Devolution of hip and knee replacement surgery?

Peter C. Coyte, PhD;* Wendy Young, MA; Jack I. Williams, PhD†

The objectives of this study were to assess trends in referral patterns for joint replacements (JRs) in Ontario between the fiscal year 1988/89 and the fiscal year 1993/94; to assess the redistribution of financial resources if services were provided to residents in the region where they reside; and to estimate the financial implications of the devolution of primary JRs from tertiary-care hospitals to community hospitals. Despite rapid growth in the provision of JRs, there was no significant change in their regional distribution. Community hospitals have increased their share of JRs at the expense of teaching hospitals. For hospitals located in Central east Ontario, the cost of providing JRs to nonresidents increased from $5.9 million in 1988/89 to $8.3 million in 1993/94. Devolution of primary JRs requires a minimum reallocation sum of $25.1 million, with potential cost savings of $4.3 million. Many obstacles limit the devolution and local provision of health care services, including modifications to referral patterns and the availability of provider expertise, especially when a substantial redistribution of resources is required. Better clinical data to evaluate outcomes and better patient-specific costing data are required. Devolution of services should be addressed in the context of appropriate institutional compensation for medical education.

Les objectifs étaient d'évaluer les tendances des présentations pour remplacement d'articulation en Ontario, entre les exercices 1988–1989 et 1993–1994, d'évaluer la redistribution des ressources financières si l'on fournissait des services à des résidents dans leur région et d'estimer les répercussions financières du transfert des remplacements d'articulations primaires des hôpitaux de soins tertiaires aux hôpitaux communautaires. Malgré la croissance rapide des interventions de remplacement d'articulations, leur répartition selon les régions n'a pas changé pour la peine. Les hôpitaux communautaires ont augmenté leur part des interventions de remplacement d'articulations aux dépens des hôpitaux d'enseignement. Dans les hôpitaux situés dans le centre-est de l'Ontario, le coût de prestation à des non-résidents de services de remplacement d'articulations est passé 5,9 millions de dollars en 1988–1989 à 8,3 millions en 1993–1994. Pour transférer des interventions de remplacement d'articulations primaires, il faudra réaffecter au moins 25,1 millions de dollars, ce qui pourrait entraîner des réductions de coûts de 4,3 millions. Beaucoup d'obstacles limitent le transfert et la prestation de services de soins de santé à l'échelon local, y compris des modifications des tendances des présentations et la disponibilité des compétences spécialisées des fournisseurs, surtout lorsqu'une importante redistribution de ressources s'impose. Il faut disposer de meilleures données cliniques pour évaluer les résultats et de meilleures données sur les coûts particuliers aux patients. Il faudrait se pencher sur le transfert des services dans le contexte de la rémunération appropriée des établissements pour l'éducation en médecine.

From the Institute for Clinical Evaluative Sciences in Ontario, North York, Ont.

**Department of Health Administration, Graduate Department of Community Health, and the Institute for Policy Analysis, University of Toronto, Ont.*

†Department of Health Administration, Graduate Department of Community Health, Institute of Medical Science, Graduate Department of Nursing Science, Department of Family & Community Medicine, University of Toronto and the Clinical Epidemiology Unit, Sunnybrook Health Science Centre, North York, Ont.

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Correspondence to: *Dr. Peter C. Coyte, Institute for Clinical Evaluative Sciences in Ontario, G-106, 2075 Bayview Ave., North York ON M4N 3M5*

Arthritis, which affects a significant proportion of the population over 65 years of age, is a leading cause of permanent incapacity. Once it affects hips or knees, it causes pain, loss of function and reduced quality of life.[1–8] When medical therapy fails, joint replacements (JRs) have been shown to relieve pain and improve physical function.[9–12]

Although JRs are cost-effective from the perspective of patients and the health system,[5,11,13,14] they represent a significant financial burden to hospitals. Thus, as hospitals strive to contain costs, limits may be placed on access to JRs by budget restrictions for prosthetic devices, by reductions in operating-room time and by bed closures. These actions may exacerbate regional variations in utilization[12,15–18] and may reduce timely access to services.[18] Consequently, mechanisms that will encourage hospitals to continue to provide (and even enhance the delivery of) cost-effective services at the same time as they endeavour to contain costs are being considered.

