Performance measures for lower gastrointestinal endoscopy: a European Society of Gastrointestinal Endoscopy (ESGE) Quality Improvement Initiative

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Abbreviations

ESGE : European Society of Gastrointestinal Endoscopy

PM(s) : Performance measure(s)

LGI : Lower gastrointestinal tract

WG : Working group

QIC : Quality improvement committee

kPM : key performance measure

mPM : minor performance measure

CRC : colorectal cancer

ASGE : American Society for Gastrointestinal Endoscopy

EPAGE : European Panel on the Appropriateness of Gastrointestinal Endoscopy

Abstract

The European Society of Gastrointestinal Endoscopy and the United European Gastroenterology present a short list of key performance measures for lower gastrointestinal endoscopy. We recommend that endoscopy services across Europe adopt the following seven key performance measures for lower gastrointestinal endoscopy for measurement and evaluation in daily practice on the centre and endoscopist level:

1. Rate of adequate bowel preparation (minimum standard 90%), 2. Cecal intubation rate (minimum standard ≥90%), 3. Adenoma detection rate (minimum standard 25%), 4. Appropriate polypectomy technique (minimum standard 90%), 5. Complication rate (minimum standard not set), 6. Patient experience (minimum standard not set), 7. Appropriate post-polypectomy surveillance recommendations (minimum standard not set).

Other identified performance measures were listed as less relevant based on assessment of importance, scientific acceptability, feasibility, usability and comparison to competing measures.

Introduction

The European Society of Gastrointestinal Endoscopy (ESGE) and the United European Gastroenterology (UEG) have identified quality of endoscopy as a major priority. We described our rationale for this priority in a recent manuscript that also addressed the methodology of the current quality initiative process.[1]

Due to variation in physician's performance, and introduction of nationwide colorectal cancer (CRC) screening programs, lower gastrointestinal (LGI) endoscopy was the first area of endoscopy to address quality.[2-4] Over more than a decade, several potential measures of quality in lower gastrointestinal (LGI) endoscopy have been identified. In consequence, many professional societies have published recommendations on performance measures (PM) for LGI endoscopy.[5-7] These were, however, numerous (44 different PMs[5-7]), country-specific, and not always evidence-based. This limited their wider adoption in Europe.

The aim of the ESGE LGI working group was to identify a short list of key PMs for LGI endoscopy, widely applicable to endoscopy services throughout Europe. This list would ideally consist of PMs with the following requirements: proven impact on significant clinical outcomes, or quality of life, well defined, reliable and simple method/approach for measurement, susceptibility for improvement, and application to all levels of endoscopy services.

This paper reports the agreed list of key PMs for LGI endoscopy and describes the methodological process applied in the process.

Methodology

We previously described the multistep process for producing the PMs.[1] In brief, at the United European Gastroenterology Week in 2014, we used a modified Delphi consensus process to develop quality measures in the following domains: pre-procedure, completeness of procedure, identification of pathology, management of pathology, complications, procedure numbers, patient experience and post-procedure.[1, 8, 9] We decided to have one to two key PMs for each quality domain. In order to identify key PMs we first created a list of all possible PMs for LGI endoscopy through email correspondence and teleconferences that took place between December 5, 2014 and February 7, 2015. Then, all possible PMs that were identified by this process were structured using the PICO framework (where P stands for Population/Patient; I for Intervention/Indicator; C for Comparator/Control and O for Outcome) to inform searches for available evidence that supported the PMs. This process resulted in 38 PICOs. Detailed literature searches were performed by an expert team of methodologists and yielded results for 29 PICOs (see Supporting Information). WG members identified additional articles relevant for the PMs in question.

The PICOs and the clinical statements derived from these were adapted or omitted during iterative rounds of comments and suggestions of the WG members during the Delphi process (http://is.njit.edu/pubs/delphibook/delphibook.pdf). The evolution and adaptation of the different PICOs and clinical statements during the Delphi process can be reviewed in the Supporting Information. The domain addressing the competence of endoscopists quality (including procedure numbers) along with associated PICOs and clinical statements were moved for future initiatives.

In total, WG members participated in a maximum of 3 rounds of voting to agree on PMs in predefined domains and their respective thresholds, discussed below. Statements were discarded if agreement was not reached over the 3 voting rounds. The agreement that is given for the different statements, refers to the last voting round in the Delphi process. The key PMs were distinguished from the minor PMs based on the ISFU criteria (Importance, Scientific Acceptability, Feasibility, Usability and comparison with competing measures), and expressed by mean voting scores.

The PMs are displayed in tables addressing different quality domains. Each table describes the PM, the level of agreement during the modified Delphi process, grading of available evidence (the evidence was graded according to the GRADE system[10]), how the PM should be measured, and recommendations supporting its adoption. The tables further list the measurement of agreement (scores), the desired threshold, and suggestions how to deal with underperformance.

The minimum number needed to assess if the threshold for a certain PM is reached can be calculated by estimating the 95% confidence intervals (CI) around the predefined threshold for different sample sizes.[8, 9, 11] Because of practicality and to simplify implementation and auditing, we suggest that at least 100 consecutive procedures (or all if < 100 performed) should be measured to assess a PM. Continuous monitoring should be, however, the preferred method of measurement.

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Using the evidence derived by the literature search group and input from the WG members, a total of 34 clinical statements addressing 27 potential PMs grouped into 8 quality domains were formulated. Over the course of two voting rounds, a consensus agreement was reached for 18 statements regarding 14 potential PMs (agreement in both voting rounds). The remaining 16 statements were again rephrased and subjected to a third and final third voting round; 4 statements were accepted. In total, 22 statements regarding 18 PMs were accepted after 3 voting rounds. Over the course of voting , we decided that the competence of endoscopists quality domain (including 3 accepted statements and 3 PMs) will be discarded from these guidelines and left for future initiatives. Finally, a total of 15 PMs (19 statements) attributed to 7 quality domains were accepted for these guidelines (see Figure 1). The entire process of PMs development can be reviewed in the Supporting Information.

We used the highest mean voting scores to identify one key PM for each of the seven quality domains (Figure 1). The remaining PMs were considered minor PMs. In the management of pathology domain there were two PMs ("Appropriate polypectomy technique" and "Tattooing resection sites") competing for being key ones. We decided to select "Appropriate polypectomy technique" as a key PM, based on wider usability and better feasibility. All PMs were deemed valuable by the WG members and were obtained after a rigorous process as described above. From a practical viewpoint, it may however be desirable to implement the key PMs first in units not monitoring any PM at this time. Once this culture of measuring quality (with the aim of improving practice, outcomes and the patient experience) is accepted and software is available, the minor PM may further aid to monitor the quality of LGI endoscopy. The use of appropriate endoscopy reporting systems is key to facilitate data retrieval on identified PMs.[12]

All PMs presented below using descriptive framework developed by the QIC and a short summary of evidence for the ISFU criteria. The PMs are listed according to the domain they were attributed to (for the summary see Figure 1).

