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Quality metrics reflecting patient experience of gastrointestinal endoscopy in inflammatory bowel disease: results of national endoscopy dataset analysis

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Abstract

Introduction: The European Society of Gastrointestinal Endoscopy has recently defined important performance measures for endoscopy in inflammatory bowel disease (IBD). The role of patient experience in quality assessment of endoscopy in IBD has yet to be defined. We undertook an observational study based on analysis of a large multi-center dataset with national coverage in Ireland. The aim was to analyze individual and composite metrics that reflect patients' experience with endoscopic procedures for IBD.

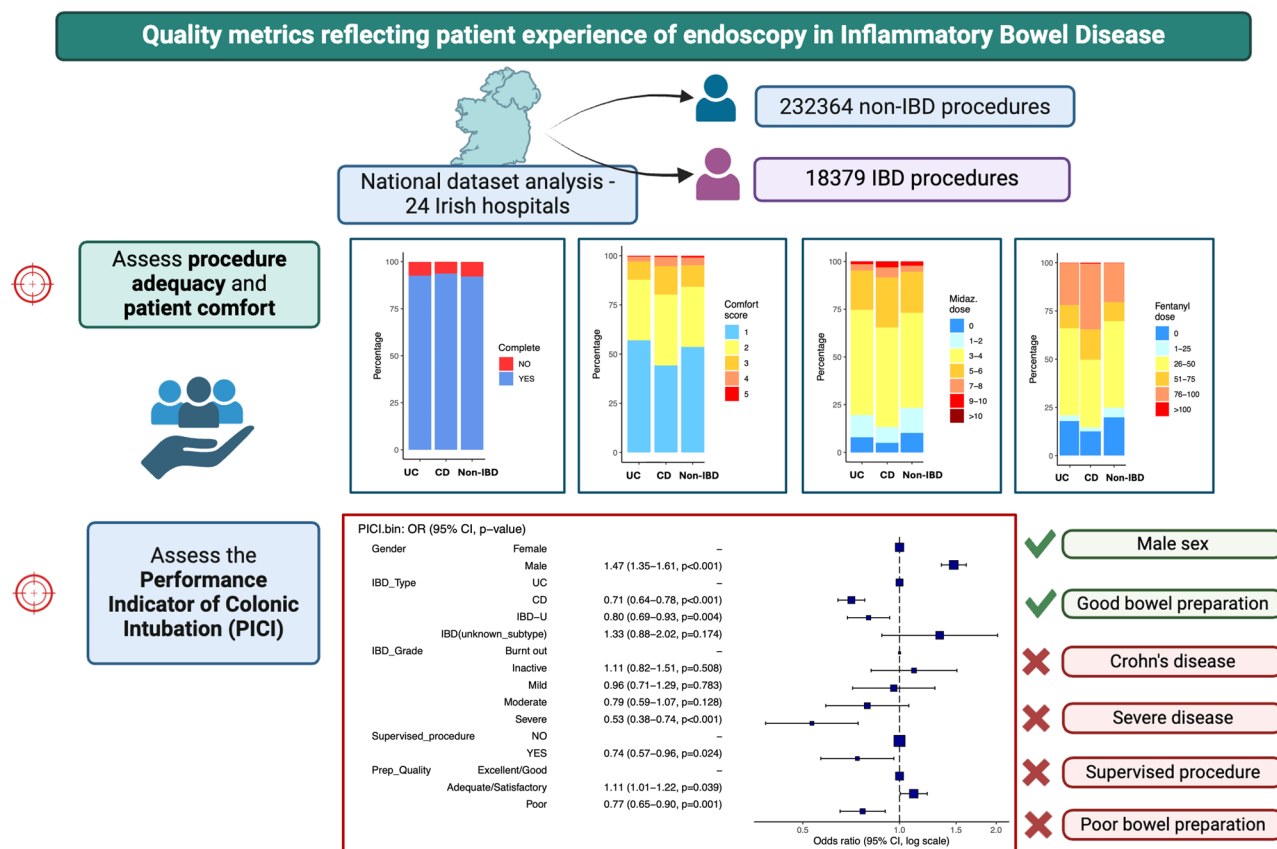
Methods: Anonymized data were extracted from electronic procedure records of patients who underwent colonoscopy in 24 Irish hospitals. The performance indicator of colonic intubation (PICI), a novel composite score reflecting sedation rates and patient comfort, and IBD-specific endoscopic domains were evaluated.

