Outcomes after the regionalization of major surgical procedures in the Alberta Capital Health Region (Edmonton)

Stewart M. Hamilton, MD;* William C. Johnston, MD;* Donald C. Voaklander, PhD†

Objective: To evaluate the impact of regionalization on the outcomes of 16 surgical procedures performed in the Capital Health Region (Edmonton) of Alberta. **Design:** A computer search of hospital discharge abstracts coded for the Canadian Institute for Health Information. **Setting:** Two major hospitals in Edmonton. **Patients:** The study population comprised 9250 patients (9727 procedures [4524, pre-regionalization, 5203 post-regionalization]) who underwent any of 16 major procedures in the 2 years before and the 2 years after restructuring. **Outcome measures:** Demographic data, Charlson's comorbidity index, number of urgent and emergent cases, death rate, average length of hospital stay and the readmission rate. **Results:** The post-regionalization patient group was slightly older, had a higher comorbidity index, and fewer urgent and emergent cases. The case volume increased by 15%, and 43.6% of patients used some form of community-based health care services. The median length of hospital stay decreased from 8.0 days pre-regionalization to 7.0 days post-regionalization ($p < 0.001$). Overall and for specific procedures the death rate was unchanged (3.1% pre-regionalization, 2.4% post-regionalization, $p = 0.06$). The readmission rates were similar for both groups (8.0% versus 7.0%). **Conclusions:** The consolidation of these 16 major surgical procedures had minimal impact on death and readmission rates even though patients in the post-regionalization group were slightly older and had greater comorbidity. There was a significant decline in the length of hospital stay, which occurred nationally over the same period, and a corresponding increase in the use of community-based services.

Objectif : Évaluer l'impact de la régionalisation sur les résultats de 16 interventions chirurgicales réalisées dans la Région de santé de la capitale (Edmonton), en Alberta. **Conception :** Recherche informatique dans les résumés de congés d'hôpital codés pour l'Institut canadien d'information sur la santé. **Contexte :** Deux grands hôpitaux d'Edmonton. **Patients :** La population visée par l'étude regroupait 9250 patients (9727 interventions [4524 avant la régionalisation et 5203 après]) qui ont subi n'importe laquelle de 16 interventions majeures au cours des deux années qui ont précédé la restructuration et des deux années qui l'ont suivie. **Mesures de résultats :** Données démographiques, indice de comorbidité de Charlson, nombre de cas urgents et émergents, taux de mortalité, durée moyenne de l'hospitalisation et taux de réadmission. **Résultats :** Le groupe de patients après la régionalisation était légèrement plus âgé, présentait un indice de comorbidité plus élevé et comportait moins de cas urgents et émergents. Le volume des cas a augmenté de 15 %, et 43,6 % des patients ont eu recours à des services de santé communautaires. La durée médiane de l'hospitalisation est tombée de 8,0 jours avant la régionalisation à 7,0 après ($p < 0,001$). Dans l'ensemble, et pour certaines interventions, le taux de mortalité n'a pas changé (3,1 % avant la régionalisation, 2,4 % après, $p = 0,06$). Les taux de réadmission ont été semblables pour les deux groupes (8,0 % contre 7,0 %). **Conclusions :** Le regroupement de ces 16 interventions chirurgicales majeures a eu une incidence minime sur les taux de mortalité et de réadmission, même si les patients du groupe consécutif à la régionalisation étaient un peu plus âgés et présentaient une plus grande comorbidité. On a constaté une diminution importante de la durée de l'hospitalisation, enregistrée à l'échelon national pendant la même période, et une augmentation correspondante du recours aux services communautaires.

