General Anesthesia

A demand-based assessment of the Canadian anesthesia workforce – 2002 through 2007

[Évaluation des effectifs canadiens en anesthésie fondée sur la demande – de 2002 à 2007]

Dale A. Engen MD, Gordon H. Morewood MD FASE, Nancy J. Ghazar MD, Ted Ashbury MD FRCPC, Elizabeth G. VanDenKerkhof DRPH, Louie Wang MD FRCPC

Purpose: The number of anesthesia providers required by the Canadian health care system remains controversial. Questions persist regarding both the adequacy of the current supply and what the future demand will be. The purpose of this study was to quantify the number and adequacy of anesthesia providers in 2002, and predict the same for the year 2007.

Methods: All licensed health care facilities potentially employing anesthetic services were identified. On February 1st, 2002 a questionnaire was mailed to each institution. On April 1st, a second mailing was sent to non-responders. Those facilities that did not respond to either mailing were contacted by telephone.

Results: Responses were obtained from 831 of 891 (93%) health care facilities. Four hundred and twenty-six of the facilities employed anesthetic services. There were 1,610 operating rooms (ORs) in use daily, and 2,134 full-time equivalent (FTE) anesthesia providers were available to the institutions surveyed. Respondents identified an immediate need for 228 additional FTEs. Hospitals with less than five ORs or five FTEs reported higher vacancy rates than hospitals with greater than five ORs or five FTEs ($P < 0.0001$). Ontario ($n = 85$) and Quebec ($n = 69$) had the largest absolute deficits of FTEs and significantly greater odds of vacancies than western provinces (Ontario OR = 1.84, Quebec OR = 2.50). The projected need for 2007 was an additional 560 FTEs.

Conclusion: This is the first study to survey a national census of "consumers" of anesthetic services: Canadian health care facilities. The results indicate substantial current and worsening future shortages of anesthesia providers in Canada.

Objectif: Le nombre de prestataires d'anesthésie réclamé par le système de soins de santé du Canada demeure controversé. Des questions subsistent sur le nombre suffisant des effectifs actuels et la demande dans l'avenir. Nous avons voulu quantifier le nombre et la capacité des prestataires d'anesthésie en 2002 et prédire ces mêmes données pour 2007.

Méthode : Tous les établissements de santé autorisés à offrir des services anesthésiques ont été recensés. Le premier février 2002, un questionnaire a été posté à chaque institution. Le premier avril, un second envoi a été fait aux non-répondants. Ceux qui n'ont répondu à aucun questionnaire ont été joints par téléphone.

Résultats : Nous avons obtenu des réponses de 831 sur 891 (93 %) établissements de santé. Des services d'anesthésie étaient offerts dans 426 centres. Il y avait 1 610 salles d'opération (SO) utilisées chaque jour et l'équivalent à temps plein (ETP) de 2 134 prestataires d'anesthésie disponibles pour les institutions sondées. Les répondants ont déterminé un besoin immédiat de 228 ETP supplémentaires. Les hôpitaux de moins de cinq SO ou cinq ETP avaient des taux plus élevés d'inoccupation que les hôpitaux de plus de cinq SO ou cinq ETP ($P < 0,0001$). L'Ontario ($n = 85$) et le Québec ($n = 69$) avaient les déficits absolus les plus importants d'ETP et des risques d'inoccupation plus significativement élevés que les provinces de l'Ouest (Ontario SO = 1,84, Québec SO = 2,50). Les besoins projetés pour 2007 étaient l'ETP supplémentaire de 560.

Conclusion : C'est le premier recensement national des «consommateurs» de services d'anesthésie : les établissements de santé du Canada. Il indique des pénuries actuelles substantielles de prestataires d'anesthésie au Canada qui vont s'aggraver dans l'avenir.

From the Department of Anesthesiology, Queen's University, Kingston, Ontario, Canada.

