

Barriers and facilitators to implementing continuous quality improvement programs in colonoscopy services: a mixed methods systematic review

Authors

Bernard Candas^{1,2}, Gilles Jobin^{3,4}, Catherine Dubé⁵, Mario Tousignant⁶, Anis Ben Abdeljelil⁶, Sonya Grenier⁶, Marie-Pierre Gagnon^{7,8}

Institutions

Institutions are listed at the end of article.

submitted 3. July 2015
accepted after revision
5. October 2015

Bibliography

DOI <http://dx.doi.org/10.1055/s-0041-107901>
Published online: 15.12.2015
Endoscopy International Open 2016; 04: E118–E133
© Georg Thieme Verlag KG
Stuttgart · New York
E-ISSN 2196-9736

Corresponding author Marie-Pierre Gagnon, PhD

Faculty of Nursing Science
Université Laval
1050 avenue de la Médecine
room 1426
Quebec City
Quebec G1V 0A6
Canada
Fax: +1-418-525-4194
marie-pierre.gagnon@fsi.ulaval.ca

Background and aim: Continuous quality improvement (CQI) programs may result in quality of care and outcome improvement. However, the implementation of such programs has proven to be very challenging. This mixed methods systematic review identifies barriers and facilitators pertaining to the implementation of CQI programs in colonoscopy services and how they relate to endoscopists, nurses, managers, and patients.

Methods: We developed a search strategy adapted to 15 databases. Studies had to report on the implementation of a CQI intervention and identified barriers or facilitators relating to any of the four groups of actors directly concerned by the provision of colonoscopies. The quality of the selected studies was assessed and findings were extracted, categorized, and synthesized using a generic extraction grid customized through an iterative process.

Introduction

With the advent of organized colorectal cancer screening in most industrialized countries, the quality of colonoscopy is increasingly becoming a focus of attention [1–4]. High quality colonoscopy services will be essential to reduce colorectal cancer (CRC) mortality, and several expert groups have stressed the importance of prioritizing the implementation of colonoscopy continuous quality improvement (CQI) programs in organized screening [5,6]. The organizational, clinical, and performance dimensions of colonoscopy quality have been addressed regularly [7–15]. They aim at ensuring timely access, appropriate information for and preparation of patients, adequate endoscopists' and nurses' skills as well as patient satisfaction [11–15]. Beyond general knowledge about the adoption of innovations in healthcare, the barriers and facilitators pertaining to the im-

Results: We extracted 99 findings from the 15 selected publications. Although involving all actors is the most cited factor, the literature mainly focuses on the facilitators and barriers associated with the endoscopists' perspective. The most reported facilitators to CQI implementation are perception of feasibility, adoption of a formative approach, training and education, confidentiality, and assessing a limited number of quality indicators. Receptive attitudes, a sense of ownership and perceptions of positive impacts also facilitate the implementation. Finally, an organizational environment conducive to quality improvement has to be inclusive of all user groups, explicitly supportive, and provide appropriate resources.

Conclusion: Our findings corroborate the current models of adoption of innovations. However, a significant knowledge gap remains with respect to barriers and facilitators pertaining to nurses, patients, and managers.

plementation of CQI in colonoscopy units have not been addressed yet in a systematic review. The successful application of CQI approaches in healthcare results from the interaction of leadership, organizational culture, and teamwork to create a culture of excellence [16,17]. As a result of the complex nature of healthcare organizations, the implementation of innovative approaches in clinical settings depends on many factors that are both external and internal to the organization [18,19]. Nevertheless, some inner characteristics of organizations are more prone to facilitate this process. Customer focus, systems thinking, learning from measurement, and teamwork, as well as communication and feedback are critical in creating motivation and empowerment among users involved in CQI processes. With respect to colonoscopy, the successful implementation of a CQI program will thus depend on the involvement of physicians, nurses, and managers [20–23]. However, as a focus on customer needs

License terms



Table 1 Search strategy for Medline.

#12 Search	(#4 AND #9) OR (#3 AND #10) OR #11
#11 Search	Colonoscopy/standards[mh]
#10 Search	Endoscopy/standards[mh:noexp] OR Endoscopy, Digestive System/standards[mh:noexp] OR Endoscopy, Gastrointestinal/standards[mh:noexp]
#9 Search	#5 OR #6 OR #7 OR #8
#8 Search	Patient participation[mh] OR Consumer participation [mh] OR Consumer advocacy[mh] OR Patient advocacy [mh] OR Consumer organizations[mh] OR patient participation*[tiab] OR Consumer participation [tiab] OR patient involvement*[tiab] OR consumer involvement*[tiab] OR consumer advocac*[tiab] OR patient advocac*[tiab] OR Public participation[tiab] OR public involvement*[tiab] OR public advocacy*[tiab] OR Consumer organizations*[tiab] OR ((Patient*[ti] OR Public[ti] OR Consumer[ti]) AND (Participation*[ti] OR Involvement [ti] OR Advocac*[ti] OR Organization*[ti]))
#7 Search	Quality of Health Care[mh:noexp] OR Quality Assurance, Health Care[mh:noexp] OR Quality Indicators, Health Care[mh:noexp] OR Quality control[mh] OR Quality[tiab]
#6 Search	Adopt*[tiab] OR Implement*[tiab]
#5 Search	Attitude[mh] OR Attitude*[tiab] OR Accept*[tiab] OR Barrier*[tiab] OR Difficult*[tiab] OR Facilitator*[tiab] OR Resist*[tiab] OR Usefulness[tiab] OR "Ease of use"[tiab]
#4 Search	#1 OR (#2 AND #3)
#3 Search	Colorectal neoplasms[mh] OR Colorectal cancer*[tiab] OR Colorectal neoplasm*[tiab] OR Colorectal Tumor*[tiab] OR Colorectal Carcinoma*[tiab] OR Colorectal neoplasia*[tiab]
#2 Search	Endoscopy[mh:noexp] OR Endoscopy, Digestive System [mh:noexp] OR Endoscopy, gastrointestinal[mh:noexp] OR Endoscop*[tiab]
#1 Search	Colonoscopy[mh] OR Colonoscop*[tiab] OR Sigmoidoscop*[tiab] OR Proctosigmoidoscop*[tiab]

and experience is key to implementing CQI in healthcare services, patients also constitute an important group of users, whether implicitly or explicitly.

The objective of this mixed methods systematic review is to summarize knowledge with regard to barriers and facilitators to the successful implementation of CQI programs in colonoscopy units from the perspective of the endoscopists, nurses, managers, and patients. With respect to the CQI program, members of these four groups are all referred to as users. This synthesis will inform all stakeholders in order to prevent or mitigate issues during the implementation of colonoscopy CQI programs. It will also contribute to a mutual understanding of the factors affecting the adoption of CQI programs by other groups of users.

Methods

We conducted a mixed methods systematic review of the scientific literature published between 1 January 2000 and 31 May 2013 on barriers and facilitators perceived by any group of individuals, about itself or the three others (the four user groups are listed below under the subheading *User groups*), with a direct interest in the implementation of CQI programs in colonoscopy services. This type of review summarizes qualitative and quantitative research evidence with the same level of rigor [24].

Search strategy

We performed standardized literature searches on 15 relevant databases already described in the published study protocol [25] (see [Table 1](#) for full electronic search strategy for Medline). We screened the references of the selected publications as a potential source of additional relevant articles. We also searched for other publications from the authors of the selected articles as well as publications citing the selected articles through the ISI Science Citation Index database.

Selection criteria

The studies included in this review should report barriers and facilitators with regard to implementing a CQI program, either as their primary outcome or as a secondary outcome related to the effects and impacts of CQI initiatives in colonoscopy. We define barriers and facilitators as technical, individual, organizational, and contextual factors that would facilitate or impede the implementation of such programs. Studies had to be based on an empirical design, using qualitative, quantitative or mixed methods, and had to use a structured and well described data collection process. Thus, we excluded studies reporting unstructured observations (defined as holistic, unstructured, and unfocused observations [26]), as well as editorials, comments, and position papers.

