

Quality Colorectal Cancer Screening: Endoscopic Performance Measures and Beyond

Matthew A. Mason¹ · Brooks D. Cash²

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Abstract

Purpose of Review The rationale behind and implementation of quality measures around colonoscopy for colorectal (CRC) screening are important topics for endoscopists to understand to deliver exemplary care with the goal of decreasing the incidence of this disease. This article will evaluate recent data on this subject and summarize pertinent findings in the growing field of quality improvement research surrounding colonoscopy for CRC screening.

Recent Findings Both pre- and intra-procedural metrics have been studied across a variety of practice models and patient populations. Contemporary metrics include adequate bowel preparation, cecal intubation rate, adenoma detection rate, polypectomy rate, proximal serrated polyp detection rate, withdrawal time, and patient satisfaction.

Summary Multiple quality metrics have been formally evaluated regarding colonoscopy, and others have recently been proposed. Additional validation is necessary to determine which quality metrics serve as practical and implementable to improve endoscopic performance and overall delivery of care.

Keywords Colonoscopy · Quality · Adenoma detection rate (ADR)

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✉ Brooks D. Cash
bcash@health.southalabama.edu

¹ Department of Medicine, University of South Alabama Medical Center, Mobile, AL, USA

² Division of Gastroenterology, University of South Alabama Medical Center, 6000 University Commons, 75 University Blvd., South, Mobile, AL 36688, USA

Introduction

In all disciplines of medicine, an expanding spotlight has been placed on quality assurance and improvement, by patients, professional organizations, regulatory authorities, healthcare systems, and payers. The concept of a link between the consistent and reproducible quality of care delivered to patients and rewards or penalties has become real for many providers. Quality metrics are meant to serve as objective measures of the quality of care and can be recorded and tracked across a multitude of healthcare constituents, from individual providers to large-scale healthcare systems. Over the last decade, the mandate to improve patient care while simultaneously decreasing healthcare costs has driven an abundance of research focusing on quality metrics in medicine.

Colonoscopy remains the preferred method for detecting and removing precancerous lesions in the colon as well as the test of choice for diagnosing lower gastrointestinal pathology in symptomatic adults [1]. The procedure is considered generally safe and effective in lowering the incidence of CRC when used for screening in a programmatic fashion. The effectiveness and quality of colonoscopy for CRC screening depend on multiple factors that can be measured by pre-, intra-, and post-procedural metrics, several of which have been evaluated as quality indicators. Pre-procedural factors include patient acceptance to undergo the procedure and deliver an adequate bowel preparation. Intra-procedural factors include cecal intubation rate, adenoma detection rate (ADR), polypectomy rate (PR), proximal serrated polyp detection rate (PSP-DR), withdrawal time, and patient comfort. Post-procedural factors are primarily assessed by measuring complications related to the procedure but may also involve ADR/PSP-DR given the post hoc requisite in many practice models for linking histopathology to findings on colonoscopy. The remainder of this report will discuss the rationale and data

surrounding these metrics as quality indicators as well as recent research aimed at enhancing quality around the various procedure-related factors.

Adequate Bowel Preparation

An excellent bowel preparation enhances the effectiveness of colonoscopy in several ways. It decreases the complication rate, making the procedure safer for the patient [2]. Moreover, it improves the quality of visual inspection of the colonic mucosa and ultimately affects procedure duration, through reduced work and time required for additional cleansing [2, 3]. An adequate bowel preparation has also been shown to improve ADR, a widely accepted metric for quality colonoscopy [4]. Several objective scales have been used to qualitatively grade bowel preparations. Previous studies have shown that “fair” bowel preparations are associated with adenoma miss rates as high as 28–34%, emphasizing the importance of adequate bowel preparation [5, 6]. A recent simulation study showed that at current average cost per colonoscopy, the rate of inadequate bowel preparation should not exceed 13% to be considered more cost effective than fecal immunochemical testing (FIT). Furthermore, the most recent American Society for Gastrointestinal Endoscopy (ASGE) and American College of Gastroenterology (ACG) recommendations state that a colonoscopist should strive for $\leq 15\%$ inadequate bowel preparations [7, 8•]. If this value is regularly exceeded, the methods used for patient instruction regarding preparation administration and completion should be re-evaluated.

