Volumes and Outcomes for Surgical Services in Canada

The thousands of Canadians who are rolled into operating rooms every year all hope for good outcomes from surgery. Our understanding of one factor that may influence surgical outcomes – where someone has surgery – continues to evolve. Over the past three decades, many studies across a variety of surgical procedures, diseases and healthcare settings have shown that patients treated in hospitals performing a larger number of procedures are less likely to die after surgery. This relationship has been found for most types of care, including rare procedures (e.g., pediatric heart surgery) and more common ones (e.g., gall bladder removal).

However, it is important to learn more about the volume-outcome association since decisions are being made to concentrate care in centres of excellence – or not to – on a regular basis. To help inform these decisions, the Canadian Institute for Health Information (CIHI) profiled the issue in "Health Care in Canada 2005," a report produced in collaboration with Statistics Canada. This article presents highlights of the volume-outcome relationship in a Canadian context.

What the Research Says

A commissioned, systematic review of the volume-outcome literature found a total of 161 relevant journal articles published between 1979 and the spring of 2004. Together these articles contain 313 separate analyses. Most (80%) studies originated from the United States, although some were conducted in Canada (9%) as well as Europe, Japan and elsewhere (11%) (Urbach et al. 2004; Canadian Institute for Health Information 2005).

More than two-thirds of the analyses (68%) found that the greater the volume of procedures performed by a hospital or a physician, the better the outcomes. However, the strength of this relationship varied according to the type of surgical procedure studied. This finding echoes those of previous reviews by Halm (2002) and Dudley (2000). In a further 31% of the analyses, the relationship between volume and outcomes was either not statistically significant or undetermined. Only a few (1%) showed a significant association between higher volumes and poorer patient outcomes. Gastrointestinal operations, vascular procedures and cardiac surgeries were among those most often studied (Table 1).

Table 1. Numbers and types of procedures studied in literature review†

Categories of Procedures (Total Number of Studies)	Top Three Procedures Evaluated in Each Category	Number of Studies
Gastrointestinal procedures (76)	Colectomy	10
	Esophagectomy	9
	Gastrectomy	7
Vascular procedures (59)	Abdominal aortic aneurysm repair*	26
	Carotid endarterectomy	22
	Lower extremity arterial bypass	3
Cardiac procedures (36)	Coronary artery bypass graft	20
	Repair of congenital heart defects	5
	Aortic valve replacement	3
Percutaneous coronary artery procedures (22)	Percutaneous transluminal coronary angioplasty	11
	Percutaneous coronary intervention	4
	Cardiac catheterization	3
Orthopedic procedures (19)	Total hip replacement	8
	Hip fracture surgery	2
	Major hip and knee surgery	2
Pancreatic surgery (16)	Whipple procedure (pancreaticoduodenectomy)	10
	Pancreatectomy	5
	Whipple procedure or total pancreatectomy	1
Lung operations (13)	Pneumonectomy	5
	Lobectomy	3
	Lobectomy or pneumonectomy	3
Urological procedures (13)	Cystectomy	4
	Transurethral resection of the prostate	4
	Nephrectomy	3

Notes:
* Includes the repair of ruptured and non-ruptured abdominal aneurysms.
† Information on 59 other procedures and health conditions not reported in this table can be found in the full document, located on the Health Care in Canada 2005 pages of the CIHI Web site (at www.cihi.ca). This material covers neurological and spine procedures, more general topics (for example, diagnoses and other health conditions) and categories with small numbers of studies.

There are two theories about why surgical volume is linked to better patient outcomes. The first theory is that hospitals performing more surgeries may have more experienced teams and a broader range of resources – that is, "practice makes perfect". The second theory argues that higher-volume hospitals have better outcomes because physicians tend to refer more patients to these "centres of excellence" – a theory known as "selective referral." Regardless of which theory is correct (or if both have some merit), the fact that such a link exists has led experts and key decision makers in healthcare to conclude that volume is an important factor in health outcomes.

New Canadian Findings

To add a Canadian perspective to the international literature on the volume-outcome association, CIHI conducted new analyses for nine elective (planned) procedures. Of interest was whether the risk of a patient dying within 30 days of admission varied according to how many procedures a hospital performed annually. Analyses covered more than 180,000 surgeries performed in the six years between 1998–1999 and 2003–2004 (excluding procedures conducted in Quebec and parts of Manitoba). Only elective surgeries performed on adults aged 20 years or older were included. Since combined procedures are more complex, other exclusions were also applied. Methods used in the analyses were similar to Birkmeyer and colleagues (2002), who conducted one of the largest volume-outcome studies in the United States.

