

Original Article

Comparison of Flexible Sigmoidoscopy Screening in Average Risk Patients Performed by Nurses Versus Gastroenterologists

Anas Makhzoum, MD, Jacob Louw, MB, ChB, FCP(SA), FRCPC, William G. Paterson, BSc, MD, FRCPC

Gastrointestinal Disease Research Unit and the Department of Medicine, Queen's University, 94 Stuart St., Kingston, ON, Canada, K7L-3N6, ON

Correspondence: William G Paterson, GI Division, Hotel Dieu Hospital, Kingston, ON Canada, K7L-5G2. FAX: 613-544-3114; e-mail: patersow@hdh.kari.net

Abstract

Background: Screening sigmoidoscopy is effective in reducing mortality from colorectal cancer. In 2009, Cancer Care Ontario (CCO) launched a nurse-performed screening flexible sigmoidoscopy program at Hotel Dieu Hospital, Kingston, Ontario. Prior to this program, there was a pilot sigmoidoscopy screening program by gastroenterologists in a similar average risk cohort.

Aim: To compare neoplasia detection rates and associated costs of screening sigmoidoscopy performed by nurses and gastroenterologists.

Method: A retrospective chart review was conducted on flexible sigmoidoscopies performed as part of two average risk screening programs performed by gastroenterologists and nurse-endoscopists. Detected polyps were categorized as hyperplastic, low-risk adenomas or high-risk adenomas. Average cost per procedure was estimated based on physician fee for service charges, nurse wage and benefits, physician supervisory fees, pathology costs and administrative expenses.

Results: There were 538 procedures performed by nurses and 174 by physicians. Adenomas were detected in 18% of nurse-performed procedures versus 9% in physician-performed procedures ($p=0.003$), with the higher adenoma detection rate restricted to low risk adenomas. One cancer was found in the physician group. Seven physicians performed the 174 sigmoidoscopies, with one physician performing the majority. This physician's adenoma detection rate was 4.5%, whereas detection rate for the remaining physicians combined was 16.5%. Nurses biopsied more polyps per case (0.96 versus 0.18). Average estimated cost per case was greater for nurses (\$387.54 versus \$309.37).

Conclusion: Well-trained nurse-endoscopists can provide an effective service for colorectal cancer screening, but as currently structured in Ontario, the associated cost is higher for nurse-performed procedures.

Keywords: Colon cancer screening, sigmoidoscopy, nurse-endoscopist, adenoma

INTRODUCTION

Colorectal cancer (CRC) is one of the most common cancers in Canada, with estimates that one in 13 men and one in 15 women will be diagnosed with CRC in their lifetime (1, 2). This translates into approximately 23,900 new cases of CRC per year in Canada (3). Accordingly, provincial health authorities have begun implementing population based screening programs across the country.

Flexible sigmoidoscopy is an acceptable method to diagnose CRC and pre-malignant neoplasms. Indeed, results from a large prospective trial indicated that population screening using flexible sigmoidoscopy reduces incidence of and mortality from CRC (4). Due to an aging population and increased demand on endoscopy procedures, Ontario faces serious capacity issues to deliver endoscopic services both for screening and follow-up. As a result, the Ministry of Health and Long Term Care, as well

as Cancer Care Ontario, have sponsored several pilot programs across Ontario where nurses trained in performing sigmoidoscopy are working under physician supervision. The first Canadian nurse-performed flexible sigmoidoscopy screening program was established in 1999 (5). In 2006, a pilot project to train nurses on performing screening sigmoidoscopy was completed in Ontario (6). This, and a technology report from the Canadian Coordinating Office for Health Technology Assessment (7) indicating that nurse-performed flexible sigmoidoscopies were safe and cost-effective, provided the incentive for establishing nurse-performed flexible sigmoidoscopy screening programs at multiple centres across the province. The structured nurse training was extensive, involving a one-week course with didactic sessions and simulator use followed by the nurse observing an experienced endoscopist perform 100 flexible sigmoidoscopies, then 100 sigmoidoscopies where the instructor inserted the scope and the nurse withdrew, and finally 100 full procedures under direct observation. Before starting independent practice, the nurses were then observed and approved by external examiners using pre-set criteria.

To date, several studies from outside Canada have reported that the outcome of flexible sigmoidoscopies performed by appropriately trained nurses is comparable to physician-performed procedures with respect to diagnostic yield and patient satisfaction (8–13). In addition, one study reported that these results could be achieved at lower cost (10). Up until now, comparable data has not been available in Canada.