Mechanisms for the delivery of cost-effective and accessible JRs have been proposed by stakeholders advising the Metropolitan Toronto District Health Council.[19] Proposals to enhance local access and to contain costs include the devolution of JRs from teaching hospitals to local community hospitals. Devolution has been defined as a transfer of greater autonomy for planning, management and delivery from central control to regional or local control.[20] The advantages of devolving JRs from teaching hospitals include lower costs for similar outcomes,[19] shorter waiting periods[18] and less travel time for patients and their families.

The purposes of this paper were to assess regional trends in Ontario in referral patterns for hip replacements (HRs) and knee replacements (KRs) between the two fiscal years 1988/89 and 1993/94; to assess the financial resources redistributed if services were provided to area residents in the region where they reside; and to estimate the dollar impact associated with the devolution of primary JRs from tertiary-care hospitals to community hospitals.

Methods

All discharges from Ontario hospitals for the fiscal years 1988/89 to 1993/94 inclusive for patients receiving KR or HR, or both, were acquired from the Canadian Institute for Health Information (CIHI). They excluded residents of Ontario who had insured JRs performed outside Ontario. KRs were identified as *Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures* (CPP) code 93.41 (total knee replacement [geomedic] [polycentric])[21] in any procedure field. HRs were identified as CCP codes 93.51 (total hip replacement with use of methyl methacrylate) and 93.59 (other total hip replacement).

Since JRs may be either primary or revision procedures, an algorithm[22] was developed to identify revision JRs. Revisions were identified through the joint occurrence of an ICD-9[23] diagnostic code 996 (complications peculiar to certain specified procedures) in any diagnostic field and one of the previously specified CCP codes. All other JRs were classified as primary JRs.

Hospitalizations were excluded from the analysis for the following reasons: if the patient was a nonresident of Ontario or was less than 20 years of age; if the information on age, gender or residence of the patient was missing; if JR surgery was not performed or if the procedure had been miscoded. Approximately 1% of JRs were excluded.

Assignment of patients to counties was based on the patient's four-digit residence code, with these collapsed into the six regions as defined by the Ontario Ministry of Health:[24] Southwest, Central west, Central east, East, Northeast and Northwest. Hospitals were classified as teaching (i.e., members of the Ontario Council of Teaching Hospitals [OCOTH]), specialty (e.g., the Orthopaedic and Arthritic Hospital in Toronto) or community hospitals.

To assess the resource implications associated with the devolution of primary JRs, cost estimates were derived by applying resource intensity weights (RIW)[25] to 1992/93 Ontario Ministry of Health data on hospital-specific costs. Four hospitals without such costing data were assigned the average cost of large community hospitals. The average cost of a JR at a community hospital was $8396. We assessed the validity of our cost estimates by acquiring audited cost data from the Ontario Case Cost Project.[26] These data were congruent with the estimates using the RIW method and indicated that the total cost of a JR was 27% greater in teaching than in community hospitals.

Only primary JRs were considered in our devolution exercise because the Metropolitan Toronto District Health Council's musculoskeletal task force suggested that some revision JRs would require tertiary care.[19] If revision JRs were also candidates for devolution, the potential redistribution of financial resources would be greater than estimated.

Two separate scenarios were used to devolve primary JRs. First, primary JRs were devolved to the hospital closest to the patient irrespective of the hospital's teaching status. Second, primary JRs were devolved to nonteaching hospitals closest to the patient. We calculated the straight line distance between each patient's residence and

(1) the institution where the JR was performed, (2) all institutions currently performing more than five primary HRs and (3) all institutions currently performing more than five primary KRs. From these calculations we derived the following: the distance travelled by each patient; the distance to the closest nonteaching hospital for each patient; and the distance to the closest hospital for each patient, irrespective of teaching status. For each scenario and for each institution we generated the number of primary and revision JRs performed in 1993/94, the number that would be performed if primary JRs were devolved to the closest nonteaching hospital and the number that would be performed if primary JRs were devolved to the closest hospital, irrespective of teaching status.