A 2016 study from China showed that delivering bowel preparation instructions using technology via social media applications yielded higher quality bowel preparations when compared to standard, in-office educational instructional sessions [9]. Furthermore, another 2014 study from China showed significantly improved bowel preparations when patients were given telephone-based re-education on instructions for bowel preparation the day prior to their planned procedure [10]. Both studies highlight the utilization of widely available technology to yield better quality bowel preparations.

There is well-established data that supports the use of split-dose preparations, which has been shown to increase both the ADR and polyp detection rate (PDR) [11]. Patients have been shown to achieve significantly better rates of satisfactory preparations than standard day-before preparations (85 vs 63%) [12•]. Split-dose preparations have been shown to be *more* tolerable and convenient for the patient, despite prior concerns regarding patient acceptance [13]. Another quality metric that should be emphasized as it relates to bowel preparation is documentation of the quality of the preparation. The ASGE/ACG recommend that all colonoscopy reports include a description of the quality of preparation using either standardized preparation scales or terms such as *adequate* or *inadequate* [8•]. While it is important to remember that no

single bowel preparation scale has been adopted universally as the “gold standard,” many have been shown to parallel polyp detection rates and several. For example, the Boston Bowel Preparation Scale has been validated and proven to be reliable and reproducible in a variety of practice settings [14]. If the preparation is inadequate to identify polyps >5 mm in size, both the ASGE/ACG Task Force and the US Multi-society Task Force (USMSTF) recommend repeating the colonoscopy in 1 year or less [8•, 15•]. Current and future integrations of these scaling systems into electronic databases are likely to expand with the persistent focus on quality improvement.

Cecal Intubation Rate

Visualization of the proximal colon, including the cecum, is an essential part of a complete colonoscopy, and higher cecal intubation rates have been shown to correlate with decreased incidence rates of CRC [16]. Colonoscopy is known to be less effective in detecting and preventing right-sided CRC compared to left-sided CRC. This observation has prompted a more complete appreciation of sessile, serrated right-sided lesions and the potential for interval cancers [17, 18]. There has been a movement in recent years regarding re-inspection of the right colon using either a retroflexed view or a second view in the forward position [19]. Both strategies have been shown to increase ADR compared to a single forward view; however, neither technique was found to be statistically superior to the other [20, 21].

Given the established importance of detecting proximal lesions in the colon, the ASGE/ACG Task Force currently recommends a cecal intubation rate $\geq 95\%$ for CRC screening cases and $\geq 90\%$ for all examinations [8•]. This may be affected by several factors such as poor bowel preparation and/or tortuosity of the colon that prevents successful complete advancement of the colonoscope. When the right colon cannot be adequately visualized during an initial colonoscopy, a repeat procedure should be performed when feasible to achieve an adequate examination [8•].

Adenoma Detection Rate

In recent years, ADR has gained significant attention as one of the most important indicators of quality colonoscopy, primarily due to its direct relationship with the development of CRC. The ADR is defined as the number of screening colonoscopies yielding at least one adenoma divided by the total number of colonoscopies performed by a specific endoscopist. A study done by Corley et al. highlighted the relationship between ADR and CRC and showed that a 1% increase in ADR generated a 3% decrease in CRC and ultimately a 5% decrease in mortality related to CRC [22•]. A 2010 study by Kaminski et al. also illustrated ADR as an

independent predictor for the development of interval CRC following a screening colonoscopy [23].

Although there is sound data to support the relationship between ADR and CRC prevention and associated mortality, there is still some debate as to what the appropriate ADR value for a colonoscopist should be. The 2006 ASGE/ACG Task Force on Endoscopy statement by Rex et al. suggested that in healthy, asymptomatic patients undergoing screening colonoscopy, the ADR should be at least 25% for males and 15% for females over the age of 50 [7]. However, after additional research, including the study by Corley, the updated 2015 recommendations have increased the target ADR to 30% for males and 20% for females [8•].

PDR has long been proposed as a proxy to ADR for several reasons. First, it can be documented immediately post-procedurally without the need for histopathologic correlation. Furthermore, it has been shown to statistically parallel the ADR and may serve as a useful tool for practices that do not have fully integrated electronic medical records (EMR) that can easily pair pathology results with previously removed polyps [24]. However, there are inherent problems that can arise with substituting PDR for ADR, namely, gaming of the PDR through the intentional or unintentional motivation to remove benign, left-sided lesions (hyperplastic polyps, lymphoid aggregates, etc.) leading to an increased PDR without a commensurate increase in ADR or benefit to the patient.