Two trained nurses began performing screening sigmoidoscopy procedures in our academic centre at Hotel Dieu Hospital in 2009, with several hundred procedures now available for analysis. In addition, gastroenterologists previously engaged in a pilot flexible sigmoidoscopy screening program in average risk subjects at the same centre, and the outcome data from this program was prospectively collected and available for comparison. Given the availability of this data, the current study sought to compare the results of our nurse-based CRC screening sigmoidoscopy program with the results of a previous pilot screening program performed by gastroenterologists in a similar average risk population. Patients in both groups who were found to have adenomatous polyps at flexible sigmoidoscopy were contacted and recommended to undergo full colonoscopy.

METHODS

A retrospective chart review of average risk screening sigmoidoscopy procedures performed by nurses from 2011 to 2014 and physicians between 2004 and 2006 was performed. To be eligible for these two screening programs, subjects had to be > 50 years of age, have no active lower gastrointestinal symptoms and no family history of CRC in first degree relatives. Patients who had undergone a previous colonoscopy were not included.

For entry into the physician program, subjects were required to have undergone fecal occult blood testing with negative results. Although recommended, this was not a requirement for enrollment into the nursing screening program. Ethics approval was obtained for this study from the Queen's Human Ethics review Board. Data pertaining to nurse and gastroenterologist performed sigmoidoscopies was extracted from the Hotel Dieu Hospital patient care electronic database, as well as individual patient paper charts and procedure notes.

Spreadsheets were developed, and data related to adenoma detection rates, depth of insertion, number of polyps and histological findings were included. The primary outcome of the study was adenoma detection rates. Detected polyps were categorized as either hyperplastic, low-risk adenomas (< 1 cm, no villous component or high-grade dysplasia) or high-risk adenomas (\geq 1 cm, villous or serrated component and/or high-grade dysplasia). When more than one neoplastic polyp was found during the same procedure, the parameters of the highest-grade pathology polyp were used in the analysis. For polyps that were not biopsied at the initial sigmoidoscopy (because neoplasia was assumed based on gross appearance and a decision was made to proceed to colonoscopy), the histology result included in the analysis was that of the tissue subsequently obtained at colonoscopy.

The average cost per procedure in Canadian dollars (CAD), including pathology and administrative costs, was calculated for both nurse- and physician-performed procedures, using Ontario Health Insurance Plan fee for physician service charges and nursing salary charges prorated to number of cases performed per half-day session. For the physicians, this included fees charged for a consultation (\$118 CAD assuming a 50:50 mix of full versus limited consult fees), the flexible sigmoidoscopy (\$58 CAD) and biopsies (\$27 CAD). This likely overestimates the actual cost of physician-performed procedures, because the majority of physicians participating in this study were funded via an alternative funding plan in which the average half-day reimbursement was significantly less than what would have been earned through fee for service billings. For the nurses, the cost of each procedure was estimated to be one-sixth of 10% of their annual salary, plus benefits (i.e. on average six procedures on one half day per week were booked during the study period), as well as the physician supervisory fee. Pathology costs (processing and interpretation) were estimated at \$65 CAD per biopsy, plus \$9 CAD charge for disposable biopsy forceps. Administrative costs for physicians were based on \$20,000 CAD grant to fund a nurse coordinator who was responsible for data collection and recruiting of patients by liaising with family physicians. Other administrative costs were handled through the physician's offices using professional income. Nursing administrative costs related to CCO funding of a 0.8 FTE nurse administrator, who was responsible for patient recruitment and

education, data collection for CCO, and follow-up of pathology results with booking of colonoscopy where appropriate. The cost of equipment depreciation, medical records and other facility costs were not included in the calculation, as these were essentially the same for both physician- and nurse-performed procedures. The nurse administrator also served as an endoscopy assistant for the nursing flexible sigmoidoscopy, so her cost was discounted by one half day per week (i.e., from 0.8 FTE to 0.7 FTE).

Data was imported into IBM SPSS (version 22.0 for Windows) for statistical analysis. It was initially analyzed descriptively, including means and standard deviations for continuous data, such as depth of insertion, number of polyps detected and location of polyps detected. Frequencies and percentages for categorical data, such as adenoma detection rates and pathology findings, were used. Comparisons between the nurse and GI groups were then made using independent samples t-tests. Categorical data was compared using Chi-square tests. *P*-value less than 0.05 was considered statistically significant.