1. Domain : Pre-procedure

Key Performance Measure	Rate of adequate bowel preparation
Description	The percentage of patients with adequately prepared bowel
Domain	Pre-procedure
Category	Process
Rationale	It has been shown, that the quality of bowel preparation affects the cecal intubation rate and adenoma detection rate. Inadequate bowel preparation results in increased costs and inconvenience as the examination has to be rescheduled, or alternative investigations have to be organized.
Construct	Denominator: Patients undergoing colonoscopy Numerator: Patients in denominator with adequate bowel preparation (assessed with a validated scale, preferably the Boston Bowel Preparation Scale (score ≥6) or Ottawa Scale (score ≤7), Aronchick Scale (excellent, good or fair)) Exclusions: - Emergency endoscopies Calculation: Proportion (%) Level of analysis: Service and individual level Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a yearly audit for a sample of 100 consecutive lower GI endoscopies.
Standards	Minimum standard: ≥90% Target standard: ≥95% Bowel preparation quality should be included in every colonoscopy report. It needs to be assessed using a validated scale, such as the Boston Bowel Preparation Scale, the Ottawa Scale or Aronchick Scale. If a minimum standard is not reached, analysis of factors influencing bowel preparation should be performed on a service level (information given to patients, dietary restrictions, cleansing agent used, colonoscopy timing). After evaluation and adjustment, close monitoring with a further audit within 6 months should be performed.
Consensus Agreement	100%
PICO (see Supporting Information)	1, 2
Evidence Grading	Moderate quality evidence

The acceptance of this PM is based on the agreement for the following statements:

- In patients undergoing screening or diagnostic colonoscopy bowel preparation quality should be recorded using a validated scale with high intra-observer reliability (N1.1). Agreement: 100%
- A service should have a minimum of ≥90% procedures and a target of ≥95% procedures with adequate bowel preparation assessed using a validated scale with high intra-observer reliability (N1.2). Agreement: 100%

The quality of bowel preparation is important for the efficacy of colonoscopy. As pointed out in the ESGE guidelines on bowel preparation for colonoscopy,[13] the quality of bowel preparation is

associated with two other important PMs of colonoscopy – adenoma detection rate and cecal intubation rate.[14] Suboptimal bowel preparation results in further costs and inconvenience, because the examination has to be repeated or an alternative examination has to be arranged.[15] To determine the scientific acceptability of a measure of bowel preparation quality we focused on performance of different bowel preparation scales and quantification of adequacy of bowel preparation. There were no direct comparisons of performance between bowel preparation scales (see Supporting Information). Three bowel preparation scales underwent comprehensive validation and showed sufficient validity and reliability: the Boston Bowel Preparation Scale (BBPS),[16] the Ottawa Scale[17] and the Aronchick Scale.[18] The BBPS is the most thoroughly validated scale and should be the preferred one.[19] There were no significant differences between intermediate and high quality bowel preparation (regardless of the scale used) in terms of adenoma or advanced adenoma detection rates (see Supporting Information).[20] Therefore the adequate bowel preparation may be defined as: BBPS ≥6, Ottawa Scale ≤7 or Aronchick Scale (excellent, good or fair). The adoption of validated scales for bowel preparation quality assessment was proven feasible in routine practice.[21] Proposed minimum standard (≥90%) and target standard (≥95%) rates of adequate bowel preparation were based on values reported in recent population-based studies[22-24] and randomized clinical trials of split-dose bowel cleansing regimens,[25, 26] respectively.

Minor Performance Measure	Time slot allotted for colonoscopy
Description	Time allotted for each colonoscopy in daily schedule
Domain	Pre-procedure
Category	Structure
Rationale	Colonoscopy needs adequate time allocated for the entire procedure (including sedation, discussion with the patient, insertion, withdrawal and therapy). Time pressure due to inadequate time slots may impair colonoscopy quality
Construct	Denominator: Number of colonoscopies scheduled in an outpatient colonoscopy list (session). Numerator: Outpatient colonoscopy list (session) working hours. Exclusions: - Emergency colonoscopy Calculation: Average time length (minutes) Level of analysis: Service level Frequency: Two-yearly checking booking log.
Standards	Minimum standard: 30 minutes for clinical and primary screening colonoscopy; 45 minutes for colonoscopy following positive fecal occult blood testing Target standard: no target standard is set If minimum standard is not reached, a systematic approach to schedule modification should be applied.
Consensus Agreement	100%
PICO (see Supporting Information)	3
Evidence Grading	No evidence

The acceptance of this PM is based on the agreement for the following statements:

- Colonoscopy needs adequate time allocated for insertion, withdrawal and therapy. Routine colonoscopy should be allocated a minimum of 30 minutes. Colonoscopies following positive faecal occult blood testing should be allocated a minimum 45 minutes to allow for therapeutic intervention (N1.3). Agreement: 100%

There is some evidence that productivity pressure may negatively affect the quality of colonoscopy.[27] Although it has been shown that working behind schedule is not associated with lower adenoma detection rates,[28] the effect of a very tight schedule on colonoscopy performance is unknown (see Supporting Information). The WG members suggested that 30 minutes and 45 minutes are minimum times that should be allotted for routine colonoscopy and colonoscopy after positive faecal occult blood testing (longer time to accommodate high prevalence of large polyps), respectively. These values correspond well with mean total procedure times for colonoscopy reported in recent studies.[29, 30]

Minor Performance Measure	Indication for colonoscopy
Description	The colonoscopy report should include an explicit indication for the procedure, categorized according to existing guidelines on appropriateness of colonoscopy use (the ASGE or the EPAGE II).
Domain	Pre-procedure
Category	Process
Rationale	Colonoscopies with appropriate indication are associated with higher diagnostic yield for relevant lesions than colonoscopies without appropriate indication.
Construct	Denominator: All colonoscopies performed. Numerator: Colonoscopies with appropriate and 'uncertain' indication (according to ASGE or EPAGEII) Exclusions: - None Calculation: Proportion (%) Level of analysis: Service level Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a yearly audit for a sample of 100 consecutive lower GI endoscopies.
Standards	Minimum standard: ≥85% Target standard: ≥ 95% All reports from colonoscopies performed should include an appropriate indication according to the ASGE or the EPAGE II guidelines. In case of screening, the colonoscopy report should state this and it has to be ensured that the subject meets the criteria for screening. Colonoscopy reporting system with drop-down menu for indication is an ideal setting both for ensuring proper indication and auditing. If the minimum standard is not met, a systematic approach to validate appropriateness of colonoscopy should be applied (i.e. validation of appropriateness before colonoscopy scheduling). After evaluation and adjustment, close monitoring with a further audit within 6 months should be performed.
Consensus Agreement	93.8%
PICO (see Supporting Information)	4
Evidence Grading	Moderate quality evidence

The acceptance of this PM is based on the agreement for the following statements:

- For audit purposes, the colonoscopy report should include an explicit indication for the procedure, categorized according to existing guidelines on appropriateness of colonoscopy use (N1.4). Agreement: 93.8%