Results: Data from 261 524 colonoscopies were analysed from 2014 to 2020. Crohn's disease (CD) patients had a significantly lower odds ratio (OR) of achieving PICI compared to non-IBD patients (0.69, 0.65-0.74, $P < .001$). Severe colitis was also associated with a significantly lower OR of achieving PICI (OR 0.53, 0.38-0.74, $P < .001$). In total, 80.2% of CD patients had a comfort score ≤ 2 compared to 87.8% of those with ulcerative colitis (UC) and 84.2% without IBD. Additionally, 60.7% of patients with CD required a midazolam dose of 3 mg or more compared to 50.4% of those with UC and 76.7% of those without IBD. In total, 50% of CD patients required fentanyl doses $> 50 \mu\text{g}$ compared to 34% of UC patients and 30.3% of patients without IBD.

Conclusion: This analysis of a large national endoscopy dataset highlights variability in quality metrics for IBD endoscopy and underscores the need for a metric such as PICI to more accurately capture and reflect patient endoscopic experience with IBD.

Key words: inflammatory bowel disease; colonoscopy; key performance indicators; quality metrics.

Graphical abstract



1. Introduction

Introducing auditable, key performance indicators (KPIs) in lower gastrointestinal (GI) endoscopy has significantly transformed and standardized endoscopic practice across countries, improving patient care.^{1,2} Establishing clear, measurable quality metrics ensures patient safety and enhances endoscopy efficiency. A National Gastrointestinal Endoscopy Quality Improvement (NEQI) program has been approved in Ireland. It requires all endoscopy units to upload quarterly data to facilitate endoscopist- and unit-level performance analysis.³ As a consequence, well-established KPIs, such as polyp detection rate (PDR), cecal intubation rate (CIR), and withdrawal time, have been ingrained into practice, serving as tools to elevate standards nationally. Indeed, data from the NEQI program have demonstrated a 10% increase in the percentage of endoscopists achieving the minimum target for CIR, with an associated increase in PDR over 5 years to 2020.⁴

Despite the aim of improving overall quality endoscopic care, most KPIs rely on detecting pre-malignant lesions with less emphasis on patient experience. Studies have shown that patient safety and tolerability are the cornerstones of high-quality endoscopic practice. Patient satisfaction with endoscopy is strongly linked to procedure-related pain, and optimizing comfort can significantly impact adherence of patients accepting future endoscopic procedures.^{5,6}

Moreover, KPIs were initially developed without considering specific groups of patients who frequently require endoscopic assessment. Patients with inflammatory bowel disease (IBD)

represent a distinct cohort in which high-quality colonoscopy remains the gold standard for disease assessment, surveillance, and management of complications.^{7,8} Therefore, the European Society of Gastrointestinal Endoscopy (ESGE) position paper on colonoscopy quality in IBD patients has sought to address this gap by providing consensus-based recommendations on KPIs tailored to IBD.⁹ However, most measures rely on moderate- to low-quality evidence, pointing to a lack of data to support KPIs in IBD endoscopy. Although essential due to the number of procedures required throughout the disease course, patient experience measures are currently lacking.

Data suggest that IBD patients may have a poorer experience of endoscopy with a higher burden associated with bowel preparation, higher GI-specific anxiety and increased procedure-related pain, particularly in Crohn's disease (CD).^{10–12} Furthermore, higher sedation requirements have been demonstrated in IBD patients undergoing colonoscopy.^{13,14} Given the potential for poorer patient experience at colonoscopy for patients with IBD, existing KPIs may be inadequate in capturing appropriate patient outcomes.