Address correspondence to: Dr. Gordon Morewood, Department of Anesthesiology, University of Pennsylvania Health System – Presbyterian Medical Center, 51 North 39th Street, Philadelphia, PA 19104, USA. E-mail: morewoog@uphs.upenn.edu

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LIMITED human resources will likely provide a major challenge to clinicians, hospital administrators and policymakers involved in Canada's health-care system over the next several years.^{1,2} Recent surveys have revealed widespread public concern about access to medical specialists.^{3–5} Historically, Canadian physician resource planning has been based on simple head counts and physician-to-population ratios.¹ In the past two decades, a number of reports based on these methodologies have predicted a potential physician surplus.¹ For example, governmental responses to the Barer-Stoddart report resulted in an 11.3% reduction in Canadian medical school enrollments over three years in the early 1990's.⁶ This was followed by a similar reduction in postgraduate positions in 1997.⁷ Simultaneously, re-entry positions for graduate medical training were reduced (historically a source of 40% of specialist anesthesiologists in Canada)^{6,7} and the Royal College of Physicians and Surgeons of Canada changed the assessment of training and specialty certification requirements for International Medical Graduates (IMGs) effectively limiting the supply of IMGs.⁸ In addition, as recently as 1998, academics were predicting that the aging of Canada's population posed no threat of shortage to the Canadian physician supply in general, including most specialist groups.⁹ Analysis of their data shows that anesthesia was not included in this assessment and that they failed to appreciate the growing percentage of elderly that utilize most specialist surgical services.

Recognizing the impending shortage of anesthesia personnel, based primarily on the work of Donen *et al.*,⁷ the Association of Canadian University Departments of Anesthesia (ACUDA) commissioned a study designed specifically to address human resource planning within the specialty of anesthesia.¹⁰ This study culminated as the Ryten report which created a model based on "per-capita" utilization of anesthetic services by age and gender. It demonstrated an increase in demand for anesthetic services in women of childbearing years (20–39 yr) and the elderly (> 60 yr).¹¹ Projecting this model into the future, Byrick *et al.* demonstrated that by 2016 the demand for anesthesia services would increase by 31% despite an increase in the general population of only 18%, due to an increasing proportion of elderly.¹² Craig *et al.* attempted to convert this future increased demand into specific numbers of physicians.¹³ According to their analysis, Canada was deficient 208 anesthesia providers in 1999, and a projected deficit of 656 would occur by 2016. However, they articulated a need for further study to validate their model and to update these conclusions.

Despite these studies, the number of anesthesia providers required by the Canadian health-care system remains controversial. Questions persist regarding both the adequacy of the current supply and what the future demand will be. Since the provision of anesthetic services remains primarily hospital based, it is one area of physician resource planning that is uniquely suited to questioning these "institutional consumers." As an alternative approach, the authors conceived a survey which would contact each health-care institution across Canada and obtain brief but fundamental information on anesthetic services. A single previous study, limited to specific centres within the province of Ontario, utilized a similar design in 1998.¹⁴ The purpose of this study was to characterize anesthesiology human resources for the whole of Canada. The main outcome was to quantify the number and adequacy of anesthesia providers in 2002, and predict the same for the year 2007.

Methods

After receiving approval from the Research Ethics Board of Queen's University a questionnaire was sent to each health-care facility across Canada that might have employed anesthetic services.

The survey consisted of 13 multiple-choice or numerical-answer questions (Appendix). The questionnaire was printed on a single page with an English version on one side and French on the other. An addressed, stamped, return envelope and a brief bilingual cover letter explaining the objectives of the study were included.

The list of institutions to be surveyed was compiled from the registry of licensed health-care facilities maintained by each provincial government in combination with a proprietary database maintained by Southam Directories Incorporated. For each institution, the survey was addressed by name to (in decreasing order of preference) the Chair or Director of Anesthesia, the Chief Medical Officer, or the Chief Executive Officer. Each addressee was encouraged to delegate completion of the questionnaire to whichever individual within their institution they felt was best able to provide the information requested.

The survey was first mailed on February 1, 2002. Responding institutions were tracked by the use of unique identifying numbers on each questionnaire. On April 1, 2002 a second identical survey was mailed to all non-responding institutions. During June and July 2002, all remaining non-responding institutions were contacted directly by telephone.