Appropriate referrals for colonoscopy may help to optimize the use of limited resources and protect patients from potential harms of unnecessary invasive procedures. Colonoscopies with appropriate indication are associated with significantly higher diagnostic yield for cancer and other relevant lesions than colonoscopies without appropriate indication.[31-34] The American Society for Gastrointestinal Endoscopy (ASGE) and the European Panel on the Appropriateness of

Gastrointestinal Endoscopy (EPAGE II) guidelines on appropriateness of colonoscopy use consistently show 67-96% sensitivity and 13-40% specificity for the detection of relevant findings (see Supporting Information).[31-34] Proposed minimum standard of appropriate indication for colonoscopy (≥85%) was based on values achieved in studies from academic and non-academic centers over last 5 years.[32, 33, 35] The use of appropriate endoscopy reporting systems with dropdown menu for indication is key to facilitate data acquisition for this PM.[12]

2. Domain : Completeness of Procedure

Key Performance Measure	Cecal intubation rate (CIR)
Description	The percentage of colonoscopies reaching and visualizing the whole cecum and its landmarks.
Domain	Completeness of Procedure
Category	Process
Rationale	Whole bowel examination is a prerequisite for complete and reliable mucosa inspection in search for lesions. Low cecal intubation rate is associated with increased risk of interval colorectal cancer. Incomplete colonoscopy leads to increased costs and inconvenience as the examination has to be repeated.
Construct	Denominator: All screening or diagnostic colonoscopies Numerator: Procedures in the denominator that report reaching the caecum (documented in written form and by photo/video) Exclusions : - Therapeutic procedures with no indication to reach the cecum - Emergency endoscopy Calculation: Proportion (%) Level of analysis: Service and endoscopist level Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a yearly audit for a sample of 100 consecutive lower GI endoscopies.
Standards	Minimum standard: ≥90% Target standard: ≥95% Cecal intubation understood as complete visualization of the whole caecum and its landmarks should be documented in written report, as well as with photo or video documentation. If minimum standard is not reached on endoscopist level, additional training should be offered. If minimum standard is not reached on service level an audit to determine the cause should be performed. After evaluation and adjustment, close monitoring with a further audit within 6 months should be performed.
Consensus Agreement	97.9%
PICO (see Supporting Information)	5, 6, 7
Evidence Grading	Moderate quality evidence

The acceptance of this PM is based on the agreement for the following statements:

- Complete colonoscopy requires cecal intubation with complete visualization of the whole caecum and its landmarks (N2.1). Agreement: 100%
- A service should have a minimum unadjusted cecal intubation rate of ≥90% and a target rate of ≥95% as a measure of the completeness of colonoscopy examination (N2.2). Agreement: 93.8%
- Complete colonoscopy (cecal intubation) should be documented in both written form and a photo or video report (N2.3). Agreement: 100%

Cecal intubation is a prerequisite for complete visualization of the colorectum. Cecal intubation must be confirmed with photo or video documentation. Clear cecal image documentation is associated with higher detection rate of polyps.[36] For the purpose of colorectal neoplasia detection, terminal ileum intubation is useful only for confirming colonoscopy completion when classic cecal landmarks are not confidently seen.[37] Failed cecal intubation results in further costs and inconvenience as the examination must rescheduled or alternative investigation organized. A cecal intubation rate <80% is associated with significantly higher risk of proximal and distal interval CRC as compared to higher completion rates.[38] Adjustment of cecal intubation rate for inadequate bowel preparation or impassable strictures makes the measurement less feasible and harbours the risk of gaming. In recent large population-based studies unadjusted cecal intubation rates always exceeded 90% and usually were above 95%.[22, 39-43] The effect of raising the target standard beyond the minimum 95% is uncertain.

3. Domain : Identification of pathology

Key Performance Measure	Adenoma detection rate (ADR)
Description	Percentage of colonoscopies with at least one adenoma identified.
Domain	Identification of pathology
Category	Process
Rationale	Adenoma detection rate reflects adequate inspection of the bowel mucosa. Adenoma detection rate is associated with interval CRC and CRC death. Improvement in adenoma detection rate lowers the risk for CRC and CRC death.
Construct	Denominator: All colonoscopies in patients 50 years of age or older. Numerator: Procedures in denominator, in which at least one adenoma was identified. Exclusions : - Emergency colonoscopy - Endoscopy with a specific therapeutic indication, including work-up of previously detected lesion or follow-up of disease activity in inflammatory bowel disease. Calculation: Proportion (%) Level of analysis: Service and endoscopist level Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a yearly audit for a sample of 100 consecutive lower GI endoscopies.
Standards	Minimum standard: ≥25% Target standard: no current target standard defined Adenoma detection rate should be monitored in all settings (screening and out-patient), which requires routine access to histopathology reports. If minimum standard is not met on endoscopist level appropriate feedback followed by competence assessment (with special consideration to withdrawal time and technique) should be given. If minimum standard is not met on a service level a comprehensive training for center leader should be considered.
Consensus Agreement	100%
PICO (see Supporting Information)	8
Evidence Grading	Moderate to high quality evidence

The acceptance of this PM is based on the agreement for the following statements:

- Adenoma detection rate should be used as a measure of adequate inspection at screening or diagnostic colonoscopy in patients aged 50 years or more (N3.1). Agreement: 100%

The detection and removal of adenomas, which are major precursor lesions for CRC, are seen as key aspects of CRC prevention. However, there is a wide variation between endoscopists in terms of their skills at detecting adenomas, expressed as adenoma detection rate (ADR).[22, 41, 44-46] ADR has been inversely associated with the risk of interval CRC[44] and colorectal cancer death.[45] Similar relationship with the incidence of distal interval CRC was confirmed for a flexible sigmoidoscopy screening.[47] Of note, serrated polyp detection rate has been shown to strongly correlate with ADR.[41] Although ADR is considered a surrogate for meticulous inspection of colorectal mucosa, the correlation with other

important, but non-neoplastic findings has never been studied. Several interventions, including education, creating awareness, feedback and benchmarking on colonoscopy quality have all helped to improve ADR.[48-51] Recently, it has been shown that improved ADR translates to risk reductions for interval colorectal cancer and death, which closes the quality improvement loop.[52] It has been postulated that ADR has an inherent limitation of not measuring the total number of adenomas detected.[39] A potentially more accurate measure, number of adenomas per colonoscopy, has been proposed, but it was proven not to be superior to ADR in a recent study.[53] It is challenging to set the standards for ADR, especially in populations enriched with faecal occult blood test (FOBT)-positive patients. In a primary colonoscopy screening setting, a 1% increase in ADR predicted a 3% decrease in the risk of interval CRC within the observed range of ADR from 7.35% to 52.5%.[45] In another study an ADR above 24.6% was associated with a reduced risk of interval CRC and subsequent death.[52] In recent population based studies a proposed minimum standard ADR of 25% was met by majority of endoscopists.[22, 45, 49] In FIT+ enriched populations the minimum standard may need to be higher, however, the exact value is yet to be established.