Currently, patient safety and comfort in overall endoscopic procedures can be evaluated through several tools, including monitoring sedation and validated patient comfort scores. Based on this, novel composite scores have been developed to simultaneously assess quality and patient experience, reflecting the goal of achieving a complete examination with minimal discomfort while using safe levels of sedation. The Performance Indicator of Colonic Intubation (PICI) is a novel composite endpoint incorporating CIR, patient-experienced comfort, and

sedation use.¹⁵ This was proposed as a KPI to meet targets without compromising patient safety and comfort. However, to date, there are no data on the validity of such measures in patients with IBD. Given the paucity of data on patient comfort, procedure adequacy, and disease-specific targets in IBD endoscopy, we sought to assess these individually and combined in the composite PICI score in a national dataset of reports of colonoscopy performed in patients with IBD across a wide range of hospitals.

2. Materials and methods

The study was approved by the National Endoscopy Programme and endorsed by all local leads, with ethics approval granted by the Royal College of Physicians of Ireland Research Ethics Committee.

2.1. Study population

Analysis of anonymized colonoscopy data extracted from the electronic procedure records of patients who underwent colonoscopy in the 24 hospitals across Ireland was performed using a single electronic reporting system, ERS—EndoRAAD (CompuGroup Medical SE & Co. KGaA & ManiTex Ireland CLG). Procedure information for all patients was prospectively collected and stored locally. For this study, de-identified metadata from all full ileo-colonoscopy records on the EndoRAAD ERS from January 2014 to December 2020 were filtered to a study-specific electronic portal (EndoDIVER), on a single national healthcare server as part of a one-off transfer of data (Figure 1). The time window was selected to allow complete data extraction for a continuous period of >5 years. The Irish health system sustained a prolonged cyberattack in early 2021 (https://en.wikipedia.org/wiki/Health_Service_Executive_ransomware_attack), resulting in procedural data being stored locally, which has rendered more recent data extracts incomplete. Data were recorded in standard report format and

included mandatory tabulations and recorded procedure information, including free text entered by the endoscopist. All adult patients aged 18–80 years were included in the analysis. The analysis includes endoscopy units that are located in secondary and tertiary hospitals, university academic centers, and private institutions.

2.2. Endoscopy procedure information

Relevant procedure information collected included demographic data, quality and type of bowel preparation, endoscopy unit factors, and whether the procedure was conducted by a trainee endoscopist supervised by a trainer. KPIs for colonoscopy include cecal intubation, ileal intubation, presence and number of biopsies performed, sedation agents, and doses administered. All endoscopy units analyzed as part of the study utilized conscious sedation as the standard procedural sedation regimen for colonoscopy. The sedation approach involves a combination of midazolam and the addition of an opiate, usually fentanyl, and, less commonly, pethidine. Conscious sedation was administered by the proceduralist and adjusted according to patient requirements during the procedure. The modified Gloucester comfort score was recorded in each unit as a marker of the patient's colonoscopy experience. This was recorded by the endoscopist on the agreement of the nurse present during the procedure, based on real-time observation of patient behavior and responses.

Procedures were categorized into IBD and non-IBD procedures based on recorded procedure indication (IBD surveillance or assessment) or a new diagnosis of IBD. IBD patients were divided according to disease sub-type (CD, ulcerative colitis [UC], IBD-unclassified [IBD-U]), using pre-selected data from the endoscopy report or free text search of reports to aid categorization. Patients without sufficient information to identify disease type were assessed separately according to the information available: known IBD (but IBD sub-type unknown); possible IBD (not confirmed); and other non-IBD

