Quality audit of colonoscopy reports amongst patients screened or surveilled for colorectal neoplasia

Daphnée Beaulieu, Alan Barkun, Myriam Martel

Daphnée Beaulieu, Alan Barkun, Myriam Martel, Division of Gastroenterology, The McGill University Health Center, McGill University, Montreal H3G 1A4, Canada
Alan Barkun, Clinical Epidemiology, the McGill University Health Center, McGill University, Montreal H3G 1A4, Canada
Author contributions: Beaulieu D, Barkun A and Martel M contributed to conception and design, acquisition of data, or analysis and interpretation of data; all authors drafted the article or revised it critically for important intellectual content and made the final approval of the version to be published.
Supported by The Research Scholar (Chercheur National) of the Fonds de la Recherche en Santé du Québec
Correspondence to: Dr. Alan Barkun, MD, CM, FRCPC(C), FACP, FACG, FAGA, MSc (Clinical Epidemiology), Division of Gastroenterology, The McGill University Health Center, Montreal General Hospital site, 1650 cedar Avenue, room D7-346, Montreal H3G 1A4, Canada. alan.barkun@muhc.mcgill.ca
Telephone: +514-9348309 Fax: +514-8348531
Received: September 26, 2011 Revised: March 9, 2012
Accepted: May 6, 2012
Published online: July 21, 2012

Abstract

AIM: To complete a quality audit using recently published criteria from the Quality Assurance Task Group of the National Colorectal Cancer Task Force.

METHODS: Consecutive colonoscopy reports of patients at average/high risk screening, or with a prior colorectal neoplasia (CRN) by endoscopists who perform 11 000 procedures yearly, using a commercial computerized endoscopic report generator. A separate institutional database providing pathological results. Required documentation included patient demographics, history, procedure indications, technical descriptions, colonoscopy findings, interventions, unplanned events, follow-up plans, and pathology results. Reports abstraction employed a standardized glossary with 10% independent data validation. Sample size calculations determined the number of reports needed.

RESULTS: Two hundreds and fifty patients (63.2 ± 10.5 years, female: 42.8%, average risk: 38.5%, personal/family history of CRN: 43.3%/20.2%) were scoped in June 2009 by 8 gastroenterologists and 3 surgeons (mean practice: 17.1 ± 8.5 years). Procedural indication and informed consent were always documented. 14% provided a previous colonoscopy date (past polyp removal information in 25%, but insufficient in most to determine surveillance intervals appropriateness). Most procedural indicators were recorded (exam date: 98.4%, medications: 99.2%, difficulty level: 98.8%, prep quality: 99.6%). All reports noted extent of visualization (cecum: 94.4%, with landmarks noted in 78.8% - photodocumentation: 67.2%). No procedural times were recorded. One hundred and eleven had polyps (44.4%) with anatomic location noted in 99.1%, size in 65.8%, morphology in 62.2%; removal was by cold biopsy in 25.2% (cold snare: 18%, snare cautery: 31.5%, unrecorded: 20.7%), 84.7% were retrieved. Adenomas were noted in 24.8% (advanced adenomas: 7.6%, cancer: 0.4%) in this population with varying previous colonic investigations.

CONCLUSION: This audit reveals lacking reported items, justifying additional research to optimize quality of reporting.

© 2012 Baishideng. All rights reserved.

Key words: Colonic-disorders; Endoscopy-general; Oncology-clinical; Colonoscopy; Endoscopic reporting system

Peer reviewer: Luis Bujanda, Professor, Department of Gastroenterology, Centro de Investigación Biomédica en Red en Enfermedades Hepáticas y Digestivas (CIBERehd), University of the Basque Country, Donostia Hospital, Avda Sancho El Sabio 17-2D, 20010 San Sebastian, Spain

Beaulieu D, Barkun A, Martel M. Quality audit of colonoscopy reports amongst patients screened or surveilled for colorectal neoplasia. World J Gastroenterol. 2012; 18(27): 3551-3557 Available from: URL: http://www.wjgnet.com/1007-9327/full/v18/i27/3551.htm DOI: http://dx.doi.org/10.3748/wjg.v18.i27.3551
INTRODUCTION

Colorectal cancer (CRC) is the second leading cause of death from cancer in Canada\(^2\). Screening of asymptomatic average-risk persons for this type of cancer is strongly recommended\(^3\). Colonoscopy is one of the most accurate screening tests for CRC. It is used for primary CRC screening but also for surveillance of patients with prior colorectal neoplasia (CRN), including cancer, and diagnosing patients with lower gastrointestinal (GI)-track symptoms. The effectiveness and safety of colonoscopy depends, however, on the quality of examination in what is a high-volume procedural setting. A growing body of evidence suggests that the quality of clinical practice varies\(^4\).

