Patterns of use of flexible sigmoidoscopy, colonoscopy and gastroscopy: A population-based study in a Canadian province

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BACKGROUND & AIMS: Flexible sigmoidoscopy, colonoscopy and gastroscopy are important in the diagnosis and treatment of gastrointestinal (GI) diseases. Pressure on endoscopy resources is expected due to increased screening for GI cancers. The present study examined patterns of use of GI endoscopy in a Canadian province, Alberta, with universal health care insurance.

METHODS: Data on physician payments from January 1, 1994 to March 31, 2002 were used to calculate age-sex adjusted rates and patterns of use.

RESULTS: The gastroscopy rate increased by 17%, from 9.7 (95% CI 9.6 to 9.9) to 10.3 (95% CI 10.1 to 10.5). The colonoscopy rate increased by 105%, from 4.8 (95% CI 4.6 to 5.0) to 9.8 (95% CI 9.6 to 10.1). Flexible sigmoidoscopy rates declined by 10%, from 4.68 (95% CI 4.56 to 4.80) to 4.21 (95% CI 4.11 to 4.32). The increase in colonoscopy rates occurred in all age groups, whereas gastroscopy rates increased only in the older age groups. Regional variation in procedure rates was evident, but rural health regions did not have consistently lower rates than the large urban regions. A polypectomy procedure rates was evident, but rural health regions did not have consistently lower rates than the large urban regions. A polypectomy was performed on 23.7% of male patients and 15.4% of female patients at time of colonoscopy. Rates of polypectomy for individual endoscopists ranged from 0% to 60%.

CONCLUSIONS: There has been a marked increase in gastroscopy and colonoscopy rates, likely due to a broadening of indications rather than just increased use for cancer screening. Modest regional variation in rates exists, but there is no direct evidence of limited rural access to endoscopy. Reasonable polypectomy rates were seen but important variations between endoscopists exist.

Key Words: Gastrointestinal endoscopy; Physician's practice patterns; Small-area analysis

When health care resources are limited, the understanding of how medical procedures are used in a population is important to identify potential inequities or inefficiencies and to plan for future needs. Since the advent of flexible endoscopes in the late 1960s, endoscopy of the upper and lower gastrointestinal (GI) tract has assumed a critical role in the diagnosis and treatment of disorders of the esophagus, stomach, duodenum, terminal ileum and colon. The most commonly performed endoscopic procedures of the GI tract are flexible sigmoidoscopy, colonoscopy and esophagogastroduodenoscopy. Changing patterns of use (1,2), especially for screening for malignant or premalignant lesions, has the
To maximize the reduction of colorectal cancer in those undergoing flexible sigmoidoscopy and colonoscopy, adequate polyp detection rates are essential. A target of adenoma prevalence rates at the time of screening colonoscopy of 25% or higher in men 50 years of age or older and 15% or higher in women 50 years of age or older has been suggested (6).

Furthermore, appropriate timing of surveillance colonoscopy is required after a polypectomy to maximize future cancer prevention while minimizing cost and risk to the patient. Current recommendations are for follow-up colonoscopy three to five years following a polypectomy, depending on the number and size of polyps removed (7).

The purpose of the present study was to examine patterns of use of flexible sigmoidoscopy, colonoscopy and gastroscopy in a population-based sample. Specific objectives were to determine provincial procedure rates from 1994 to 2002; to determine if significant regional variations in procedure rates exist; to determine polyp prevalence rates and whether individual endoscopists polypectomy rates depend on their annual colonoscopy volume; and to determine patterns of colonoscopy use following a flexible sigmoidoscopy or a polypectomy.

To meet these objectives, the author examined endoscopy use in Alberta, Canada. In 2001, this Canadian province had a population of 3.06 million with two large urban centres (population greater than 750,000), several smaller cities and large, less populated rural and northern areas. Albertans, like all Canadians, receive health care through a publicly funded universal insurance program that covers costs of all medically necessary hospital and physician services. During the time of this study, health care was administered through 17 health regions (Figure 1). In 2001, the population of these regions ranged from just over 20,000 to nearly one million. Two regions (Regional Health Authorities 4 and 10) encompass primarily the two large cities, Calgary and Edmonton. The remaining health regions cover larger geographic areas that may include smaller cities, towns and rural areas. Regional variation could suggest limited access for rural residents if higher rates were noted in the health regions for the two large urban health regions (Calgary Health Region and Capital Health Region [Edmonton]).