All questions were closed-ended with categorical responses, therefore statistical analysis included frequencies and percentages on all variables. Variables

TABLE I Current and future need for full-time equivalent (FTE) anesthesia providers

	Hospitals <i>n</i> (%)	FTE positions <i>n</i>
<i>2002</i>		
Sufficient number of FTEs	263 (62)	
Insufficient number of FTEs	150 (35)	228.1
Excessive number of FTEs	4 (1)	0.5
Net deficit of FTEs in 2002		227.6
<i>2007</i>		
No change in FTEs needed	190 (45)	
Fewer FTEs needed	28 (6)	23.0
More FTEs needed	195 (46)	353.2
Net additional FTEs by 2007		332.2
Total deficit of FTEs by 2007		559.8

FTEs = full-time equivalents.

included location and type of anesthetic services, and current (2002) and future (2007) full-time equivalent (FTE) needs. An FTE was defined as an anesthesiologist who was in hospital providing direct patient care 40 hr per week (Appendix). Cross-tabulations were performed on FTE deficit (i.e., proportion of unfilled positions) by: hospital size, number of operating rooms (ORs), number of available FTEs, population size, and province/region. Associations between vacancy rates and demographic characteristics were assessed using Chi-square for trend. Odds ratios and 95% confidence intervals (CI) were calculated to assess for the magnitude and the precision of the associations. Cross-tabulations were also calculated for response rates by province. Finally, net FTE deficits for this study were compared to studies in the literature. Analysis was performed using MS Excel and EpiInfo 2002.

Results

Eight hundred and ninety-one health-care facilities were identified for inclusion in the study. Eight hundred and thirty-one (93%) hospitals responded. After exclusion of redundant data due to hospital mergers and closures, the final data sheet consisted of 773 questionnaires.

Four hundred and twenty-six (55%) facilities employed anesthetic services. Twelve (2%) institutions that had no access to anesthetic services at the time of the survey identified a need for such services. Of the institutions that employed anesthesia services, there were approximately 1,610 ORs in use daily across the country. These institutions identified 2,134 FTE spe-

FIGURE 1 Full-time equivalent anesthesiologist (FTE) deficit by province.

cialist anesthesiologists and family practice anesthesiologists, available to provide care nationally.

Anesthesia human resources in 2002 and 2007

The data regarding the availability of anesthesia providers is summarized in Table I. Sixty two percent of institutions that provide anesthetic services reported that they had an adequate supply of providers. Of note, however, 35% were understaffed and 228 FTE positions for anesthesia providers were reported as unfilled at the time of the survey. Furthermore, 46% of respondents anticipated expanding their need for anesthetic services by the year 2007. Overall, a need for 560 additional anesthesiologists by the year 2007 was identified.

Geographic distribution

The largest absolute deficits of FTE anesthesiologists were found in Ontario ($n = 85$, 37%) and Quebec ($n = 69$, 30%; Figure 1).

Demographic distribution (Table II)

The proportion of vacancies (vacancy rate) was greater the smaller the hospital (χ^2 for trend = 16.3) and least in hospitals with greater than 500 beds (OR = 0.49, 95% CI 0.31–0.77). Hospitals with five or more ORs reported proportionately fewer vacancies than hospitals with less than five ORs ($\chi^2 = 28.6$, $P < 0.0001$). Similarly, hospitals with five or more FTEs reported proportionately fewer vacancies than hospitals with less than five FTEs ($\chi^2 = 43.2$, $P < 0.0001$). Centres with a population of at least 250,000 had half the

TABLE II Health care institutional characteristics *vs* vacancy rate for anesthesia providers