Several other recent studies have focused on leadership training in attempts to improve the ADR. Kaminski et al. evaluated 40 Polish colonoscopy centers that were achieving suboptimal ADRs (<25%) and compared feedback on individual quality benchmarks versus a multi-phase Train-Colonoscopy-Leaders (TCL) program on delivering quality colonoscopy [25]. They found that center leaders enrolled in the TCL program had an ADR improvement of 7.1 versus 4.2% in the feedback-only group [25]. Another study from 2015 by Belderbos et al. showed considerable variation in ADR among individual hospitals, independent of bowel preparation quality and cecal intubation rates, which further supports the concept of implementing regimented performance-directed quality improvement programs for low performers with the objective of increasing their ADR to the minimal standards mentioned above [26].

As the focus on quality improvement and its relationship to financial reimbursement evolves, it remains to be seen how ADR goals will be defined and ultimately utilized by regulatory authorities or payers. Nevertheless, given the established relationship of ADR to CRC development and mortality, these metrics will likely persist and take on greater importance in the expanding arena of accountable care [27].

Proximal Serrated Polyp Detection Rate

Over the past decade, significant focus has been placed on sessile serrated adenomas (SSAs) and their relationship to

the development of interval CRC (defined as CRC detected within 5 years of a clearing colonoscopy) [28–30]. On endoscopy, SSAs generally appear flat, ≥ 5 mm, are often covered by a thin mucus layer, and are more commonly located in the proximal colon [31, 32] than non-serrated adenomas. These lesions do not follow the traditional adenoma-carcinoma sequence, but rather the serrated pathway characterized by BRAF oncogene mutations, hyper-methylation (CpG island methylator phenotype (CIMP)), and potentially a more rapid transformation to CRC [33, 34]. Furthermore, SSAs are more likely to be present in the transverse and ascending colon, which is already susceptible to increased polyp miss rates [27]. A large, retrospective cohort study by Kahi et al. in 2011 demonstrated a prevalence of at least one proximal serrated lesion in average risk patients of 13% [35].

Although the importance of SSAs has been well defined in the literature, there are few available guidelines regarding detection of these lesions during screening and surveillance colonoscopy with regard to defining quality metrics. The 2012 consensus update by the USMSTF on CRC recommends surveillance intervals ranging from 1 to 5 years depending on size, number, and histology of serrated lesions found on colonoscopy [15•]. However, these are consensus recommendations with low to moderate quality of evidence and are not based on new evidence beyond the 2006 guidelines [15•].

An important question that is currently being evaluated pertains to the metrics that could be used to define a quality parameter related to SSA detection. One possibility is the PSP-DR, similar in concept to the ADR. A recent article by Anderson et al. evaluated two potential metrics, the clinically significant serrated polyp detection rate (CSS-DR) as well as the PSP-DR, among endoscopists performing screening and surveillance colonoscopies [36•]. CSS-DR was defined as a SSA, traditional serrated adenoma (TSA), or hyperplastic polyp (HP) ≥ 1 cm detected anywhere in the colon or >5 mm in the proximal colon, divided by total number of colonoscopies. PSP-DR was defined as any serrated polyp located proximal to the sigmoid colon divided by total number of colonoscopies. The ADR was used to stratify endoscopists into high or low performers. Endoscopists with an ADR $>25\%$ had median CSS-DR and PSP-DR of 6.8 and 10.8%, respectively. This is in stark contrast to endoscopists with an ADR $<15\%$ in which the CSS-DR and PSP-DR were 1.3 and 2.5%, respectively. These investigators concluded that a proposed benchmark for CSS-DR and PSP-DR should be approximately 7 and 11%, respectively. Importantly, these metrics, contrary to the ADR, have not been linked to improved patient outcomes, so it is unlikely that they will become established until such data is available.

