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Billing Patterns of Canadian Anesthesiologists over a Decade

Michael J. Tessler*, Ian Shrier and Russell J. Steele

Department of Anesthesia, and the Centre for Clinical Epidemiology and Community Studies of the Lady Davis Institute for Medical Research, Sir Mortimer B Davis-Jewish General Hospital and McGill University, 3755 Cote Ste Catherine Road, Montreal, Quebec H3T 1E2, Canada

Abstract

Purpose: Over the past decade several authors have focused on the demand for anesthesiologist services. The objective of this article is to determine the clinical work billed by Canadian anesthesiologists at different stages of practice.

Methods: Ten years worth of specialist anesthesiologists' billing data from Jan 1, 1993 to Dec 31, 2002 were obtained from British Columbia (BC), Ontario (Ont), and Quebec (Que). The anesthesiologists were stratified into three age categories (<51, 51-64, and 65+). The number of unique physician – patient interactions and days with submitted billings were extracted for each anesthesiologist in each province.

Results: The median number of anesthesiologists per year over the 10 year period for the <51, 51-64, and 65+ age groups were, respectively, 323, 138, and 51 in Quebec, 476, 235, and 66 in Ont and 225, 83, and 8 in BC. The median number of days with billings per year and unique physician-patient interactions was dependent on the province and lower for the 65+ age group, but were similar for the <51 and 51-64 age groups.

Conclusion: The median number of days with submissions for billing by anesthesiologists is relatively constant until at least 65 years of age and then declines in each province. There is much variability in billing among anesthesiologists between and within the provinces studied. Canadian health care delivery is quite dependent on anesthesiologists 65+ despite the reduced number of days with billings and physician-patient interactions in this age group.

Keywords: Aging; Anesthesiologist; Clinical practice pattern

Introduction

Over the past decade several authors have suggested that there is a lack of anesthesiologists to meet the current and predicted demand [1-5]. Approaches used include surveying all Canadian health care facilities that might employ anesthesiologists [2], asking the departmental anesthesiologist-in-Chief in ten Ontario cities about an immediate need to recruit anesthesiologists [3], assessing the use of "per capita" expenditures for anesthesiologists in Quebec [4], and examining the billing by Quebec (Que) and British Columbia (BC) anesthesiologists [5].

The focus of the majority of these articles regarding human resources is demand for services [1-4]. While many anesthesiologists are involved in medical education, research, and administration, the major focus from a public health and patient care perspective is physician-patient interractions (clinical work). Although surveys of medical specialists can quantify this work, they are retrospective and depend upon accurate recall and a response from all specialists. Further, there is often limited distribution of the information obtained. The articles by Engen et al [2] and Yang et al [3] suffer from some of these limitations as they report subjective, limited assessments of need. A more complete and reliable method to determine the clinical work performed by anesthesiologists is to review their billing submissions to the provincial health authorities for clinical work done. With computerized record keeping, even if this review occurred years after the submissions, the results would remain objective and complete. The article by Byrick et al4 used health care costs to report on projected demand for anesthesiologist services in 2016, but did not assess individual practitioners' patterns of billing. Aside from the article by Tessler et al [5], no previous article has assessed the impact of anesthesiologist age on the volume of clinical work. Therefore, the aim of this article is to determine the number of unique physician – patient interactions billed and days with billings for anesthesiologists in three provinces to quantify the clinical work done by Canadian anesthesiologists at different stages of practice.

Methods

The Sir Mortimer B Davis – Jewish General Hospital (SMBD-JGH) institutional ethics committee granted approval of the study. The design of this study was that of a historical cohort. We obtained billing data for all procedures performed by specialist anesthesiologists from BC (BC Medical Services Commission), Que (Regie de l'Assurance Maladie du Quebec) and Ont (Ministry of Health and Long-Term Care – MOH-LTC) for the 10-year period from Jan 1, 1993 – Dec 31, 2002.

The information included the age category of the specialist anesthesiologist at the time of billing (divided into age categories of <51, 51 – 64, 65+ i.e. early-mid, mid-late, and pre-retirement), billing code for the act, unique anonymized patient identifier code, and the date of the procedure. For BC, the data also contained the start time and end time of the procedure. In order to exclude anesthesiologists who might have licenses in more than one province and bill provincial agencies for work done outside the province studied, we excluded all anesthesiologists who billed for fewer than 50 patients per year. We did not stratify anesthesiologists according to gender as this might have allowed for identification of individual anesthesiologists.