Minor Performance Measure	Withdrawal time (WT)
Description	Time spent on withdrawal of endoscope from a cecum to anal canal and inspection of entire bowel mucosa at negative (no biopsy or therapy) screening or diagnostic colonoscopy.
Domain	Identification of pathology
Category	Process
Rationale	Mean WT of 6 minutes or longer was associated with higher adenoma detection rates and lower interval cancer rates as compared to shorter withdrawal time.
Construct	WT is measured from cecum to anal sphincter. Denominator: Number of negative (no biopsy/therapy) screening or diagnostic colonoscopies Numerator: Sum of withdrawal time in colonoscopies included in the numerator Exclusions : - Emergency colonoscopy - Incomplete colonoscopy Calculation: Mean time in minutes Level of analysis: Endoscopist level Frequency: Measured only in case of insufficient adenoma detection rate using a sample of 100 consecutive colonoscopies.
Standards	Minimum standard: mean 6 minutes Target standard: mean 10 minutes Time can be measured with different means: stopwatch operated by nurse, time stamp on photo documentation of cecum and rectum, length of video recording or external device (this requires inclusion of WT in colonoscopy report). WT should be measured only in case of insufficient adenoma detection rate. Feedback on mean WT should be given to endoscopist.
Consensus Agreement	87.5%
PICO (see Supporting Information)	9
Evidence Grading	Moderate quality evidence

The acceptance of this PM is based on the agreement for the following statements:

- A mean withdrawal time (WT) of at least 6 minutes should be used as a supportive measure of adequate identification of pathology at negative screening or diagnostic colonoscopy (N3.6). Agreement: 87.5%

Colonoscope WT provides information about the time endoscopists spend to identify pathology. A mean WT of > 6 minutes has been associated with higher adenoma detection rates (ADR).[54] Although the association between WT and ADR was not observed in all studies,[55] a recent large population based analysis confirmed the positive relation between those two measures, with an absolute 3.6% increase in ADR per minute increase in WT.[24] Importantly, the latter study showed also an inverse association between mean WT and incidence of interval CRC.[24] The observed association was not linear and the risk of interval CRC leveled off at mean WT of 8 minutes (the most significant difference was observed for the 6 minutes cut off). In another study the increase in mean WT beyond 10 minutes had a minimal effect on adenoma detection rate.[56] Therefore the minimum standard mean WT of 6 minutes and the target standard of 10 minutes are quite well defined. Monitoring WT or institution policy of WT above a certain threshold showed, however, inconsistent effects on ADR

values.[57-59] The explanation could be that the variation in withdrawal technique is more important than the WT.[60] Therefore, it appears that the WT is particularly useful as a supportive tool when observed ADR is less than the minimum standard of 25%.[61]

Minor Performance Measure	Polyp detection rate (PDR)
Description	Percentage of colonoscopies in patients aged 50 years or more in which at least one polyp was identified.
Domain	Identification of pathology
Category	Process
Rationale	Polyp detection rate reflects adequate inspection of bowel mucosa. Polyp detection ratel correlates with adenoma detection rate and polypectomy rate is weakly associated with interval CRC risk.
Construct	Denominator: All screening and diagnostic colonoscopies in patients 50 years of age or older. Numerator: Procedures in the denominator with at least one polyp identified Exclusions : - Emergency colonoscopy - Endoscopy with a specific therapeutic indication, including work-up of previously detected lesion or follow-up of disease activity in inflammatory bowel disease Calculation: Proportion (%) Level of analysis: Service and endoscopist level Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a yearly audit for a sample of 100 consecutive lower GI endoscopies.
Standards	Minimum standard: 40 % Target standard: no current target standard defined Polyp detection rate is an approximation of adenoma detection rate and should only be used when there is limited access to histopathology reports. Caution is needed, however, because polyp detection rate is susceptible to gaming. If the minimum standard is not met, there should be attempt to obtain histopathology reports and calculate adenoma detection rate.
Consensus Agreement	84.6%
PICO (see Supporting Information)	10
Evidence Grading	Low quality evidence.

The acceptance of this PM is based on the agreement for the following statements:

- Polyp detection rate should be used as a measure of adequate inspection at screening or diagnostic colonoscopy in patients aged 50 years or more (N3.5). Agreement: 84.6%

Polyp detection rate (PDR) is a surrogate for ADR, which is more feasible to measure as it does not require histological verification. In some studies PDR has been shown to correlate well with ADR,[62-64] in other, however, the correlation was poor for polyps in the distal colorectum.[65, 66] In one study, polypectomy rates of at least 25% were associated with significantly lower risk of proximal interval CRC.[38] In a recent study PDR was found to not be inferior to ADR in predicting the risk of interval CRC.[53] Using the average adenoma to polyp detection quotient of 0.64 the minimum standard PDR was estimated at 40%, which corresponds with ADR of 25%.[64] The detection of adenomas and non-neoplastic polyps are associated, however, what may inflate PDR.[65] The use of PDR instead of ADR could be therefore considered in case of limited availability of histopathology data and with potential

risks of gaming. We note that an increased quality pressure may force endoscopists to detect and remove non-neoplastic lesions that would otherwise be undetected only to inflate the rate of detection of ‘so-called’ polyps.

4. Domain : Management of Pathology

Key Performance Measure	Appropriate polypectomy technique.
Description	Adequate resection technique of colorectal polyps includes biopsy forceps removal of polyps ≤3 mm in size and snare (cold or with diathermy) polypectomy for larger polyps. Polyps size estimated by endoscopists has to be included in the endoscopy report.
Domain	Management of pathology
Category	Process
Rationale	Inappropriate polypectomy technique increases risk of incomplete polyp removal. Incomplete polyp removal leads to further costs and inconvenience as the examination has to be repeated. Incomplete polyp removal is also considered to contribute to development of interval CRCs.
Construct	Denominator: Polyps >3mm in size removed at colonoscopy (polyp size estimated by endoscopist) Numerator: Polyps in the denominator removed with snare polypectomy (cold or with diathermy) Exclusions : - None Calculation: proportion (%) Level of analysis: Service and endoscopist Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a yearly audit for a sample of 100 consecutive lower GI endoscopies.
Standards	Minimum standard: ≥80% Target standard: ≥90% Colonoscopy reports have to include information on polyp resection technique. If the minimum standard is not met, a rate of complete polyp resection should be measured and a feedback to the endoscopist or service should be given. Additional training on basic polypectomy technique should be considered. After evaluation and adjustment, close monitoring with a further audit within 6 months should be performed .
Consensus Agreement	93.3%
PICO (see Supporting Information)	12
Evidence Grading	Low quality evidence

The acceptance of this PM is based on the agreement for the following statements:

- Adequate resection technique of small and diminutive colorectal polyps includes biopsy forceps removal of polyps >3mm in size and snare polypectomy for larger polyps (N4.6). Agreement: 93.3%

Incomplete polypectomy is considered the cause for up to 25% of interval CRCs.[67, 68] Incomplete resection of polyps 5-20mm in size varies from 6.5% to 22.7% among endoscopists.[69] Completeness of polyp resection is considered, however, challenging to measure, and statements regarding this topic have not reached agreement in the current Delphi process (see Supporting Information). Biopsy forceps resection of polyps 4-5mm in size or larger has been shown inferior to snare technique, regarding completeness of resection.[70, 71] Therefore appropriate resection technique of colorectal

polyps includes biopsy forceps removal of polyps ≤3 mm in size and snare (cold or with diathermy) polypectomy for larger polyps. Despite that, in a recent large, cohort study it has been demonstrated that 28.2% of lesions ≥5mm in size were resected using biopsy forceps instead of snare technique.[72] Contrary to this, in a large study from the UK over 90% of polyps larger than 3 mm in size were removed using a snare.[73] There are insufficient data to set the minimum and target standards reliably, but the proposed values for use of appropriate polypectomy techniques of ≥80% and ≥90%, respectively, seem relatively easy to achieve.

