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Importance of Determining Indication for Colonoscopy: Implications for Practice and Policy

Amit G. Singal, MD MS[1], **Samir Gupta, MD MSCS**[2], **Jeffrey Lee, MD**[3], **Ethan Halm, MD MPH**[1], **Carolyn M. Rutter, PhD**[4], **Douglas Corley, MD PhD PMH**[5], and **John Inadomi, MD**[6]

[1]Department of Internal Medicine and Clinical Sciences, UT Southwestern Medical Center, Dallas, TX

[2]Department of Internal Medicine, University of San Diego, San Diego, CA

[3]Department of Internal Medicine, University of California San Francisco, San Francisco, CA

[4]Group Health Research Institute, Seattle, WA

[5]Division of Research, Kaiser Permanente Northern California, Oakland, CA

[6]Department of Internal Medicine, University of Washington, Seattle, WA

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Colorectal cancer (CRC) is the second leading cause of cancer-related death in the United States[1]. Colonoscopy plays a central role in the CRC screening process and can be performed for several indications, ranging from screening to surveillance to diagnostic work-up (Supplemental Table 1)[2]. In this commentary, we discuss the importance of accurately determining indication for colonoscopy in clinical care, healthcare quality reporting, research, and policy. Colonoscopy indication plays a central role in characterizing adenoma detection rates (ADR), overuse and underuse of CRC screening and surveillance, and the comparative effectiveness of different CRC screening strategies. Accordingly, documentation of procedural indication is one of the key recommendations for colonoscopy reporting from the Quality Assurance Task Force of the National Colorectal Cancer Roundtable (NCCRT)[3]. However, several challenges and inconsistencies make determination of colonoscopy indication difficult. For example, there are several varying perspectives of indication and data sources, each potentially yielding a different answer. We

Correspondence: Amit G. Singal, M.D., M.S., Dedman Scholar of Clinical Care, Division of Digestive and Liver Diseases, University of Texas Southwestern, 5959 Harry Hines Blvd, POB 1, Suite 420, Dallas TX 75390-8887, Tel: 214-645-6029, Fax: 214-645-6294, amit.singal@utsouthwestern.edu.

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review several published algorithms to determine indication to highlight these issues and propose suggestions for future research in this area.

Importance of Assessing and Reporting the Indication for Colonoscopy

Accurate determination of colonoscopy indication is important for several reasons including clinical care, payment, healthcare quality metrics, and clinical research (Supplemental Table 2). From a clinical perspective, indication has implications for procedural urgency and scheduling given the prevalence of adenomas, CRC, and/or other findings requiring medical therapy is higher among individuals referred for diagnostic colonoscopy than those referred for a screening exam[4,5]. Similarly, patient-reported benefits and adherence to colonoscopy are greater when performed for diagnostic purposes than average-risk screening[6].

Indication for colonoscopy also has implications for procedural reimbursement. With advent of the Affordable Care Act, insurers are required to offer preventive services listed as Grade A or B recommendations (including colonoscopy for CRC screening) to beneficiaries without cost-sharing or copayment[7]. However, colonoscopies performed for diagnostic or surveillance indications may not be covered or may require co-pays from patients. Therefore, inaccurate determination of exam indication can have substantial reimbursement implications for health systems and cost implications for patients.

Accurate determination of indication for colonoscopy is critical for several quality metrics. For example, the ADR – defined for each colonoscopist by the percent of patients with at least one adenoma among those undergoing *screening* colonoscopy – has become an important metric for measuring colonoscopy quality. Given the consistent observed inverse relationship between ADR and interval cancers[8, 9], the Centers for Medicare And Medicaid Services (CMS) included ADR in its list of 2014 Physician Quality Reporting System (PQRS) measures and the American College of Gastroenterology (ACG) published target ADRs for average-risk screening exams[10]. However, ADRs could be falsely elevated if surveillance or diagnostic colonoscopies are misclassified as screening exams given the prevalence of adenomas differs by exam indication[3, 4, 11, 12]. Therefore, accurate determination of the indication for colonoscopy is necessary to accurately assess ADRs and compare the performance of a colonoscopist to his/her peers and national benchmarks.