We calculated the number of patients treated by first counting all

***Corresponding author:** Michael J. Tessler, Department of Anesthesia, Room A-335, SMBD-Jewish General Hospital, 3755 Cote Ste Catherine Road, Montreal, Quebec H3T 1E2, Tel: 514-340-8222 ext 5701; Fax: 514-340-8108; **E-mail**: mtessler@ana.jgh.mcgill.ca

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procedures billed by each anesthesiologist. When more than one procedure (e.g. low anterior resection with cystocopy and ureteral stent insertion and total abdominal hysterectomy with bilateral salpingoohorectomy) was applied to the same patient on the same day, we categorized it as a single case. However, if an anesthesiologist billed for procedures on two separate days (e.g. femoral artery to popliteal artery bypass graft on May 5 and a below knee amputation on May 6), we considered this as two separate cases.

Our analysis considered 00:00 to 23:59 as one day. If any anesthesiologist submitted a bill for a physician – patient interaction at any time during that period, our analysis would have included that as a day with a submission. We considered on-call billings and procedures that spanned midnight to be work done on the date that the procedure was indicated for in the billing. Weekend days and statutory holidays with at least one billed submission (eg hospital visit to a ventilated patient) counted as a day with clinical billings, even if all surgeons working at the hospital were away. Also, for BC only, we received the start and end time for submissions involving surgical procedures. Using the logic described below, we calculated the case duration for each procedure and summed the hours of anesthesia care for each BC specialist.

Case durations

Although we had access to all billing data, we needed to correct for incomplete or invalid billing records. We first deleted all cases where the start time or end time was absent from the billed submission because we could not calculate case duration. We then deleted those cases where the end time was exactly midnight (00:00) because we felt these represented errors due to limitations of the database; databases normally have a default so that if only a date is entered, the time defaults to midnight. This appeared a valid assumption considering many of these cases deleted had start times in the morning or afternoon.

For the remaining cases, we noticed that some procedures had calculated case durations that were negative. This occurred for two reasons. Some cases had the entered end time earlier than the start time, clearly representing a data entry error. In addition, cases that lasted past midnight had the same start dates and end dates, even though the end date should have been the following day. Case durations calculated by simply subtracting start time from end time would give a negative value. For cases with a negative value, we made corrections according to the following steps. If there was more than one procedure billed for that particular patient by the same physician on the same day, and one of the values was positive, we accepted that result for the case duration of all procedures. If all calculated case durations were negative, we added 24 hours to the end time to correct the error in the end date, and then subtracted the start time from the end time. To minimize the risk of changing entries that should not have been changed, we then manually checked the newly calculated case durations that were greater than 12 hours. If the code submitted appeared consistent with a procedure that might require 12+ hours we accepted the duration as described; if it did not appear consistent, we deleted that procedure.

Statistical analysis

We present the number of specialist anesthesiologists in each province in each year over the 10-year period. In Ont, there were 2-3 anesthesiologists per year for whom we could not determine age and these were omitted from the analysis. We calculated the number of days and total number of cases per anesthesiologist in each year by counting the individual patients for whom an anesthesiologist billed for on a given day, regardless of the number of procedures per patient. Because the numbers of surgical cases per anesthesiologist were quite skewed, we present median number of days worked and cases per anesthesiologist (interquartile range, IQR) rather than the mean (SD). In addition, some distributions were bimodal and in these cases, the median is highly sensitive to slight fluctuations. Therefore, we

	Que			Ont			BC		
	<51	51-64	65+	<51	51-64	65+	<51	51-64	65+
1993	311	157	54	480	223	58	217	66	10
1994	312	156	61	472	229	65	217	71	7
1995	322	146	65	461	215	64	224	75	7
1996	320	134	69	469	223	65	227	75	5
1997	321	127	43	464	237	64	226	81	8
1998	324	131	46	470	241	67	228	84	7
1999	327	140	49	481	233	70	227	91	6
2000	351	137	49	485	239	80	231	90	11
2001	363	138	49	499	249	82	219	102	11
2002	372	138	53	504	262	78	213	106	13

Table 1: Numbers of specialist anesthesiologists in the three age groups who billed more than 50 acts in Que, Ont, and BC per year from Jan 1, 1993 to Dec 31, 2002.