Minor Performance Measure	Tattooing resection sites
Description	In patients undergoing removal of colorectal non-pedunculated lesions 20 mm in size or larger or with suspicious macroscopic features regardless of size, the resection site should be tattooed to improve future relocation of the resection site.
Domain	Management of pathology
Category	Process
Rationale	Facilitates detection of post-polypectomy site at surveillance colonoscopy or surgical resection.
Construct	Tattooing resection site of the abovementioned lesions should be applied in all cases. A service must provide appropriate equipment. For feasibility reasons Denominator: Colonoscopies with removal of non-pedunculated lesions 20 mm in size or larger or suspicious macroscopic features regardless of size. Numerator: Procedures in the denominator where resection site was marked with a tattoo. Exclusions : - None Calculation: Proportion (%) Level of analysis: Service level Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a three-yearly audit of all colonoscopies performed over 3 months period.
Standards	Minimum standard: Unknown Target standard: 100% Every endoscopy report, where removal of abovementioned lesions was performed, should include written information on tattooing the resection site. If the tattooing is not performed in all cases a feedback to the service and all endoscopists should be given.
Consensus Agreement	93.3%
PICO (see Supporting Information)	11
Evidence Grading	Very low quality evidence

The acceptance of this PM is based on the agreement for the statement:

- In patients undergoing removal of colorectal lesions with a depressed component (0-IIc according to the Paris classification) or non-granular or mixed-type laterally spreading tumors, located between ascending and sigmoid colon, the resection site should be tattooed to improve future relocation of the resection site. (Agreement 93.3%)

Colorectal lesions with depressed component and non-granular or mixed-type laterally spreading tumors harbor an increased risk of malignancy.[74-76] Therefore the site of endoscopic removal of these lesions often needs to be relocated to identify recurrence or guide surgical management. It has been shown that tattooing significantly shortens the time to relocate the resection site on endoscopy.[77] There is no evidence, however, that tattooing resection site increases to the rate of relocated lesions (see Supporting Information). Preoperative tattooing using prepacked kits was proven to be very

effective method for tumor localization in laparoscopic surgery.[78] Moreover, some studies have shown that tattooing improves lymph node yield and facilitates harvesting suspicious lymph nodes at colorectal surgery.[79, 80] Although the accepted statement focused on lesions at increased risk of malignancy only, for audit purposes it will be much more feasible to track tattooing of resection sites of all lesions larger than 20mm in size. These lesions are frequently removed piecemeal, which increases the risk of recurrence,[81] and have considerable risk of malignancy.[82] The minimum standard for tattooing resection sites is unknown.

Minor Performance Measure	Polyp retrieval rate
Description	Percentage of polyps removed that were retrieved for histopathology.
Domain	Management of pathology
Category	Process
Rationale	Retrieving polyps is required for histopathological diagnosis and a prerequisite to recommend proper post-polypectomy surveillance interval.
Construct	Denominator: Polypectomies of polyps >5 mm. Numerator: Denominator where polyps were retrieved for histopathology examination. Exclusions : - Removal of diminutive polyps (≤5mm) Calculation: Proportion (%) Level of analysis: Service and endoscopist level Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a yearly audit for a sample of 100 consecutive lower GI endoscopies.
Standards	Minimum standard: ≥90% Target standard: ≥95% Colonoscopy report must include information on non-retrieval of non-diminutive polyps. If the minimum standard is not reached, feedback should be given on importance of this performance measure.
Consensus Agreement	86.7%
PICO (see Supporting Information)	13
Evidence Grading	Very low quality evidence

The acceptance of this PM is based on the agreement for the statement:

- The non-diminutive polyp retrieval rate should be monitored. A service should have polyp retrieval rate of ≥90%. (Agreement 86.7%)

Retrieving polyps after endoscopic resection is a *sine qua non* requirement for histopathology examination. Histopathology examination guides further management including post-polypectomy surveillance. Diminutive polyps (≤5mm in size) harbor a very low risk of cancer or advanced histology and are considered amenable for a resect-and-discard policy following in vivo optical diagnosis under strictly controlled conditions.[83] Furthermore, diminutive polyps are frequently removed using biopsy forceps what makes their retrieval rather straightforward. Therefore, it has been decided to monitor retrieval of polyps larger than 5mm in size only. Their retrieval is not only more important from the clinical perspective but also technically more difficult because requires suctioning of the transected polyp into a trap or ensnaring the polyp or grasping using Roth net and removing together with endoscope.[84, 85] Even though the need for polyp retrieval seems obvious, it is unknown what is the effect of substandard retrieval on repeat colonoscopy rates or appropriateness of recommended post-polypectomy surveillance. Proposed minimum standard (≥90%) and target standard (≥95%)

rates of polyp retrieval rate were based on values reported in recent large studies.[39, 43, 86, 87] Polyp retrieval rate seems feasible to measure and is amenable for improvement through education and competitive feedback.[88]

Minor Performance Measure	Advanced imaging assessment
Description	In patients undergoing removal of colorectal lesions with a depressed component (0-IIc according to the Paris classification) or non-granular or mixed-type laterally spreading tumors, conventional or virtual chromoendoscopy should be used to improve delineation of lesion margins and predict potential depth of invasion.
Domain	Management of pathology
Category	Process
Rationale	Polyps with depressed component (0-IIc) and non-granular or mixed type laterally spreading tumors harbor higher risk of submucosal invasion. Frequently they have indistinct borders, therefore better margin delineation is warranted. Improved delineation and prediction of deep invasion may optimize management of these lesions.
Construct	Advanced imaging assessment should always be used before an attempt to remove the abovementioned lesions. A service offering removal of these type of lesions must provide dedicated equipment. Denominator: Colonoscopies with removal of lesions with a depressed component (0-IIc according to the Paris classification) or non-granular or mixed-type laterally spreading tumors. Numerator: Procedures in the denominator where virtual or conventional chromoendoscopy was used to improve delineation of lesion margins (described in the report). Exclusions : - None Calculation: Proportion (%) Level of analysis: Service and endoscopist Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a three-yearly audit of all colonoscopies performed over 3 months period..
Standards	Minimum standard: Unknown. Target standard: 100%. If the target standard is not met a feedback on appropriate use of advanced imaging assessment is warranted. At a service level the availability of equipment should be analyzed and facilitated. After evaluation and adjustment, close monitoring with a further audit within 6 months should be performed
Consensus Agreement	93.3%
PICO (see Supporting Information)	14
Evidence Grading	No evidence