Although relatively few (1.2%) patients died during or immediately after any of the surgeries studied (rates ranged from 0.2% for patients who underwent carotid endarterectomy or angioplasty, to 5.9% for pneumonectomy patients), for three of the nine procedures, patients treated in higher-volume hospitals were at less risk of dying within 30 days of admission (Table 2). There was a steady drop in death rates with higher volumes, after controlling for patient characteristics, the presence of comorbid conditions and the year the procedure was performed. Specifically, for every 10 additional procedures a hospital performed, the risk of dying within 30 days was 44% lower for esophagectomy and 46% lower for Whipple surgery. A smaller but still statistically significant effect was also found for angioplasty (1% reduction). In the six other procedures, a difference was found only between hospitals performing the highest and lowest volumes of surgery, or no statistically significant relationship was observed. These Canadian results confirm findings in the international literature that hospitals that treat more patients tend to have better outcomes for some types of surgery, but the nature and strength of the relationship varies according to the procedure.

Table 2. What is the risk?

Higher hospital volume was associated with lower mortality rates for esophagectomy, angioplasty, and Whipple procedures. For the remaining six procedures, a steady increase in volume was not associated with significantly lower mortality. Some other studies with larger samples, however, have shown a significant association between volumes and outcomes for these six procedures.

		Changes in the likelihood of dying within 30 days			
Procedure	Death rate*	For every 10 additional procedures	For every five year increase in age	For women (relative to men)	Comorbidities
Unruptured abdominal aortic aneurysm repair (AAA repair)	2.3%	0%	+35%†	+27%	+39%†
Carotid endarterectomy	0.2%	-6%	+38%†	-18%	+99%†
Coronary artery bypass grafting (CABG)	1.0%	0%	+40%†	+49%†	+38%†
Colon/rectal surgery (colon or rectal excision)	0.6%	0%	+56%†	-36%†	+15%†
Esophagectomy**	4.3%	-44%†	+27%†	-14%	+1%
Lobectomy‡	1.3%	-3%	+35%†	-47%†	+15%†
Pneumonectomy‡**	5.9%	-4%	+33%†	-18%	0%
PTCA (percutaneous transluminal coronary angioplasty)	0.2%	-1%†	+34%†	+30%	+81%†
Whipple procedure**	3.0%	-46%†	+19†	-47%†	+6%

Notes:
* Adjusted for age, sex, comorbidity, hospital volume and year procedure was done.
**Mortality rate was not adjusted for year the procedure was done due to small counts.
† Statistically significant at $p<0.05$.
‡ Based on advice from clinical experts, hospital volume for lung surgeries is the combined volume of lobectomy and pneumonectomy.

Source: Discharge Abstract Database, CIHI

Canadians' Views: What Matters?

Across the country, decisions are being made on a regular basis about how healthcare services are organized and delivered. Increasingly, due in part to evidence of a link between surgical volumes and better patient outcomes, more complex surgical procedures such as cardiac surgery are being consolidated in higher-volume hospitals. For example, in 1998–1999, 55% of hospitals performing bypass surgery each did 500 operations or more. By 2002–2003, two-thirds (67%) did. Clearly, deciding how and when to consolidate care is a complex process. The "right" balance likely varies from procedure to procedure and place to place. The potential travel burden for patients and families is just one of many factors that may weigh in the balance.

In 2004 CIHI commissioned a survey of 1,230 Canadian adults aged 20 years or older to ask about the extent to which they would consider the following issues when undergoing a planned surgery: proximity of a hospital to their home; reputation of the surgeon; referral by a family doctor; and the number of similar procedures performed in a hospital or by a surgeon. One-third (33%) of those surveyed reported that it would be "extremely important" that surgery take place at a hospital close to their home. However, this finding varied depending on where the respondent lived, as well as their age. Canadians living in Prince Edward Island (55%) were more likely than Manitobans (17%) to value receiving care close to their home. Seniors (41%) were more likely than younger adults (24%) to report that proximity was "extremely important" to them.

However, when forced to choose among these options, only 9% of those surveyed were primarily concerned with how close to home they received their surgery. More respondents valued having a surgeon recommended by their family doctor (42%) or the number of similar procedures the surgeon had performed in the past (41%). Additionally, when forced to choose between going to a hospital further away but with a better reputation for performing a certain procedure versus going to the hospital closest to their home, the majority of respondents (70%) placed more value on the hospital's reputation.

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