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ORIGINAL RESEARCH

Colonoscopy in rural communities: a systematic review of the frequency and quality

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ABSTRACT

Introduction: In this systematic review, the authors review studies of rural colonoscopy to determine specialty types providing rural colonoscopy and the quality of these procedures.

Methods: A systematic MEDLINE search was conducted for articles pertaining to rural colonoscopy. Inclusion criteria were rural location, report of quality outcomes, or report of endoscopy workforce in rural areas. Two investigators independently reviewed and abstracted included articles. The following information was obtained from each study: author identification, citation, study design, source of funding, study duration and follow-up, study population, sample size, study setting, population characteristics, outcomes and results. Standard abstraction forms were used to summarize and assess the quality of evidence.

Results: From 121 articles in the MEDLINE search, 11 met inclusion criteria. One additional article found from a reference list was included. Eleven articles from three countries reported on 8703 colonoscopies performed by 25 rural generalists. Reach-the-cecum rates (RCR) ranged from 36% to 96.5% with more recent studies showing higher RCRs. Adenoma detection rates ranged from 16.6% to 46%. The rate of complications was low in all studies. One study of the rural endoscopist workforce reported that general surgeons performed most rural colonoscopies in Canada.

Conclusions: Rural generalist physicians can safely and effectively perform colonoscopies. More research is needed on the rural endoscopist workforce.

Key words: colonoscopy, generalist, primary care, quality.

Introduction

Colorectal cancer is the third most common cancer worldwide and ranks fourth among cancer killers[1]. The highest incidence rates occur in Australia, New Zealand, Canada, the USA, and parts of Europe[2]. Colonoscopy is effective for screening and prevention of colorectal cancer, and colonoscopic screening has been shown to save lives[3]. The procedure is recommended by multiple governmental and advocacy organizations as an effective means of screening for colon cancer[4-6].

Well-accepted methods of screening for colorectal cancer include annual fecal occult blood testing and endoscopic screening. Despite the consensus recommendations for colon cancer screening in general, and for colonoscopy specifically, only 65% of people in the USA are current on their colon cancer screening[7]. Internationally, there is inadequate capacity to screen all eligible persons[8-13]. As the populations in both developing and developed countries age, it is anticipated that the need for well-trained endoscopists will continue to rise.

Residents in rural areas are screened for colon cancer at lower rates than their urban counterparts[14-19]. Most rural physicians are generalists and are not trained in colonoscopy. In the USA and Canada the majority of colonoscopies are performed by gastroenterologists[20]. In the USA overall, only 2.6% of family physicians provide colonoscopy to their patients, but this rate may be higher in rural areas[21,22]. If colonoscopies are to be available for colon cancer screening for patients in rural areas of developed countries, then generalists will need to be able to safely and efficaciously provide this service.

There are widely accepted standards for safe and effective colonoscopy that include reach-the-cecum rate (RCR), adenoma detection rate, cancer detection rate and rates of complications. The National Bowel Cancer Screening Program (NBCSP) Quality Working Group (Australia)[23], the American College of Gastroenterology/American Society of Gastrointestinal Endoscopists[24], the National Health Service in England[25] and the Canadian Association of Gastroenterology[26] have all published guidelines.

The purpose of this article is to systematically review available studies of rural colonoscopy to determine which types of providers are performing the procedure and to assess the reported quality of these procedures. Evidence of quality and effectiveness of colonoscopies provided by rural physicians is needed to guide development of programs to increase colonoscopy capacity in rural areas.

Methods

Study selection

A systematic literature search was conducted utilizing MEDLINE from 1951 to 1 September 2013. A search strategy was developed combining medical subject headings (MeSH) and text key words (tw) for (colonoscopy[tw] OR colonoscopies[tw] OR 'colonoscopy'[MeSH Terms:noexp] OR polypectomy[tw] OR polypectomies[tw]) AND rural[tw]. The search was not restricted by language. Inclusion criteria were rural location, report of quality outcomes, or report of endoscopy workforce in rural areas. Two investigators (DE, AC) reviewed potentially relevant articles independently, with differences resolved through discussion. To ensure completeness of the literature search, citation lists for the included studies published in the previous 5 years were reviewed. Additional articles identified through review of citation lists were reviewed and included if appropriate. This study did not meet criteria for human subjects research and did not require Institutional Review Board approval.