<i>Institutional characteristics</i>	<i>Filled FTEs n</i>	<i>Unfilled FTEs n (%)</i>	<i>Odds ratio</i>	<i>95% confidence interval</i>	<i>χ^2 for trend</i>	<i>P value</i>
<i>Number of beds</i>						
0-100	447	57 (11.3)	1.00			
101-300	526	82 (13.5)	1.22	0.84-1.98		
301-500	556	51 (8.4)	0.72	0.47-1.09	16.3	< 0.0001
500 +	581	36 (5.8)	0.49	0.31-0.77		
<i>Number of operating rooms</i>						
< 5	591	103 (17.4)	1.00			
5 - < 10	554	54 (8.9)	0.56	0.39-0.80		
10 - < 20	489	43 (8.1)	0.50	0.34-0.75	28.6	< 0.0001
20 +	448	26 (5.5)	0.33	0.21-0.53		
<i>Number of FTEs available in 2002</i>						
< 5	464	93 (20.0)	1.00			
5 - < 10	399	42 (9.5)	0.53	0.35-0.79		
10 - < 20	498	47 (8.6)	0.47	0.32-0.69	43.2	< 0.0001
20 +	760	45 (5.6)	0.30	0.20-0.44		
<i>Population</i>						
< 50,000	414	59 (14.3)	1.00			
50 K-99,999	208	29 (12.2)	0.98	0.59-1.61		
100 K-249,999	337	43 (11.3)	0.90	0.58-1.39	12.5	0.0004
250 K-999,999	558	45 (7.5)	0.57	0.37-0.87		
1,000,000 +	587	47 (7.4)	0.56	0.37-0.86		
<i>Regions*</i>						
West	774	51 (6.2)	1.00			
East	216	20 (8.5)	1.41	0.79-2.48		
Ontario	700	85 (10.8)	1.84	1.26-2.69	24.1	< 0.001
Quebec	419	69 (14.1)	2.50	1.68-3.72		

FTEs = full-time equivalent anesthesia providers. *Excludes Yukon, Northwest Territories and Nunavut. "East" includes NS, NB, PEI, and NF; "West" includes MN, SK, AB, BC.

vacancy rate of centres with a population less than 50,000 (population 250,000–999,999 OR = 0.57, 95% CI 0.37–0.87; population 1,000,000 + OR = 0.56, 95% CI 0.37–0.86). Institutions in Ontario (OR = 1.84, 95% CI 1.26–2.69) and Quebec (OR = 2.50, 95% CI 1.68–3.72) had significantly greater odds of vacancies than those in western provinces.

Obstetrical services

A total of 369 respondent institutions from this survey reported an aggregate of 282,546 estimated annual births. By comparison, a total of 327,187 live births was reported by statistics Canada for July 1, 2001 to June 30, 2002.¹⁵ Only half of the institutions provided full-time epidural analgesia services, but these institutions encompassed 89% of all deliveries (Table III). Ninety-seven percent of all deliveries occurred in an institution where at least part-time epidural analgesia services were available.

Non-OR activity

Anesthesiologists were also commonly active in many areas of the hospital outside the OR (Figure 2). In 318 (75%) of the respondent institutions that provided anesthetic services, anesthesiologists provided patient care in one or more locations other than the OR suite.

Discussion

This is the first study to survey a national census of "consumers" of anesthetic services: Canadian health care facilities. The results indicate substantial current and worsening future shortages of anesthesia providers across Canada. While these shortages affect the entire spectrum of health-care facilities across the country, they were greatest in smaller hospitals, smaller communities, and the provinces of Ontario and Quebec.

Strengths of this study included the excellent response rates from all regions of the country (Table IV); the direct querying of the "consumers" of anesthesia services; and the use of a standardized number

TABLE III Characteristics of institutional epidural analgesia availability for labour and delivery

	Hospitals n (%)	Annual deliveries n (%)
No anesthetic services in hospital	52 (14)	1,155 (0.4)
Epidurals not available for labour and delivery	35 (10)	5,956 (2)
Epidurals provided by obstetrical physicians	9 (2)	930 (0.3)
Epidurals during the day when anesthesia available	69 (19)	21,570 (8)
Epidurals available 24 hr per day	197 (54)	252,121 (89)
Total	362 (98)*	281,732 (99.7)*

*A total of seven hospitals reporting 814 births annually did not characterize the availability of epidural analgesia for labour and delivery in their institution.