There is, however, a great deal of interest with regard to improving the detection of SSAs during colonoscopy through the implementation of advancements in endoscopic technology such as high-definition white light endoscopy (WLE), narrow-band

imaging (NBI), and chromoendoscopy. There is some data, although conflicting, to suggest an advantage with high-definition WLE in detecting small, right-sided SSAs compared to standard definition WLE [37, 38]. Other endoscopic adjuncts that have been studied include cap-assisted colonoscopy, water-infusion techniques, Third-Eye Retroscope®, Full Spectrum Endoscopy™, and the previously mentioned cecal retroflexion technique [39]. Most have shown marginal improvements in polyp detection, with NBI and high-definition WLE yielding the greatest improvement in PSP-DR when compared to standard definition colonoscopy [39, 40].

Withdrawal Time

Allowing adequate time to inspect the colonic mucosa is regarded as a quality measure for CRC screening with colonoscopy [8••]. A direct linkage between adequate mucosal examination time, similar to that seen with adequate bowel preparation, to increased ADR has been established in multiple studies. A landmark community-based study published in 2006 of nearly 8000 gastroenterologist-performed colonoscopies found that an average withdrawal time of ≥ 6 min was associated with a significantly larger ADR compared to procedures with shorter withdrawal times [41]. It is important to note that the withdrawal time should not include time related to polyp removal and should reflect the *average* withdrawal time for a given endoscopist [8••]. Several other studies have evaluated alternative time cutoffs, with variable results. One analysis of the New Hampshire Colonoscopy Registry database found that the ADR increased from 23.8 to 33.6% when the withdrawal time increased from 6 to 9 min [42•]. Of note, however, this registry includes endoscopists from multiple specialties including gastroenterology, general and colorectal surgery, and family medicine, which may have skewed the results due to other intra-procedural related parameters [42•].

Adherence to Surveillance Guidelines

Although the pre- and intra-procedural measures outlined above are vital components of delivering quality colonoscopy, it is also critical to ensure that at-risk patients are undergoing surveillance colonoscopies at appropriate intervals, as the benefits of a high-quality examination can be compromised if the patient fails to undergo appropriate surveillance. For instance, a Norwegian study from 2014 showed no correlation between polypectomy and decreased incidence of CRC [43]. However, local recommendations during this period included a 10-year follow-up examination for advanced adenomas and no recommended follow-up for smaller adenomas. Patients in the 10-

year follow-up group were found to have a higher incidence of CRC compared to the low-risk group without recommended follow-up. This is potentially because the group instructed to follow up in 10 years was at a higher risk to develop CRC based on the findings on their initial colonoscopy than the no follow-up group. The 2012 USMSTF guidelines highlight the importance of appropriate surveillance intervals, suggesting shorter intervals for higher risk adenomas (>2 and/or ≥ 1 cm) ranging from 1 to 3 years and longer intervals (5–10 years) for smaller, non-advanced adenomas [15••]. By way of contrast, however, there is significant data to suggest that US gastroenterologists repeat colonoscopies too soon, putting the patient at higher risk for procedure-related complications and increasing surveillance costs without convincing evidence of patient benefit [44, 45].

Patient Satisfaction

As patient-centered healthcare continues to evolve, there has been more emphasis on patient satisfaction and the potential penalties for not reaching certain benchmarks regarding delivering quality care. The ASGE/ACG Task Force considers patient satisfaction as part of the post-procedural quality metrics [8••]. Certainly, several post-procedural complications may affect a patient's overall satisfaction, such as bleeding, infection, or perforation. However, many of the other quality measures have not been shown to dramatically affect a patient's perception of their care and overall satisfaction [46]. One study showed that playing music during the procedure improved patient tolerance without having an effect on the endoscopist's ability to perform [47]. Many studies have evaluated patient comfort during the procedure as it relates to patient satisfaction. A systematic review and meta-analysis by McQuaid and Laine showed that sedation using midazolam and a narcotic improved patient comfort, tolerance, and ultimately satisfaction [48]. Furthermore, a pooled analysis by Ulmer et al. showed that patients had higher rates of satisfaction when they received propofol either alone or in combination compared to standard conscious sedation [49].

Conclusion

Quality metrics in colonoscopy are meant to serve as objective means to quantify delivery of care and subsequently improve the value of the procedure. The pre- and intra-procedural metrics discussed above continue to evolve, as do other contributors to care such as technology and reimbursement. Additional research is needed to identify specific strategies to improve the delivery of high-quality colonoscopy across a broad range of practice models.

Compliance with Ethical Standards

Conflict of Interest The authors declare they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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