*From the *Department of Surgery and Capital Health Authority and the †Department of Public Health Sciences, University of Alberta, Edmonton, Alta.*

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Correspondence to: *Dr. Stewart Hamilton, Department of Surgery, University of Alberta, 2D2 Mackenzie Health Sciences Centre, 8440–112th St., Edmonton AB T6G 2B7; fax 780 407-7394, shamilto@cha.ab.ca*

The restructuring of Canada's health care system began in earnest in the early 1990s as governments focused on the accumulated public debt. Although medicare was originally established as a shared federal and provincial program, constitutionally it is a provincial responsibility. Historically, Canada's health care expenditures have been high, rising to 10.1% of the Gross Domestic Product in 1992. With the aging "baby boomers," advances in technology and the rise of consumerism in the health care sector, it became evident that the growth in government funding of health care was not sustainable. As the federal government withdrew equalization payments and the provinces grappled with their own budget deficits, redesigning the health care system at the provincial level became necessary to meet the new fiscal reality.[1–3]

The province of Alberta chose to regionalize its health care system as a means to fiscal responsibility and the integration of its health care services. Seventeen regions were established, each being governed by an appointed board, the Regional Health Authority. These bodies were charged with the responsibility of developing and implementing a business plan for a regional health care delivery model over a 1-year period beginning in June 1994. Fiscal targets were established, requiring the regions to maintain service and to cut their budgets by 18% to 23%.[4,5]

The business plan of the initial regional board for the Edmonton region (the Capital Health Region) created a new model of health care delivery, which was implemented on July 1, 1995. This new model affected all health care disciplines, and each of the acute care institutions significantly. Surgical services were to be delivered by defining procedures as high or low acuity, with the consolidation of these types of activity into specific institutions. The 2 larger institutions, the University of Alberta Hospital and the Royal Alexandra Hospital, became the sites of consolidation for vascular surgery, thoracic surgery, major joint procedures, major abdominal surgery, major trauma and major urologic procedures. Neurosurgery, of which almost all major procedures were done at the 2 major institutions before regionalization, was consolidated at the University of Alberta Hospital. Cardiac surgery remained exclusively at the University of Alberta Hospital.[6]

Low acuity procedures were consolidated at community health centres, downsized community hospitals. In these facilities some inpatient services were available, but the capacity and support services for major procedures did not exist. As an example of the magnitude of the shift in patient services, approximately 12 000 low acuity procedures were moved from the University of Alberta Hospital and distributed among the community health centres to make way for high acuity cases from these institutions. The new delivery model called for an overall reduction in inpatient beds to 1.5 / 1000 population and a bed utilization ratio of 550 / 1000 population.[6]

The purpose of this study is to evaluate the impact of regionalization on the outcomes of 16 surgical procedures that were consolidated as part of the post-regionalization surgery delivery model in the Capital Health Region. Specifically, the objective is to compare the outcomes of the 2 years preceding regionalization (July 1, 1993, to June 30, 1995), with the outcomes of the first 2 years following regionalization (July 1, 1995, to June 30, 1997). The null hypothesis states that there is no difference in the outcomes of these 16 major surgical procedures as a result of their consolidation within the Capital Health Region on July 1, 1995. The list of procedures evaluated comprised the following: repair of abdominal aneurysm, femoropopliteal bypass, coronary artery bypass grafting, aortic valve replacement, mitral valve replacement, colon resection for cancer, colon resection for diverticular disease, pancreatectomy for cancer, radical nephrectomy, radical prostatectomy, craniotomy for tumour, craniotomy for subdural hematoma, hip fracture procedures, total hip arthroplasty, total knee arthroplasty and thoracotomy for tumour.

Methods

Case selection

The study population was obtained from a computer search of electronic hospital discharge abstracts (Canadian Institute for Health Information [CIHI]) for the period July 1, 1993, to June 30, 1997. The reliability and utility of administrative health care data have been established.[7–9] Sixteen procedure groups were selected for the study. The selection criteria included only cases that were consolidated into the 2 major acute care centres as a result of regionalization. To obtain a broad cross-section of surgical activity, cases were selected from most surgical disciplines. The exceptions were otolaryngology, obstetrics and gynecology, and ophthalmology, owing to differences in the service delivery model for these specialties. All records were retrieved for patients who had received care for any of these procedures at 1 or more of the 5 acute care institutions in the region during the study period [the criteria for extracting cases are available from the authors upon request]. These hospitals provide all inpatient surgical services covered under Alberta Health Care for patients within the Capital Health Region. Thus, 100% of the cases performed within the region were available for analysis. All patients were 18 years of age or older and were coded as living within the boundaries of the Capital Health Region. Regional residence was determined by the identification of an in-region postal code.