RESULTS

There were a total of 712 procedures performed by nurses and gastroenterologists during the study periods analyzed. Nurses performed 538 (76%) of the procedures, and physicians performed 174 procedures (24%) (Table 1). Two nurses participated in the program. Nurse 1 completed 472 (87.7%) procedures, and Nurse 2 completed 66 (12.3%) procedures. Seven gastroenterologists performed the screening sigmoidoscopies, with the majority (61%) done by one physician. There were 34 procedures in the nursing arm, and 19 procedures in the physician arm where the flexible sigmoidoscopy had to be aborted due to poor bowel prep (even after repeating the enema) that significantly affected the ability to perform a satisfactory screening, or due to a patient experiencing severe discomfort.

The mean age of participants was slightly younger in the nursing program (60.7+/-6.9 versus 62.4+/-7.7; *p*=0.038), and there was a higher proportion of female participants in the nursing group (61.0% versus 47.1%; *p*=0.0012) (Table 1).

Adenoma Detection Rate

The adenoma detection rate was significantly higher in the nursing group (18.0% vs 9.2%; *p* = 0.003; Figure 1). Of note, adenoma detection rate varied substantially between individual physicians with the physician performing the majority of the procedures having an adenoma detection rate of 4.5%, whereas the other physicians combined had a detection rate of 16.5%. The higher adenoma detection rate in the nursing group was restricted to low risk adenomas (14% vs 4.5%), with the high-risk adenoma detection rate being comparable (4.5% in physician group; 4.1% in nurses group). A partially obstructing cancer was detected in the physician group, despite the patient being asymptomatic at the time of the sigmoidoscopy. The higher adenoma detection rate was associated with a much higher polyp biopsy rate per case in nurse-performed versus physician-performed procedures (0.96 versus 0.18; CI -0.997, -0.571; *p*=0.001), with the majority of polyps (65%) being hyperplastic in the nursing cohort.

Depth of Insertion

The reported depth of insertion was slightly larger in the physician arm (61.02 ± 12.8 cm versus 57.89 ± 10.5 cm for Nurses; *p*=0.001; Table 1).

Cost

The average costs per procedure in the two groups are summarized in Table 2. Although the charges for the actual procedure were much less for the nurse-performed sigmoidoscopy, this was offset by the higher administrative and pathology costs, such that the average total cost per physician-performed procedure was substantially less than that of nurse-performed procedure (\$309.37 CAD versus \$387.54 CAD). The cost to detect one patient with an adenoma was \$3,830 in the gastroenterology program versus \$2,149 in the nursing program. On the other hand, the cost to detect one patient with a high-risk adenoma was \$6,729 for gastroenterologists and \$9,447 for nurse-endoscopists.

DISCUSSION

This study confirms the ability of an adequately trained nurse-endoscopist to provide a high-quality screening program with excellent adenoma detection rates. Contrary to

Table 1. Comparison of Nurse and Physician-Performed Screening Flexible Sigmoidoscopies

	Physician	Nurse	p-value
# of endoscopists	7	2	
Total # of patients	174	538	
Patient sex (F/M)	82/92	329/210	0.0012
Mean patient age (range)	62.1 (50–88)	60.7 (50–75)	0.038
Mean depth of scope insertion (+/-SD) (cm)	61.02 ± 12.8	57.89 ± 10.5	0.001
Mean # of polyps biopsied/procedure	0.18	0.96	0.001

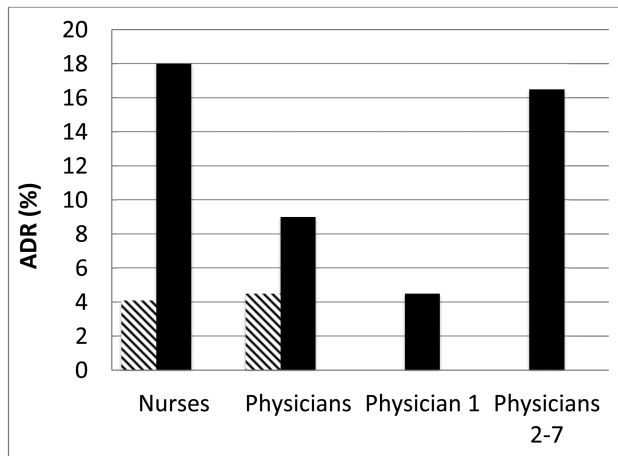


Figure 1. Comparison of adenoma detection rate (ADR) of sigmoidoscopy performed by nurses or physicians. Solid bars represent overall ADR, whereas diagonal cross-hatched bars represent high risk ADRs. Overall, adenomas were detected in a significantly higher proportion of subjects in nurse-performed (18%) than physician-performed procedures (9%) ($p=0.003$), however the detection rates for high risk adenomas were the same (4.1% versus 4.5%). There was significant variation in the ADR between physicians; the physician who did the majority of the procedures had an ADR of 4.5%, whereas the ADR for all other physicians combined was 16.5%.

expectations, however, it appears that the cost of the nursing flexible sigmoidoscopy program, as structured in Ontario, is higher than a comparable program provided by physicians.