METHODS

Data sources
Data from the Alberta Health Care Insurance Plan (AHCIP) on physician payments for endoscopy-related services were obtained from Alberta Health and Wellness, the provincial government department responsible for administering health care. Data elements included patients' date of birth, sex, postal code of residence at date of service, service date, procedure code, up to three diagnostic codes, facility code and service provider specialty. Annual population estimates for Alberta and each of Alberta’s 17 health regions for 1994 to 2002 were obtained from Alberta Health and Wellness (8).

Sample selection
Patients were included in the sample if they had at least one record for a flexible sigmoidoscopy, colonoscopy or gastroscopy (Schedule of Medical Benefits Codes 1.24B, 1.22 and 1.14) from January 1, 1994 to March 31, 2002. Records were also obtained for these patients for any large intestine polypectomy (55.21A). Patients were excluded if their postal code of residence at the time of the procedure was missing or outside of Alberta.

Analysis
Direct age-sex standardized procedure rates were calculated using the 1991 Canadian population as the standard (9). Because endoscopy rates are expected to vary depending on the age, and possibly the sex, of individuals, differences in crude procedure

Figure 1) 2001 Alberta health region boundaries
rates between different populations could be due to true differences in procedure rates and/or differences in the sex and/or age distributions of each population. Direct age-sex standardized rates are derived by applying the age- and sex-specific rates observed in each population to a single standard population. For each population, a single summary rate is calculated that reflects the numbers of events that would have been expected if the populations being compared had identical distributions by age and sex. Therefore, the age-sex adjusted rate is not the same as the observed 'crude' rate. However, because the age and sex distribution of the Alberta population during the years included in this study is so similar to the 1991 Canadian population, the crude Alberta endoscopy rates per 1000 population are always very close to the age-sex adjusted rates. Rates for 2002 were estimated based on procedures performed until March 31, 2002. To estimate the 2002 rates, the number of procedures performed in the first three months was multiplied by four and then by a correction factor. The correction factor was required because the number of procedures performed in the first quarter of each preceding year differed slightly from the average performed in the subsequent three quarters. The correction factor was based on quarterly rates from 1999 to 2001. Five-year age groups were used except for children and younger adults (0 to 19 years and 20 to 34 years, respectively) and those older than 75 years to insure adequate numbers of procedures in each strata. Rates were calculated for the entire province and for each health region (2001 boundaries). To insure stable rates for the health region analysis, three-year average rates were calculated and three northern health regions (regions 14, 15 and 17) were grouped together. Each patient was assigned a health region of residence using a postal code to health region link created by Alberta Treasury. Bonferroni corrected 95% CIs were calculated for each rate. To test the null hypothesis of equality of rates, the \( \chi^2 \) test described by Carriere and Roos was used (10). The advantage of this method is that it is robust to departures from parametric assumptions, such as extrabinomial variation and recurrence of events within the time period studied. It tests the null hypothesis that the rate for each strata (ie, health region) is equal to the standardized rate for all stratum combined. Correlation coefficients were used to measure the strength of the relationship between regional rates of the three procedures.

The proportion of patients aged 50 to 80 years undergoing a polypectomy at the time of a first recorded colonoscopy was determined. For each endoscopist performing at least 10 colonoscopies annually, the proportion of colonoscopies with a concomitant polypectomy was calculated and compared with the endoscopist’s experience, measured by the annual average number of colonoscopies performed by that endoscopist in patients of all age groups. This study was approved by the Conjoint Health Research Ethics Board at the University of Calgary.

RESULTS

Sample

Records on 120,224 individuals who underwent 161,591 colonoscopies, 162,000 individuals who underwent 242,163 gastroscopies and 84,689 individuals who underwent 104,914 flexible sigmoidoscopies from January 1, 1994 to March 31, 2002 were provided by Alberta Health and Wellness. Postal code of residence was missing for 388 (0.24%), 746 (0.31%) and 398 (0.38%) of those undergoing a colonoscopy, gastroscopy or flexible sigmoidoscopy, respectively. The postal code of residence was missing for 388 (0.24%), 746 (0.31%) and 398 (0.38%) of those undergoing a colonoscopy, gastroscopy or flexible sigmoidoscopy, respectively. Postal code of residence was missing for 109 (0.10%) of those undergoing a colonoscopy, gastroscopy or flexible sigmoidoscopy, respectively. Those with a missing or out-of-province postal code were excluded from further analysis.

Provincial endoscopy rates

From 1994 to 2001, the number of gastroscopies performed annually increased by 39%, from 24,463 to 34,060. The annual number of colonoscopies increased by 147%, from 12,495 to 30,818. The number of flexible sigmoidoscopies increased by 6%, from 11,7565 to 12,541. The annual provincial age-sex adjusted colonoscopy, flexible sigmoidoscopy and gastroscopy rates from 1994 to 2001 and estimated rates for 2002 are shown in Table 1 and Figure 2. Between 1994 and 2001, the annual age-sex adjusted rate increased 17% for gastroscopy and 105% for colonoscopy but decreased by 10% for flexible sigmoidoscopy.