To calculate the total incremental cost of devolving JRs, we multiplied our estimates of the additional cost of a JR (i.e., either 50% of the average cost or 100% of the average cost) by the number of devolved JRs. These estimates of the additional cost were used in our sensitivity analysis, since they represent current cost-accounting estimates in the literature.[27]

Results

The number of HRs, both primary and revision, increased at an average annual rate of 5.0% between the fiscal year 1988/89 and the fiscal year 1993/94; primary HRs increased at a higher rate than revision HRs (5.1% v. 4.7%) (Table I). Over the same period, the number of KRs, both primary and revision, increased at an average annual rate of 14.6%; revision KRs increased at a greater rate than primary KRs (19.3% v. 14.1%) (Table II).

Community hospitals have increased their share of JRs at the expense of teaching hospitals, the greatest increase occurring in the provision of KRs, particularly revision KRs. In 1988/89, 49.9% of primary JRs were performed in community hospitals in Ontario; the remaining procedures were performed in teaching (44.4%) or specialty (5.6%) hospitals. By 1993/94, community hospitals had increased their market share to 59.0%, and this trend was more apparent for primary KRs than for primary HRs. There was rapid growth in revision KRs performed in community hospitals between 1988/89 and 1993/94 and a commensurate decline in the share performed in teaching or specialty hospitals. Little change has occurred with respect to revision HRs, 36.3% being performed in community hospitals.

Table III reports the number and distribution of JRs in 1993/94 by residence of the patient and location of the performing institution. Four of the six major regions in Ontario (Southwest, Central east, East and Northwest) provide more than 93% of primary JRs and more than 89% of revision JRs to their resident population. For patients who reside in the Central west region, including Hamilton, 83% of primary JRs and 72% of revision JRs were performed by area institutions. There was a significant "outflow" of patients requiring JRs from the Central west region; 72.4% of these JRs were performed in the Central east region, including Metropolitan Toronto, and 26.6% were performed in the Southwest region. Despite growth in the local provision of JRs in the Northeast region since 1988/89, many patients were referred to other communities: 85.1% to Central east; 7.3% to East; 3.7% to Southwest; and 3.9% elsewhere.

The pattern of JR referral has been relatively constant since 1988/89, with a slight reduction in the "outflow" of patients from the Central west region, down from 22.7% to 18.2% of all JRs, and from the Northeast region, down from 52.6% to 48.2% of all JRs.

For the regions outside Central east, the percentage of all JRs performed by area institutions on nonresidents was 5.1% in 1988/89 and 5.0% in 1993/94. In contrast, in Central east 15.3% of all JRs performed in 1988/89 were performed on nonresi-

Table I

Number of Total Hip Replacements in Ontario for the Years 1988/89 and 1993/94 and Average Annual Growth Rate

Type of hip replacement	1988/89	1993/94	Annual growth rate, %
Primary	4 133	5 302	5.1
Revision	875	1 100	4.7
Total/mean	5 008	6 402	5.0

Table II

Number of Total Knee Replacements in Ontario for the Years 1988/89 and 1993/94 and Average Annual Growth Rate

Type of knee replacement	1988/89	1993/94	Annual growth rate, %
Primary	2 788	5 400	14.1
Revision	223	540	19.3
Total/mean	3 011	5 940	14.6

dents, whereas in 1993/94 this percentage had fallen slightly to 14.9% of all JRs performed (Table IV). For Central east, the cost of JRs performed on nonresidents increased from $5.9 million for 523 patients in 1988/89 to $8.3 million for 801 patients in 1993/94.