In 2007, the Quality Assurance Task Group of the National CRC Roundtable developed a reporting and data system for colonoscopy (CO-RADS) to assist endoscopists in establishing standards that permit the monitoring of quality indicators in their practice. The Quality Assurance Task Group created a standardized reporting system that represents a consensus among experts in gastroenterology, diagnostic radiology, primary care and health care delivery\(^5\). A national US study was recently conducted, using the standardized reporting system, and uncovering lacks in the colonoscopy reports. Yet in Canada, to our knowledge, no such initiative has been published to date\(^6\).

The objective of this study was therefore to assess the level of adherence of a sample of colonoscopy reports from an academic university-based endoscopy unit using the criteria set out by the Quality Assurance Task Group CO-RADS, and to determine reporting of quality indicators with the poorest adherence.

MATERIALS AND METHODS

Patient population

We selected consecutive colonoscopy reports completed from procedures performed in June 2009. We only considered procedures carried out for the screening or surveillance of patients with prior CRN, excluding colonoscopy reports completed for other reported indications.

Electronic reporting system and institutional database

The Montreal General Hospital site of the McGill University Health Centre (MUHC-MGH) is a tertiary care institution with a 4-room endoscopy unit staffed by 12 medical and surgical endoscopists. Patients can access the services of the unit both through a same-day consultation and procedural critical path of care at the request of a referring physician providing screened information, or on a subsequent date, after the specialist endoscopist has initially assessed the patient in the office. On average, 11 000 procedures are performed at the MUHC-MGH per year, of which 75% were colonoscopies in 2008. Average waiting time between the indication of the colonoscopy and the colonoscopy is currently around 2-3 mo. All patients receive an information sheet on the procedure prior to colonoscopy and consent is obtained by the endoscopist. Patients also receive written instructions after the colonoscopy is performed.

The unit is equipped with a structured, computerized endoscopic report generator allowing for image and video capture (Endoworks, Olympus Corporation, Center Valley, PA, United States). It is used for all cases performed during and outside regular hours by all endoscopists. The data file from the report is electronically transmitted to a central data repository housed at the MUHC-MGH. The information is then securely locked in an MUHC Endoworks database.

The routine colonoscopy report at the MUHC-MGH endoscopy unit includes some compulsory fields, default population of certain fields included in the final report for which the endoscopist needs to approve or choose alternatives, drop down menus for selecting other components of the report, and data acquisition fields for free text entries. Endoscopists were not aware we would be carrying out the audit at the time the reports were entered in Endoworks. Any post-hoc amendment of a report can be identified through a review of the electronic log entries.

We also accessed pathology results from an institutional electronic medical file software (OACIS, Telus, Vancouver, Canada) which is not part of Endoworks as the current practice is not to link directly the pathology results as part of the actual colonoscopy report. These latter data provided us with the prevalences of adenomas, advanced adenomas, and cancer detection rate.

Quality indicators

Based upon continuous quality improvement indicators established by the Quality Assurance Task Group of the National CRC Roundtable\(^2\), we developed a specific list of quality indicators (Table 1) that should be explicitly addressed in the colonoscopy reports, and made available to the referring physician. Unplanned interventions for adverse events included only those interventions that were reported at the time of colonoscopy since no specific mechanism or manpower support currently exists at the MUHC-MGH digestive endoscopy unit to allow for the reliable capture of downstream adverse events once the patient has returned home.