	Que			Ont			BC		
	<51	51-64	65+	<51	51-64	65+	<51	51-64	65+
1993	772.5 (520.5)	724 (429)	511.5 (444.5)	1044 (595.8)	984 (509)	805 (556)	667.5 (335.5)	700 (303)	380.5 (140.2)
1994	807 (465.5)	761 (508.5)	492 (429.2)	1059 (683.5)	1005 (559)	696 (593.5)	635.5 (343.2)	672 (361.2)	330 (445)
1995	787.5 (456)	753 (421.5)	491 (402.5)	1112 (613)	1038 (574.5)	686.5 (736.5)	651 (309)	720 (249)	470.5 (349.5)
1996	768 (409)	771 (325)	325 (456)	1124 (635)	1064.5 (588.5)	702 (783)	649 (358.2)	680 (316)	662.5 (346.5)
1997	772 (400)	805 (317.8)	381.5 (644)	1180 (731.5)	1146 (607)	665.5 (850.2)	718 (466)	780 (401)	557 (473)
1998	745.5 (401.8)	792 (393.5)	310 (563.5)	1184 (708)	1122 (656)	700.5 (806.8)	731 (458)	732.5 (411.5)	537 (463.2)
1999	777 (393)	815.5 (401.5)	346 (644)	1231.5 (717)	1169 (639)	909 (825.5)	752 (453)	737 (400)	570 (376)
2000	784 (402)	839.5 (377.2)	360 (530)	1266 (783)	1220 (731)	866.5 (874.2)	722 (461)	719 (414.2)	711 (515)
2001	756 (410.2)	830 (385)	402 (554)	1224 (787)	1214 (832.5)	745 (625)	726 (420.2)	670 (418.5)	843 (463.2)
2002	742.5 (439.2)	790 (421)	448 (483)	1212 (720.5)	1231 (829.5)	733 (886.5)	712 (452)	671 (458.5)	834 (465.2)

Table 2: Median number of unique physician-patient interactions per year (interquartile range) in Que, Ont, and BC annually from Jan 1, 1993 to Dec 31, 2002 for each of the three age groups. Comparisons between provinces may reflect differences in patterns of work or patterns of billing.

	Que				Ont			BC	
	<51	51-64	65+	<51	51-64	65+	<51	51-64	65+
1993	209 (58.5)	211 (60)	196 (91)	227 (69.3)	219 (59)	184 (86.3)	185 (52)	188 (49)	87 (34)
1994	213 (50.5)	217 (50.5)	186 (84)	225.5 (69)	218 (56)	175 (109)	179 (48)	182 (50.5)	64 (71.5)
1995	212 (43)	217.5 (48.3)	196.5 (112.8)	227 (62)	226 (43.5)	180 (97.5)	175 (52.5)	178 (45)	87 (117)
1996	216 (42.5)	220 (43.5)	117 (125)	229 (68)	225 (50.5)	167 (112)	179 (57)	182 (39)	108 (37)
1997	214 (41)	214 (40)	156 (134)	229 (65.3)	226 (47)	162.5 (97)	171 (63.5)	181 (46)	101.5 (108)
1998	211 (38)	216 (31.8)	136 (142)	228 (59)	218 (60)	162 (97)	164 (59)	168.5 (48.5)	153 (91)
1999	210 (37)	210 (39.8)	114.5 (135)	225 (68)	220 (54)	186.5 (75.8)	166 (59.5)	161 (53)	83.5 (42)
2000	211 (50)	214.5 (41)	125 (106.3)	221 (73)	216 (62)	171.5 (97.8)	168 (57.5)	157 (57.8)	147 (115)
2001	206 (49)	205 (47)	127 (107)	222 (79)	221 (69)	159 (102.5)	163 (64.5)	166.5 (67.5)	143 (89)
2002	206 (45)	199 (47.5)	138 (115.5)	216 (63)	216 (57.5)	171 (83.3)	163 (73)	162 (57.3)	137 (88)

Table 3: Median number of days with at least one act billed, per anesthesiologist, per year (interquartile range) in Que, Ont, and BC annually from Jan 1, 1993 to Dec 31, 2002 in each of the three age groups.