Table V provides estimates of the redistribution of financial resources associated with the devolution of primary JRs under two devolution scenarios: devolution to the hospital closest to the patient's residence and devolution to the closest nonteaching hospital. With the relative cost of each devolved primary JR set at 50% of the average cost of JR, nonteaching hospitals would require an additional $10.4 million under scenario 1 and the global budget of teaching hospitals could be reduced by $14.7 million. Devolution of primary JRs to the hospital closest to the patient results in a reallocation of $25.1 million and potential cost savings of $4.3 million. Under scenario 2, in which primary JRs would only be performed in community or specialty hospitals, nonteaching hospitals would require an additional $15.2 million, and the global budget of teaching hospitals could be reduced by $21.7 million. Devolution of primary JRs to the closest nonteaching hospital results in a reallocation of $36.9 million and potential cost savings of $6.5 million.

Devolution per se and the method of devolving primary JRs did not have uniform impacts on all regions of the province. Under scenario 1, hospitals in the Central east region account for 57% of all reallocated hospital expenditures for primary JRs, and 86% of potential cost savings through devolution. Under scenario 2, these hospitals account for 43% of all reallocated expenditures and 63% of potential cost savings.

If the relative cost of devolved primary JRs were greater than 50% of the

Table III

Number of Joint Replacements in 1993/94 by Patient Residence and Institutional Region

	Patient residence						
Institutional region	SW	CW	CE	E	NE	NW	Total
SW	2 333	115	21	6	14	2	2 491
CW	53	1 936	43	2	11	2	2 047
CE	92	313	4 575	68	325	3	5 376
E	2	4	38	1 665	28	2	1 739
NE	—	—	—	—	410	1	411
NW	—	—	—	—	4	274	278
Total	2 480	2 368	4 677	1 741	792	284	12 342

Since each row represents the number of joint replacements performed in a hospital in a given region on residents from various regions, the absence of referred patients is indicated by a dash.
SW = Southwest, CW = Central west, CE = Central east, E = East, NE = Northeast and NW = Northwest

Table IV

Number and Cost of Joint Replacements (JRs) Performed on Nonresidents in 1988/89 and 1993/94

	1988/89			I993/94		
Ontario region	No. of JRs	% of all JRs performed on nonresidents	Costs, $	No. of JRs	% of all JRs performed on nonresidents	Costs, $
SW	153	8.5	1 681 815	158	6.3	1 627 044
CW	46	3.6	489 511	111	5.4	997 646
CE	523	15.3	5 865 185	801	14.9	8 259 806
E	33	2.7	375 720	74	4.3	712 623
NE	2	0.9	16 300	2	0.2	7 173
NW	2	1.1	16 592	4	1.4	25 141
Total/mean	759	5.1	8 445 123	1 149	5.0	11 629 433

average cost of JRs, the financial implications of devolution would be correspondingly increased. For example, if the relative cost of devolved JRs were 100% of the average cost of JRs, estimates reported in Table V would double. As a result, under scenario 1 there would be a total reallocation of $50.2 million and potential cost savings of $8.6 million, whereas under scenario 2 there would be a total reallocation of $73.8 million and potential cost savings of $13 million.

Discussion

In the last 5 years, despite provincial support for health service devolution, there has been no major change in the regional distribution of JRs. If JRs were provided to area residents in the region in which they reside, significant financial resources would need to be redistributed. Based on our sensitivity analysis, the devolution of primary JRs would require a minimum reallocation of $25.1 million, and the potential savings would be $4.3 million. Since teaching hospitals account for 34.8% of primary JRs and 53.0% of revision JRs, devolution would result in lower transfer payments to teaching hospitals and higher payments to nonteaching hospitals.

Many barriers limit the extent to which health care services may be devolved. Devolution requires modifications to JR referral patterns, the availability of orthopedic expertise and hospital resources to finance prosthetic devices, increased operating-room time and beds for orthopedic services. Achievement of the potential cost savings of devolution requires both maintenance of current case-cost differences between teaching and nonteaching hospitals, irrespective of the patterns of medical education, and no infusion of additional capital funds to community hospitals for the provision of devolved services.