Implementations of CQI programs in colonoscopy services are defined as initiatives aiming at the improvement and maintenance of the quality and safety of the procedure (also called Clinical Quality and Safety) or at the enhancement of consumer care (also called Quality of Patient Experience). The selected studies could report on a pre, current or post implementation experience of a CQI program. We also considered the utilization of standards related to sigmoidoscopy and colonoscopy services.

User groups

The user groups are the four parties directly involved in the implementation of colonoscopy CQI programs, i.e. endoscopists (physicians, gastroenterologists, and surgeons), nurses, managers, and patients.

Screening and data abstraction

Pairs of authors (SG, MT, AB, BC, MPG) screened all titles and abstracts independently to assess compliance with inclusion criteria. We resolved discrepancies among reviewers on study inclusion through discussion with other team members. Full-text copies of relevant articles were independently reviewed by two authors (AB, MT) and were assessed for compliance with the selection criteria. One of the co-authors (CD), a gastroenterologist trained at the National Health Services (NHS), categorized the publications according to their specific focus using the Global Rating Scale (GRS) dimensions of colonoscopy services: appropriateness of colonoscopy, colonoscopy clinical quality, discharge process, patient satisfaction, patient compliance, and attitude towards the CQI program [12].

Then we extracted findings defining barriers and facilitators with respect to the implementation of CQI programs and the user group(s) it related to. Using a generic extraction grid based on previous works, we initially grouped the findings under distinct attributes best defining the type of the reported facilitators or barriers [27,28]. We gradually adapted the extraction grid through an iterative process based on consensus among the reviewers so as to adapt to the specific topic of this review. We relabeled some of the original attributes to provide a better de-

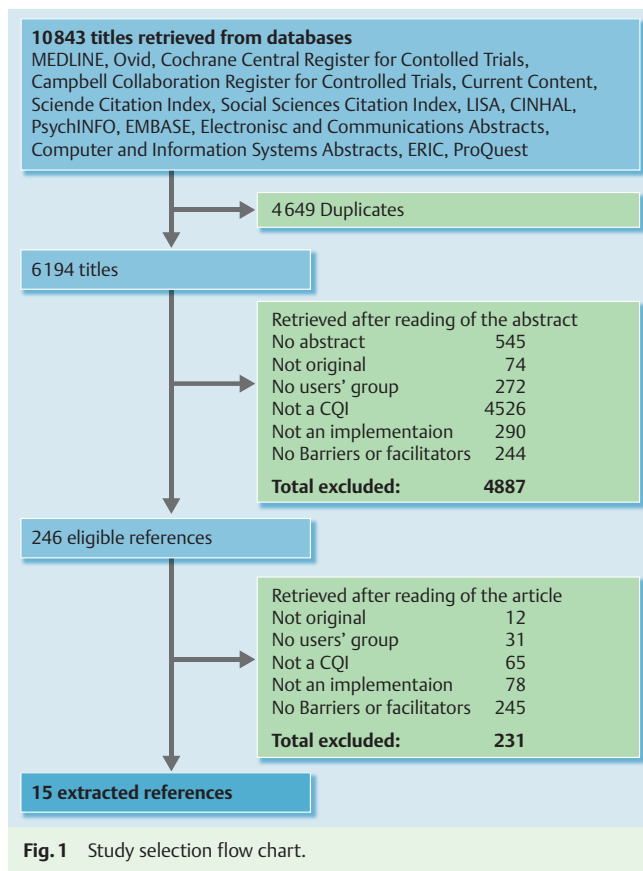


Fig. 1 Study selection flow chart.

scription of findings, adding emergent attributes and removing those not addressed by any of the selected publications. We further grouped attributes under three main themes: features of the CQI program, attitudes and perceptions, and organizational environment. We reported findings using consensual guidelines for narrative syntheses and meta-analytical techniques [29,30]. Finally, we presented findings in the form of a narrative synthesis [29].

Appraisal of study quality

We assessed the quality of all selected studies and each type of design using scales based on a recent tool that proposes criteria specific for quantitative (experimental and observational), qualitative, and mixed methods designs [31].

Results

Included studies

We screened the titles and abstracts of the 6194 references identified through the search strategy. We retained a total of 246 publications for full-text analysis, of which 15 studies met the selection criteria [32–46]. The selection flow chart is depicted in

• **Fig. 1.**

Characteristics of included studies

The characteristics of the 15 selected studies are summarized in • **Table 2.** All studies were conducted in countries with comparable standards of living according to the Organisation for Economic Co-operation and Development (OECD): Australia [39, 42], the United Kingdom [32,43], the United States [33,44–46],

Italy [35,36], Norway [34,37], Canada [41], Israel [38], and the Netherlands [40]. The study design of 10 publications (67%) is quantitative [33–38,40,43,45,46]; two (13%) studies have a qualitative design [39, 41]; and the other three (20%) use a mixed methods approach [32,42,44]. Most studies collected data either through questionnaires (n=9, 60%) [34, 35, 37, 38, 40, 41, 44–46] or audits (n=4, 27%) [32, 36, 42, 43]. The other two studies (13%) report telephone surveys or document analyses [33, 39]. A quality score of 100, 75, 50, and 25% was allocated, to three, six, four, and two studies, respectively. Since findings extracted from the low-quality studies were comparable to those from studies of higher quality, no study was rejected based on the quality score.

Extracted findings

• **Supplementary File 1** presents the 99 findings that were extracted from the 15 selected studies. Three major themes emerged from the iterative classification of the extracted findings. The first theme, features of CQI programs, includes 59 findings extracted from 14 studies and grouped under 11 distinct attributes. The second theme, attitudes and perceptions, was addressed by nine studies that provided 16 findings grouped under three attributes. Finally, 24 findings extracted from 10 studies fell under the third theme, organizational characteristics, divided into five distinct attributes (• **Table 3**).

Most of the selected studies focus on the clinical quality of colonoscopies (n=11 studies, 55 findings) [32,34–38,41,43–46], followed by appropriateness of colonoscopy (n=3 studies, 23 findings) [33,41,42] and patient satisfaction (n=2 studies, 9 findings) [37,38]. Attitude toward the CQI programs [40], quality of the discharge process [39], and patient compliance [38] are addressed in only one study each, providing 16 findings, four findings, and one finding, respectively.

User groups

• **Table 3** presents the themes and attributes according to each user group with which they are associated. Among the four user groups, the endoscopists were by far the most studied (13 out of 15 studies), and most of the extracted findings are associated with this group (64 findings extracted, 65%). Their perspective dominates the attributes related to the features of CQI programs (12 studies and 44 out of 59 findings, 75%), and those related to attitudes and perceptions (8 studies and 14 out of 16 findings, 88%). Management is largely associated with the third theme, namely the organizational characteristics of CQI programs, where 10 out of the 17 findings (59%) associated with this user group are categorized. Findings related to nurses and patients represent only 18% of all extracted findings. Eight studies consider nurses' perspective (9 findings, 10%), and five studies account for the patients' experience (9 findings, 9%).

“Involving all users in the planning and implementation of CQI programs” is the only attribute shared across the four user groups. “Feasibility and adaptability” as well as “training and education” are reported for three out of the four user groups (endoscopists, patients and either management or nurses, respectively). Six other attributes are associated with two user groups (three with endoscopists and nurses, two with endoscopists and patients, and one with endoscopists and management). Finally, seven and four attributes were exclusively documented in association with endoscopists and management, respectively. There was no attribute exclusive to nurses.

Table 2 Characteristics of included studies.