Age-specific rates for men and women for each of the three endoscopic procedures are shown in Figure 3. The increase in colonoscopy rates was seen in all adult age groups. Overall, the age-adjusted colonoscopy rate was consistently higher in

<table>
<thead>
<tr>
<th>Year</th>
<th>Gastroscopy</th>
<th>Colonoscopy</th>
<th>Flexible sigmoidoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>9.73 (9.56–9.91)</td>
<td>5.03 (4.91–5.16)</td>
<td>4.68 (4.56–4.80)</td>
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<td>1996</td>
<td>10.7 (10.52–10.87)</td>
<td>5.88 (5.74–6.01)</td>
<td>4.61 (4.49–4.73)</td>
</tr>
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<td>1997</td>
<td>10.68 (10.50–10.85)</td>
<td>6.2 (6.07–6.34)</td>
<td>4.71 (4.59–4.82)</td>
</tr>
<tr>
<td>1998</td>
<td>10.7 (10.52–10.87)</td>
<td>6.6 (6.46–6.73)</td>
<td>4.75 (4.64–4.87)</td>
</tr>
<tr>
<td>1999</td>
<td>10.79 (10.62–10.96)</td>
<td>7.46 (7.32–7.60)</td>
<td>4.94 (4.82–5.06)</td>
</tr>
<tr>
<td>2000</td>
<td>11.18 (11.01–11.36)</td>
<td>8.78 (8.63–8.93)</td>
<td>4.85 (4.74–4.97)</td>
</tr>
<tr>
<td>2001</td>
<td>11.43 (11.26–11.61)</td>
<td>10.3 (10.14–10.47)</td>
<td>4.21 (4.11–4.32)</td>
</tr>
</tbody>
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*Estimated based on first three months

Figure 2) Provincial age-sex adjusted endoscopy rates, 1994 to 2002. There has been a marked increase in colonoscopy rates. The rates for gastroscopy increased somewhat between 1994 and 2001. Flexible sigmoidoscopy (Flex Sig) rates remained stable between 1994 and 2000, but have declined more recently. Rates for 2002 are estimated based on data from January to March 2002.
Regional variations in endoscopy rates

To examine regional variations in gastroscopy and colonoscopy rates, three-year average rates for 1994 to 1996 and 1999 to 2001 were calculated for each health region and the province as a whole. Figure 5 shows the 95% CIs for the gastroscopy and colonoscopy rate for 1999 to 2001 for each health region. In each three-year time period, there were marked variations in regional rates that exceeded what would be expected by chance alone (P<0.0001 for each period). There was a 3.3-fold difference between the highest and lowest regional gastroscopy rates in 1994 to 1996 and a 2.9-fold difference in 1999 to 2001. There was a 2.8-fold difference between the highest and lowest regional colonoscopy rate in 1994 to 1996, but this fell to a two-fold difference in 1999 to 2001. There was only a weak correlation between health regions’ colonoscopy and gastroscopy rates in either 1994 to 1996 (correlation coefficient: 0.46, P=0.08) or 1997 to 2001 (correlation coefficient: 0.43, P=0.11).

The ratio of the regions with the highest to lowest flexible sigmoidoscopy rate was 3.2 from 1994 to 1996 and 2.3 from 1999 to 2001. There was a strong negative correlation between regional colonoscopy and flexible sigmoidoscopy rates from 1994 to 1996 (correlation coefficient: –0.63, P=0.011) but less so in the later time period (correlation coefficient: –0.36, P=0.19).

Colonoscopy following a flexible sigmoidoscopy

There were 30,615 patients age 50 to 75 years who underwent a flexible sigmoidoscopy without having undergone a colonoscopy in the previous 12 months. Of these, 3608 (11.8%) underwent a colonoscopy within six months of their sigmoidoscopy. A polypectomy was performed in 1286 (35.6%) at the time of their colonoscopy. The likelihood that a patient underwent a colonoscopy within six months of a flexible sigmoidoscopy depended on their health region of residence. For example, for those who underwent their flexible sigmoidoscopy in the later time period (correlation coefficient: –0.36, P=0.19).