In the current study, the overall polyp detection rate was 18% in the nursing screening program. This was significantly higher

Table 2. Comparison of Procedural Costs Between Nurse- and Physician-Performed Screening Flexible Sigmoidoscopy: (\$CAD)

A) Cost per flexible sigmoidoscopy performed by Gastroenterologist	
Procedure + Consult (limited/full)	\$176
Biopsy fee	\$4.05
Biopsy forceps	\$1.34
Pathology charges	\$13.04
Administrative	\$114.94
TOTAL	\$309.37

B) Cost per flexible sigmoidoscopy performed by Nurse endoscopist	
Procedure	\$34
Physician Supervision	\$66.67
Biopsy forceps	\$4.68
Pathology	\$65.19
Administration	\$217
TOTAL	\$387.54

C) Comparison of cost to detect a patient with an adenoma		
Endoscopist	Any Adenoma	High-risk Adenoma
Nurse	\$2,149	\$9,477
Gastroenterologist	\$3,830	\$6,729

than that in the physician program (9%), as well as that reported previously in other average risk flexible sigmoidoscopy screening programs performed by nurses or physicians, which has ranged from 5.8 to 9% (5,10,11,12,14). Adenoma detection rates ranging from 9 to 16% were previously reported in a large flexible sigmoidoscopy screening program in the UK, but the population studied included subjects with a family history of CRC (15). This clearly demonstrates that a high-quality flexible sigmoidoscopy screening program can be conducted by well-trained nurses, thereby freeing up physician time.

The reason for the higher adenoma detection rate in the nursing arm of the study is unclear. This did not appear to relate to the reported depth of insertion, as this was slightly greater in the physician group. It could partly relate to the population under study. The physician pilot project was performed in average risk individuals over 50 years of age who also had negative fecal occult blood testing. Although it was strongly recommended in the nursing program that all participants have a FOBT as part of the program, this was not required before having a flexible sigmoidoscopy. It is therefore possible that the nurse program was seeing a slightly higher risk population (that is, a portion of patients in the nursing group may have been FOBT positive). This is unlikely to be a significant number, however, based on the rate of positivity in an average risk population. Furthermore, the increased risk conferred by including a small proportion of patients who may have tested positive for FOB would likely be offset by the fact that the nursing group included a slightly younger population and a significantly higher proportion of female patients, who are known to be at lower risk for colonic neoplasia than male subjects of comparable age. The more likely explanation is the care and thoroughness with which the procedure was performed, as well as the lower threshold for the nurses to sample very small polyps that physicians might ignore or consider likely to be hyperplastic. Certainly, the markedly increased biopsy rate in the nursing arm would be consistent with this explanation and likely contributed to the higher adenoma detection rate. This is also supported by an analysis of the adenoma detection rate between the seven physicians performing the procedure. The one physician who performed the majority of the procedures had a fairly low adenoma detection rate (4.5%), whereas the adenoma detection rate for the remaining physicians combined (16.5%) was comparable to that of the nurses.

A surprising finding related to relative cost. One would assume that a program in which the flexible sigmoidoscopy procedures were carried out by a nurse, rather than physician, would be less costly, but this proved not to be the case. Although charges incurred by actually doing the procedure were much higher with physicians versus nurses, a number of factors resulted in the estimated per case cost being higher than the nursing program. The increased biopsies resulted in an increased pathology lab cost, but the major difference related to administrative costs. As currently structured, the nursing flexible sigmoidoscopy program in Ontario employs a 0.8 FTE nursing administrative and patient

education position. This person promotes the program by liaising with the local primary care physicians and is responsible for data collection, patient education and follow-up of pathology with booking of colonoscopy where appropriate. In addition, fees are paid to gastroenterologists who supervise the nursing program. Although these administrative costs were undoubtedly of importance in getting the program established, it appears the expense may not be necessary on an ongoing basis. Indeed, since this study was conducted, Cancer Care Ontario has reduced administrative costs slightly by reducing the physician supervision fee, but even if this were eliminated, the costs per procedure would still be substantially higher for nurse-performed procedures. Nevertheless, the overall adenoma detection rate was higher in the nurse-endoscopist program, such that the cost per patient found to have an adenoma was lower in the nursing program. However, the reverse was true with respect to detecting patients with high-risk adenomas, which arguably are more relevant with respect to reducing CRC risk.