Data abstraction and validity assessment

Two reviewers (DE, AC) independently reviewed and abstracted data from each included study using a standardized data abstraction tool (Appendix I). The following information was obtained from each study: author identification, citation, study design, source of

funding, study duration and follow-up, study population, sample size, study setting, population characteristics, outcomes and results. Validity was assessed using an Agency for Healthcare Research and Quality tool for assessing the strength of scientific evidence[27]. Each reviewer assessed for potential bias in assigning exposure and measuring outcomes, as well as incomplete reporting or selective reporting.

Results

The search strategy identified 121 potentially eligible articles. After reviewing the abstracts and full texts when needed, only 11 articles met inclusion criteria. Ten of the included articles measured colonoscopy quality by rural physicians[28-37]. One study reported on the rural colonoscopy workforce[20]. An additional article on colonoscopy quality[38] was identified by review of a 2009 meta-analysis of colonoscopy by primary care physicians[39]. There were no eligible systematic reviews, meta-analyses or randomized studies. Articles were excluded if they did not report standard quality outcomes or did not report results from colonoscopies done in a rural setting. Only primary research studies, not review articles, were included.

Table 1 summarizes the characteristics of the 11 studies measuring colonoscopy quality by rural practitioners. It includes four reports from Canada, one from Australia and six from the USA. The studies encompass 8703 procedures by 25 colonoscopists. Ten of the 11 studies report on consecutive procedures. Seven collected data prospectively, three were retrospective chart reviews, and one did not report the method of data collection. Five were multi-physician studies. Colonoscopist training is summarized when available.

Table 2 displays the results of the 11 studies reporting colonoscopy quality measures. All studies reported RCR, adenomatous polyp detection rates and cancer detection rates. Four studies reported procedure time and one reported on scope withdrawal time. All studies reported complications of perforation and bleeding. Other reported complications included sedation complications and referrals to specialists, but there was considerable variation in how these complications were defined.

RCRs ranged from 36% to 96.5%. In studies less than 10 years old representing 6454 cases the RCR ranged from 80.6% to 96.5%. Adenoma detection rates ranged from 16.6% to 46%. Cancer detection rates ranged from 0.4% to 2.1%. Complications were uncommon. A total of six perforations, ten bleeding events and nine sedation complications were reported.

Studies focusing on the rural colonoscopist workforce studies were scarce. Hilsden et al. conducted a national study of Canadian endoscopists performing more than 100 cases per year[20]. In rural areas, 54% of colonoscopies were performed by general surgeons, 39% by gastroenterologists, and only 7% were performed by generalists.

Discussion

This systematic review contributes to the growing body of literature that demonstrates that well-trained primary care providers can safely and effectively perform colonoscopy in rural settings. This is particularly important in developed countries where colonoscopy is the standard of care for colon cancer screening but access to colonoscopy in rural areas is limited.

Who performs colonoscopy in rural communities?

The only study meeting inclusion criteria and specifically focusing on workforce demonstrated that general surgeons perform most colonoscopy procedures in rural Canadian communities. The American Academy of Family Physicians workforce study noted that a small minority (2.6%) of US family physicians provide colonoscopy for their patients but it did not report on the rurality of these physicians. The vast majority of studies included in this review reporting quality showed cases by family physicians or general practitioners. Based on this literature review, the question of who provides colonoscopies in rural areas is unanswered. Future research to assess availability and training of colonoscopy providers in rural areas is warranted.