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Polypectomy

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undergone a colonoscopy within the preceding 36 months. A concomitant polypectomy was performed on 9780 (19.2%). Males were more likely to undergo a polypectomy than females (23.7% versus 15.4%, 95% CI for the difference 7.7 to 9.1, P<0.0001). When considering procedures performed by individual endoscopists in these patients, marked variation in the proportion of colonoscopies performed by each endoscopist with a concomitant polypectomy was noted ranging from a low of 0% to a high of 60%. Figure 6 shows for each endoscopist, the proportion of colonoscopies with polypectomy by the average number of colonoscopies (patients of all ages) performed annually by the endoscopist.

There were 9024 individuals aged over 30 years who underwent a first polypectomy between 1994 and 1998. A second colonoscopy was performed on 4885 (54.1%). The median time to the second colonoscopy was 26 months. Twenty-five per cent of those who underwent a repeat colonoscopy did so within 13 months of their first colonoscopy. A polypectomy was performed at the time of the second colonoscopy in 1581 (32.5%).

DISCUSSION
The Alberta population registered with AHCIP increased by 11% from 1994 to 2001. Over the same time period, the number of gastroscopies and colonoscopies increased by 39% and 147%, respectively. Flexible sigmoidoscopy numbers decreased by 6%. For gastroscopies, increased rates of use were confined to the older age groups, whereas increases in colonoscopy rates were seen in all age groups. These patterns do not suggest that increased utilization was solely due to increased use for screening purposes. If that were the case for colonoscopy, one would have expected a disproportionate increase in colonoscopy rates in those over the age of 50 years, the starting age at which screening is commonly recommended to begin (7,11). However, the effect of screening should not be underestimated. At my own institution in 2001, approximately 20% of all colonoscopies were performed for screening purposes (unpublished data). Colon cancer screening is likely to place increasing demands on colonoscopy services for the foreseeable future. Public awareness of colorectal cancer has been increased by celebrities and media campaigns and has resulted in increased colonoscopy performance in the United States (12). The American Consortium guidelines recommend screening all people for colorectal cancer using fecal occult blood testing (FOBT), flexible sigmoidoscopy, air-contrast barium enema or colonoscopy (13). The more conservative Canadian Task Force for the Preventative Health Exam guidelines support the use of FOBT or flexible sigmoidoscopy (11). Experts often advocate for the use of colonoscopy even in those at average risk for colorectal cancer (14). Colonoscopy is the preferred diagnostic test following a positive FOBT. With positivity rates of up to 4.4% in the published clinical trials (15), a population-based FOBT screening program would generate a large number of colonoscopies. Therefore, regardless of the primary screening tool used, a program to increase colorectal cancer screening will dramatically increase the number of colonoscopies performed. Concerns have already been raised by the Canadian gastroenterology community as to the potential impact on endoscopy resources of widespread colorectal cancer screening (16).

Despite the increased emphasis on colorectal cancer screening, there has been no appreciable increase in flexible sigmoidoscopy rates. It is uncommon for Canadian family physicians to perform flexible sigmoidoscopy (17). Therefore, most physicians who perform flexible sigmoidoscopy also perform colonoscopy. Physicians who perform both procedures may preferentially use colonoscopy for screening of asymptomatic people and the diagnostic evaluation of symptomatic ones, a practice that could have been driven by both clinical trial evidence and expert opinion (14,18-20). In fact, one might have expected a much more significant and consistent decrease in flexible sigmoidoscopy rates coinciding with the increase in colonoscopy rates. The flat flexible sigmoidoscopy rates throughout the 1990s suggest that the increase in colonoscopy rates was not due to physicians using colonoscopy instead of flexible sigmoidoscopy. A possible
decline in flexible sigmoidoscopy was only seen in 2001 and the estimated rate for 2002. Endoscopy resources may have been maximized by the increase in colonoscopy rates in the late 1990s requiring physicians to shift existing endoscopy resources away from flexible sigmoidoscopy towards colonoscopy to continue the expansion of colonoscopy.

Increases in gastroscopy and colonoscopy rates are also likely due to a broadening of indications. Whether any of the increase is due to procedures performed for inappropriate indications cannot be determined with this data. Previous attempts have been made to explain geographic variations in endoscopy rates by examining the proportion of procedures deemed inappropriate based on expert consensus (1). Classifying procedures as appropriate or inappropriate is problematic because the classification scheme may quickly become out of date. For example, Chassin et al (21) of the Rand Corporation rated indications for upper GI tract endoscopy as appropriate, equivocal or inappropriate based on a consensus of experts. The most frequent inappropriate indication in a study of patients from the United States was “patient has dysphagia with normal immune system; neither manometry nor upper GI tract roentgenogram performed” (21). However, there has been growing recognition of the superiority of gastroscopy for the evaluation of upper GI symptoms, both in terms of diagnostic accuracy and patient acceptance (22,23). This is reflected in a Canadian study that demonstrated that endoscopists classified many procedures as appropriate that were classified as equivocal or inappropriate by Chassin et al (21), including the one described above (24). The authors felt the differences between the Rand and Canadian endoscopists’ ratings were due to concerns about missing malignancies and a lack of confidence in barium studies. Thus, the indications for endoscopy have clearly broadened in Canada and elsewhere, with endoscopy being used earlier in the diagnostic process and frequently supplanting other diagnostic modalities, especially contrast radiology.