Data collection

The current study is a retrospective review of all consecutive eligible reports using a standardized checklist developed using the Quality Assurance Task Group of the National CRC Roundtable publication\(^2\). We dichotomized screened patients into those for whom the indication for colonoscopy was average or increased-risk (patients with a family or personal history of CRC or polyps). Data were compiled and individually analyzed by a trained research assistant using a specially developed electronic data abstraction form. Using a standardized glossary of study variables, 10% of all entered data was reviewed by an independent observer and validated.
Statistical analysis

The sample size was based on a preliminary analysis of the first 111 consecutive reports. The widest point estimate for presence (or absence) of documentation of a quality indicator was for that of polyp removal (51.1%; 95% CI: 35.9%-63.3%). We estimated the number of reviewed reports, needed to narrow the range of uncertainty around this point estimate to 10%. Assuming an identical projected point estimate of 51%, we calculated that we would need to audit 250 scope reports to narrow a 95% CI down to 45.5%-55.8%. We therefore completed the audit up to this consecutive number of patients.

Descriptive variables are presented as means and standard deviations for continuous variables and proportions with 95% confidence intervals for categorical variables. All analyses were performed by using SAS software version 9.1 (SAS Institute Inc, Cary, NC, United States).

RESULTS

From June 1st to June 30th 2009, 250 reports on 250 consecutive patients were audited for the frequency of reporting of patient demographics and history, procedure indications, technical descriptions, colonoscopy findings, interventions, unplanned events, follow-up plan, and we reviewed the corresponding histological information. These 250 colonoscopy reports were reported by 11 different physicians including 2 colorectal surgeons, 1 general surgeon, and 8 gastroenterologists. Not all endoscopists were included since they do not all perform screening colonoscopies. The average number of years of practice of the 11 endoscopists was 17.1 ± 8.5 years.

Patient demographics and endoscopists’ description

The overall patient population and endoscopists’ description of the reports are presented in Table 2. The mean age of the patient population was 63.2 ± 10.5 years with 42.8% of the patients being women. The procedure indication pertaining to the risk of the patient was indicated in every report. Overall, 38.5% of examinations were performed on average risk individuals, 43.3% of patients had a past personal history of prior CRN, while 20.2% of patients had first-degree relatives with CRC or a CR adenoma. Only one patient had a hereditary nonpolyposis CRC syndrome, while another had familial adenomatous polyposis.

Pre-procedure indicators

The American Society of Anesthesiology (ASA) classification field was not completed in any of the reports. The documentation of informed consent was noted in all reports. Overall, 9.6% of patients had had previous colonoscopies, but the date of the prior examination was only noted in 14% of reports with details about previous polyp resection in 25%. In most cases, the colonoscopy report lacked sufficient information to determine wheth-

| Table 1 Colonoscopy quality indicators |
|----------------------------------------|
| Patient demographics and history       |
| Age                                    |
| Sex                                    |
| MRN                                    |
| Management plans                       |
| Informed consent documentation         |
| Previous GI procedures: documented date (yes/no) |
| Documentation of ASA classification   |
| Indications for procedure              |
| Average risk                           |
| Increased risk                         |
| Incomplete colonoscopy                 |
| Post adenoma resection                 |
| Procedure: Technical description       |
| Date and time                          |
| Sedation                               |
| Level of difficulty of the procedure   |
| Bowel preparation                      |
| Type and dosage                        |
| Quality                                |
| Actual extent of examination          |
| Cecal intubation (yes/no)              |
| Documentation of cecal landmarks      |
| Appendiceal orifice                    |
| Ileocecal valve                        |
| Total and withdrawal time recorded (yes/no) |
| Colonoscopic findings                 |
| Colonic polyp(s):                      |
| Number                                 |
| Size                                    |
| Morphology                             |
| Morphology anatomic location           |
| Method of removal                      |
| Completeness of removal (yes/no)       |
| Retrieved (yes/no)                     |
| Sent to pathology (yes/no)             |
| Interventions/unplanned events         |
| Unplanned interventions and complications |
| Documentation of discharge plans (info to patient, info to referring MD) |
| Pathology                              |
| Documentation of pathology results to the patient and the physician |
| Adenoma detection (yes/no)             |
| Cancer detection (yes/no)              |