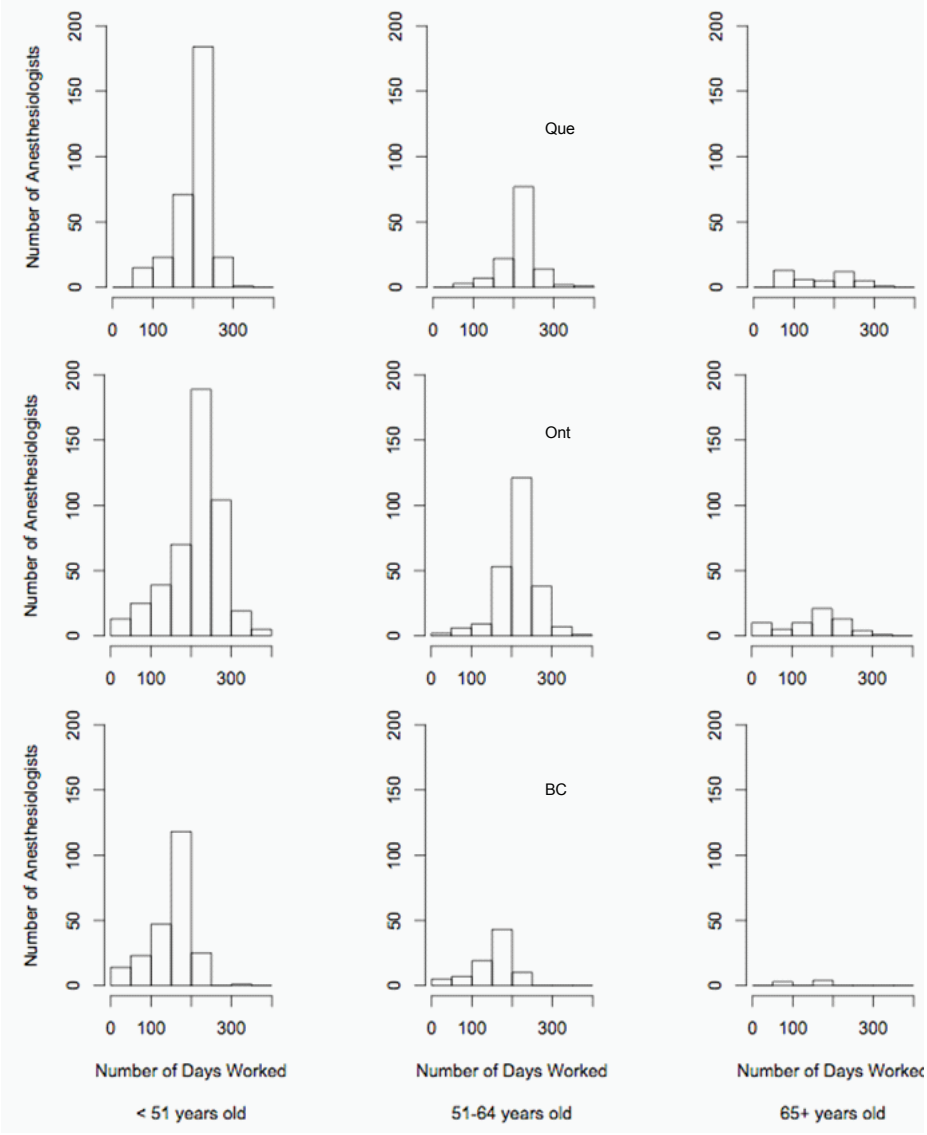

Figure 1: Representative histograms of the number of days with at least one billed act, per year, per anesthesiologist for the <51, 51-64, and 65+ age groups of anesthesiologists in Quebec (Que, top panel), Ontario (Ont, middle panel) and British Columbia (BC, bottom panel).

also present representative histograms of the raw data where appropriate. Finally, using the corrected case duration data for BC, we calculated the mean number of hours billed per day for each BC physician in each year, and stratified the results by age group.

In almost all research examining differences between groups, researchers only have samples of the population of interest and can only estimate the population means. Therefore, they use tests to determine if these estimates are "statistically significantly different", i.e. what is the probability that the different samples came from the same population. In our study, statistical significance testing and confidence intervals are meaningless because we have all the data from the population and therefore our means are true population means and not estimates. As such, any differences are real differences and the only remaining question is whether the differences are large enough to have policy implications, which requires a value judgment and cannot be answered with statistics.

Results

The total number of specialist anesthesiologists in the three provinces studied ranged from 1575 to 1741 over the 10-year period studied. The median number of anesthesiologists per year over the 10 year period for the <51, 51-64, and 65+ age groups were respectively 323, 138, and 51 in Que, 476, 235, and 66 in Ont and 225, 83, and 8 in BC (see Table 1). In Quebec, there was a large drop in the number of anesthesiologists 65+ between 1996 and 1997 due to a financial incentive provided by the Quebec government to retire5. This reduction in senior anesthesiologists is not seen in either BC or Ont. However, neither BC nor Ont experienced as large an increase in anesthesiologists <51 as that occurred over the decade in Que; BC saw a reduction in practitioners in this age group during the same time period!

The median number of unique physician-patient interactions per year was similar for the <51 and 51-64 age groups but much less for the 65+ age group, and was dependent on the province (Table 2). The provinces ranked Ont, Que, and then BC in decreasing order for the number of unique anesthesiologist – patient interactions per year. However, comparisons between provinces may reflect differences in patterns of work or patterns of billing. The lowest median in each province in each year was found in the 65+ age group (except BC for 2001 and 2002) and the highest medians in each province studied were maintained from <51 to 64.