None of the procedures captured for this analysis occurred in the same episode of care for any patient. Therefore, any duplicate patients selected would have had the surgical procedures of interest conducted at different

times. This potentially changes time-dependent characteristics such as age and subsequent comorbidity for any given patient and allows the patient to be eligible for re-sampling at a future point during the study period when further surgical services are obtained. Although this may partially violate the statistical concept of independence of observations, this method ensures that sicker patients are not eliminated from the sampling frame.

Patient characteristics

All patient characteristics were derived from the computerized hospital abstracts. Each abstract contains 16 fields using ICD-9-CM diagnostic codes for primary and comorbid conditions. Selection criteria for comorbidities followed the administrative version of the Charlson comorbidity index.[10,11] This index was calculated using the ICD-9-CM codes with the original weighting.[10] The index is an inpatient mortality based system that gives different weightings (range 1 to 6) for different comorbidities. For example, congestive heart failure is given a score of 1 whereas AIDS is given a score of 6. In addition, obesity was coded for cases in which the diagnostic code 278 appeared; malnutrition was coded for cases in which the diagnostic codes 262 to 263.9 appeared; and alcohol abuse was coded for cases in which the diagnostic codes 303 to 303.9 appeared.

Patient health system variables

For each selected case, a search was performed using unique personal health numbers for preadmissions and readmissions. Preadmission was defined as hospital discharge identified within 30 days before the admission under study. Readmission was defined as hospital admission within 30 days of discharge for the admission under study. Readmissions and preadmissions could have occurred at any of the region's 5 acute care institutions offering services during the study period. All patients who were discharged after July 1, 1995, were considered to be post-regionalization patients. The electronic abstracts also contain information on the admission type (emergent, urgent or elective). Owing to known inconsistencies of definition within the region, emergent and urgent admissions were merged into a single category. Homecare refers to publicly funded nursing care in the home or at a community health centre. The subacute program was developed as part of the regional plan to develop an intermediate level of care outside the hospital system. It consists of allocated beds within the nursing homes where a higher level of staffing exists and where a patient may stay for up to 30 days. The beds in the subacute program are assigned by surgical discipline and are protected for that discipline. Other in-region facility refers to rehabilitation and convalescent hospitals.

Statistical analyses

Univariate comparisons

Univariate comparisons of patient characteristics were conducted using the χ^2, *t*, and Mann–Whitney U tests as appropriate. Because of the positive skew of length of stay (LOS) data, the natural logarithm of LOS was used in all analyses. Univariate Spearman correlation coefficients were generated, relating patient characteristics and system variables to LOS. Nominal variables were assigned dummy values of 0 and 1, with 1 being present when a patient possessed a specific characteristic. A risk adjustment model for LOS was determined for all cases, excluding in-hospital deaths. Variables significant at the $p < 0.05$ level were considered for entry into a multiple linear regression model predicting LOS. Patient characteristics were entered into the model, followed by patient health system variables (urgent and emergent admission, transfer from another facility, previous hospitalization, with the exception of post-regionalization status). Age and sex as well as variables that were significant at the $p < 0.05$ level were retained in the multiple linear regression model. This risk adjustment model was then applied to each of the procedure groups separately with the concurrent forced entry of pre-/post-regionalization status. A Bonferroni correction was used to adjust the *p* value accordingly over the 16 procedures. Significance was accepted at the $p < 0.003$ level for these analyses.