| Table 2 Patient population and endoscopists description | n (%) |
|---------------------------------------------------------|------|
| Patients (n = 250)                                      |      |
| endoscopists (n = 11)                                   |      |
| Mean age (yr)                                           | 63.2 ± 10.5 |
| Sex                                                     |      |
| Women                                                   | 107 (42.8) |
| Men                                                     | 143 (57.2) |
| Procedure indications                                   |      |
| Average risk                                            | 85 (38.5)  |
| Past personal history                                   | 90 (43.3)  |
| Past family history                                     | 42 (20.2)  |
| HNPCC                                                   | 1 (4.4)    |
| FAP                                                     | 1 (1.4)    |
| Specialty of endoscopists                               |      |
| Surgical                                                | 3 (27.3)   |
| GI                                                      | 8 (72.7)   |
| Average years of endoscopists practice (yr)             | 17.1 ± 8.5 |

HNPCC: Hereditary nonpolyposis colorectal cancer syndrome; FAP: Familial adenomatous polyposis; GI: Gastrointestinal.
The effectiveness of colonoscopy in reducing cancer prevalence cannot be improved if procedural reports do not include critical quality indicators to track performance in colonoscopy. In other words, the potential benefits of colonoscopy depend on the quality of the examination[13], and thereby its reporting. The final version of the Standardized Colonoscopy Report includes important elements that can be measured in diverse clinical practice settings. Patient demographics and history, assessment of patient risk and comorbidities, procedure indications, procedure technical description, colonoscopy findings, assessment, interventions and unplanned events, follow-up plan, and pathology are the main variables proposed by the Standardized Colonoscopy Report established by the Quality Assurance Task Group of the National CRC Roundtable, requiring recording[14].

The current study revealed that even with a computerized endoscopic report generator, some key quality fields were lacking, some often. Several of these fields are

| Table 3 Pre-procedure indicators n (%) |
|----------------------------------------|
| Quality indicator sought in the report (n = 250) | |
| Consent documentation | 250 (100.0) |
| Management plan for anticoagulation | 1 (0.5; 95% CI: 0.0-1.5) |
| Previous GI colonoscopy date | 24 (14.0; 95% CI: 8.7-19.2) |
| ASA classification | 0 (0) |
| Previous polyp resection | 20 (12.7; 95% CI: 7.4-17.9) |
| Details available | 5 (25.0; 95% CI: 4.2-45.8) |
| 1-2 tubular adenoma < 1 cm | 2 (33.3; 95% CI: 0.0-87.5) |
| 3-10 tubular adenoma > 1 cm | 1 (16.7; 95% CI: 0.0-59.9) |
| 10 adenomas | 1 (16.7; 95% CI: 0.0-59.9) |
| Sessile adenoma > 2 cm | 1 (16.7; 95% CI: 0.0-59.9) |