Accurate characterization of colonoscopy under- and overuse is also dependent on careful assessment of colonoscopy indication. Quality and research work addressing under- and overuse has potential to improve the value of colonoscopy by improving outcomes (through addressing underuse) and reducing risk (through addressing overuse[13–16]). Accordingly, CMS has designated recommendations for the appropriate timing of repeat colonoscopy after normal average-risk screening as a PQRS measure[10]. Additionally, the American Gastroenterological Association (AGA) has partnered with the American Board of Internal Medicine (ABIM) Foundation as part of the “Choosing Wisely” campaign to promote appropriate screening and surveillance intervals after colonoscopy[17]. However, appropriate intervals are based on several factors, including exam indication and findings at the time of prior colonoscopy[2]. For example, guidelines recommend a 10-year interval for repeat colonoscopy in an average-risk patient with a normal *screening* exam; however, a 5-year

interval would be appropriate in a patient undergoing *surveillance* for a personal history of adenomatous polyps. Similarly, a repeat colonoscopy for *surveillance* two years after a colonoscopy with a small tubular adenoma, without high-grade dysplasia, would be considered overuse, whereas a *diagnostic* colonoscopy for gastrointestinal (GI) bleeding at that same time interval would be appropriate. Thus, without careful adjudication of indication, assessment of colonoscopy under- and over-use is impossible.

Finally, accurate determination of indication is also important for comparative effectiveness research of different CRC screening tests and strategies[18]. When evaluating the effectiveness of screening tests to reduce interval cancers and mortality, it is important to exclude exams done for non-screening purposes, particularly diagnostic exams. A recent case-control study demonstrated an association between screening colonoscopy and reduced rates of right- and left-sided late-stage CRC; however, the authors found this association was stronger in colonoscopies done for screening purposes (OR 0.30, 95%CI 0.15–0.59) than those done for surveillance (OR 0.38, 95% CI 0.15–1.0), or "probable diagnostic" intent (OR 0.48, 95% CI 0.18–1.24)[19]. Overall, from clinical, healthcare quality, and clinical research perspectives, accurate assessment of indication for colonoscopy is vital.

Challenges to Accurate Classification of Colonoscopy Indication

Although it is clear that colonoscopy indication is important to determine, there are several challenges to its accurate classification. First, variability in history taking among providers and/or patient knowledge about his/her personal and family history may lead to incorrect documentation of indication. For example, a referring provider may order "average-risk screening" for a patient with a family history of CRC if they fail to take an adequate family history[20, 21]. Similarly, the true colonoscopy indication may stem from information not initially recognized by the patient or provider. Providers and patients may not know results of prior colonoscopy exams, including the presence or type of polyps, leading to misclassification of screening versus surveillance exams. Similarly, a provider may miss the presence of a positive fecal immunochemical test (FIT) if a complete review of laboratory tests is not performed, leading to inaccurate classification of a colonoscopy as screening instead of a diagnostic exam, even though risk for neoplasia associated with a positive FIT indication is much higher compared to screening[22, 23].

Second, differences in determination of exam indication may arise from taking different perspectives (e.g., patient, referring provider, endoscopist, chart review). An example is provided in Supplemental Figure 1: a patient with a first-degree relative who had CRC should be regarded as "high-risk screening"; however, a primary care provider may have referred the patient for "average-risk screening". If the patient reports symptoms, these may be recorded at the time of exam. Even in the absence of symptoms, the exam may be billed by the endoscopist as a "diagnostic exam" if polyps are removed during the procedure[24]. Finally, if a chart reviewer looks back and observes a positive FIT within the last year, or finds evidence of symptoms that might be evaluated by colonoscopy, then the exam might be considered a diagnostic test. Therefore, it is possible that the same procedure could be classified with different indications, depending on the perspective.