The median number of days with submissions for clinical work per year was again similar for the lower two age groups and lower for the 65+ age group, and dependent on the province studied (Table 3). As with unique physician-patient interactions, the most days per year with submissions came from Ontario anesthesiologists and the fewest from BC anesthesiologists.

To demonstrate the range of patterns of billing by different individuals, Figure 1 illustrates representative histograms of the number of days with at least one act billed per year per anesthesiologist for the <51, 51-64, and 65+ age groups of anesthesiologists in Que, Ont, and BC. The highest median number of days with billings was found in each of the ≤64 age groups in all three provinces but the 65+ groups show a bimodal distribution.

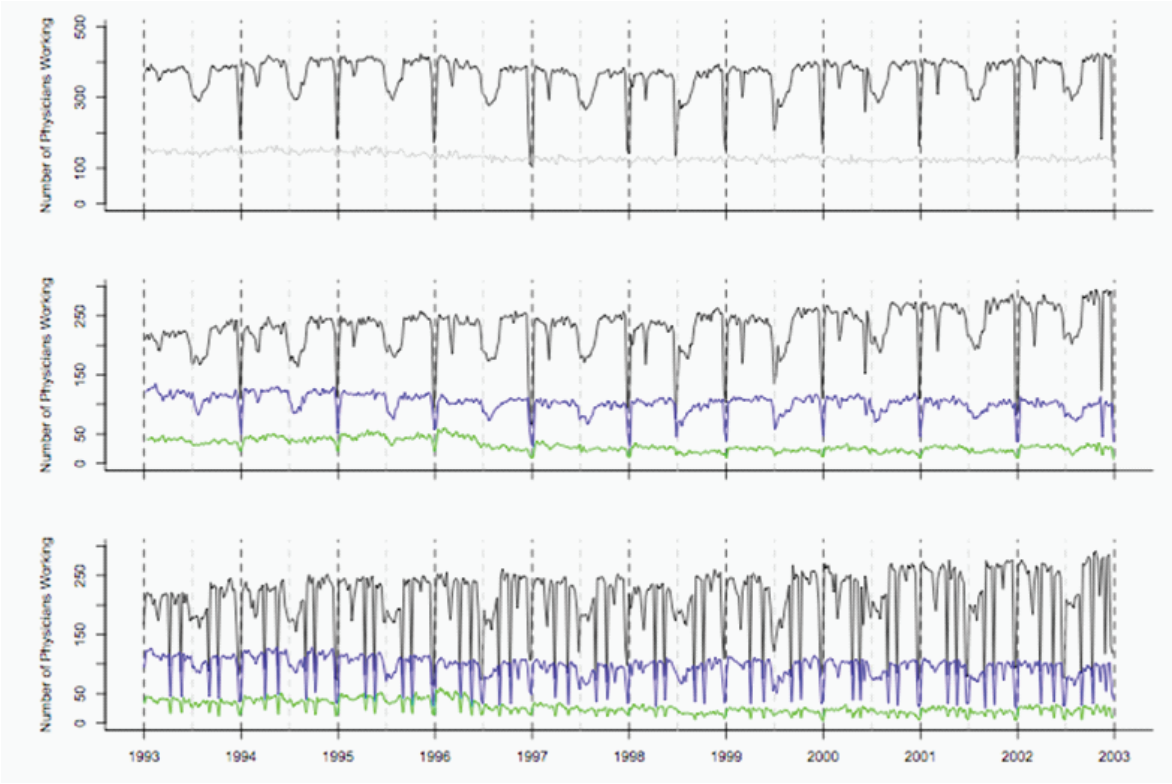

Figure 2: Top Panel: Graphic representation of all Quebec anesthesiologists billing for physician-patient interractions on Wednesdays (black lines) and Saturdays (gray lines) from Jan 1, 1993 to Dec 31, 2002. Middle Panel: The number of anesthesiologists in each age group (<51: black line, 51-64: blue line, 65+: green line) billing for physician-patient interractions on Wednesdays from Jan 1, 1993 to Dec 31, 2002. Bottom Panel: The number of anesthesiologists in each age group (<51: black line, 51-64: blue line, 65+: green line) billing for physician-patient interractions on Mondays from Jan 1, 1993 to Dec 31, 2002.