The acceptance of this PM is based on the agreement for the statement:

- In patients undergoing removal of colorectal lesions with a depressed component (0-IIc according to the Paris classification) or non-granular or mixed-type laterally spreading tumours, conventional or virtual chromoendoscopy should be used to improve delineation of lesion margins and predict potential depth of invasion. (Agreement 93.3%)

In 2014, the ESGE issued guidelines on advanced endoscopic imaging for detection and differentiation of colorectal neoplasia in which it suggested the use of advanced endoscopic imaging for margin assessment and prediction of deep submucosal invasion in lesions with a depressed component (0-IIc according to the Paris classification) or non-granular or mixed-type laterally spreading tumors.[83] The quality of evidence supporting these recommendations was considered very low and moderate for margin delineation and assessment of depth of submucosal invasion, respectively. Since then no evidence with clinically relevant endpoints for the patients (incomplete resection, interrupted procedure, cancer detection) was published to further support its use (see Supporting Information). The availability, feasibility and minimum standard of advanced imaging use, particularly in the community setting, are unknown. Colonoscopy services should set up structured monitoring and initiate audit to generate further evidence for advanced imaging.

Minor Performance Measure	Adequate description of polyp morphology
Description	Paris classification should be routinely used to describe the morphology of non-pedunculated lesions identified at colonoscopy.
Domain	Management of pathology
Category	Process
Rationale	Paris classification is a helpful tool to assess the risk of invasion. In case of adequate polyp description, removal of polyps harboring suspicious features is likely to be avoided.
Construct	Denominator: Colonoscopies with removal of non-pedunculated lesions. Numerator: Procedures in the denominator where Paris classification was used to describe lesions. Exclusions : - None. Calculation: Proportion (%) Level of analysis: Service and endoscopist Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a three-yearly audit of all colonoscopies performed over 3 months period
Standards	Minimum standard: Unknown Target standard: 100% Written colonoscopy report should include lesion description based on the Paris classification. If the target standard is not met a feedback on adequate description of polyp morphology is warranted. After evaluation and adjustment, close monitoring with a further audit within 6 months should be performed .
Consensus Agreement	84.6%
PICO (see Supporting Information)	15
Evidence Grading	Very low quality evidence

The acceptance of this PM is based on the agreement for the statement:

- Paris classification should be routinely used to describe the morphology of non-polypoid lesions identified at colonoscopy. (Agreement 84.6%)

The Paris classification aimed at standardizing the terminology of superficial colorectal lesions morphology.[74] It divided lesions into two main groups: polypoid and non-polypoid, further defining four subtypes of the latter. Although its use is widely endorsed, it has never been fully validated. Recent studies showed only moderate inter-observer agreement for the Paris classification, even among experts.[89, 90] More importantly, short training sessions are not sufficient to improve the agreement, suggesting that refinement of the classification is needed.[89] Adoption of the classification in the community setting is unknown. Introduction of the Paris classification had, however, two important effects. It raised awareness of subtle colorectal lesions among Western endoscopists[91] and helped to predict submucosal invasion of colorectal lesions before their removal.[76, 91] In light of lack of better classifications, the Paris classification should be routinely used to describe the morphology of non-polypoid lesions identified at colonoscopy and its usage should be monitored. No minimum standard for this key PM was defined due to lack of evidence.

5. Domain : Complications

Key Performance Measure	Complication rate
Description	Percentage of patients in which complications (immediate, 7-day readmission rate and 30-day mortality rate) occur after screening, diagnostic or therapeutic colonoscopy.
Domain	Complications
Category	Outcome
Rationale	Monitoring the rate of complications after screening, diagnostic and therapeutic colonoscopy is important to assess safety of procedures, identify possible targets for improvement and allows for accurate patient's informed consent.
Construct	Record following parameters: - Early complications, adverse events, harms - 7-days readmission rate (30-days readmission rates in case of reliable registries and sufficient resources) - 30-days mortality rate Assessment should be done using a reliable method that allows for identification of immediate and delayed complications, e.g.: - Direct contact (for example telephone call) with patient - Analysis of hospital records (readmission rate) - Analysis of registries (readmission rate and mortality rate) Denominator: All colonoscopies Numerator: Procedures in the denominator with a complication registered (separately for early, 7-days readmission (30-days readmission rates in case of reliable registries and sufficient resources) and 30-day mortality) Exclusions : - None Calculation: Proportion (%) (separate for each parameter) Level of analysis: Service Frequency: Yearly for all colonoscopies performed at a service level
Standards	Minimum standard: ≤0.5% for 7-day readmission rate, N/A for 30-day mortality rate or immediate complication rate Target standard: N/A Endoscopic reporting systems should allow for reporting early (in-hospital) complications, including type of complication, description of action related to the complication (need for transfusion, hospitalization or prolonged hospitalization, surgery, death, need for endoscopic re-intervention) and time from endoscopic procedure to onset of complication. Regular morbidity and mortality conferences are encouraged to assess causes of complications and discuss solutions to avoid them.
Consensus Agreement	93.8%
PICO (see Supporting Information)	16
Evidence Grading	Low quality evidence

The acceptance of this PM is based on the agreement for the statement:

- In patients undergoing colonoscopy a 6-day readmission rate and 30-day mortality rate should be monitored using a reliable system. (Agreement 93.8%)

The rate of complications, adverse events, and harms are important outcome measures of colonoscopy performance. Some studies and guidelines reported rates of specific complications like perforation, bleeding or sedation-related cardiopulmonary adverse events.[6, 43, 92-94] These specific outcomes are, however, difficult to compare across services, because they are infrequent, have variable definitions and depend on case-mix. For feasibility reasons we propose to measure adverse outcomes defined in previous studies,[95-98] the overall rate of complications and drill down into specific outcomes only if the standard is not met.