| Table 4 Procedural indicators and colonoscopic findings n (%) |
|----------------------------------------|
| Procedural indicators | |
| Quality indicator sought in the report | n = 250 |
| Date of exam | 246 (98.4, 95% CI: 96.8-100.0) |
| Medications with dosage | 248 (99.2, 95% CI: 98.1-100.0) |
| Level of difficulty | 247 (98.8, 95% CI: 97.4-100.0) |
| Bowel preparation quality | |
| Poor | 10 (4.0, 95% CI: 1.6-6.5) |
| Fair | 27 (10.8, 95% CI: 7.0-14.7) |
| Good | 212 (85.1, 95% CI: 80.7-89.6) |
| Actual extent of examination | |
| Cecum | 236 (94.4, 95% CI: 91.7-97.3) |
| Ascending colon | 6 (2.4, 95% CI: 0.5-4.3) |
| Transverse colon | 2 (0.8, 95% CI: 0.0-1.9) |
| Descending colon | 2 (0.8, 95% CI: 0.0-1.9) |
| Recto sigmoid | 4 (1.6, 95% CI: 0.0-3.2) |
| Cecal intubation | 236 (94.4, 95% CI: 91.5-97.3) |
| Photodocumentation | 186 (74.4, 95% CI: 69.0-79.8) |
| Documentation of cecal landmarks | |
| Appendiceal orifice | 168 (67.2, 95% CI: 61.2-73.2) |
| Ileocecal valve | 103 (41.2, 95% CI: 35.1-71.3) |
| Retroflexion in rectum | 177 (70.8, 95% CI: 65.1-76.5) |
| Withdrawal time | 0 (0) |
| Total time | 0 (0) |
| Intra-procedural complications | 1 (0.4, 95% CI: 0.0-1.2) |
| Colonoscopic findings: polyps | |
| Polyp findings | 111 (44.4, 95% CI: 38.2-50.6) |
| Mean polyp number | 2.2 ± 2.5 |
| Polyp size documented | 73 (65.8, 95% CI: 56.8-74.7) |
| Mean polyp size (mm) | 17.6 ± 33.1 |
| Morphology | |
| Documented | 69 (26.2, 95% CI: 53.0-71.3) |
| Pedunculated | 17 (23.9, 95% CI: 13.8-34.1) |
| Sessile | 56 (22.0, 95% CI: 12.0-32.0) |
| Anatomic location documented | 110 (99.1, 95% CI: 97.3-100.0) |
| Method of removal | |
| Cold biopsy | 28 (25.2, 95% CI: 17.0-33.4) |
| Cold snare | 20 (18.0, 95% CI: 10.8-25.3) |
| Snare cautery | 35 (13.5, 95% CI: 22.8-48.3) |
| Not mentioned | 23 (20.7, 95% CI: 13.1-28.4) |
| Retrieved | 72 (84.7, 95% CI: 76.9-92.5) |
| Sent to pathology | 85 (76.5, 95% CI: 67.3-85.7) |
important in determining the quality of the examination including photo documentation ofecal landmarks present in only (67.2%; 95% CI: 61.3%-73.1%). Of course, the absence of these data does not allow us, to infer about a poor examination quality, but makes its tracking difficult, and even impossible for certain aspects. Assuming all past procedures were indicated, the current reports should include documentation of the prior colonoscopy examinations and their findings. In most cases, we found this documentation lacking (86%; 95% CI: 81.5%-90.5%), and, therefore, it was often not possible to determine the appropriateness of the screening interval. Additional important missing information in the report included historical data which, according to current local practice, may be present in a separate consultation report. Nonetheless, the Quality Assurance Task Group of the National CRC Roundtable has mandated that, to facilitate adequate benchmarking, this information should be found in the endoscopic report.

The omission of key polyp descriptors like polyp size absent in (34.2%; 95% CI: 25.3%-43.2%), the number of polyps found, and the morphology lacking in (37.8%; 95% CI: 28.7%-47.0%) of reports can impact subsequent decisions on surveillance colonoscopy intervals[11], although a more accurate determination of polyp size is available from the histological reports, when available. This information should eventually find its way back to the endoscopy report for benchmarking purposes of endoscopists and for good clinical practice to ensure a copy is sent to the referring physician[10]. Here too, these data may have been documented in a separate follow-up form. However once again, Lieberman et al.[13,14] have suggested that these data be present in the actual (follow-up) endoscopy report. Indeed, any subsequent quality initiative would otherwise be limited with various pieces of information being present in different places-i.e.; not all documented in the electronic report. Furthermore, if the documentation of whether the polyp was sent to pathology or not was omitted in many (23.5%; 95% CI: 14.3%-32.7%) of examinations, and affects the immediate patient care, that could lead to risks of undiagnosed cancers if this information is not efficiently retrieved and integrated in overall management. We also had no way of validating whether post-procedural complications were noted without reviewing a patient’s file (and even then, such information may be lacking) These data should also find their way back to the endoscopy report. Perhaps data cross links or integrated data management will help future enhancement of reporting quality across pre, intra- and post-procedural domains of quality reporting.

Procedure durations (withdrawal and total times) were never recorded. Although, somewhat of a controversial subject, there is evidence that there exists a significant correlation between withdrawal time and adenoma detection rates[15,17]. It is thus recommended as a quality indicator and has been found useful in previous audits[15].

We noted other lacks in reporting of selected variables which are recommended but do not directly impact examination quality including the ASA classification which was absent in all reports in this audit. Although, this indicator does not reflect examination quality, it can be an important surrogate of co-morbidity[18], and better defines the screened population, aiding the explanation of possible subsequent morbidity and the interpretation of medications dosing and the interpretation of reported patient satisfaction.