Study	Country	Study design	Colonoscopy quality domains ¹	Setting of care	Description of the intervention	Participants	Main outcomes	Data collection	Quality score
Abukis et al. (2001) [38]	Israel	Quantitative (Randomized controlled trials)	D – Patient satisfaction E – Patient compliance	Gastroenterology department in a tertiary center	Education program targeting patients conducted by a dedicated nurse; the program comprises brochures detailing procedures, explanation of the specific aspects of procedures, answering all patients' questions, and a telephone number to contact the nurse with last-minute questions.	Patients	The education program was associated with success of endoscopy, low level of cancellations because of poor preparation, and a reduction in the cost of colonoscopy by 8.9%.	Questionnaire & document analysis	50 %
Ball et al. (2004) [32]	United Kingdom	Mixed Qualitative Quantitative (descriptive)	B – Quality of colonoscopy	Endoscopy department in a university general hospital in north-east England	Two audit cycles examining reported reasons for incomplete colonoscopies. Results were reviewed at departmental meetings and consensus on methods aiming at improving completion rates was achieved.	Doctors at all stages of training: consultants, academics, specialist registrars in gastroenterology and surgery, clinical assistants, staff grades, and nurses.	Completion rates for colonoscopies were significantly improved.	Two completed cycles of audit	25 %
Bampton et al. (2007) [42]	Australia	Mixed Qualitative Quantitative (descriptive)	A – Appropriateness of colonoscopy	Department of gastroenterology at a primary care setting in Australia	A program aiming to 1) disseminate the NHMRC guidelines on CRC prevention; 2) assist in the education of the general population; and 3) integrate the hospital aspects of CRC prevention with practice in the primary care setting.	General practitioner and gastrointestinal specialists, staff specialist in gastroenterology and general population	High compliance with guidelines for colonoscopy surveillance was achieved and maintained.	Audit	75 %
Cardella et al. (2008) [41]	Canada	Qualitative	A – Appropriateness of colonoscopy	A tertiary care center in Toronto	A stringent colorectal cancer follow-up protocol: clinical visits every 6 months for the first 3 years followed by visits at 12-month intervals until 5 years post-resection, with CEA blood level, chest radiography, and abdominal imaging in conjunction with these clinic visits.	Patients, surgeons, gastroenterologists, oncologists and nurses	Incomplete compliance with colorectal cancer follow-up protocols.	Chart review + Questionnaires	75 %
Conigliaro et al. (2006) [35]	Italy	Quantitative (descriptive)	B – Quality of colonoscopy	60 centers: 31 first-level centers (diagnostic and operative gastroscopies and colonoscopies) and 29 second-level centers (biliary-pancreatic tract procedures)	A nationwide dissemination program which includes 17 seminars was carried out to implement the Italian Society of Digestive Endoscopy guidelines for sedation.	Endoscopists, nurses and anaesthesiology staff	Sedation usage increased. The rate of completeness of examinations is higher in sedated patients. No significant impact on patient satisfaction.	1) Data sheet for patient; 2) Satisfaction questionnaire completed by patients; 3) Checklist for medical instruments	50 %

Table 2 (Continuation)

Study	Country	Study design	Colonoscopy quality domains ¹	Setting of care	Description of the intervention	Participants	Main outcomes	Data collection	Quality score
De Jonge et al. (2010) [40]	Netherlands	Quantitative (descriptive)	F – Attitude toward CQI program	All endoscopy units in the Netherlands	Assessment of gastroenterologists' opinion about quality assurance program in the endoscopy department, how to design and what aspects should be included in such a program.	A representative sample (63 %) of registered gastroenterologists in the Netherlands	Positive attitude towards quality assessment (QA). Concerns about time investment and disclosure of results. Information provision and procedure characteristics must be included in QA program.	Questionnaire	100 %
Gall and Bull (2004) [39]	Australia	Qualitative	C – Quality of the discharge process	A general hospital in Adelaide, South Australia	Education program designed for endoscopists and nurses to review guidelines for patient discharge after endoscopy procedures.	Out-patients, endoscopists and nurses	Reduction in potential problems and promotion of safe practice for post-procedure patients.	Telephone survey	25 %
Hoff et al. (2006) [34]	Norway	Quantitative (descriptive)	B – Quality of colonoscopy	14 colonoscopy centers in the south of Norway	Registration of quality indicators using two questionnaires and focusing primarily on colonoscopy completion rates and patient satisfaction with continuous feedback information on performance.	Endoscopists and patients	A great variation in technical procedures, performance and severe pain experienced by patients has been highlighted with respect to centers, which calls for a more systematic training.	Questionnaire	100 %
Imperiali et al. (2007) [36]	Italy	Quantitative (descriptive)	B – Quality of colonoscopy	An open-access endoscopy unit at a secondary care center in northern Italy	Two components: 1) Six-monthly audit cycles to record quality indicators (completion rate and prevalence rate of polyps); 2) Departmental meetings to discuss standards for quality colonoscopy, review the audit results, evaluate the causes of failures, examine the variability among endoscopists, and discuss the action plan to improve performance.	Endoscopists	Colonoscopy completion rates improved. No improvement in polyp detection rates, but the extent of variation among the endoscopists regarding this quality indicator decreased.	Six-monthly audit cycles	75 %
Lin et al. (2010) [46]	USA	Quantitative (descriptive)	B – Quality of colonoscopy	Endoscopy unit of a teaching hospital	A monitoring and feedback program in two phases. 1) Withdrawal times, polyp detection rates and patient satisfaction scores were recorded. 2) Written feedback for these quality indicators is given periodically to each endoscopist.	Endoscopists, patients, and nurses	Withdrawal times and polyp detection rates increased for most endoscopists. No change in satisfaction scores was observed. The effect of the monitoring and feedback program is more pronounced for the slowest endoscopists.	Document analyses & Questionnaire	50 %
Naylor et al. (2003) [43]	United Kingdom	Quantitative (descriptive)	B – Quality of colonoscopy	Gastroenterology unit in teaching hospital	QA program designed on ASGE guidelines. Following an initial 6-month audit of all procedures, colonoscopy data were prospectively collected for 6 months.	Endoscopists and patients	Two registrars were experiencing poor cecal intubation rates. Initiating action to improve this was “politically” difficult.	Reviews of the procedure report and the endoscopy unit log book & Audit	50 %

Table 2 (Continuation)

Study	Country	Study design	Colonoscopy quality domains ¹	Setting of care	Description of the intervention	Participants	Main outcomes	Data collection	Quality score
Sanaka et al. (2006) [33]	USA	Quantitative (non randomized)	A – Appropriateness of colonoscopy	A tertiary care, academic medical center in Cleveland (Ohio)	Three components: 1) distribution of a wallet-size laminated card summarizing post-polypectomy surveillance guidelines; 2) placement of summary guideline charts near computers; 3) discussion about this study and distribution of the full-text guideline articles during monthly meetings.	Gastroenterologists and fellows in gastroenterology	Improvement in compliance with post-polypectomy surveillance guidelines, which would result in cost savings.	Document analyses	75%
Seip et al. (2010) [37]	Norway	Quantitative (descriptive)	B – Quality of colonoscopy D – Patient satisfaction	10 endoscopy centers in South East Norway	Registration of quality indicators using two questionnaires and focusing primarily on colonoscopy completion rates and patient satisfaction with continuous feedback information on performance.	Endoscopists and patients	Maintaining high compliance and high response rates in quality assurance (QA) programs is mandatory.	Questionnaire	100%
Spiegel et al. (2011) [44]	USA	Mixed Qualitative Quantitative (randomized controlled trials)	B – Quality of colonoscopy	University affiliated health-care facility	Tested an educational booklet to improve bowel preparation quality.	Endoscopists and patients	The primary outcome was preparation quality based on blinded ratings using the validated Ottawa score. The secondary outcome was bowel preparation quality as measured by the principal endoscopist for each procedure.	Standardized Ottawa scoring system	75%
Hillyer et al. (2012) [45]	USA	Quantitative (descriptive)	B – Quality of colonoscopy	Member of the American College of Gastroenterology	Explored perceived patient barriers to optimal pre-colonoscopy bowel preparation from the perspective of the gastroenterologist.	Gastroenterologist members of the American College of Gastroenterology	Demographic and practice characteristics and practice-related and perceived patient barriers to optimal bowel preparation were assessed among 288 respondents.	Online and mail survey	75%

¹ We used the Global Rating Scale dimensions of colonoscopy services (clinical quality and quality of the patient experience) to categorize publications based on the specific domains of colonoscopy quality that were addressed by the studies (represented by letters A to F): A, appropriateness of colonoscopy; B, quality of colonoscopy; C, quality of the discharge process; D, patient satisfaction; E, patient compliance; and F, attitude toward CQI program.