The retrospective nature of the current study is an obvious limitation, and clearly, a prospective randomized controlled trial comparing outcomes would have provided more robust results. Although both population cohorts studied were average risk patients > 50 years old referred for screening flexible sigmoidoscopy, there were some differences in patient demographics between the two groups, a problem that would not likely to have occurred in a prospective randomized trial. However, a prospective randomized study might actually have been less reflective of 'real world' practice in that participant endoscopists, knowing that the quality of their procedure is being compared to others, might alter their practice accordingly. Another limitation is that the two cohorts were studied approximately seven years apart, and during that interval, there has been an increased focus on improving endoscopic quality, which may be reflected in the improved performance of the nurse-endoscopists. Also, at the time of the physician program, 'cold snaring' of small polyps at sigmoidoscopy was not performed. This intervention would increase the cost of physician-performed flexible sigmoidoscopies, although this would be offset by lower costs incurred at a subsequent colonoscopy.

In conclusion, this study confirms that appropriately trained nurse-endoscopists can perform high-quality screening flexible sigmoidoscopies, but it appears that further reductions in associated administrative costs are required to optimize the cost-effectiveness of this program in Ontario.

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Author Competing Interests: None

References

1. Canadian Cancer Society's Advisory Committee on Cancer Statistics. Canadian Cancer Statistics 2013. Toronto, ON: Canadian Cancer Society, 2013.
2. Cancer Care Ontario: Insight on Cancer. News and Information on Colorectal Cancer. Toronto: Canadian Cancer Society (Ontario Division), 2004.
3. Canadian Cancer Society's Advisory Committee on Cancer Statistics. Canadian Cancer Statistics 2013. Toronto, ON: Canadian Cancer Society, 2013.
4. Schoen RE, Pinsky PF, Weissfeld JL, et al. Colorectal-cancer incidence and mortality with screening flexible sigmoidoscopy. *N Engl J Med* 2012;366(25):2345-57.
5. Shapero TF, Alexander PE, Hoover J. Colorectal cancer screening: Video-reviewed flexible sigmoidoscopy by nurse endoscopists: A Canadian community-based perspective. *Can J Gastroenterol* 2001;15:441-5.
6. Dobrow M, Cooper M, Rabeneck L. Referring patients to nurses: Outcomes and evaluation of a nurse flexible sigmoidoscopy training program for colorectal cancer screening. *Canadian Journal of Gastroenterology* 2007;21:301-208.
7. Costa E, Coyte P, Laporte A, et al. The use of registered nurses to perform flexible sigmoidoscopy procedures in Ontario: A cost minimization analysis. *Health Policy* 2012;7:e119-30.
8. DiSario JA, Sanowski RA. Sigmoidoscopy training for nurses and resident physicians. *Gastrointest Endosc* 1993;39:29-32
9. Palitz AM, Selby JV, Grossman S, et al. The colon cancer prevention program (CoCaP): rationale, implementation, and preliminary results. *HMO Pract* 1997;11;5-12.
10. Wallace MB, Kemp JA, Meyer F, et al. Screening for colorectal cancer with flexible sigmoidoscopy by nonphysician endoscopists. *Am J Med* 1999;107:214-218.
11. Schoenfeld P, Lipscomb S, Crook J, et al. Accuracy of Polyp Detection by Gastroenterologists and nurse endoscopists during flexible sigmoidoscopy: A randomized trial. *Gastroenterology* 1999;117:312-318.
12. Schoenfeld PS, Cash B, Kita J, et al. Effectiveness and patient satisfaction with screening flexible sigmoidoscopy performed by registered nurses. *Gastrointest Endosc* 1999;49;158-62.
13. Williams J, Russell I, Durai D, et al. Effectiveness of nurse delivered endoscopy: findings from randomized multi-institution nurse endoscopy trial (MINuET). *BMJ* 2009;338:b231.
14. Shapero TF, Hoover J, Paszat LF, et al. Colorectal cancer screening with nurse-performed flexible sigmoidoscopy: results from a Canadian community-based program. *Gastrointest Endosc* 2007;65:640-5.
15. Atkin W, Rogers P, Cardwell C, et al. Wide variation in adenoma detection rates at screening flexible sigmoidoscopy. *Gastroenterology* 2004;126(5):1247-56.