideration by another journal), the integrity of the data presented, and the statements regarding compliance with institutional review board/Declaration of Helsinki requirements.

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