Table 3 Number of extracted items and number of articles in which they were identified according to major themes and attributes for each user group.

	Number of items/Number of articles				
	Endoscopists	Nurses	Management	Patients	Total
1. Features of the CQI program	44/12	2/2	7/4	6/3	59/14
1.01 Voluntary participation	2/2				2/2
1.02 Summative and formative evaluation	6/6				6/6
1.03 Disclosure of results	10/7				10/7
1.04 Quality indicators	7/5				7/5
1.05 Training and education	5/5	1/1		1/1	7/6
1.06 Patient centered	2/1			1/1	3/2
1.07 Clinical quality centered	1/1				1/1
1.08 Feasibility and adaptability	5/3		2/2	4/2	11/5
1.09 Clarity of the intervention	3/3	1/1			4/3
1.10 Cost and cost-effectiveness	1/1		5/4		6/5
1.11 Maintaining of compliance	2/2				2/2
2. Attitudes and perceptions	14/8	1/1		1/1	16/9
2.01 Attitude towards intervention or the action plan	8/6				8/6
2.02 Sense of ownership as regards the intervention	3/3	1/1			4/3
2.03 Perception of impact	3/1			1/1	4/2
3. Organizational characteristics	6/6	6/6	10/8	2/2	24/10
3.01 Involving all in the planning and implementation	5/5	4/4	2/2	2/2	13/5
3.02 Support from hospital administration			2/2		2/2
3.03 Dedicating staff to perform new roles	1/1	2/2			3/3
3.04 Access to human resources			1/1		1/1
3.05 Access to material			3/3		3/3
3.06 Access to training			2/2		2/2
Total	64/13	9/8	17/9	9/5	99/15

Features of the colonoscopy CQI programs

When it comes to implementing CQI, the features of the CQI programs are most important for endoscopists as confirmed in 12 (80%) out of 15 studies. The attribute most often cited in relation to endoscopists is “ensuring confidentiality of individuals’ quality assessment results” (10 findings) [32, 34, 36, 37, 40, 43, 46]; followed by the utilization of “quality indicators” (7 findings) [34, 36, 37, 40, 43]; “training and education” (7 findings) [32–34, 36, 39]; and “formative evaluation” (6 findings) [32–34, 36, 38, 43]. The “clarity of the intervention” expressed in comprehensive, clear, and simple guidelines covering all clinical situations and clearly depicting responsibilities is deemed critical by endoscopists and nurses [33, 41, 42]. Better compliance with the guidelines is reported when these two user groups are involved in their development [42].

Concerns about “feasibility and adaptability”, an attribute shared by endoscopists, management, and patients is the most frequently cited among the features of the CQI program (11 findings) [33, 42–45].

Unsurprisingly, “cost and cost-effectiveness” issues are mainly reported by management [32, 33, 38, 43]. However, the necessity to invest resources (time, money, and personnel) is also acknowledged by management [43].

Finally, “maintaining compliance” with a CQI program is identified as a challenge [37, 42]. The absence, right from its inception, of explicit features favoring the integration of the CQI program into routine activities is detrimental [37, 42]. Nevertheless, no facilitating approach is suggested to overcome this barrier.

Attitudes and perceptions concerning CQI programs

“Attitudes toward the intervention” are reported by endoscopists as an influential attribute in eight (53%) out of 15 studies. Some studies documented the facilitating effect of a positive attitude [32, 34, 35] while others confirmed that a negative attitude was a barrier [35, 38, 42]. The longer the experience, the more positive the endoscopists’ attitude seems to be [40]. Similarly, “sense of ownership” [33, 34, 37] and “perception of the (potentially positive) impact” on the quality and capacity of endoscopy units [34] have a positive influence on implementation. The positive relationship with “sense of ownership” is also documented for nurses [37]. None of the included papers contained findings pertaining to the attitudes and perceptions of managers.

Organizational environment

“Involving all users in the planning and implementation” of the CQI program is the most frequent finding and the only one common to all user groups [32, 33, 40, 41, 43]. Four of the other five attributes under this theme are exclusively associated with management role in the provision of support and resources: “support from the administration”, for example, in explicitly adopting guidelines or planning no clinical activities during CQI meetings [33, 39] and ensuring appropriate “access to human resources and material” [35, 41, 43] as well as “access to training” [34, 39]. The favorable influence of ensuring that new roles required by the implementation of CQI programs are specifically assigned to dedicated staff is deemed important to both endoscopists and nurses [36, 42, 43].

Table 4 Summary table of the main findings of the review.

Strength of finding	Main message
Most recurrent findings (≥ 10) in at least a third (≥ 5) of the selected studies	All user groups should be involved in the CQI program implementation and follow-up (endoscopists, nurses, managers, and patients) to ensure the appropriateness of the program in regards to all important aspects impacting on quality. (Re: all users' groups)
	Guidelines, standards, and procedures must be reviewed and adapted locally to ensure feasibility. Otherwise, they can be counterproductive and be detrimental to quality. (Re: endoscopists, managers, and patients)
	The confidentiality of results regarding the quality performance of individual endoscopists seems to be a prerequisite to the implementation of a CQI program. (Re: endoscopists)
Recurrent findings ($< 10, \geq 5$) in at least a third (≥ 5) of the selected studies	The CQI program must be aiming at enhancing and maintaining the quality of the colonoscopy unit and not at tackling poor performers. Issues are better resolved through discussions and mutual understanding. (Re: endoscopists)
	Systematically collecting information to produce indicators and evaluate quality is deemed necessary. However, time and efforts required to do so must be minimized and the indicators need to be meaningful to allow identification of potential issues and successful resolutions. (Re: endoscopists)
	Implementation of CQI programs requires that personnel be instructed and trained for all modifications to their duties. Individual and collective reviews of performance and audit results are part of training. Offering support to those having difficulties is the favored approach. (Re: endoscopists, nurses and managers)
	Administration must agree that there are resources involved in the implementation of CQI programs. However, it is reported that expenses can be minimal and that CQI programs were found cost-effective. (Re: managers)
	Implementation of a CQI program must foster a positive attitude, especially from the part of the endoscopist. Being inclusive of all stakeholders, voluntary participation, production of indicators, and confidentiality of evaluation results are among the important features that can create a favorable attitude while mitigating the negative effects of too much self-confidence. The more experienced endoscopists tend to have a better attitude. (Re: endoscopists)

Main messages

The extraction of the attributes according to the three major themes (Table 3), associated with the quotes extracted from the selected publications, allows formulating the main messages from these empirical studies. Table 4 lists the main findings (observations appearing at least five times in at least five different studies) that emerge from this review. The vast majority of the other findings are particular instances of the more general messages of Table 4.

Discussion

This review pinpoints specific attributes consistently reported by empirical studies to facilitate the successful implementation of CQI initiatives in colonoscopy services. The findings are consistent with several constructs of current models of adoption and implementation of innovations in healthcare by validating the advantage of a clearly defined, voluntary, participatory, and formative approach that is adaptable and agreeable to the different user groups involved. CQI initiatives relying on a team effort inclusive of all user groups, implemented in supportive organizations, and providing adequate resources are more likely to succeed.

Extracting and analyzing facilitators and barriers of the implementation process with respect to each user group reveal that their specific roles and contributions have not yet been adequately assessed by research. Significant knowledge gaps remain with respect to barriers and facilitators associated with patients

and nurses resulting from a lack of appropriate consideration of these groups in most studies.

Implementation of CQI is a process aiming at the achievement and maintenance of standard of performance, persuading individuals to all contribute to the clinical quality, and enhance the patient's experience by maximizing the benefits with the minimum harm [21]. Even though the review confirms that all groups acknowledged the importance of managers', nurses' and patients' involvement, the perspective of non-clinicians remains understudied. Considering patients as full partners apparently remains a challenge, and although patient satisfaction was the explicit focus of two of the included studies, it was not addressed from the patient's perspective [37, 38]. This is clearly in contrast to current knowledge in the field of implementation of innovations in clinical practice [18, 47, 48], even if two of the most recent studies offer insightful findings with respect to the perspective of patients when analyzing the feasibility of CQI programs and the need for training and education [44, 45].