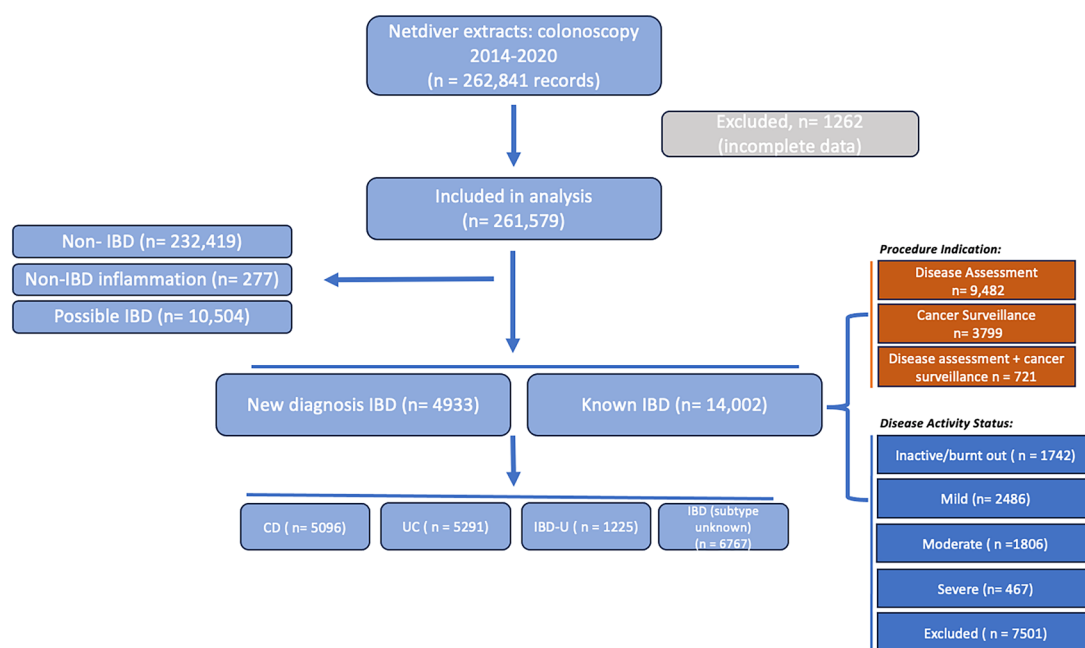


Figure 1. Flowchart illustrating creation of the analysis dataset using national endoscopy data from EndoRAAD (ManiTex Ireland CLG).

Table 1. Modified Gloucester comfort scale.

Score	Scale	Description
1	No	No discomfort, resting comfortably throughout
2	Minimal	One or two episodes of mild discomfort, well tolerated
3	Mild	More than two episodes of discomfort, adequately tolerated
4	Moderate	Significant discomfort, experienced several times during procedure
5	Severe	Extreme discomfort, experienced frequently during procedure

(other inflammatory conditions such as infectious, diversion colitis, etc.). Disease extent and severity (mild, moderate, severe, inactive) were also assessed. In addition, a keyword search of procedure-free text was performed to identify IBD-specific disease description parameters, such as disease activity scores.

2.3. Statistical analysis

PICI is based on the novel composite score in colonoscopy published by Valori et al.¹⁵ To reflect quality guidelines in Ireland, the National GI Endoscopy Quality Improvement Programme published a modified PICI in 2018 utilizing a slightly higher cut-off for midazolam dose of 3 mg and slightly lower cut-off of ≤ 2 for modified Gloucester comfort score (Table 1).¹⁶ A binary model was created defined as the number of procedures in each group that achieved cecal intubation (CI) with a midazolam (MDZ) dose ≤ 3 mg and a Gloucester comfort score (GCS) ≤ 2 :

$$\text{PICI} = \text{CI} + \text{MDZ} \leq 3 + \text{GCS} \leq 2$$

Categorical variables were described through absolute (n) and relative (%) frequencies. Continuous numerical variables were described as mean and standard deviation, or median and interquartile range (IQR), depending on distribution. The distribution of categorical data between independent groups was assessed with a chi-square test or Fisher's exact test as appropriate. Spearman's correlation coefficient (ρ) was also used to determine the relationship correlation. A P value of ≤ 0.05 was deemed to be significant.

To assess factors that predict achieving PICI in this population, mixed effects logistic regression was performed with PICI as the binary dependent variable and selected independent variables. Hospital was used as the random effect. Plotting was conducted in the R statistical environment (v.4.2.0) using the *finalfit* package (v.1.0.6). Plotting was performed with *ggplot2* (v.3.4.1).

3. Results

Tables 2 and 3 detail patients' demographic characteristics, overall procedure metrics, and variables relating to the PICI score across IBD and non-IBD patients.