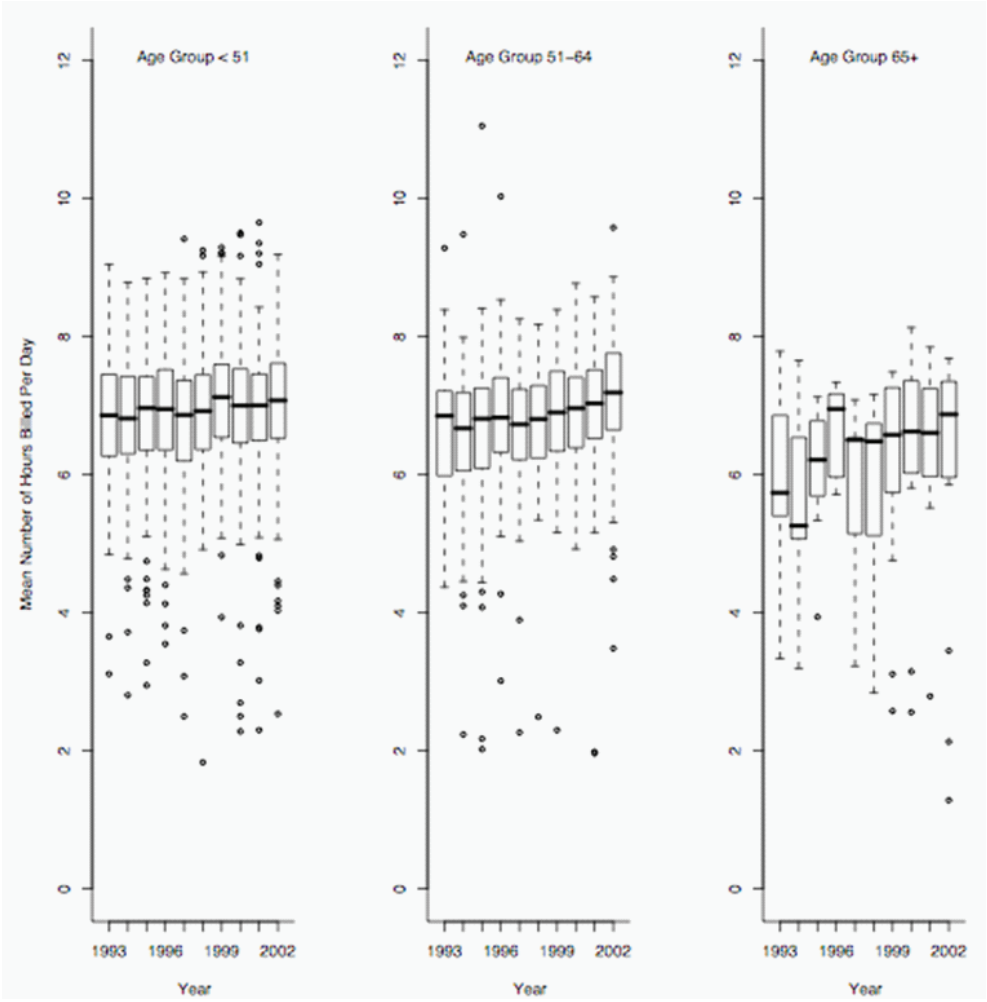

Figure 3: Box plots for the mean number of hours billed per day for each British Columbia anesthesiologist, in each year of the study, stratified by age groups. The dark solid line represents the median among all physicians for that year, and the upper and lower lines of the box represent the 25th and 75th percentiles. The lines extending from the boxes show the range 1.5 times the interquartile range (IQR) or stop at the maximum value if this is less than 1.5 times the IQR. Outlying data points are shown as circles.

Figure 2 (Que) explores the data slightly differently. The figure illustrates the number of anesthesiologists who billed at least one act on a particular day of the week over the entire 10-year period studied. For example, the top panel shows the total number of anesthesiologists who billed at least one act on any given Wednesday (00:00-23:59) and Saturday (00:00-23:59) between Jan 1, 1993 and Dec 31, 2002. The figure demonstrates the reduction in anesthesiologist number seen on Saturdays (the line for Sundays was nearly identical, data not shown). This is similar to the reduction on Jan 1, and seemingly represents the lower limit of anesthesiologist availability in the province. The lower two panels show the numbers of anesthesiologists stratified by age group who submitted bills for clinical work on Wednesday (middle graph) or Monday (bottom graph). The multiple dips seen on the Monday graph represent the Monday statutory holidays. Canada Day (July 1) would result in a decrease on Monday only in those years where July 1 was a Saturday, Sunday, or Monday. The 65+ group also decreased their billing over the summer months but this is not easily seen because of the scale of the graphs. Further, the gradual increase in the number of anesthesiologists <51 over the 10-year period is shown, as is the sudden reduction of anesthesiologists 65+ in 1996 due to a retirement incentive package [5]. The sudden drop in anesthesiologists 65+ observed in Quebec is not seen in similar figures for Ontario or BC.