Table 1: Summary of published studies reporting results of rural colonoscopy

Author (year)	No. colonoscopies	No. colonoscopists	Ave. patient age (years) /range /SD	% F	Setting	Study Design	Endoscopist Characteristics and Training
Kobler (2013)	577	10	57.6 SD 13.3	51	Alberta, Canada	Consecutive Prospective Multiple physician	8 FPs and 2 GIMs. Physicians had performed an estimated median of 1850 (range 1400–4000) colonoscopies prior to study. Nine of 10 perform own sedation
Azzopardi (2012)	3000	1	60 SD 14	NR	Echuca, Australia	Consecutive Prospective Multiple physicians	Recognized by Australian Conjoint Committee for Recognition in Gastrointestinal Endoscopy. Requires minimum of 100 unassisted and supervised colonoscopies and 30 polypectomies
Kobler (2009)	1178	1	52.2 (7–92)	58.8	Peace River, Canada	Consecutive Prospective Single physician	'Additional skills training in gastroenterology'
Cotterill (2005)	152	2	(22–80)	44.1	Wawa, Canada	Consecutive Prospective Multiple physician	NR
Newman (2005)	731	2	62.7 (20–92)†	51.6	Rural southern state, USA	Consecutive Retrospective Multiple physician	NR
Kirby (2004)	616	1	NR	NR	Northern Ontario, Canada	Consecutive RetrospectiveSingle physician	NR
Edwards (2004)	200	4	62 (16–90)	45.5	Cottonwood Idaho, USA	Consecutive RetrospectiveSingle physician	3 of 4 physicians were trained in residency. The fourth had been doing flexible sigmoidoscopies in practice and was trained by a partner. No mention of number of cases done prior to study
Pierzchajlo (1997)	751	11	53.8 SD 18.1	46.2	Rural Georgia, USA	Consecutive Prospective Single physician	Doctor had done over 700 flexible sigmoidoscopies in practice then did coursework to train for colonoscopies. He then was proctored by general surgeons and family physicians for 80 cases over 2 years
Hopper (1996)	1048	1	57 (14-91)	41	Rural USA	Consecutive Prospective Single physician	Performed sigmoidoscopies in practice and advanced to colonoscopies

Table 1: cont'd

Author (year)	No. colon-oscopies	No. colonos-copists	Ave. patient age (years) /range /SD	% F	Setting	Study Design	Endoscopist Characteristics and Training
Rodney (1993)	293	1	67 (13–93)	50	Rural southern state, USA	Consecutive Prospective Single physician	Self trained in sigmoidoscopy and advanced to colonoscopy on own
Godreau (1992)	157	NR	58 (22–92)	54.7	Dedham Massachu-setts, USA	NR	Trained in flexible sigmoidoscopies. Then did a CME course followed by 13 proctored colonoscopies
Total	8703	25					

† Age range and sex distribution reported on all endoscopy cases (colonoscopy, gastroscopy, sigmoidoscopy)
F, female. FP, family physician. GIM, general internal medicine physician. NR, not recorded. S, standard deviation.

What, where and how well?

In contrast to the paucity of data around 'who' comprises the rural colonoscopy workforce, this review reports on 8703 colonoscopies by 25 rural physicians in three countries. Most studies report on both screening and diagnostic colonoscopies. The majority of these studies demonstrate high quality as measured by the generally accepted measures of reaching the cecum, adenoma detection and cancer detection.

Rex et al. report that 90% of all colonoscopies should reach the cecum and that the percentage should increase to 95% for screening exams[40]. However, a 2003 study of more than 17 000 procedures by 69 gastroenterologists in North America showed a median RCR of 88%. Only 55% of physicians had an RCR of 90% or greater[41].

RCRs of rural colonoscopists are consistent with recommended standards. The present review found that 6 of 11 studies, representing 5411 of 8703 procedures, reported RCRs exceeding the 90% recommended by Rex et al[29-32,34,35]. One additional study of 1178 procedures exceeded 88%[28]. In the 1996 case series of 1048 procedures by Hopper et al[36], they reported an RCR of only 36% in non-sedated patients. Using sedation the RCR increased to 93%.

The studies included in this review show variation in both cancer and adenoma detection rates. This variation is consistent with other studies of experienced colonoscopists[40,42,43]. Current accepted benchmarks of adenoma detection on screening of normal risk individuals are 25% in males and 15% in females[23-26]. Kolber et al. is the only study in this review that reported adenoma detection by gender, but included multiple indications for colonoscopy[29].

While a small number of studies reported quality over time and demonstrated a training effect with respect to RCR[30,32-34], other included studies did not[29,31,35]. Previous studies of gastroenterologists in training show improved quality with number of procedures[44]. There may also be improvement in performance with improvements in technology, as more recent cases show better RCRs.