The definitions of complications are of paramount importance, because the differences between major and minor ones or minor and routine events encountered during the course of the procedure can be vague. All-cause 30-day mortality rate is certainly well defined and important to measure. In large clinical or administrative databases, the rate of all-cause 30-day mortality was estimated at 0.07% (1 in 1,500)[93-95, 98-100] and colonoscopy-specific mortality at least 10 times lower (1 in 15,000 or lower).[93, 94, 100, 101] Although, all-cause 30-day mortality rates would be impossible to compare across services, all death cases should be discussed during morbidity and mortality conferences.[102] 7-days or 30-days hospital admission/readmission rates is a well-defined and objective way to track late complications of colonoscopy.[93-95, 97, 98] Late complications represent over a half of all colonoscopy-associated complications.[96] Furthermore, the 6-days readmission rate was shown to predict 30-day all-cause mortality.[97] The reported all-cause 7-days and 30-days hospital admission/readmission rates were 0.5%[97] and 1.1-3.8%[93, 95, 98] (0.5% for colonoscopy-specific readmission rates).[93] Thus, the minimum standard of 0.5% seems acceptable for 6-day overall or 30-day colonoscopy-specific readmission rates. Early complication rate (diagnosed immediately during the procedure or before patient discharge) is relatively easy to measure using appropriate endoscopy reporting systems.[12] The definition of early complication is, however, more challenging and in our view should only include complications that result in one of the following: (i) lengthening of the hospital stay, (ii) unscheduled further endoscopic procedure, or (iii) emergency intervention, including blood transfusion or surgery.[6]

Reliable recording of all colonoscopy complications is a major concern.[96] Direct telephone call with a patient,[99] analysis of hospital records,[98] and analysis of administrative data claims[95, 98] were all used for this purpose, but it is uncertain which method is the most feasible and reliable (see Supporting Information).[96]

6. Domain : Patient experience

Key Performance Measure	Patient experience
Description	Patient experience during and after colonoscopy and sigmoidoscopy should be routinely measured and self-reported by patients using validated scales.
Domain	Patient experience
Category	Outcome
Rationale	Colonoscopy can be an unpleasant experience. Moreover, there are considerable differences between endoscopists and between different sedation modalities with regards to patient-reported pain and discomfort. Patient experience and it's improvement is crucial for the acceptance of procedures.
Construct	Denominator: All colonoscopies Numerator: Procedures in the denominator in which patient experience was measured using a validated scale (the Global Rating Scale, the Gastronet or others) Exclusions : - Emergency procedures Calculation: Proportion (%) Level of analysis: Individual endoscopist and service. Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a yearly audit for a sample of 100 consecutive lower GI endoscopies.
Standards	Minimum standard: Unknown Target standard: ≥90% Currently there is no standard approach to measuring patient experience. Different questionnaires are available, and the comparative performance is unclear. Ideally, patient experience should be self-reported using a standardized and validated reporting method. Audits should be performed on both service and individual endoscopist level to assess patient-reported outcomes. In case of sub-standard results (for example if one endoscopist performs worse than other at the same service) additional training and feedback should be considered.
Consensus Agreement	93.8%
PICO (see Supporting Information)	18, 19
Evidence Grading	Very Low Quality Evidence

The acceptance of this PM is based on the agreement for two statements:

- Patient experience during and after unsedated or moderately sedated colonoscopy or sigmoidoscopy should be routinely measured. (Agreement 93.8%)
- Patient experience with colonoscopy or sigmoidoscopy should be self-reported by a patient using a validated scale. (Agreement 93.8%)

Colonoscopy may be perceived to be a painful and embarrassing procedure and this perception hampers patient participation in screening programs, adherence to surveillance recommendations or even diagnostic work-up for large bowel symptoms.[103-105] Although sedation may decrease pain

during colonoscopy, it does not eliminate it,[106] has little effect on post-procedure pain[22] and increases the risk of complications.[107] Therefore, monitoring patient experience, including intra- and post-procedure pain levels are crucial. Monitoring patient experience is feasible, yet not universal and no standardized approach exists. Two most widely used and validated questionnaires for assessing patient experience are the Global Rating Scale[108, 109] and the Gastronet.[22, 106, 110-113] Patient coverage and response rates varied across services from less than 80% to over 90%[22, 114, 115] and sustained compliance is a concern.[114] Of note, there is poor to moderate correlation between physician or nurse recorded and patient reported pain levels thus the latter measure should be the preferred one.[116] Two main validated scales for pain assessment are a Visual Analog Scale and 4-point Verbal Rating Scale. Three studies showed similar sensitivity of both scales (See Supporting Information).[117-119]

7. Domain : Post-Procedure

Key Performance Measure	Appropriate post-polypectomy surveillance recommendations
Description	Adherence to post-polypectomy surveillance recommendations should be monitored. The reason for deviation from national/European guidelines should always be provided.
Domain	Post-procedure
Category	Process
Rationale	Post-polypectomy surveillance recommendations reflect the best-evidenced balance between benefit and harm. Too early surveillance wastes the resources and exposes patients to complications of an invasive procedure. Too late surveillance may limit the effectiveness of surveillance.
Construct	This PM takes into account not only patient's adherence to recommendations but also if patient received written recommendations at all (letter to the patient or patient's general practitioner). Denominator: Patients after colorectal polypectomy Numerator: Patients in the denominator who received proper (national or European) surveillance recommendations Exclusions: - Provided reason for deviation from actual surveillance recommendations Calculation: Proportion (%) Level of analysis: Service and individual endoscopist Frequency: Continuous monitoring using novel endoscopy reporting systems[12] should be the preferred approach. An alternative approach is a yearly audit for a sample of 100 consecutive lower GI endoscopies.
Standards	Minimum standard: no standard defined Target standard: ≥95% All endoscopists should follow national or European guidelines for post-polypectomy surveillance. Any deviation from guidelines should be clearly stated. When no written recommendation is given, it should be treated as missing recommendation. Endoscopic reporting system should contain data about surveillance recommendations issued to the patient. In case of suboptimal performance automated system for issuing surveillance recommendations from the endoscopy database and reminders to the patients should be considered.
Consensus Agreement	93.8%
PICO (see Supporting Information)	20
Evidence Grading	Low quality evidence

The acceptance of this PM is based on the agreement for two statements:

- Adherence to post-polypectomy surveillance recommendations should be monitored. The reason for deviation from national/European guidelines should always be provided. (Agreement 93.8%)

Patients who have had adenomas removed are believed to be at increased risk of developing new adenomas or cancer in the future.[120-122] In order to mitigate the risk, professional societies recommend them colonoscopy surveillance depending on age, co-morbidity, and adenoma

characteristics.[123, 124] Surveillance intervals recommended in the guidelines represent the best-evidenced balance between the benefits (protection against CRC) and harms (too frequent invasive examinations) of subsequent colonoscopies. Therefore adherence to these recommendations is key to efficacy and efficiency of colonoscopy surveillance. Unfortunately, studies from the Netherlands and Canada showed that less than 30% of patients after adenoma removal receive appropriate surveillance.[125, 126] One of the key reasons for inappropriate surveillance is inappropriate recommendation given by a gastroenterologist, surgeon or primary care physician.[127, 128] Physicians adherence to post-polypectomy surveillance recommendations could be relatively easy monitored using modern endoscopy reporting systems.[12] Any deviation from guideline recommendation should be clearly stated in the reporting system, and rationale for it provided. No minimum standard for this key PM was defined due to lack of evidence.

General conclusions, research priorities and future prospects

This paper describes a short list of key PMs for LGI endoscopy with the best evidenced impact on clinical outcomes, feasible to measure and susceptible to improvement.