Univariate odds ratios

Univariate odds ratios were generated, relating patient characteristics and patient health system variables to 30-day readmission to hospital. A risk adjustment model for 30-day readmission was determined for all in-region cases, excluding inhospital deaths. Variables significant at the $p < 0.05$ level were considered for entry into a multiple logistic regression model. Patient characteristics related to 30-day readmission were followed by patient health system variables (with the exception of post-regionalization status). Age and sex as well as variables that were significant at the $p < 0.05$ level were retained in the multiple logistic regression model. The *c*-statistic,[12,13] a measure of model performance, was calculated for the logistic regression model. This risk adjustment model was then applied to each of the procedure groups separately with the concurrent forced entry of pre-/post-regionalization status. A Bonferroni adjustment was used to adjust the *p* value accordingly over the 16 procedures. Significance was accepted at the $p < 0.003$ level for this analysis. Thus, 99.7% confidence intervals were calculated, relating the odds of being readmitted in the post-regionalization period for each of the 16 procedures. All data were analyzed with use of the Stastical Package for the Social Sciences[14] software.

Results

The initial extraction of cases gave 16 888 patients available for analysis. Further examination revealed that 128 cases were duplicated because a hip fracture had resulted in a total hip arthroplasty. The total hip arthroplasty cases were deleted from the analysis, as the hip fracture was considered to be the primary reason for admission to hospital. Also, all out of region patients were removed from the study, leaving a final study population of 9250 patients who underwent 9727 procedures.

Table 1 illustrates the demographics and outcomes for the 16 selected surgical procedures. Fifty percent of the patients were men. The mean age of the post-regionalization group was 66.3 years, slightly older than the pre-regionalization group ($p < 0.05$). The percentage of urgent and emergent admissions fell during the study period ($p < 0.001$) and fewer patients were hospitalized within 30 days preceding their operation ($p < 0.001$). There was no statistical difference between the rates of inhospital death before (3.1%) and after (2.4%) regionalization ($p = 0.06$), nor was there a statistically different rate of readmission pre-regionalization (8.0%) compared with post-regionalization (7.0%) ($p = 0.06$). The median length of stay declined from 8.0 to 7.0 days ($p < 0.001$). The advent of enhanced post-institutional care in the community setting resulted in patients being discharged to the subacute care and homecare programs after regionalization. Unfortunately, accurate coding for patients receiving homecare was not available before regionalization and the subacute care program was developed at the time of regionalization. Fewer patients were discharged to another in-region hospital facility after regionalization ($p < 0.001$). Finally, Table 1 records the numbers of cases for each of the procedures during the 2 study periods. Overall, there was an aggregate increase across the 16 procedures of 15%.

Patients were coded as follows: previous acute myocardial infarction (AMI) 11%, peripheral vascular disease 3.1%, for cerebrovascular disease 1.5%, for dementia 3.2%, chronic pulmonary disease 14.2%, gastric ulcer disease 2.7%, diabetes mellitus 8.7%, diabetes with complications 1.5%, hemiplegia or paraplegia 5.4%, mild liver disease 2.0%, moderate or severe liver disease 2.2%, renal disease 2.8%, malignant disease 1.5%, metastatic or solid tumour 5.1%, alcohol dependence 1.4%, obesity 11.3%, and malnutrition 0.4%. Comparison of the 2 study groups demonstrated that the post-regionalization patients had a significantly ($p < 0.01$) higher Charlson's comorbidity index.

Variables correlated with LOS included the following: age ($r = 0.21$, $p < 0.001$); sex ($r = –0.08$, $p < 0.001$);

Table 1

Patient Demographic Variables and Outcomes for 16 Selected Surgical Procedures Before (July1, 1993, to June 30, 1995) and After (July1, 1995, to June 30, 1997) Regionalization*