Another controversial variable was retroflexion in the rectum (performed in 70.8% of examinations); it provides additional data that can be added to complete an accurate colonoscopy report, and its recording may be useful either in demonstrating its need in identifying pathology; it remains a controversial quality indicator[13,14].

A number of the variables were recorded in the great majority of the reports such as the date of the exam (98.4%; 95% CI: 96.8%-100.0%), used medications with dosage (99.2%; 95% CI: 98.1%-100.0%), the level of difficulty of the procedure (98.8% 95% CI: 97.4%-100.0%) and the bowel preparation quality. The compulsory nature of some fields, pre-formatted text, and drop-down menus in the electronic reporting system no doubt participated in this high level of reporting, and should serve to guide improvement in areas of in which the recording of variables was lacking. Indeed, these fields likely need to be developed for other variables which are less frequently reported yet needed.

We compared the findings of the current study with the one conducted by Lieberman et al.[13]. The study using a national CORI database[15] included 73 US gastroenterology practice sites, and 43 8521 reports. Some differences in patient characteristics existed (Table 5). Quality outcomes from the procedure were similar or superior in the Canadian study polyp detection rate (44.4% vs 36.3%; 95% CI: 38.2%-50.6%), while the documentation of patient or procedural variables was poorer in many instances [such as for ASA classification, withdrawal times, previous colonoscopy date, photo-documentation of

### Table 5 Comparison between national United States study and the current audit

| % | Current audit (%) |
|---|------------------|
| **Patient characteristics** | |
| Women | 49 | 42.8, 95% CI: 36.6-49.0 |
| Men | 51 | 57.2, 95% CI: 51.0-63.4 |
| Average risk | 29.6 | 38.5, 95% CI: 32.0-44.9 |
| Past family history | 13.4 | 20.2, 95% CI: 14.7-25.7 |
| Past personal history | 19 | 43.3, 95% CI: 36.5-50.1 |

ASA: American Society of Anesthesiology; GI: Gastrointestinal.

Beaulieu D et al. Procedural audit for colon cancer screening.
celiac landmarks, and polyp description, (Table 5). They also used the proportion of patients with polyp(s) > 9 mm or with suspected malignant tumour as a surrogate end point for advanced neoplasia.

Although not our primary aim, this quality initiative also allowed us to benchmark the quality of the colonoscopies performed in this successive sample, and compare them to established consensus thresholds. In total, 110 polyps were found (44.4%). The adenoma detection rate was of (24.8%; 95% CI: 19.4%-30.2%) which suggests that even in this population with a varying colonoscopy screening history, adenoma pick-up rates were excellent, since respective recommended thresholds are > 25% in men older than 50% and > 15% in women according to current recommendations by the United States Multi-Society Task Force on CRC[20–22], and a recent meta-analysis[23]. Furthermore, the recommended benchmark for cecal intubation rate is 95% which is comparable to the cecal intubation rate achieved in this study (94.4%; 95% CI: 91.5%-97.3%)[20–22]. These recommendations are part of a series of recent studies published in the world literature aimed at improving the quality of colonoscopy[22–24] in an attempt to optimize patient outcomes in CRC screening[22].

In summary, the overall quality of the reports was good (considering the location of reported information pre- and post-procedures), although not optimal. Indeed, the MUHC-MGH group appears to perform within the threshold set by the Quality Assurance Task Group of the National Colorectal Cancer Roundtable[20–22] for most indicators, although improvement is required for some documentation (e.g., ASA score, and withdrawal time). It is now imperative to continue to improve the appropriate use of the reporting system and revise the user-interface of the software accordingly to optimize the quality of colonoscopies and CRC screening care. Moreover, further improvements are needed in linking databases for optimal consolidation of information on past procedures, post-procedural complications, and pathology results such that they all appear in a single report that can be provided to referring physicians and patients.

COMMENTS

Background
Colonscopic quality is critical in colorectal cancer screening. Formal quality assessments of colonoscopy reporting are few. The authors completed a quality review according to criteria of the Quality Assurance Task Group of the National Colorectal Cancer (CRC) Roundtable.

Research frontiers
Prospective studies assessing the completeness of colonoscopic reporting for CRC screening are few in the literature.