With the increasing role of nurses in clinical procedures, it is surprising that their perspective had very little echo in studies on the implementation of CQI colonoscopy initiatives. The fact that none of the facilitators or barriers identified through this review was exclusive to nurses is likely an indication that the role of nurses has not been addressed as a distinct contribution to CQI programs. However, the critical role of lead nurses in the quality enhancement of an endoscopy service is one of the key lessons learned from the British experience [21]. During the implementation of a colonoscopy CQI program, nurses are expected to renew the definition of their roles and work procedures as well as

to adopt new models of relationships with patients and endoscopists.

Our results also highlight the responsibilities of organizations in the implementation of CQI initiatives. Organizational characteristics such as the involvement of all user groups in the implementation of the CQI program as well as support from hospital administration and access to training are reported to be important management roles [32–34,39,40,43]. Studies on adoption of innovations also suggest that tangible management support is a prominent feature of successful adoptions of innovation [48]. It is known that the extent to which innovative interventions will be expected, supported, and acknowledged contributes to a favorable inner organizational environment [18]. In fact, Greenhalgh et al. indicate that these characteristics reflect on system readiness, which emphasizes their role as pre-existing favorable factors rather than merely accompanying or following the initiative [18].

Knowledge translation and innovation adoption models stress the critical role of monitoring in a successful implementation, sometimes referred to as the confirmation phase [18,48]. In his recent review of the English endoscopy CQI program, Valori insists on the essential quality assurance component of colonoscopy quality improvement programs, although he warns against the reluctance of physicians to accept monitoring [23]. Our review confirms that summative assessment based on quality indicators facilitates quality improvement. However, the acceptability of such a practice is conditional upon voluntary participation, using non-punitive approaches, preserving the confidentiality of individuals' results, and limiting the number of indicators that are collected [34,36,37,40,43,46].

Attributes supported by almost half of the studies refer to the non-disclosure of physicians' individual results to quality assessment [32,34,36,37,40,43,46]; the positive attitude toward the intervention or the action plan [32,33,35,37,38,40–43]; and the involvement of all stakeholders in the planning and implementation of a CQI program [32,33,41,43]. These seem crucial to lever clinical leadership and engagement and are consistent with the overall value of mutual respect conveyed by most of the attributes identified through this review. These factors contribute to the quality of internal relationships that can positively influence implementation, and that have been described as possibly more important than individual attributes [18,49,50].

The importance of the formative approach is further acknowledged by the positive impact of incorporating education and training for endoscopists and nurses, including mentoring by peers, as part of a CQI program [32–34,36,37,39]. Providing individualized and intensive support to the most challenged endoscopy provider sites and developing and supporting sites to create an achievable action plan for reform are key elements of a successful development of endoscopy CQI in England [21]. Formative approach, administrative support, and availability of sufficient resources (human and material) are facilitating attributes that advocate for the creation of supportive environments.

Competing interests: None

Institutions

- ¹ Institut d'excellence en santé et services sociaux du Québec, Quebec City, Quebec, Canada
- ² Université Laval – Department of Social and Preventive Medicine, Quebec City, Quebec, Canada
- ³ Université de Montréal – Department of Medicine, Montreal, Quebec, Canada
- ⁴ Maisonneuve-Rosemont Hospital – Gastroenterology, Montreal, Quebec, Canada
- ⁵ University of Calgary – Department of Community Health Sciences, Calgary, Alberta, Canada
- ⁶ CHU de Québec Research Center – Public Health and Practice-Changing Research, Quebec City, Quebec, Canada
- ⁷ Université Laval – Faculty of Nursing, Quebec City, Quebec, Canada
- ⁸ CHU de Québec Research Center – Population Health and Optimal Health Practices, Quebec City, Quebec, Canada

Acknowledgments

This study is funded by the Canadian Institutes of Health Research (CIHR) (grant # 200905KR8 – 205038-KRS-CFCC-168527).

References

- 1 *Leddin D, Hunt R, Champion M* et al. Canadian Association of Gastroenterology and the Canadian Digestive Health Foundation: Guidelines on colon cancer screening. *Can J Gastroenterol* 2004; 18: 93–99
- 2 *DeGroff A, Boehm J, Goode Green S* et al. Facilitators and challenges to start-up of the colorectal cancer screening demonstration program. *Prev Chronic Dis* 2008; 5: A39
- 3 *Pignone M*. Challenges in implementation of effective and efficient colon cancer screening. *Dig Liver Dis* 2007; 39: 251–252
- 4 *Shaukat A, Mongin SJ, Geisser MS* et al. Long-term mortality after screening for colorectal cancer. *New Engl J Med* 2013; 369: 1106–1114
- 5 *Miller A, Candas B, Berthelot JM* et al. Pertinence et faisabilité d'un programme de dépistage du cancer colorectal au Québec [Relevance and feasibility of a colorectal cancer screening program in Quebec]. Quebec City: Institut national de santé publique du Québec; 2009
- 6 Colorectal cancer screening advisory group. Report of the Colorectal Cancer Screening Advisory Group. Wellington: Ministry of Health; 2006
- 7 *Misra T, Lalor E, Fedorak RN*. Endoscopic perforation rates at a Canadian university teaching hospital. *Can J Gastroenterol* 2004; 18: 221–226
- 8 *Singh H, Turner D, Xue L* et al. Risk of developing colorectal cancer following a negative colonoscopy examination: evidence for a 10-year interval between colonoscopies. *JAMA* 2006; 295: 2366–2373
- 9 *Zappa M, Castiglione G, Grazzini G* et al. "Does fecal occult blood testing really reduce mortality? A reanalysis of systematic review data." by Moayyedi P and Achkar E *Am J Gastroenterol* 2006; 101: 2433–2434
- 10 *Hewitson P, Glasziou P, Irwig L* et al. Screening for colorectal cancer using the faecal occult blood test, Hemoccult. *Cochrane Database Syst Rev* 2007: CD001216
- 11 *Kahi CJ, Azzouz F, Juliar BE* et al. Survival of elderly persons undergoing colonoscopy: implications for colorectal cancer screening and surveillance. *Gastrointest Endosc* 2007; 66: 544–550
- 12 National Endoscopy Team. Endoscopy Global Rating Scale. Available at: <https://www.jagaccreditation.org/Page.aspx?ID=5> Accessed June 6, 2015
- 13 *Strul H, Kariv R, Leshno M* et al. The prevalence rate and anatomic location of colorectal adenoma and cancer detected by colonoscopy in average-risk individuals aged 40–80 years. *Am J Gastroenterol* 2006; 101: 255–262
- 14 *Winawer SJ, Zauber AG, Fletcher RH* et al. Guidelines for colonoscopy surveillance after polypectomy: a consensus update by the US Multi-Society Task Force on Colorectal Cancer and the American Cancer Society. *Gastroenterology* 2006; 130: 1872–1885
- 15 *Sewitch MJ, Dube C, Brien S* et al. Patient-identified quality indicators for colonoscopy services. *Can J Gastroenterol* 2013; 27: 25–32
- 16 *Nadeem E, Olin SS, Hill LC* et al. Understanding the components of quality improvement collaboratives: a systematic literature review. *Milbank Q* 2013; 91: 354–394
- 17 *Sollecito WA, Johnson JK*. Factors influencing the application and diffusion of CQI in health care. In: Sollecito WA, Johnson JK (eds.) *McLaughlin and Kaluzny's Continuous Quality Improvement in Health Care*. 4th edn. Burlington, MA: Jones & Bartlett Publishers; 2011: 49–74