Demographic variable	Before regionalization	After regionalization
Patient characteristics		
Mean (and standard deviation) age, yr	65.8 (15.2)	66.3 (14.9)†
Sex (% male)	4297 (50.3)	4953 (54.7)
Charlson's comorbidity index score		
0	4463 (56.7)	4860 (54.7)‡
1	1837 (23.3)	2121 (23.9)
2	590 (7.5)	758 (8.5)
3	299 (3.8)	289 (3.3)
4	102 (1.3)	131 (1.5)
≥5	583 (7.4)	727 (8.2)
Urgent/emergent admission	1901 (42.0)	1956 (37.6)§
Transfer from another facility	765 (16.9)	976 (18.8)§
Hospital discharge within 30 days before index admission	282 (6.2)	97 (1.9)§
Discharged to homecare	0 (0)	508 (9.8)
Discharged to subacute program	0 (0)	783 (15.0)
Discharged to another in-region facility	1088 (24.0)	980 (18.8)§
Procedure		
Aortic aneurysm repair	131 (2.9)	140 (2.7)
Aortic valve replacement	108 (2.4)	139 (2.7)
Colon resection for cancer	251 (5.5)	260 (5.0)
Colon resection for diverticular disease	109 (2.4)	106 (2.0)
Coronary artery bypass grafting	722 (16.0)	799 (15.4)
Craniotomy for subdural hematoma	47 (1.0)	59 (1.1)
Craniotomy for tumour	134 (3.0)	142 (2.7)
Femoropopliteal bypass grafting	147 (3.2)	121 (2.3)
Repair of fractured hip	996 (2.0)	1028 (2.0)
Mitral valve replacement	60 (1.3)	79 (1.5)
Pancreatectomy for tumour	10 (0.2)	18 (0.3)
Radical nephrectomy	153 (3.4)	184 (3.5)
Radical prostatectomy	163 (3.6)	181 (3.5)
Thoracotomy for cancer	197 (4.4)	197 (3.8)
Total hip arthroplasty	664 (14.7)	998 (19.2)
Total knee arthroplasty	1160 (25.6)	1603 (30.8)
Patient outcomes		
Inhospital death (<30 d)	139 (3.1)	127 (2.4)
Median (and interquartile range) length of stay, d (for patients discharged alive only)	8.0 (6.0–12.0)	7.0 (6.0–9.0)§
30-day readmission (in-region residents only)	360 (8.0)	365 (7.0)

Figures are numbers (and %) of patients or procedures, as applicable, unless otherwise indicated.
†$p < 0.05$, ‡$p < 0.01$, §$p < 0.001$.

alcohol dependence ($r = 0.05$, $p < 0.001$; malnutrition ($r = 0.09$, $p < 0.01$); urgent and emergent admission ($r = 0.35$, $p < 0.001$); admitted by ambulance ($r = 0.22$, $p < 0.001$); transfer from another hospital ($r = 0.02$, $p < 0.001$); hospital discharge within 30 days before index admission ($r = 0.06$, $p < 0.001$); discharged to subacute care ($r = –0.09$, $p < 0.001$); discharged to an other in-region facility ($r = 0.21$, $p < 0.001$); post-regionalization status ($r = –0.18$, $p < 0.001$); and Charlson's comorbidity index ($r = –0.01$ to $r = 0.17$, $p < 0.001$).

With the results from the correlational analysis, a multiple linear regression risk adjustment model was constructed. It included age, sex, alcohol use, malnutrition, urgent and emergent admission, hospital discharge within 30 days before index admission, transfer from another in-region facility, discharged to subacute care, discharge to another in-region facility, and Charlson's comorbidity index. This model explained 22% of the variance in the natural logarithm of LOS with a multiple correlation coefficient of 0.47.

Table 2 illustrates the procedure-specific regression coefficients for post-regionalization status when variables from the risk adjustment model are controlled. All of the coefficients were negative, indicating that post-regionalization patients had a shorter LOS across all procedure groups.

Univariate odds ratios (ORs) were calculated, relating independent variables to readmission status. Variables related to readmission were as follows: sex (OR = 1.31, 95% CI = 1.12 to 1.52), Charleson's comorbity index score (CCIS) of 1 (OR = 1.26, 95% CI = 1.04 to 1.52), CCIS of 2 (OR = 1.71, 95% CI = 1.32 to 2.22), CCIS of 3 (OR = 1.73, 95% CI = 1.19 to 2.51), CCIS of 4 (OR = 2.12, 95% CI = 1.28 to 3.52), CCIS of 5 or greater (OR = 1.77, 95% CI = 1.36 to 2.29), urgent and emergent admission (OR = 1.55, 95% CI = 1.33 to 1.80), admission by ambulance (OR = 1.26, 95% CI = 1.07 to 1.49), transfer of patient to index hospital (OR = 1.54, 95% CI = 129 to 1.85), hospital discharge within 30 days before index admission (OR = 2.00, 95% CI = 1.52 to 2.61), discharge to subacute program (OR = 0.66, 95% CI = 0.48 to 0.91) and discharge to another in-region facility (OR = 0.70, 95% CI = 0.57 to 0.85).