Innovations and breakthroughs
The authors audited reports of 250 patients (63.2 ± 10.5 years, 42.8% female) scoped in June 2009 by 8 gastrointestinal and 3 surgeons (mean practice years = 15.3). While some quality indicators were routinely reported, others were systematically lacking.

Applications
Modification of the electronic reporting software for colonoscopy reporting is required to optimize quality indicator reporting.

Peer review
This is a good descriptive study in which authors complete a quality audit using recently published criteria from the Quality Assurance Task Group of the National CRC Roundtable. The results are interesting and suggest two hundred and fifty patients were scoped in June 2009 by 8 gastroenterologists and 3 surgeons.

REFERENCES
1. Leddin DJ, Enns R, Hilsden R, Plourde V, Rabeneck L, Saudowsky DC, Sighn H. Canadian Association of Gastroenterology position statement on screening individuals at average risk for developing colorectal cancer: 2010. Can J Gastroenterol 2010; 24:705-714
2. Lieberman D, Nadel M, Smith RA, Atkin W, Duggirala SB, Fletcher R, Glick SN, Johnson CD, Levin TR, Pope JB, Potter MB, Ransohoff D, Rex D, Schoen R, Schroy P, Winawer S. Standardized colonoscopy reporting and data system: report of the Quality Assurance Task Group of the National Colorectal Cancer Roundtable. Gastrointest Endosc 2007; 65:757-766
3. Qaseem A, Denberg TD, Hopkins RH, Humphrey LL, Levine J, Sweet DE, Shekelle P. Screening for colorectal cancer: a guidance statement from the American College of Physicians. Ann Intern Med 2012; 156:378-386
4. Telford JJ. Canadian guidelines for colorectal cancer screening. Can J Gastroenterol 2011; 25:479-481
5. Cairns SR, Scholefield JH, Steele RJ, Dunlop MG, Thomas HJ, Evans GD, Eaden JA, Rutter MD, Atkin WP, Saunders BP, Lucassen A, Jenkins P, Fairclough PD, Woodhouse CR. Guidelines for colorectal cancer screening and surveillance in moderate and high risk groups (update from 2002). Gut 2010; 59:666-689
6. Burt RW, Barthel JS, Dunn KB, David DS, Drellichman E, Ford JM, Giardiello FM, Gruber SB, Halverson AL, Hamilton SR, Ismail MK, Jasperson K, Lazenby AJ, Lynch PM, Martin EW, Mayer RJ, Ness RM, Provenzale D, Rao MS, Shike M, Steinbach G, Terdiman JP, Weinberg D. NCCN clinical practice guidelines in oncology. Colorectal cancer screening. J Natl Compr Canc Netw 2010; 8:8-61
7. Rex DK, Bond JH, Winawer S, Levin TR, Burt RW, Johnson DA, Kirk LM, Litlin S, Lieberman DA, Waye JD, Church J, Marshall JB, Riddell RH. Quality in the technical performance of colonoscopy and the continuous quality improvement process for colonoscopy: recommendations of the U.S. Multi-Society Task Force on Colorectal Cancer. Am J Gastroenterol 2002; 97:1296-1308
8. de Jonge V, Sint Nicolaas J, Cahlen DL, Moorenaar W, Ouwendijk RJ, Tang TJ, van Tilburg AJ, Kuipers EJ, van Leer MWJ, Schmiegel W, Dijkgraaf MG, van der Cruysse J, Steenwinkel B, Vermaas EW, Vermeulen LM, Vrolijk M, Capdeville F, de Vries J, Hazebroek J, Kuijper A, Vrencken J, Wijkhuizen G, de Lange DJH, van Wijk MC, Theunissen J, van der Meulen P, Roelofsen J, Steenwinkel B, Gortel M, Vermaas EW, Vermeulen LM, de Lange T, Mouna BA, Tholfsen JK, Larsen S, Aabakken L. Standardization and quality of endoscopy text reports in ulcerative colitis. Endoscopy 2003; 35:835-840
9. Palmer LB, Abbott DH, Hamilton N, Provenzale D, Fisher DA. Quality of colonoscopy reporting in community practice. Gastrointest Endosc 2010; 72:321-327, 327 e1
10. Spencer HL, Lobo AJ, Riley SA. Variations in the reporting of endoscopies by different endoscopists. Clin Med 2007; 7:23-27
11. Cotton PB, Connor P, McGill D, Jowell P, Nickl N, Schutz S, Leung J, Lee J, Libby E. Colonoscopy: practice variation among 69 hospital-based endoscopists. Gastrointest Endosc 2003; 57:352-357
12. Lieberman DA, Faigel DO, Logan JR, Mattek N, Holub J, Eisen G, Morris C, Smith R, Nadel M. Assessment of the quality of colonoscopy reports: results from a multicenter consortium. Gastrointest Endosc 2009; 69:645-653
13. Fox CP, Altenhofen L, Brenner H, Theilmann A, Stillfried DV, Schmigiel W. Efficacy of a nationwide screening colonoscopy program for colorectal cancer. Gastroenterology
2012; Epub ahead of print