- 18 Greenhalgh T, Robert G, Macfarlane F et al. Diffusion of innovations in service organizations: systematic review and recommendations. *Milbank Q* 2004; 82: 581–629
- 19 Greenhalgh T, Robert G, Bate P et al. Diffusion of innovations in health service organisations: a systematic literature review. Malden, MA: Blackwell Publishing; 2008
- 20 Hilsden RJ, Rostom A, Dube C et al. Development and implementation of a comprehensive quality assurance program at a community endoscopy facility. *Can J Gastroenterol* 2011; 25: 547–554
- 21 Stebbing JF. Quality assurance of endoscopy units. *Best Pract Res Clin Gastroenterol* 2011; 25: 361–370
- 22 Bosch M, van der Weijden T, Wensing M et al. Tailoring quality improvement interventions to identified barriers: a multiple case analysis. *J Eval Clin Pract* 2007; 13: 161–168
- 23 Valori R. Quality improvements in endoscopy in England. *Tech Gastrointest Endosc* 2012; 14: 63–72
- 24 Hemingway P, Brereton N. What is a systematic review? Available at <http://www.medicine.ox.ac.uk/bandolier/painres/download/whatis/syst-review.pdf> (Accessed June 6, 2015)
- 25 Jobin G, Gagnon MP, Candas B et al. User's perspectives of barriers and facilitators to implementing quality colonoscopy services in Canada: a study protocol. *Implement Sci* 2010; 5: 85
- 26 McKechnie LEF. Unstructured observation. In: Given LM (ed.) *The SAGE Encyclopedia of Qualitative Research Methods*. Thousand Oaks, CA: SAGE Publications; 2008: 1072
- 27 Gagnon MP, Desmartis M, Labrecque M et al. Systematic review of factors influencing the adoption of information and communication technologies by healthcare professionals. *J Med Syst* 2010; 36: 241–277
- 28 McGinn CA, Grenier S, Duplantie J et al. Comparison of user groups' perspectives of barriers and facilitators to implementing electronic health records: a systematic review. *BMC Med* 2011; 9: 46
- 29 Mays N, Pope C, Popay J. Systematically reviewing qualitative and quantitative evidence to inform management and policy-making in the health field. *J Health Serv Res Policy* 2005; 10: 016–20
- 30 The Cochrane Collaboration, JBI Research Unit. Cochrane Qualitative Research Methods Group. Available at <http://cqim.cochrane.org/> (Accessed June 6, 2015)
- 31 Pace R, Pluye P, Bartlett G et al. Testing the reliability and efficiency of the pilot Mixed Methods Appraisal Tool (MMAT) for systematic mixed studies review. *Int J Nurs Stud* 2012; 49: 47–53
- 32 Ball JE, Osbourne J, Jowett S et al. Quality improvement programme to achieve acceptable colonoscopy completion rates: prospective before and after study. *BMJ* 2004; 329: 665–667
- 33 Sanaka MR, Super DM, Feldman ES et al. Improving compliance with postpolypectomy surveillance guidelines: an interventional study using a continuous quality improvement initiative. *Gastrointest Endosc* 2006; 63: 97–103
- 34 Hoff G, Bretthauer M, Huppertz-Hauss G et al. The Norwegian Gastronet project: Continuous quality improvement of colonoscopy in 14 Norwegian centres. *Scand J Gastroenterol* 2006; 41: 481–487
- 35 Conigliaro R, Rossi A Italian Society of Digestive Endoscopy (SIED) Sedation Commission. Implementation of sedation guidelines in clinical practice in Italy: results of a prospective longitudinal multicenter study. *Endoscopy* 2006; 38: 1137–1143
- 36 Imperiali G, Minoli G, Meucci GM et al. Effectiveness of a continuous quality improvement program on colonoscopy practice. *Endoscopy* 2007; 39: 314–318
- 37 Seip B, Bretthauer M, Dahler S et al. Sustaining the vitality of colonoscopy quality improvement programmes over time. Experience from the Norwegian Gastronet programme. *Scand J Gastroenterol* 2010; 45: 362–369
- 38 Abuksis G, Mor M, Segal N et al. A patient education program is cost-effective for preventing failure of endoscopic procedures in a gastroenterology department. *Am J Gastroenterol* 2001; 96: 1786–1790
- 39 Gall S, Bull J. Clinical risk: discharging patients with no-one at home. *Gastroenterol Nurs* 2004; 27: 111–114
- 40 De Jonge V, Nicolaas JS, Van Leerdam ME et al. The opinion of gastroenterologists towards quality assurance in endoscopy. *Gastrointest Endosc* 2010; 71: AB219
- 41 Cardella J, Coburn NG, Gagliardi A et al. Compliance, attitudes and barriers to post-operative colorectal cancer follow-up. *J Eval Clin Pract* 2008; 14: 407–415
- 42 Bampton PA, Sandford JJ, Young GP. Achieving long-term compliance with colonoscopic surveillance guidelines for patients at increased risk of colorectal cancer in Australia. *Int J Clin Pract* 2007; 61: 510–513
- 43 Naylor G, Gatta L, Butler A et al. Setting up a quality assurance program in endoscopy. *Endoscopy* 2003; 35: 701–707
- 44 Spiegel BM, Talley J, Shekelle P et al. Development and validation of a novel patient educational booklet to enhance colonoscopy preparation. *Am J Gastroenterol* 2011; 106: 875–883
- 45 Hillyer GC, Basch CH, Basch CE et al. Gastroenterologists' perceived barriers to optimal pre-colonoscopy bowel preparation: results of a national survey. *J Cancer Educ* 2012; 27: 526–532
- 46 Lin OS, Kozarek RA, Arai A et al. The effect of periodic monitoring and feedback on screening colonoscopy withdrawal times, polyp detection rates, and patient satisfaction scores. *Gastrointest Endosc* 2010; 71: 1253–1259
- 47 Damschroder LJ, Aron DC, Keith RE et al. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci* 2009; 4: 50
- 48 Feldstein AC, Glasgow RE. A practical, robust implementation and sustainability model (PRISM) for integrating research findings into practice. *Jt Comm J Qual Patient Saf* 2008; 34: 228–243
- 49 Plsek PE, Wilson T. Complexity, leadership, and management in health-care organisations. *BMJ* 2001; 323: 746–749
- 50 Safran DG, Miller W, Beckman H. Organizational dimensions of relationship-centered care. *J Gen Intern Med* 2006; 21: 9–S15

Supplementary File 1 Findings reported as barriers (B) or facilitators (F) as regards implementation of CQI programs in colonoscopy services.

CQI program implementation themes and attributes	Main colonoscopy quality domains of the study ¹	Reference	Quality Score (%)	User group	Items ²
1. Features of the CQI program					
1.01 Voluntary participation	B – Colonoscopy clinical quality	Hoff et al. (2006) [34]	100	Endoscopists	F “Participation was voluntary and decided by individual endoscopists”
	B – Colonoscopy clinical quality & D – Patient satisfaction	Seip et al. (2010) [37]	100	Endoscopists	F “It will be up to the endoscopists to apply the knowledge gained through the QA program and to change their clinical practice”
1.02 Summative and formative evaluation	A – Appropriateness of colonoscopy	Sanaka et al. (2006) [33]	75	Endoscopists	F “The value of CQI lies in identifying and changing the system, instead of in punishing outliers”
	B – Colonoscopy clinical quality	Hoff et al. (2006) [34]	100	Endoscopists	F “Not as a means for them to be punished”
		Imperiali et al. (2007) [36]	75	Endoscopists	F “Instead of concentrating performance of these examinations in the hands of the more proficient [...] which is a punitive approach that conflicts with the core of any CQI program”
		Lin et al. (2010) [46]	50	Endoscopists	F “There were no punitive measures for short withdrawal times, low polyp detection rates, or low satisfactions scores”
		Naylor et al. (2003) [43]	50	Endoscopists	F “There are no clear guidelines for tackling poor doctor performance. The ultimate responsibility lay with the divisional medical doctor who was supplied with a summary of each quarterly QA meeting”
		Ball et al. (2004) [32]	25	Endoscopists	F “We decided to concentrate the colonoscopies in the hands of the more successful colonoscopists [...]. The least successful operators either shifted to do only gastroscopy or gave up endoscopy sessions altogether”
1.03 Disclosure of results	B – Colonoscopy clinical quality	Hoff et al. (2006) [34]	100	Endoscopists	F “Each individual endoscopist was only to know his or her own identity and that of his or her endoscopy centre and the number of colonoscopies registered by the individual in question”
		Ball et al. (2004) [32]	25	Endoscopists	F “...to further secure the anonymity of centres and endoscopists, reports only gave percentages and p-values”
		Ball et al. (2004) [32]	25	Endoscopists	F “Results for individual colonoscopists were known only by themselves”
		Imperiali et al. (2007) [36]	75	Endoscopists	F “Results for individual colonoscopists were known only by themselves and by the chief of the endoscopy unit”
		Lin et al. (2010) [46]	50	Endoscopists	F “Periodic confidential written feedback would be given to each endoscopist”
		Naylor et al. (2003) [43]	50	Endoscopists	F “[...] each endoscopist was given a summary of his or her performance”
		Seip et al. (2010) [37]	100	Endoscopists	F “Data regarding success rates and complications were presented anonymously...”
	B – Colonoscopy clinical quality & D – Patient satisfaction	Seip et al. (2010) [37]	100	Endoscopists	F “Thus the endoscopist was only informed about his or her own results and the results of his or her endoscopy centre”
					F “Endoscopists’ individual performance was anonymised”