An 8-variable model was derived using multiple logistic regression that contained age, sex, Charlson's comorbidity index, urgent and emergent admission, transfer of a patient to the index hospital, hospital discharge within 30 days before the index admission, discharge to a subacute program, and discharge to another in-region facility. This model had a *c*-statistic of 0.68, indicating that one could correctly determine whether a person would be readmitted 68% of the time.

The procedure group odds ratios or post-regionalization status risk, adjusted using the previously mentioned model, are shown in Table 3.

Table 2

Adjusted* Regression Coefficients Relating Post-Regionalization Status to the Logarithm Length of Stay for Each Procedure

Procedure	Regression coefficient	*t* value
Aortic aneurysm repair	–0.108	–1.37
Aortic valve replacement	–0.160	–2.33
Colon resection for cancer	–0.089	–2.30
Colon resection for diverticular disease	–0.173	–2.52
Coronary artery bypass grafting	–0.054	–1.85
Craniotomy for subdural hematoma	–0.081	–0.67
Craniotomy for tumour	–0.028	–0.41
Femoropopliteal bypass grafting	–0.307	–3.91†
Repair of fractured hip	–0.331	–9.76†
Mitral valve replacement	–0.073	–0.77
Pancreatectomy for tumour	–0.110	–0.36
Radical nephrectomy	–0.133	–2.92†
Radical prostatectomy	–0.164	–4.96†
Thoracotomy for cancer	–0.147	–3.00†
Total hip arthroplasty	–0.172	–9.37†
Total knee arthroplasty	–0.231	–12.89†
All procedures	–0.165	–15.69†

*Age, sex, alcohol abuse, malnutrition, Charlson's comorbidity index, urgent and emergent admission, hospital discharge within 30 days before index admission, transfer from another hospital, discharged to subacute program and discharged to other in-region institution.
†$p < 0.003$.

Table 3

Adjusted Odds Ratios Relating Post-Regionalization Status to 30-Day Readmission for Each Procedure

Procedure	Adjusted odds ratio*	99.7% confidence intervals
Aortic aneurysm repair	0.83	0.22–3.18
Aortic valve replacement	0.93	0.26–3.35
Colon resection for cancer	1.14	0.44–2.93
Colon resection for diverticular disease	0.52	0.19–2.46
Coronary artery bypass grafting	0.71	0.44–1.12
Craniotomy for subdural hematoma	2.95	0.31–80.22
Craniotomy for tumour	0.60	0.13–2.83
Femoropopliteal bypass grafting	3.09	0.90–10.67
Repair of fractured hip	0.87	0.44–1.71
Mitral valve replacement	0.39	0.08–1.94
Pancreatectomy for tumour	0.00	0.00–>100
Radical nephrectomy	1.13	0.28–4.59
Radical prostatectomy	3.03	0.41–22.12
Thoracotomy for cancer	1.62	0.43–6.18
Total hip arthroplasty	0.76	0.34–1.79
Total knee arthroplasty	1.03	0.44–2.40
All procedures	0.90	0.77–1.06

*Age, sex, Charlson's comorbidity index, urgent/emergent admission, discharged to subacute program, discharged to another in-region institution, transfer patient, previous admission within 30 days, and length of stay.

No odds ratios relating post-regionalization status to 30-day readmission for any procedure were found to be significant at the $p < 0.003$ level.