FIGURE 2 The provision of anesthesia services outside of the operating room. POC = preoperative clinic; ICU = intensive care unit; APM = acute/inpatient pain management service; CPM = chronic/outpatient pain management clinic; Rad = radiology suite; Cath = cardiac catheterization laboratory.

of hours per week to define a FTE anesthesiologist. The 93% response rate allows confidence that the results are representative of the nation overall. The direct questioning of individuals in the institutions in which anesthetic services were utilized allowed us to obtain direct estimates of need rather than theoretical projections. The sensitivity of physician demand to number of hours worked per week as emphasized by Ryten¹¹ prompted the decision to clearly define a FTE anesthesia provider. Forty hours spent per week providing direct patient care appears to be a reasonable number based on the results of a recent survey of anesthesiologists.¹⁶

A weakness of the present study is that the specific individual completing the questionnaire in each case was not identified. It is possible that clinicians and administrators might have interpreted anesthesia resource needs differently. However, the designation of a FTE based on hours of direct patient care was

intended to allow any individual within the institution to objectively translate OR, intensive care unit, or clinic hours directly to FTE requirements. A second weakness is that we did not address how many additional FTE anesthesiologists would be required to enable researchers, educators, and physician leaders to pursue academic and administrative endeavours.

The deficit numbers reported in this study were somewhat greater than those of previous reports. One explanation for this discrepancy is the inclusion of both specialist anesthesiologists and family physician anesthesiologists nationwide in the current survey. Yang *et al.* studied ten urban institutions in Ontario and did not attempt to measure shortages in rural areas.¹⁴ Craig *et al.* extrapolated data from the Ryten report that was modelled on billing patterns for anesthesia services in Quebec. There are very few family practice anesthesiologists working within this province,¹¹ thereby likely under-representing national shortages in this group.

Within anesthesia, physician resource planners now have two studies, utilizing distinctly different methodologies, which show that the current supply of anesthesiologists is inadequate and that the deficit will worsen over the next five years (Table V). The consistency of these findings provides support for the use of Ryten's model in calculating future anesthesia resource needs. Ryten's report recommended graduating 150 FTE anesthesiologists per year to correct our current deficit and the predicted additional demand by the year 2016.¹¹ The Canadian post-graduate medical education system currently produces 80 to 90 specialist anesthesiologists,¹³ and fewer family physician anesthesiologists per year.¹⁷ In addition, not all specialist anesthesiologists are entering clinical practice¹¹ and the average anesthesia career length of family physician anesthesiologists is only ten years.⁷ Making the shortages worse, Canadian physicians are training longer, are older as a group, and are retiring at an increasing rate.¹⁸

TABLE IV Institutional response rate by province

Province	Total institutions <i>n</i>	Responding institutions <i>n</i>	Response rate %
BC	105	99	94
AB	125	116	93
SK	104	103	99
MB	81	76	94
ON	187	176	94
QC	177	150	85
NB	29	29	100
PE	8	8	100
NS	34	33	97
NF	35	35	100
YT	2	2	100
NT	3	3	100
NU	1	1	100
Overall	891	831	93

TABLE V Comparison of current and predicted national deficits of full-time equivalent (FTE) anesthesiologists between studies

	1999	2002	2007
Present study	N/A	228	560
Craig <i>et al.</i> ¹³	208	(increase in deficit of 41 FTE/year)	536

The specialty of anesthesia is uniquely intertwined with most aspects of modern medicine. In the United Kingdom it is estimated that anesthesiologists are involved in the care of two thirds of all patients admitted to hospital.¹⁹ The recent Romanow report, Commission on the Future of Health Care in Canada, confirms that Canadians highly value their universal, accessible, single payer health-care system.²⁰ However, as exemplified by news reports over the past few years, with the worsening shortage of anesthesiologists waiting lists will grow (a recent report states that waiting times have grown on average by 77% between 1993 and 2002),²¹ surgeries will be cancelled,²² ORs will be closed,²³ and diagnostics tests will be delayed. This will accelerate the frustration felt by patients, family physicians and other specialists already struggling with an overtaxed system.