In addition to calculating the number of days or physician-patient interractions that an anesthesiologist billed for, the additional detail in the data from BC allowed us to calculate the mean number of hours worked for the cases that were billed (Figure 3). We deleted 14.5% cases from the analysis because of missing or invalid data as described in the methods section. The mean number of hours per year for cases billed was less for the 65+ group in each year. In addition, except for one 65+ anesthesiologist in one year, there were no other 65+ anesthesiologists who averaged more than 8 hours per day of work for billing cases over the entire 10-year period, whereas there were at least some anesthesiologists billing 8+ hours in each of the other age groups, in each of the years.

In addition to our data between 1993-2002, we obtained data from an independent source (BC Health Services Commission) to verify our calculations with respect to billing days (Table 4), and to extend the years with information to 2008 (BC Health Services Commission – Mr Paul Lam, personal communication). Although BC Health included anesthesiologists

	Physician count	Median Age	Total Number of Days with billings	Mean Number of Days with billings per year per anesthesiologist
1998/1999	346	46	58,038	168
1999/2000	350	47	61,274	175
2000/2001	351	47	60,383	172
2001/2002	359	48	59,481	166
2002/2003	366	48	59,399	162
2003/2004	380	48	60,412	160
2004/2005	412	48	62,657	152
2005/2006	437	49	66,111	151
2006/2007	445	50	68,432	154
2007/2008	461	50	69,897	150

Table 4: Number of BC specialist anesthesiologists, median age, and total number of days with billings and mean number of days with submitted billings, per anesthesiologist, annually from 1998 through 2008 (Knowledge Management and Technology Division BC Health – personal communication).

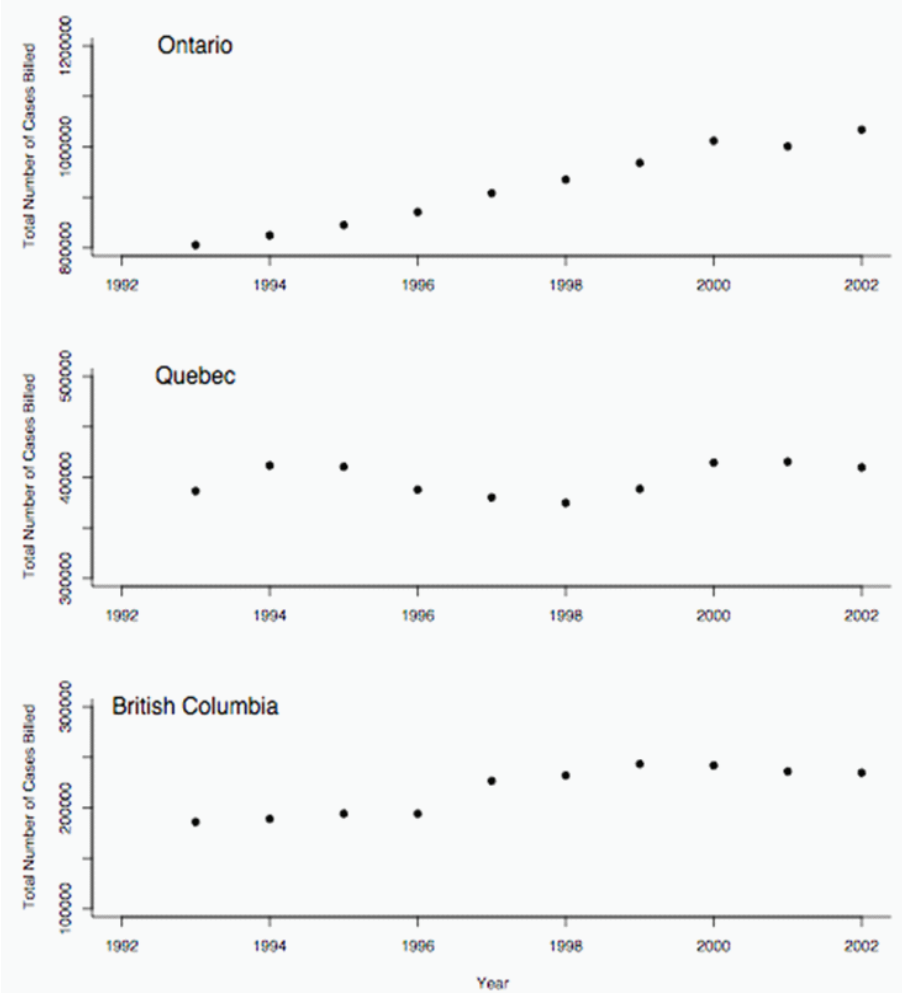

Figure 4: Total number of submissions by Quebec, Ontario, and BC specialist anesthesiologists each year from 1993 through 2002.

with fewer than 50 physician- patient interactions in any year, and did not stratify by age group, the similarity between their results and ours supports the validity of our analysis.