Discussion

By regionalizing the health care system in the province of Alberta, the government hoped to achieve 2 major objectives. The first was to develop a system of integrated care organized for the needs of a regional population, and the second was to decentralize the fiscal controls from the Ministry of Health to the regional authorities (boards). With both objectives the intent was to move the decision-making closer to the community, and in so doing provide a more participatory environment for finding ways to cut health care costs. Access to and the quality of health care services were to be maintained.[4,5]

In striving to achieve a regionally integrated health care system, the original board (1994) of the Capital Health Region redesigned the acute care service delivery model. The Capital Health Authority (1994) planned the bed ratio and bed-utilization targets on the basis of this new service delivery model, where surgical procedures were to be delivered at different sites depending on their complexity. Thus, a massive reorganization was undertaken in a region with a population of approximately 800 000, a referral population of 1.5 million, and a budget of approximately $900 million. Facing very short timelines imposed by the government, the Authority undertook to plan the regional service delivery model and the regional governance model over 6 months, without formal consultation with the health professions.[6]

The extensive literature on the regionalization of surgical procedures.[15–21] provides evidence that there are multiple factors affecting surgical outcomes. There is a set of surgeon-dependent factors that are mainly related to training and to the number of procedures performed.[22] There is also a set of hospital-dependent variables. Most studies have reported an improvement in surgical outcomes as a function of institutional volume. For both the surgeon and the institutional factors there have been attempts to define a minimal volume required to maintain quality.[20–22] The literature on the regionalization of surgical oncology presents a mixed picture of the impact on surgical outcomes;[23,24] however, subspecialization within surgical disciplines dealing with malignant tumours appears to have a positive impact.[25–27] To the authors' knowledge, no literature exists on the Canadian experience following province-wide regionalization or on the impact of the consolidation of multiple surgical procedures into major tertiary care centres.

This study focuses on a multidisciplinary inpatient population in which a major surgical procedure has been performed. The major difference between the 2 study groups, in which there was a 15% increase in volume, is a significant decline in the LOS. This improvement occurred in the post-regionalization group even though the patients were slighty older and had greater comorbidity. On the other hand, the post-regionalization group had a lower proportion of urgent and emergent cases, fewer patients had been hospitalized during the 30 days immediately preceding their operation, and there were more community-based services available.

Overall, LOS will decline as more surgical procedures are done in the ambulatory setting, with the use of same day admission for inpatient procedures and with shorter postoperative stays. In a previously published study,[25] the authors observed that within the Capital Health Region the shift to ambulatory care and the use of same day admission had largely preceded the restructuring of the regional health care system. Paradoxically, if outpatient and day surgery procedures are excluded from the analysis of LOS (as they are in Alberta), an increase in LOS can be observed due to the resulting change in case-mix. Among the 16 procedures studied, there was no shift of activity from the inpatient to outpatient categories.

The shorter postoperative stay observed in this study may be due to the faster recovery of the patient. Alternatively, it may have resulted from the availability of alternatives to the acute care system for convalescent care. One of the major components of the Capital Health Region's service delivery plan was the development of homecare services and a subacute care program. After regionalization 24.8% (homecare 9.8%, subacute care 15.0%) of patients used these services, with another 18.8% being discharged to other in-region facilities. Statistical comparison of the utilization of these programs is not possible because before regionalization, accurate coding of patients using homecare was not available, and the subacute program did not exist. Before restructuring, a higher percentage of patients were transferred to other in-region facilities (24%, see Table 1). As a result of regionalization, the total proportion of patients receiving formal postdischarge care in the community rose to 43.6%.

The trend in LOS for inpatients in Canada's health care system has been declining since the beginning of the last decade. Alberta's hospital utilization rate and falling postoperative stay mirror the national trend. The trend to a higher level of acuity is also reflected both nationally and provincially.[28] A review of national (except Quebec) data from the CIHI for the 16 specified procedures showed a similar trend across the board, and in those provinces that have instituted a regionalized governance model (Saskatchewan and New Brunswick) (Canadian Institute for Health Information. Unpublished data, 1998).