Table 2: Summary of quality of colonoscopies performed in rural areas

Author (year)	RCR	Adenoma detection rate	Cancer detection rate	Procedure time (min)	Withdrawal time (min)	Perforations	Bleeding	Complications of sedation	Referral to specialist
Kobler (2013)	95.3% (93.3,96.9%)	46% (38.5,54.3) in males, 30.2% (22.3,38.2) in females	2.10%	23.6 (22.7,24.5)	7.0 (6.6,7.4)	1(0.17%)	3(0.52%)†	NR	NR
Azzopardi (2012)	96%	39%	2%	17 (SD 6)	NR	4(0.13%)	5(0.17)¶	NR	NR
Kolber (2009)	88.30%	18.9%§	2.1%‡	24.9§	NR	1(0.08%)	1(0.08%)††	5(0.3%)¶¶	NR
Cotterill (2005)	94%	23.70%	0.70%	NR	NR	0	0	NR	NR
Newman (2005)	92.8%	17.7%§§	0.80%	NR	NR	0	1(0.14%)	0	29(3.9%)‡‡
Kirby (2004)	80.6%	16.6%	2.4%	NR	NR	0	0	0	NR
Edwards (2004)	96.5%	22.5%	2.5%	34.4	NR	0	0	1§§	NR
Pierzchajlo (1997)	91.5%	17.8%	0.4%	NR	NR	0	0	3	NR
Hopper (1996)	36% non-sedated, 93%when sedated†††	43.8%	NR	NR	NR	0	0	NR	NR
Rodney (1993)	48%	24.9%¶¶¶	2.0%	NR	NR	0	0	0	NR
Godreau (1992)	83%	22%§§§	2%	NR	NR	0	0	0	NR

†Three bleeding events after snare polypectomy of advanced adenoma. All were hospitalized overnight. One patient required a transfusion. No repeat procedures or surgeries.
¶One patient required transfusion
§Time recorded on only the last 187 cases
‡Adenoma detection and cancer detection rates include both colonoscopies and sigmoidoscopies
††Required repeat procedure. No transfusion
¶¶Required naloxone
§§19 cases with polyp larger than 1 cm referred to gastroenterologist. 10 referred to surgeon for resection of large polyp or cancer
‡‡Sedation related bradycardia that responded to atropine
†††Both adenomatous polyps and cancers recorded as 'significant findings'
¶¶¶Findings reported at colon polyps
§§§Adenoma detection rate on screening colonoscopies only
NR, not recorded. RCR, reach-the-cecum rate

A recent study from Canada reports that patients who have a negative colonoscopy performed by a gastroenterologist are less likely to develop colorectal cancer than those performed by people from other specialties[45]. This study reports on more than 110 000 cases but draws on data from 1992 to 1997. This finding was only significant among cases performed in a hospital and was not statistically significant among cases completed in a private/office setting. Further studies will be needed to corroborate these results.

This systematic review shows lower-than-expected rates of complications among rural colonoscopists. Frequency of

colon perforation is reported at 0.14–0.65% for diagnostic procedures[46,47]. Perforations during therapeutic procedures in prior studies were found to be as high as 3%[48]. Only seven perforations were reported among the 8703 procedures (0.07%) reported here. The percentage of bleeding complications was only 0.11%. Many of the studies included here are from single providers. These solo endoscopists might have considerable influence on which patients are eligible for procedures locally and which patients require specialty referral. Referring physicians in a rural community might send more complex cases to tertiary settings as well. This could influence the low complication rate. Meyer et al. found that generalist cases are often of lower complexity than cases done by gastroenterologists[49].

Limitations

This systematic review has multiple limitations. First, five of the studies reporting quality data are of cases performed by a single physician who was often the author. These cases may not be representative of rural endoscopists as a whole and may also introduce reporting bias. Second, most of the studies include multiple indications for colonoscopy or do not report specific indications as part of their data. Accepted benchmarks for cecal intubation and polyp and cancer detection are specific for screening exams. If a case series includes more repeat procedures, for example, the adenoma detection rate might be artificially high. Similarly, therapeutic procedures usually take longer and often result in higher complication rates.

Conclusions

This systematic review of 11 studies reporting on 8703 colonoscopies performed by rural generalists in three countries demonstrates that rural physicians can perform colonoscopies safely and effectively. These cases demonstrate cancer and adenoma detection rates consistent with generally acceptable standards and practices with correspondingly low rates of complications. Not enough data was available to draw conclusions about the specialty distribution of the rural colonoscopist workforce. However, it is clear that more rural colonscopists will be required to perform the recommended colon cancer screening on rural patients in developed countries. Training programs should be developed to address this need for high quality and effective rural colonoscopy.