Supplementary File 1 (Continuation)

CQI program implementation themes and attributes	Main colonoscopy quality domains of the study ¹	Reference	Quality Score (%)	User group	Items ²
	F – Attitude toward CQI program	De Jonge et al. (2010) [40]	100	Endoscopists	B “Gastroenterologists had a negative attitude towards disclosing the results to the media (53 %), insurance companies (23 %), and the government (16 %). Respondents were less negative towards sharing the results with referrers (7 %), patients (8 %), and other hospitals (8.5 %)”
1.04 Quality indicators	B – Colonoscopy clinical quality	Hoff et al. (2006) [34]	100	Endoscopists	F “Starting off with registering a modest number of variables”
					F “Questionnaire was designed to require only a few seconds of the endoscopist’s time. [...]” “Once the potential value [...] had been presented they accepted a modest increase in the number of variables registered”
		Imperiali et al. (2007) [36]	75	Endoscopists	F “We prioritized those indicators that could be easily tracked from endoscopy charts”
		Naylor et al. (2003) [43]	50	Endoscopists	F “There is a temptation to collect and present too much data. The sheer volume of information tended to overwhelm the audience at the quarterly QA meeting”
	B – Colonoscopy clinical quality & D – Patient satisfaction	Seip et al. (2010) [37]	100	Endoscopists	F “Maintaining interest and compliance can’t necessarily be solved by changing variables regularly, but it can be achieved by innovative exploration of the variables already present in the registrations and application of the results in daily practice”
	F – Attitude toward CQI program	De Jonge et al. (2010) [40]	100	Endoscopists	F “The possibility of comparing the quality of endoscopy within the Netherlands with a QA assurance program was deemed to be important by 84 %”
					F “Most important aspects to be included in a QA program were number and characteristics of complications (97 %), completeness of reporting (96 %), adequate patient information (95 %), and sufficient aftercare (94 %)”
1.05 Training and education	A – Appropriateness of colonoscopy	Sanaka et al. (2006) [33]	75	Endoscopists	F “Our CQI initiative incorporated medical education”
	B – Colonoscopy clinical quality	Hoff et al. (2006) [34]	100	Endoscopists	F “Use it as a tool for self-adjustment, a means to improve performance with the support of the hospital”
		Imperiali et al. (2007) [36]	75	Endoscopists	F “We tried to allocate colonoscopies to the less proficient practitioners... We also allowed the less skilled endoscopists to have more endoscopy sessions with the supervision of an experienced colleague”
		Ball et al. (2004) [32]	25	Endoscopists	F “[...] achieving consensus on methods of improving completion rates by using the results of the audit... The endoscopists who continued to do colonoscopies also agreed to have further training to maintain skills”
		Spiegel et al. (2011) [44]	75	Patients	B “Lack of knowledge of patients”
	C – Quality of the discharge process	Gall and Bull (2004) [39]	25	Endoscopists	F “Further education of endoscopists and nurses in the outpatient department was necessary to emphasize to patients pre-procedure the need for a responsible adult to stay overnight and to identify patients who may not be able to meet this requirement”
				Nurses	F “Further education of endoscopists and nurses in the outpatient department was necessary to emphasize to patients pre-procedure the need for a responsible adult to stay overnight and to identify patients who may not be able to meet this requirement”
1.06a Patient centered care	B – Colonoscopy clinical quality	Hoff et al. (2006) [34]	100	Patients	F “76 % patient compliance”

Supplementary File 1 (Continuation)

CQI program implementation themes and attributes	Main colonoscopy quality domains of the study ¹	Reference	Quality Score (%)	User group	Items ²
	F – Attitude toward CQI program	De Jonge et al. (2010) [40]	100	Endoscopists	"27.5 % had a very negative attitude towards time available for patient contact (19.5 % very positive and 53 % neutral attitude)"
1.07 Clinical quality centered care	F – Attitude toward CQI program	De Jonge et al. (2010) [40]	100	Endoscopists	"A QA program should place clinical quality of the procedures as central according to 93 %, as well as patient centred care according to 90 %"
1.08 Feasibility and adaptability	A – Appropriateness of colonoscopy	Bampton et al. (2007) [42]	75	Endoscopists	"It was felt by the colonoscopist that the guidelines did not specifically cover the clinical situation encountered"
					"Clinicians are more likely to follow guidelines if they feel that they can provide input into their utility"
		Sanaka et al. (2006) [33]	75	Management	"The intervention is easy to implement"
	B – Colonoscopy clinical quality	Naylor et al. (2003) [43]	50	Endoscopists	"Our data collection was too time-consuming and difficult"
				Management	"QA programs evolve over time and must reflect local resources and practice"
		Hillyer et al. (2012) [45]	75	Endoscopists	"Physician practice related and perceived patient barriers to optimal bowel preparation by level of self-reported suboptimal bowel preparations per week. Most agreed that lack of physician time presented a barrier (53.4 %)"
					"Physician practice related and perceived patient barriers to optimal bowel preparation by level of self-reported suboptimal bowel preparations per week. 39.8 % agreed that volume of information presented a barrier"
		Hillyer et al. (2012) [45]	75	Patients	"Endoscopists each reported three to four patient barriers to optimal bowel preparation. The endoscopist in the study perceived the patient's inability to tolerate the full course of purgative to be the most common barrier to optimal bowel preparation (78.7 %)"
					"Endoscopists each reported three to four patient barriers to optimal bowel preparation. The endoscopists in the study report problems such as duration, convenience, and palatability of purgative (72.5 %)"
		Spiegel et al. (2011) [44]	75	Patients	"Belief that instructions are too complicated to follow and are not sufficiently "personal" to instill motivation"
					"Purgatives are just too difficult to take..." Concerns included unpalatable taste, risk of severe diarrhea, and risk of nausea and vomiting"
1.09 Clarity of the intervention	A – Appropriateness of colonoscopy	Sanaka et al. (2006) [33]	75	Endoscopists	"The intervention was relatively simple"
		Bampton et al. (2007) [42]	75	Endoscopists	"Other areas felt not to be clear in the guidelines"
		Cardella et al. (2008) [41]	75	Endoscopists	"Barriers identified by providers included unclear guidelines and confusion about responsibility for ordering tests when multiple providers are involved"
				Nurses	"Barriers identified by providers included unclear guidelines and confusion about responsibility for ordering tests when multiple providers are involved"
1.10 Cost and cost-effectiveness	A – Appropriateness of colonoscopy	Sanaka et al. (2006) [33]	75	Management	"A reimbursement system that continues to pay for these frequent inappropriate examinations"
					"The intervention is inexpensive"
	B – Colonoscopy clinical quality	Naylor et al. (2003) [43]	50	Management	"Quality does not come for free. Setting up and maintaining a QA program requires investment in time, money, and personnel"