Within the Capital Health Region, the cardiac surgical procedures

represent an internal control. These subsets of procedures were not affected by regionalization, and the surgeons carrying out the procedures were the same in both study periods. Furthermore, the funding envelope for cardiac procedures lies outside the global regional budgets, and within 6 months of regionalization, the provincial government infused extra funding. None of the cardiac procedures examined in this study showed a significant drop in LOS after regionalization, indicating that the impact of regionalization was less for those services consolidated before the funding and structural changes.

In part, the justification for realigning the surgical delivery model in the Capital Health Region was based on the anticipated improvement in outcomes. Most of the literature on regionalization has suggested[18–21,26,29] that a fall in perioperative mortality should have occurred. While a statistically significant fall in total mortality was not observed, the post-regionalization rate of 2.4% (versus 3.1% pre-regionalization, $p = 0.06$) occurred in a patient population that would have been expected to have a higher mortality because they were slightly older and had greater comorbidity. Procedure-specific death rates were also unchanged.

A contributing factor to the small change in the death rate could be the fact that as procedures were consolidated into the 2 tertiary centres within the Capital Health Region, the surgeons moved with their patients. This resulted in the same surgical team performing the procedure, albeit in a different hospital but with higher tertiary surgical volumes. Furthermore, 2 of the 3 community hospitals that exported their tertiary cases to the major centres were teaching hospitals and derived the benefits of surgical resident coverage. This discounted much of the difference in the make-up of the surgical team that might have been anticipated with consolidation into the major tertiary care centres.

The change in the readmission rate also failed to achieve statistical significance. The stable rate for readmissions occurred despite the fact that the LOS was considerably shorter, a consequence of which might have been a higher readmission rate. While not specifically measured in the study, the impact of the homecare and subacute care programs might have been considerable and in a large way responsible for keeping the rate of readmission as low as it was, in the face of the reduced LOS. These trends are also reflected in the CIHI data.[28]

The impact of the restructuring of the health care system in the Capital Health Region has been profound in terms of the realignment of services and medical staff, and in terms of the impact on the nursing profession and other allied health professionals. Given the pace of the restructuring and the associated funding cuts, one might have expected a rise in readmission rates and, possibly, death rates. It may be that the conclusions reached in other studies of regionalization, identifying the positive relationship between institutional case volumes, and individual surgeon case volumes, with morbidity and mortality, are not applicable within the Capital Health Region. This could be owing to factors unique to the Capital Health Region and to Canada. Specifically, 2 of the most important factors would be the relatively large volumes of procedures handled by all of the Region's hospitals and by the individual surgeons prior to July 1995.

In this analysis the impact on surgical outcomes is primarily a shorter LOS. This occurred in an older, sicker, patient population and was accompanied by a regional augmentation of post-discharge community-based services. Whether this was a cause and effect relationship attributable to regionalization, whether the shorter LOS is a result purely of fiscal pressures or whether the shorter stays are just reflective of the national trend in practice patterns, cannot be definitively answered by this study.

In so far as LOS is a major driver of hospital and procedural costs, the ability to decrease inpatient days will remain a key strategy in controlling acute care institutional costs and in meeting regional budgets. The provincial government did achieve its goal of a 20% reduction in health care spending. There is, however, a limit, beyond which further shortening of the hospital stay will result in the deterioration of the quality of health care and in increased costs. With the significant increase in community-based service utilization witnessed in this study, a rigorous analysis of the quality and costs of patient care within the integrated regional health care system is required. Finding the balance between hospital and community-based care is a cornerstone of the integrated health care system that regionalization was intended to create.

As Canada's health care system enters the new millennium, the era of evidence-based medicine is upon us. Although there are many limitations to administrative data sets, they remain integral to the evaluation of the health care system. Despite the weaknesses inherent in this study, it is a case-controlled analysis and to our knowledge the first attempt at a region-wide evaluation of a surgical service delivery model. As changes in the health care system are introduced, it is essential that regions evaluate their "practice" of service delivery, in order to develop an evidence-based approach to health care delivery and to maximize the effectiveness of Canada's health care system.

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