Third, there are several potential data sources to determine colonoscopy indication (e.g., billing data, electronic medical record (EMR) data, patient self-report), which may yield different exam indications. Historically, the most commonly used data source has been billing data (i.e. International Classification of Diseases (ICD) and current procedural terminology (CPT) codes); however, this method is prone to random misclassification from coding errors and systematic error from coding practices being determined by financial reimbursement. For example, a colonoscopy performed for screening purposes may incorrectly have a billing code for diagnostic colonoscopy if a polyp is removed during the procedure[24].

Several commercial endoscopic reporting software programs (e.g. Provation (Provation Medical Inc, Minneapolis, MN) and Endoworks (Olympus America Inc, Center Valley, PA)) now facilitate indication to be captured as a discrete data field. In this case, colonoscopy indication is based on the endoscopist's pre-procedure history and chart review. Similar to billing data, this method could be prone to endoscopist error and/or potential modification of indication due to different coverage and reimbursement realities. For example, an endoscopist may list clinically insignificant gastrointestinal complaints (e.g. minor rectal bleeding from hemorrhoids) as the indication for a short-interval colonoscopy, instead of screening, if he/she perceived an insurance company would be less likely to deny payment for a diagnostic exam. Patient self-report, another potential source of capturing procedural indication, has moderate to substantial agreement with that of the endoscopist, with kappa ranging from 0.58 to 0.70[25]. Although potentially reliable, there are scant data regarding the validity of endoscopist impression or patient self-report for determining indication. Furthermore, it is unclear if patient report would work equally well for low literacy patients, those of low socioeconomic status, and/or patients who are less involved with their medical care. Similarly, the referring provider's reason for colonoscopy request can be captured as discrete data in several EMR systems, although no studies to date have evaluated the accuracy of this perspective.

Finally, the EMR contains data regarding past history, laboratory data, and prior procedures; thus, it can serve as an increasingly powerful source to determine indication for colonoscopy. A recorded family history of colon cancer can help categorize an exam as high-risk screening, while a personal history of adenomas or cancer can categorize a colonoscopy as surveillance. Similarly, pathology results confirming prior adenomatous polyps can identify surveillance exams, and laboratory results can identify diagnostic procedures performed for positive FIT test or iron-deficiency anemia. Unfortunately, key information in the EMR (e.g. data regarding polyps) is often not recorded in easily ascertainable, electronically discrete data fields but instead may reside solely as free text in progress notes, colonoscopy reports, or pathology reports. Natural language processing (NLP) techniques have promise for extracting such information from free text fields in EMRs to provide valid assessment of procedural indication[26, 27]. NLP has been used to extract other data from colonoscopy reports for quality metrics, such as cecal intubation rate and documentation of prep quality[27, 28]. NLP has also been successfully used to determine the highest level of pathology (cancer, advanced adenoma, adenoma, hyperplastic polyp, and normal) and inform surveillance colonoscopy intervals[29, 30]. It is possible that advances in EMR capabilities and NLP in the future may eventually allow a triangulation of several

perspectives using different data sources (i.e. provider notes and orders, laboratory and pathology data, and endoscopy reports), facilitating a more accurate and less variable reference standard for colonoscopy indication.

Prior Algorithms for Colonoscopy Indication

Several algorithms have been developed to classify colonoscopy indications using administrative or claims data (Supplemental Table 3). Clinically informed algorithms to distinguish screening and non-screening colonoscopy have been developed using a combination of ICD-9 codes and CPT codes prior to the procedure[31, 32, 33]. However, all such models had important limitations including demonstrating only moderate sensitivity and specificity; evaluating CRC screening history only in the 1–4 years prior to the index colonoscopy; inability to link administrative or claims data with gastroenterology referral notes, pathology records, or cancer registry data; and only reporting the algorithms' sensitivity and specificity for screening exams.

Statistical algorithms have also been developed to help discriminate colonoscopy indications. Using classification trees and linear discriminant analysis, Ko and colleagues developed and validated three algorithms to classify colonoscopy indication using ICD-9 and CPT codes within 12 months prior to colonoscopy[34]. The algorithms demonstrated high specificity for screening and surveillance indications (>95%) but only moderate sensitivity (varying between 55% and 58%). Similarly, Sewitch et al developed a logistic regression model to determine if a colonoscopy was performed for screening purposes[35]. The algorithm demonstrated high sensitivity (~85%) but only moderate specificity (62–63%). It should be noted that these algorithms used endoscopist impression as the criterion standard, which may be subject to misclassification, particularly if prior medical records or pathology reports were unavailable to the endoscopist.