Supplementary File 1 (Continuation)

CQI program implementation themes and attributes	Main colonoscopy quality domains of the study ¹	Reference	Quality Score (%)	User group	Items ²
		Ball et al. (2004) [32]	25	Management	"The cost of this quality improvement program, although not measured, was minimal"
	B – Colonoscopy clinical quality	Hillyer et al. (2012) [45]	75	Endoscopists	"Physician practice related and perceived patient barriers to optimal bowel preparation by level of self-reported suboptimal bowel preparations per week. Most agreed that [...] lack of reimbursement for patient education (42.4%) presented a barrier"
	D – Patient satisfaction & E – Patient compliance	Abuksis et al. (2001) [38]	50	Management	"The cost of examination was reduced by 8.9% when patients participated in an education program"
1.11 Maintaining of compliance	A – Appropriateness of colonoscopy	Bampton et al. (2007) [42]	75	Endoscopists	"Maintaining the improvement made remains one of the major challenges in clinical practice improvement"
	B – Colonoscopy clinical quality & D – Patient satisfaction	Seip et al. (2010) [37]	100	Endoscopists	"An important challenge is to maintain interest among participating endoscopists to ensure high data quality over time"
2. Attitudes and perceptions					
2.01 Attitude towards intervention or the action plan	A – Appropriateness of colonoscopy	Bampton et al. (2007) [42]	75	Endoscopists	"Proceduralists stated they disagreed with the guidelines"
	B – Colonoscopy clinical quality	Conigliaro et al. (2006) [35]	50	Endoscopists	"Physician's unwillingness was the most important barrier to following sedation guidelines (80%)"
		Lin et al. (2010) [46]	50	Endoscopists	"Monitoring had a greater impact on endoscopists who are slow at baseline. Fast endoscopists are highly confident in their skills and believe they can perform an adequate examination even with short withdrawal time"
		Ball et al. (2004) [32]	25	Endoscopists	"An agreed-upon action plan was then put in place"
	B – Colonoscopy clinical quality & D – Patient satisfaction	Seip et al. (2010) [37]	100	Endoscopists	"Willingness to change practice if the QA program demonstrates suboptimal results"
	F – Attitude toward CQI program	De Jonge et al. (2010) [40]	100	Endoscopists	"The opinion of gastroenterologists towards feasibility of implementation is very positive for 72.6%, and this attitude is not related to the endoscopists' characteristics"
					"Years of endoscopy experience was found to be of influence on an overall positive attitude towards QA programs"
					"The general opinion about the implementation of a QA program was positive among 95% of respondents"
2.02 Sense of ownership to the intervention	A – Appropriateness of colonoscopy	Sanaka et al. (2006) [33]	75	Endoscopists	"Physicians themselves were also involved in the process"
	B – Colonoscopy clinical quality	Hoff et al. (2006) [34]	100	Endoscopists	"It is important that endoscopists have a sense of ownership with respect to this type of program"
	B – Colonoscopy clinical quality & D – Patient satisfaction	Seip et al. (2010) [37]	100	Endoscopists	"A feeling of ownership by the endoscopists will ensure higher compliance"
2.03 Perception of impact	F – Attitude toward CQI program	De Jonge et al. (2010) [40]	100	Nurses	"A feeling of ownership by the endoscopists will ensure higher compliance"
					"35% thought that the capacity of the endoscopy department would decrease (54.5% neutral and 11% very positive attitude)"

Supplementary File 1 (Continuation)

CQI program implementation themes and attributes	Main colonoscopy quality domains of the study ¹	Reference	Quality Score (%)	User group	Items ²
				F	"66.2% thought that the quality of the endoscopy department would increase (33.3% neutral and 0.5% very negative attitude)"
				F	"55.7% thought that the publicity around the endoscopy department would increase (41.3% neutral and 1.0% negative)"
				F	"A QA program should place clinical quality of the procedures central according to 93%"
				B	"Perceived risks and benefits"
3. Organizational environment					
3.01 Involving all in the planning and implementation of CQI programs	B – Colonoscopy clinical quality A – Appropriateness of colonoscopy	Spiegel et al. (2011) [44] Cardella et al. (2008) [41]	75 75	Endoscopists	"Consensus was reached by the multidisciplinary GI site group on CRC follow-up regime" "Consensus was reached by the multidisciplinary GI site group on CRC follow-up regime" "Patients indicated that they wanted to be involved in their care and wanted to be more responsible for making sure their appointments were made and appropriate testing was completed"
				F	"Attendance at the [CQI] meeting is mandatory for all the [...] gastroenterologists, [and] the fellows [in training]"
				F	"Attendance at the [CQI] meeting is mandatory for [...] the chief of endoscopy nursing"
				F	"Our program involves all endoscopy unit staff"
				F	"...considering the views of the endoscopist staff..."
				F	"We held departmental meetings to review the results..."
				F	"...considering the views of the nursing staff..."
				F	"Gastroenterologists deemed it important to involve nurses, managers of the endoscopy department, and patients"
				F	"Gastroenterologists deemed it important to involve nurses, managers of the endoscopy department, and patients"
				F	"Gastroenterologists deemed it important to involve nurses, managers of the endoscopy department, and patients"
				F	"Gastroenterologists deemed it important to involve nurses, managers of the endoscopy department, and patients"
3.02 Support from hospital administration	A – Appropriateness of colonoscopy C – Quality of the discharge process	Sanaka et al. (2006) [33] Gall and Bull (2004) [39]	75 25	Management Management	"Attendance at CQI meetings is facilitated by the hospital administration (no clinical activities are scheduled)" "Staff members attended a clinical risk management course"
3.03 Dedicating staff to perform new roles	A – Appropriateness of colonoscopy B – Quality of colonoscopy	Bampton et al. (2007) [42] Imperiali et al. (2007) [36]	75 75	Nurses Endoscopists	"The critical component of the SCOOP programme is the role of the nurse coordinator" "Data were collected by a staff gastroenterologist with official credentials in quality control (hospital quality controller) and experience in clinical auditing"

Supplementary File 1 (Continuation)

CQI program implementation themes and attributes	Main colonoscopy quality domains of the study ¹	Reference	Quality Score (%)	User group	Items ²
		Naylor et al. (2003) [43]	50	Nurses	"Immediate colonoscopy complications were recorded within the endoscopy unit.... The endoscopy nurse kept a separate record of each procedure, sedation used, reversal of sedation, pulse oximetry readings, and complication"
3.04 Access to human resources	A – Appropriate-ness of colonoscopy	Cardella et al. (2008) [41]	75	Management	"Barriers identified by providers included [...] access to oncologists"
3.05 Access to material	A – Appropriate-ness of colonoscopy	Cardella et al. (2008) [41]	75	Management	"Barriers identified by providers included access to testing"
	B – Colonoscopy clinical quality	Naylor et al. (2003) [43]	50	Management	"Current endoscopy software packages are not designed for audit purposes"
3.06 Access to training	B – Colonoscopy clinical quality	Conigliaro et al. (2006) [35]	50	Management	"The percentage of cases in which implementation of the guidelines was impossible due to the lack of availability of monitoring during recovery decreased drastically, from 13.6% in phase 0 to 3.5% in phase 2"
	C – Quality of the discharge process	Hoff et al. (2006) [34]	100	Management	"The hospital administration must allow adequate opportunity for necessary training... To improve performance with the support of the employing hospital"
		Gall and Bull (2004) [39]	25	Management	"The guidelines are supported by the hospital administration"

¹ According to the GRS, clinical quality and quality of patient experience are dimensions of quality colonoscopy services, each comprising six criteria. Clinical quality includes: 1, consent process including patient information; 2, safety; 3, comfort; 4, quality of the procedure; 5, appropriateness; and 6, communicating results to referrer. Quality of patient experience includes: 1, quality of access and equity of provision; 2, timeliness; 3, booking and choice; 4, privacy and dignity; 5, aftercare; and 6, ability to provide feedback to the service.

² F = Facilitator, B = Barrier.