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Appendix I: Individual studies abstract form†

Article information	
Title	
Author(s) and affiliation(s)	
Language	
Journal	
Volume and page numbers	
Year of publication	
Sources of support	
Study question/objectives	
Study design	___ RCT ___ Non-randomized clinical trial ___ Cohort ___ Case-control study ___ Survey ___ Cross-sectional study ___ Case-series (without control group) ___ Other descriptive study ___ Other _____ Does this study have an intervention? (Y/N)
Study time period	
Study location	
Study population	
Number and characteristics of the subjects	
Setting/source of participants	
Inclusion/exclusion criteria	

Sampling technique	___ Random ___ Consecutive ___ Nonsystematic ___ Unspecified				
For cross-sectional groups under comparison					
For case-control **Cases**					
Controls					
Matched characteristics					
Types of controls	__ Hospital controls __ Community controls __ Other				
For cohortexposed					
Unexposed					
Follow-up					
Duration of follow-up/schedule of follow-up					
Losses to follow-up					
What were the characteristics of the subjects lost to follow-up?					
Measurement of compliance w/intervention					
Measurements					
Main exposures /interventions (w/measurements and definitions)					
Other exposures /interventions (w/measurements and definitions)					
Main outcomes (w/measurements and definitions)					
Other outcomes (w/measurements and definitions)					
Possible confounders /effect modifiers (measurements)					
Analysis					
How was the analysis conducted?					
Results					
Response rate/% of eligible participants enrolled					
Are groups comparable at baseline?					
Findings (include CI p-value, magnitude of treatment effect) ▪ *Significance of findings (trends, etc)* ▪ *Raw data* ▪ *2 X 2 tables*					
Strengths/limitations		**Y**	**N**	**Not reported**	NA
General questions	Is there a clear statement of the research hypothesis?				
	Are the main outcomes to be measured clearly described in the introduction or methods section?				
	Is there a clear definition of the intervention?				
	Are the main findings of the study clearly described?				
Exposure and outcome					
	Is the assessment of exposure likely to be precise and accurate (amount and duration) ?				
	Are outcomes measured in a standard, valid and reliable way?				
Study design					
	Is the study design appropriate for the hypothesis?				
	Is there proper sampling?				

	Is there a suitable reference group?				
	Is there a similar method of data collection for all groups?				
	Was compliance with the interventions reliable?				
Analysis					
	Was the analysis adequately described?				
	Were the appropriate analyses conducted? *(For RCTs was there an A or B for the control of bias after treatment assignment)*				
	Is the sample size adequate to answer the research questions?				
Bias	(Note: A 'No' response in this section is seen as favorable)				
	Are any of the following biases applicable to this study:				
	For observational studies				
	Is the method of selection of subjects likely to have biased results (selection bias)?				
	Is measurement of either the exposure or the outcome likely to be biased (information bias)?				
	Is the information bias likely to be differential?				
	Is there differential loss to follow-up or overall high loss to follow-up that would impact the results?				
	Did the investigators fail to consider confounders?				
	Did the investigators fail to consider whether uncontrolled confounders could account for the observed results?				
Reproducibility/ generalizability					
	Are the methods reproducible?				
	Is the evidence applicable to the general population?				
Interpretation of the results					
	Do the results have clinical significance?				
	Are the author's conclusions supported by the data?				
	Does the author state any implications of the study's results? If yes, what were they? _____				
Summary of evidence					
Grading system	__ I. Evidence obtained from at least one properly designed randomized controlled trial. __ II-1.Evidence obtained from well-designed controlled trials without randomization. __ II-2. Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one center or research group. __ II-3. Evidence obtained from multiple time-series with or without intervention. Dramatic results in uncontrolled experiments could also be regarded as this type of evidence. __ III. Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.				
Bottom-line of the article					

[†] This abstract form was developed through the review of recommended elements and sample abstracts included in the 2002 US Agency for Healthcare Research and Quality report, *Systems to rate the strength of scientific evidence*. This abstract form serves only as a guide, with the most critical part being the strengths and limitations section of the forms.