Recently, attempts have been made to use NLP techniques to determine colonoscopy indication[27]. Harkema and colleagues reported concordance of 87% but a kappa statistic of only 0.39 between an NLP-based algorithm and manual chart review to determine colonoscopy indication[36]. Therefore, although NLP may potentially offer a long-term solution to determine colonoscopy indication, further refinement and validation of NLP-based algorithms is still needed[28].

Next Steps and Conclusions

It is clear that establishing colonoscopy indication is important for clinical care, assessment of quality metrics, payment, and clinical research. Documentation of procedural indication was therefore included as one of the key recommendations for colonoscopy reporting from the Quality Assurance Task Force of the NCCRT. However, there are several barriers to accurate determination of indication, including variations in perspective and the quality of data ascertainment. Several algorithms have been developed using a variety of different methods, although each has its limitations. It will be important for researchers to continue exploring this area to determine the best way to determine indication. Although NLP has emerged as a potential promising approach to determining colonoscopy indication, further improvement and validation of this approach is needed.

As part of the National Cancer Institute (NCI)-funded Population-based Research Optimizing Screening through Personalized Regimens (PROSPR) Network, we are in the process of developing and comparing three novel algorithms to accurately determine indication for colonoscopy. The overall aim of PROSPR is to conduct multi-site, coordinated, trans-disciplinary research to evaluate and improve cancer-screening processes. The seven PROSPR Research Centers reflect the diversity of US delivery system organizations. The PROSPR algorithms differ with regard to their perspective as well as data sources so we hope that this effort will shed light on the optimal method to determine indication.

To help encourage progress in this area, we have proposed recommendations for how future studies regarding colonoscopy quality and outcomes should report on procedural indications (Table 1). First, we recommend that colonoscopy indication should be recorded and reported for all studies assessing colonoscopy quality. At a minimum, colonoscopy exams should be characterized as screening vs. non-screening. Ideally, colonoscopy exams should be characterized as average-risk screening, high-risk screening, surveillance, and diagnostic colonoscopies. Second, we recommend studies detail the exact criteria used to classify indication, including the factors the algorithm did and did not include, and how they were assessed. Third, the perspective of indication should be articulated (patient, referring provider, endoscopist, or chart review). Fourth, there should be a clearly defined gold standard to determine indication, preferably definitive chart review that includes all laboratory, pathology, family history, and clinical data available prior to the colonoscopy exam. Fifth, the distribution of exams by indication should be summarized. Finally, studies regarding the appropriate use and effectiveness of colonoscopy (e.g. adenoma detection rates, polypectomy rates, or impact on survival) should stratify results based on indication.

As policymakers seek to promote more value-based reimbursement models, assessment of the quality and outcomes of colonoscopy and different CRC screening strategies will become even more important. Not only will documentation of the indication for procedures be a quality measure, but indication will also allow correct stratification of procedural outcomes. The appropriateness of colonoscopy (overuse and underuse) will be determined by the reason the procedure was performed; moreover, the rating of an endoscopist’s ability to perform a complete, high quality exam will also hinge on procedural indication. Thus we postulate that efforts to optimize documentation and measurement of colonoscopy indication will result in improved research, policy, and quality measurement that may translate into better strategies for CRC prevention.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

PROSPR Network Recommendations for studies regarding colonoscopy quality

1. Indication (at minimum screening vs. non-screening) should be measured
2. The criteria used to classify indication should be specified, including the factors included in the algorithm and how they were assessed
3. The perspective of indication determination should be reported (patient, referring provider, endoscopist, or chart reviewer).
4. There should be a clearly defined gold standard to determine indication
5. The distribution of exams by indication should be summarized
6. Sensitivity analyses should be considered for results that might change based on indication classification