Although modifications to JR referral patterns may be difficult, because outcomes are perceived to be better in teaching and specialty hospitals than in nonteaching hospitals, data from Northeast Ontario, where the number of JRs performed in Sudbury doubled over the study period after the introduction of special funding for prosthetic devices, suggests that JR referral patterns may be modified.

The availability and expertise of orthopedic services at community hospitals may be addressed by attracting surgeons from teaching hospitals. This could be achieved by allowing such surgeons to retain their affiliation with academic health science centres. This policy, which requires the concerted efforts of many stakeholders, has been proposed by one academic science centre in Ontario.[28]

Enhancing the availability of prosthetic devices, operating-room time and beds in community hospitals could be addressed through cooperative efforts by the provincial hospital association and the ministry of health. For example, if funding arrangements were modified to penalize regions with substantial outflows of patients, hospitals would have incentives to provide programs locally, and funds could be transferred from tertiary-care hospitals to community hospitals.

Devolution may improve JR cost-effectiveness, but better information is required to facilitate the efficient, effective and equitable devolution of services. For example, better clinical data to identify difficult cases and evaluate outcomes, and better costing data are required. Moreover, the devolution of orthopedic services should be addressed in the context of appropriate institutional compensation for medical education and consideration of the number of orthopedic residents and institutions with orthopedic programs. Devolving health care services will not be simple.

Table V

Estimated Dollars That Would Be Distributed if Primary JRs Were Devolved to the Closest Hospital (Scenario 1) and the Closest Nonteaching Hospital (Scenario 2)

	Scenario 1		Scenario 2	
Ontario region	Teaching	Nonteaching	Teaching	Nonteaching
SW	(3 172 984)	2 168 676	(5 093 522)	3 813 347
CW	(561 032)	1 038 891	(3 653 935)	3 003 026
CE	(8 438 614)	4 713 779	(9 992 734)	5 902 075
E	(2 524 136)	1 374 105	(2 971 803)	1 428 972
NE*	—	1 033 258	—	1 033 258
NW*	—	22 845	—	22 845
Total	(14 696 766)	10 351 554	(21 711 994)	15 203 523