The systematic process of development of these key PMs revealed broad variation in available evidence between the PMs in different quality domains. Although the domains of completeness of procedure, identification of pathology or pre-procedure have relatively robust scientific support, other, like management of pathology or patient experience are rather understudied. Indeed, these two quality domains were listed among key research priorities by the ESGE research committee and are considered key research questions by the LGI WG (see Table 1).[129]

The other notable feature of identified PMs is that the evidence behind them comes almost exclusively from the field of colorectal cancer prevention and early detection. Although PMs from the pre-procedure and completeness of procedure domains are rather universal, PMs identified in the identification of pathology, management of pathology or post-procedure domains are not applicable outside of the CRC screening/surveillance setting. Further research on the topics is warranted (see Table 1).

The first step now is to implement these key PMs in endoscopy practise throughout Europe. We encourage individual endoscopists as well as heads of endoscopy units to start implementation of the PMs without delay. Implementing PMs is important to identify services and individual endoscopists with substandard levels of performance. The aim is not to penalize these endoscopists or services but to have a tool to improve the quality of endoscopy. Feedback and benchmarking on colonoscopy PMs are usually sufficient to positively influence the overall quality of colonoscopy.[52, 130] If provision of such information turns out to be insufficient to promote improvement, the next step is to provide assistance and additional training.[48, 50]

At a service level, implementation of key PMs may well require investing into hardware to accommodate a more efficient auditing process. We want to encourage hospital management to support the implementation of these PMs in their endoscopy services. We think that in an era where general hospital accreditations become increasingly important, hospital administrations will be more susceptible to support such actions. Moreover, we owe it to our patients to overcome individual or financial barriers to ensure that endoscopy services are of the highest quality and to set research priorities to gather data which will inform the next generation of PMs.

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Figure. 1

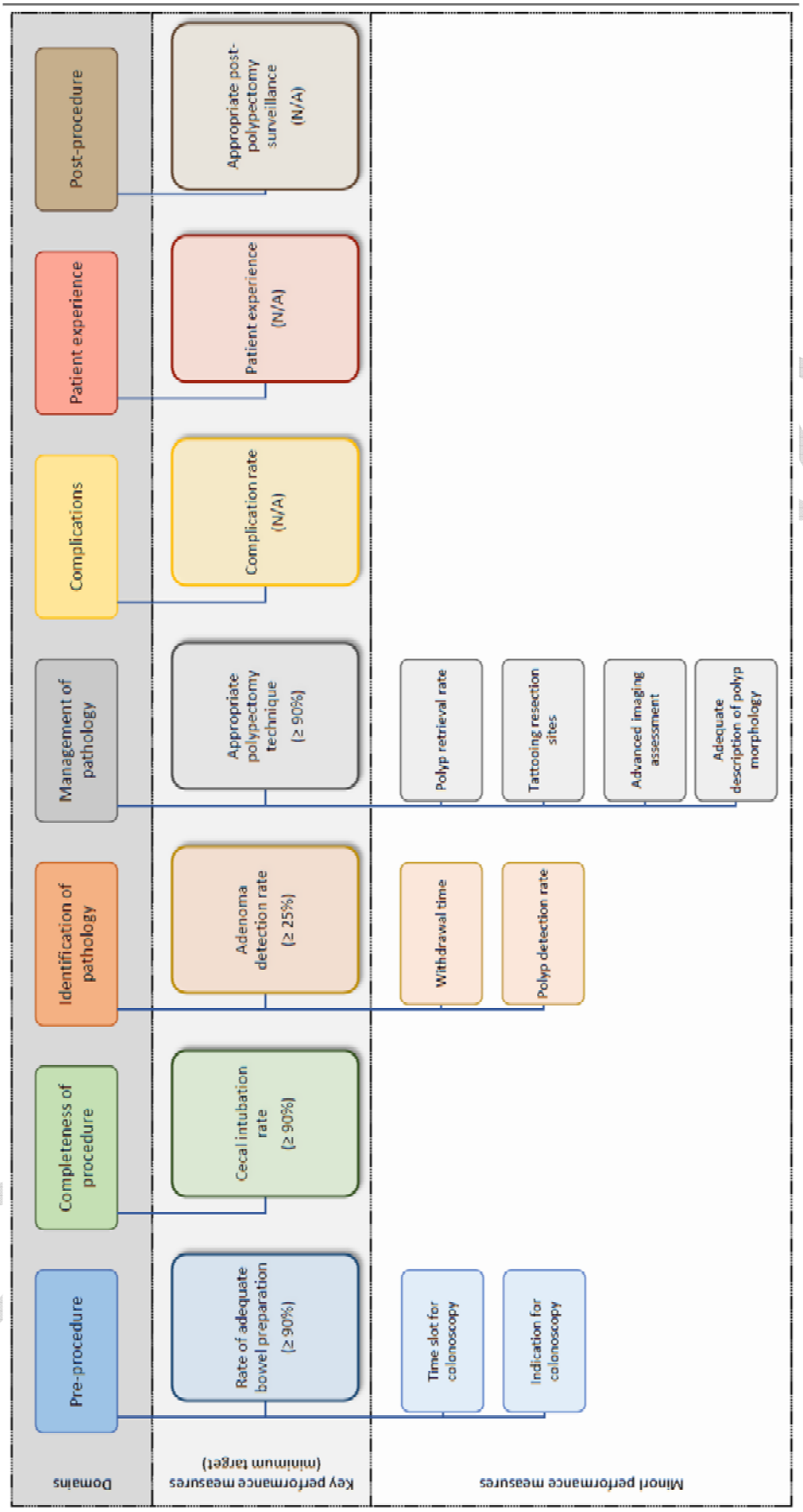

Table 1. Areas for further research

DOMAIN	KEY RESEARCH QUESTIONS
1. Pre-procedure	1. What kind of intervention improves the rate of adequate bowel preparation? 2. What is the appropriate time allotted for screening and diagnostic colonoscopy?
2. Completeness of procedure	1. What is the diagnostic yield (and interval cancer rate) according to increasing cecal intubation rate? 2. What is the benefit of cecal intubation documented with a written report only or with a written and photo report?
3. Identification of pathology	1. What is the target standard for adenoma detection rate? 2. What PM reflects identification of pathology outside the CRC screening/surveillance setting?
4. Management of pathology	1. What is the most reliable and feasible method of measuring completeness of polyp removal? 2. What is the effectiveness of add-on techniques/scales (chromoendoscopy/Paris classification/tattooing resection sites) in the management of pathology?
5. Complications	1. What is the most reliable and feasible method to monitor the complication rates? 2. Does monitoring help to reduce complication rates?
6. Patient experience	1. What is the most reliable and feasible method to monitor the patient experience? 2. How to optimize patient experience with colonoscopy?
7. Post-procedure	1. What are the optimal surveillance intervals following colorectal polyps removal? 2. What is the effect of monitoring appropriate post-polypectomy surveillance recommendations on adherence to surveillance colonoscopy?

Supporting Information

The evolution and adaptation of the different PICOs and clinical statements during the Delphi voting process can be viewed in Supporting Information.

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