15 Rex DK, Petreni JL, Baron TH, Chak A, Cohen J, Deal SE, Hoffman B, Jacobson BC, Mergener K, Petersen BT, Safdi MA, Faigel DO, Pike IM. Quality indicators for colonoscopy. Gastrointest Endosc 2006; 63: S16-S28

16 Armstrong D, Barkun A, Bridges R, Carter R, de Gara C, Dube C, Enns R, Hollingsworth R, Macintosh D, Borgaonkar M, Forget S, Leontiadis G, Meddings J, Cotton P, Kuipers EJ. Canadian Association of Gastroenterology consensus guidelines on safety and quality indicators in endoscopy. Can J Gastroenterol 2012; 26: 17-31

17 Barclay RL, Vicari JJ, Doughty AS, Johanson JF, Greenlaw RL. Colonoscopic withdrawal times and adenoma detection during screening colonoscopy. N Engl J Med 2006; 355: 2533-2541

18 Shingina A, Barkun AN, Razzaghi A, Martel M, Bardou M, Gralnek I. Systematic review: the presenting international normalised ratio (INR) as a predictor of outcome in patients with upper nonvariceal gastrointestinal bleeding. Aliment Pharmacol Ther 2011; 33: 1010-1018

19 Heitman SJ, Ronksley PE, Hilsden RJ, Manns BJ, Rostom A, Hemmelgarn BR. Prevalence of adenomas and colorectal cancer in average risk individuals: a systematic review and meta-analysis. Clin Gastroenterol Hepatol 2009; 7: 1272-1278

20 Romagnuolo J, Enns R, Ponich T, Springer J, Armstrong D, Barkun AN. Canadian credentialing guidelines for colonoscopy. Can J Gastroenterol 2008; 22: 17-22

21 Rabeneck L, Rumble RB, Axler J, Smith A, Armstrong D, Vinden C, Belliveau P, Rhodes K, Zwaal C, Mai V, Dixon P. Cancer Care Ontario Colonoscopy Standards: standards and evidentiary base. Can J Gastroenterol 2007; 21 Suppl D: 5D-24D

22 Benson ME, Reichelderfer M, Said A, Gaumnitz EA, Pfau PR. Variation in colonoscopic technique and adenoma detection rates at an academic gastroenterology unit. Dig Dis Sci 2010; 55: 166-171

23 Denis B, Sauleau EA, Gendre I, Piette C, Bretagne JF, Perrin P. Measurement of adenoma detection and discrimination during colonoscopy in routine practice: an exploratory study. Gastrointest Endosc 2011; 74: 1325-1336

24 Levin B, Lieberman DA, McFarland B, Andrews KS, Brooks D, Bond J, Dash C, Giardiello FM, Glick S, Johnson D, Johnson CD, Levin TR, Pickhardt PJ, Rex DK, Smith RA, Thorton A, Winawer SJ. Screening and surveillance for the early detection of colorectal cancer and adenomatous polyps, 2008: a joint guideline from the American Cancer Society, the US Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology. Gastroenterology 2008; 134: 1570-1595

25 Kaminski MF, Regula J, Kraszewska E, Polkowski M, Wojciechowska U, Didkowska J, Zwierko M, Rupinski M, Nowacki MP, Butruk E. Quality indicators for colonoscopy and the risk of interval cancer. N Engl J Med 2010; 362: 1795-1803

S- Editor Gou SX  L- Editor A  E- Editor Zheng XM