*No teaching hospitals in Northeast or Northwest Ontario

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References

1. Verbrugge LM. Physical and social disability in adults. In: Hibbard HH, Nutting PA, editors. *Functional and health status measures for primary care*. Washington: US Department of Health and Human Services, 1991:31-57.
2. Peyron JG, Altman RD. The epidemiology of osteoarthritis. In: Moskowitz RW, Howell DS, Goldberg VM, Mankin HJ, editors. *Osteoarthritis: diagnosis and medical/surgical management*. 2nd ed. Toronto: WB Saunders, 1992:15-37.
3. McAlindon TE, Cooper C, Kirwan JR, Dieppe PA. Knee pain and disability in the community. *Br J Rheumatol* 1992;31:189-92.
4. Kramert JS, Yelin EH, Epstein WV. Social and economic impacts of four musculoskeletal conditions: a study using national community-based data. *Arthritis Rheumatism* 1983;26:901-7.
5. Liang MH, Larson MG, Thompson MS, Eaton H, McNamara E, Katz R, et al. Cost and outcomes in rheumatoid arthritis and osteoarthritis. *Arthritis Rheumatism* 1984;27:522-9.
6. Pincus T, Mitchell JM, Burkhauser RV. Substantial work disability and earnings losses in individuals less than age 65 with osteoarthritis: comparisons with rheumatoid arthritis. *J Clin Epidemiol* 1989;42:449-57.
7. Hadler NM. Osteoarthritis as a public health problem. *Clin Rheum Dis* 1984;11:175-85.
8. Moskowitz RW, Howell DS, Goldberg VM, Mankin HJ, editors. *Osteoarthritis: diagnosis and medical/surgical management*. 2nd ed. Toronto: WB Saunders, 1992.
9. Harris WH, Sledge CB. Total hip and total knee replacement. *N Engl J Med* 1990;323:801-7.
10. Scott N, Rubinstein M, Scuderi G. Results after knee replacement with a posterior cruciate-substituting prosthesis. *J Bone Joint Surg [Am]* 1988; 70:1163-73.
11. Liang MH, Cullen KE, Larson MG, Thompson MS, Schwartz JA, Fossel AH, et al. Cost-effectiveness of total joint arthroplasty in osteoarthritis. *Arthritis Rheumatism* 1986;29:937-43.
12. Jonsson H, Larsson BJ. Functional improvement and cost of hip and knee arthroplasty in destructive rheumatoid arthritis. *Scand J Rheumatol* 1991;20:351-7.
13. Laupacis A, Bourne R, Rorabeck C, Feeny D, Wong C, Tugwell P, et al. The effect of elective total hip replacement on health-related quality of life. *J Bone Joint Surg [Am]* 1993;75:1619-26.
14. Rorabeck CH, Bourne RB, Laupacis A, Feeny D, Wong C, Tugwell P, et al. A double-blind study of 250 cases comparing cemented with cementless total hip arthroplasty. Cost-effectiveness and its impact on health-related quality of life. *Clin Orthop* 1994;298:156-64.
15. Cohen MM, De Boer D, Young W. Variations in surgical services over time and by site of residence: total hip replacement. In: Naylor CD, Anderson GM, Goel V, editors. *Patterns of health care in Ontario*. Ottawa: Canadian Medical Association, 1994:72-6.
16. Cohen, MM, De Boer D, Young W. Variations in surgical services over time and by site of residence: total knee replacement. In: Naylor CD, Anderson GM Goel, V, editors. *Patterns of health care in Ontario. The ICES practice atlas*. Ottawa: Canadian Medical Association, 1994:76-9.
17. Coyte PC, Wright JG, Freund DA, Bombardier C, Heck DA, Hawker GA. Regional variation in the utilization of knee replacement procedures and the supply of orthopaedic surgeons in Ontario, Canada. *Proceedings of the Fifth Canadian Conference on Health Economics: 1993*; 1993 Aug 26-28; Regina: Canadian Plains Research Center, University of Regina, 1994:160-73.
18. Coyte PC, Wright JG, Hawker GA, Bombardier C, Dittus RS, Paul JE, et al. Waiting times for knee-replacement surgery in the United States and Ontario. *N Engl J Med* 1994;331:1068-71.
19. Metropolitan Toronto District Health Council. *MTDHC hospital restructuring project: musculoskeletal services patient service group task force. Summary of deliberations*. Toronto: The Council, 1994.
20. Premier's Council on Health, Well-being, and Social Justice. *Devolution of health and social services in Ontario: refocusing the debate*. Toronto: Queen's Printer, 1994.
21. Statistics Canada. *Canadian classification of diagnostic, therapeutic and surgical procedures*. 2nd printing. Ottawa: Minister of Industry, Science and Technology, 1993.
22. World Health Organization. *Manual of the international statistical classification of diseases, injuries and causes of death*. 9th rev. Geneva: The Organization, 1977.
23. Coyte PC, Croxford R, Wright JG. *Reoperations following primary knee replacements*. Toronto: Department of Health Administration, University of Toronto, 1995. Report.
24. Ministry of Health. *Residence coding manual. Effective April 1, 1993*. Toronto: The Ministry, 1993.
25. Pink, GH, Bolley HB. Physicians in health care management: 3. Case mix groups and resource intensity weights: an overview for physicians. *Can Med Assoc J* 1994;150(6):889-94.
26. Joint Planning and Policy Committee. Ontario case costs: developing Ontario case cost weights using data from 13 Ontario hospitals. *JPPC News* 1995; 3(1):4.
27. Advisory Board Company. *Hospital networking: mergers, acquisitions and affiliations*. Washington: Health Care Advisory Board, 1994:83.
28. Marshall J. Recruitment and retention: role of the academic medical centre [briefing]. Canadian Institute; February 1995; Toronto.

[Dr. J.P. Waddell comments on this article in the Quill on Scalpel section (pages 354 and 355).]