Finally, there is an urgent need to determine why all specialist anesthesiology graduates are not entering clinical practice and why family physician anesthesiologists make limited use of their anesthesia training.^{1,11} The barriers to IMGs and to the return of Canadian anesthesiologists trained or practicing abroad need to be investigated to ensure that we are not unnecessarily foregoing these valuable resources. Also, as recommended by recent government and academic reports, Canada needs to increase medical school, postgradu-

ate, re-entry and IMG training positions and evaluate whether or not the current pedagogy is relevant for our health care system.^{1,2,11,24,25} Just as important, we need to consider rejuvenating the medical profession by decreasing the length of training or by reducing the time spent in pre-medicine years. New models of delivering health care, including the appropriate use of anesthesia assistants, need to be explored to increase clinical output and emphasize the role of physicians as diagnosticians.^{1,24} An inevitable result of inaction will be the withdrawal of anesthesiologists' from participation in patient care other than in the OR. This would have a negative impact not only on patient care, but also on the development of the specialty itself. A national human resources plan that is specialty-specific is required.^{7,11,13} The Canadian Medical Forum Task Force Two and the possible creation of the Health Institute for Human Resources, as recommended by the Canadian Medical Association,²⁶ appear to be positive initiatives. However, the Canadian Anesthesiologists' Society should be proactive and lead the way on this issue in order to preserve the future of the profession.

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APPENDIX Survey questionnaire

The questionnaire was printed as a single page with English on one side and French on the other. Answers to multiple choice questions were indicated by “check boxes.”

1. Name of Hospital(s): _____
2. Province in which your institution is located: _____
3. Local urban population: < 10,000; 10,000–49,999; 50,000–99,999; 100,000 – 249,999; 250,000 – 999,999; > 1,000,000
4. Surgical services routinely available at your institution include (check all that apply): None; General; Orthopedic; Neuro; Cardiac
5. The number of acute care beds at your institution is: 0; 1 – 50; 51 – 100; 101 – 300; 301 – 500; > 500
6. The approximate number of obstetrical deliveries annually is: _____
7. Is care available from an anesthesiologist at your institution? yes, 24 hr per day, seven days per week; yes, 24 hr on some days, but less than seven days per week; yes, but only on a scheduled basis; no, but it is needed; no, it is not needed (skip remainder of questionnaire and return in enclosed envelope)
8. Average number of operating rooms used daily at your institution: _____
9. Are epidurals provided by an anesthesiologist for labour and delivery? not applicable (no obstetrical services provided); no, epidurals are not available to obstetrical patients; no, but the physician providing obstetrical care may also provide this service; yes, during the day if an anesthesiologist is available; yes, 24 hr per day
10. Other locations where anesthesiologists provide scheduled care at your institution (check all that apply): intensive care unit; cardiac catheterization laboratory; radiology suite; pain service - (acute/inpatient, chronic/outpatient); preoperative assessment clinic; other (specify): _____
11. For the purposes of the last three questions, anesthesiologists who work less than full-time should be defined on

the basis of Full Time Equivalents (FTEs). One FTE anesthesiologist is expected to be in the hospital providing patient care roughly 40 hr per week. For example, an institution that has two anesthesiologists who each work 30 hr per week would have 1.5 FTE anesthesia providers available. ($[30 + 30] / 40 = 1.5$)

12. *The total number of full-time and FTE anesthesia providers at your institution is:_____*

13. *The number of full-time and FTE anesthesia providers currently available is: about right; too few (number of FTE anesthesia positions unfilled:_____); too many (excess number of FTE anesthesia providers:_____)*

14. *As best as you can estimate, five years from now the number of full-time and FTE anesthesia providers needed by your institution will be: unchanged; fewer (estimate number of positions eliminated:_____); more (estimate number of positions added:_____)*

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