Finally, the increases in submitted billings in Que, Ont, and BC through the decade studied are shown in Figure 4. There was a slight drop in Quebec total submissions in 1996 as a consequence of the end of career package introduced by the province5, which is not seen in the other two provinces.

Discussion

This is the first paper to describe the billing patterns of Canadian anesthesiologists. We have analyzed the three largest Canadian provinces

representing almost 80% of anesthesiologists in Canada. We found that the number of physician-patient interractions billed and days with submitted billings per year per anesthesiologist is determined in large measure by where one works in Canada. However, our analysis is limited by the fact that we did not assess out of province/out of country and private billing. A second profound point is that anesthesiologists maintain the number of days with clinical billing submissions until at least age 65. We have also described the annual pattern of anesthesiologist billings and shown the lower limit of anesthesiologist availability.

Our study analyzed gross patterns across age groups. It is also possible to use billing data to follow the career paths of individuals over time and address many other questions. We plan to conduct these types of analyses in future papers. For confidentiality reasons, such analyses must be conducted with care in order to ensure that it is not possible to actually identify individual practitioners.

Our results are consistent with previous work. We found as did Craig et al that approximately 90% of anesthesiologists retire by age 65 [6]. However, by studying the billing submissions of older anesthesiologists, we have found that provincial delivery of health services is quite dependent on these older practitioners. Should a large cohort of older anesthesiologists retire suddenly, as they did in Quebec in 1996, the number of surgical cases managed will be adversely affected [5]. The impact would be even greater in terms of numbers in Ontario where there are many anesthesiologists over 65 years of age still practicing. We did not adjust to normalized clinical days (nCD) as did Abouleish et al [7]. This is because we assessed the entire cohort of anesthesiologists who billed more than 50 patients per year in each of the provinces studied, including nonacademic departments [7]; the nCD referred only to academic departments. We were not able to identify academic institutions for confidentiality reasons for our analysis.

We also found that once a specialist anesthesiologist commences practice, he can expect the number of days with clinical billing submissions to remain relatively constant until well after his training has ended. The complexity of the case might change5, but the number of unique physician – patient interactions seems to remain constant. This inference warrants further analysis and reinforces the need for continuing medical education.

There are strengths and limitations to our analysis. Because we used billing data obtained directly from the provinces, recall bias is not an issue. In addition, we have the entire billing history so any differences are true differences between populations, and statistics are not necessary to test for "statistical significance". We also assessed 10 years worth of billing and therefore our results represent trends over time and not an isolated single year's "snapshot" of experience. For reasons of privacy, we could not stratify between academic and non-academic hospitals [8], nor did we assess the impact of anesthesiologist gender [9]. Both of these variables have been shown to impact on hours worked by anesthesiologists in the United States. Also, our age groups were quite large. We might have uncovered some of the finer age-related details had we investigated more age groups. However, by investigating the possibilities listed above, we might have been able to identify individual physicians and this would violate research ethics. We considered all statutory holidays and weekend days as a work day where at least one act was billed; if the anesthesiologist's availability was assured but no cases were billed, we would not have had a record and this would not have been considered a clinical work day.

While we are the first to publish on this subject, most of the data being presented is at least five years old. Since then, alternate funding plans have been adopted in each of the three provinces studied and some of our inferences might no longer apply. However, most anesthesiologists submit bills for clinical work, so analysis of billing patterns remains relevant. In addition, the results shown in Table 4 strongly suggest that our data, at least for BC, is consistent with more recent billings (BC Health Services Commission, Mr Paul Lam – personal communication). Further, if some anesthesiologists are no longer submitting billings for work done by virtue of alternate funding, then our data will be the most inclusive and possibly best record of Canadian anesthesiologists'-patient interractions. Finally, examining billing patterns from the past provides insight into the effectiveness of various government policies. Our data illustrates that the Quebec policy for early retirement led to a sharp reduction in services, which then required a subsequent increase in younger anesthesiologists over the next several years.

In summary, we assessed all billed acts submitted by specialist anesthesiologists stratified into three age categories in Que, Ont, and BC over a 10-year period. The median number of days with submissions for billing by anesthesiologists is relatively constant until at least 65 years of age and then declines in each province. There is much variability, both per year and over the decade, in billing among anesthesiologists between and within the provinces studied. Canadian health care delivery is quite dependent on anesthesiologists 65+ despite the reduced number of days with billings and physician-patient interactions in this age group.

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