The financial benefits of performing more procedures has also been suggested as a driver of increasing procedure rates (25). However, if this were the primary driver, one would have expected relatively similar increases in both gastroscopy and colonoscopy rates. In June 2000, there was only a 30% difference in the physician fees paid for these two procedures. Furthermore, a typical gastroscopy takes less time to perform than a colonoscopy.

Therefore, the modest increase in gastroscopy rates and the marked increase in colonoscopy rates are likely due to several factors, including a broadening of indications, a greater availability of endoscopy services and greater acceptance of endoscopy as an initial diagnostic test over barium studies.

Modest regional variation in procedures rates was noted. However, there was no evidence that rates were highest in regions encompassing large urban centers. In fact, the Calgary Health Region was consistently below the provincial average for both colonoscopy and gastroscopy. Therefore, residents of more rural areas appear to have appropriate access to GI endoscopy. A study of regional endoscopy patterns in Quebec in 1994 published only in abstract form also concluded that there was no evidence that remote regions were underserved (5).

Adequate access to colonoscopy is critical for the successful implementation of colorectal cancer screening, regardless of the primary screening test used. Local access to colonoscopy for either initial screening or appropriate diagnostic follow-up following FOBT will be critical to minimize costs, increase patient acceptance and prevent overwhelming endoscopy resources in larger centers.

Regional variation in procedure rates is a widely appreciated phenomenon, but a ready explanation for these variations, or even the ability to define the right rate, remains elusive. In most instances, attempts to link procedure rates to the health care needs of the population have been unsuccessful (26,27). The important finding in this study is that rural areas do not appear to be disadvantaged. Whether some regional rates are too low and others are too high or all rates are too low or all rates are too high is beyond the scope of this study and the answer may depend more on one's philosophy on the use of endoscopy, especially as a primary screening modality, rather than scientific evidence. Validation of endoscopists’ increased performance of colonoscopy may require future documentation of decreased incidence and mortality rates of colorectal cancer. Similarly examining regional trends in colorectal cancer incidence and mortality may provide insights into whether regional variation in colonoscopy rates are significantly affecting the health of the population.

Cost effective colorectal cancer screening also requires appropriate rates of polypectomy and colonoscopy intervals. Recent continuous quality assurance guidelines have suggested that adenoma detection rates of 23% for men and 15% for women should be achieved (6). In Alberta, 23.7% of men and 15.4% of women aged 50 to 80 years undergoing their first observed colonoscopy underwent a polypectomy. The fact that a polypectomy was performed does not indicate that the removed polyp was an adenoma. Furthermore, the majority of these procedures would have not been performed for screening. However, the observed polypectomy rates are reassuring. Unfortunately, marked variation in polypectomy rates were seen between individual endoscopists ranging from 0% to 60%. This is clearly concerning and suggests that not all patients are achieving a benefit from their colonoscopy.

Guidelines currently recommend a three or five year interval for most patients following polypectomy. In Alberta, 50% of patients who underwent a subsequent colonoscopy following a polypectomy did so within 26 months of their initial colonoscopy. This suggests that resources are being used for overly intensive surveillance that may be better used elsewhere, such as primary screening.

The use of administrative databases in this study for providing population-based data is associated with several limitations. First, accurate indication and diagnosis information is not available from the AHCIP database. Because physicians are remunerated based on their billings, it is expected that the reporting of endoscopic procedures is high. Over the years examined, the billing codes for these procedures remained constant. However, some misclassification of procedures may occur by physicians billing colonoscopies as flexible sigmoidoscopies and vice versa.

CONCLUSION

There has been a marked increase in gastroscopy and colonoscopy rates from 1994 to 2002. The more than doubling in the colonoscopy rate cannot clearly be attributed to screening for colorectal cancer because increases were seen in all age groups. Modest regional variation in procedure rates exists, but there is no direct evidence of limited rural access to endoscopy.
Appropriate polypectomy rates were seen, but important variation between the polypectomy rates of individual endoscopists exists.

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**REFERENCES**

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