3.1. Patient population

Procedure data from a total of 262 840 colonoscopies were captured from 24 hospitals nationally from 2014 to 2020. In total, 261 524 procedures were included in the final analysis

after excluding those with missing variables. Figure 2A shows the location of the 24 hospitals nationally contributing to the data. In total, 18 379 procedures were identified as IBD procedures with 232 364 non-IBD procedures and a further 10 781 procedures performed for other indications including diverticulitis and radiation proctitis. Of the patients with a known or new diagnosis of IBD, a subgroup did not have adequate information available to classify disease sub-type ($n=6767$). Absolute numbers of IBD and non-IBD procedures grew steadily or remained constant up to 2020 where figures were impacted by the COVID pandemic (Figure 2B). Increased procedure numbers from 2016 to 2018 reflect the migration of six additional sites nationally to the electronic database (EndoRAAD). The number of IBD procedures dropped by 33.2% from 2019 to 2020, compared to a reduction of 37.8% for non-IBD procedures. This may reflect the ongoing need for IBD endoscopic procedures for inpatients during a time when many routine procedures were deferred or cancelled.

The mean age in IBD cohorts was 47.4 years (SD 15.9) compared to 58.6 years (SD 15) in non-IBD cohorts. There was a slight preponderance of male patients in the IBD cohort and female patients in the non-IBD cohort (53.2% and 51.2%, respectively).

3.2. Endoscopic procedure adequacy

3.2.1. Overall cohort

CIRs in IBD and non-IBD cohorts exceeded the minimum national standard and were similar between IBD (92.6%) and non-IBD (92%) procedures, or within IBD sub-types. CIRs gradually increased over time from 87.7% in 2014 to 93.2% in 2020. The CIR was slightly lower in women (90.9%) than in men (93.2%). The percentage of bowel preparations deemed poor was marginally lower in IBD patients (11.4%) versus non-IBD patients (12.8%). There were no significant differences in complication rates between IBD and non-IBD groups and photo-documentation rates were similar. A midazolam dose >3 mg was more common in IBD patients (55.4%) than non-IBD patients (48%), while a comfort score ≤ 2 was similar (83.5% IBD vs 84.2% non-IBD). Polyps were more commonly excised in non-IBD patients (mean number of polyps excised 0.7 [SD 1.4]) than in IBD patients (mean 0.2 [SD 0.7]).

3.2.2. Endoscopic procedure comfort

Overall, in both IBD and non-IBD cohorts, $>80\%$ of patients had a comfort score ≤ 2 . Patients with CD had the poorest experience at colonoscopy, with significantly higher comfort scores. In total, 80.2% of CD patients had a comfort score ≤ 2 compared to 87.8% of those with UC and 84.2% without IBD.

Higher doses of both midazolam and fentanyl were required in patients with CD compared to UC or non-IBD patients. In total, 60.7% of patients with CD required a midazolam dose of 3 mg or more compared to 50.4% of those with UC and 76.7% of those without IBD. Also, 50% of CD patients required fentanyl doses $>50\mu\text{g}$ compared to 34% of UC patients and 30.3% of patients without IBD. CIR, sedation rates, and comfort scores across the different subgroups are shown in Figure 3.

3.2.3. Performance indicator of colonic intubation score

Overall, PICI was achieved in 33.5%, 43.9%, and 43.8% of CD, UC, and non-IBD patients, respectively. A midazolam dose

Table 2. Demographics and procedure metrics across inflammatory bowel disease (IBD) and non-IBD-subtypes.

		Non-IBD	IBD
Age, years (mean, SD)		58.4 (15)	47.1 (SD 15.)
Gender (male)		48.7%	52.8%
Preparation quality (n, %)	Excellent/good	94 502 (38.9%)	8875 (48.3%)
	Adequate/satisfactory	117 592 (48.4%)	9145 (40.3%)
	Poor	31 051 (12.8%)	2089 (11.4%)
Hospital model (n, %)	District Hospital	31 127 (12.8%)	1297 (6.5%)
	Regional General Hospital	128 118 (52.7%)	9098 (49.5%)
	Tertiary Referral Center	79 362 (32.6%)	7886 (42.9%)
Buscopan administered (%)		13.8%	10.7%
Trainee involved (Yes, n, %)		9631 (4%)	783 (4.3%)
Polyps removed (≥ 1), (%)		30.5%	10.9%
Tumor present (n, %)		4979 (2%)	33 (0.2%)
Biopsies taken (≥ 1), (%)		29.2%	89.6%
Photo-documentation (n, %)		217 883 (89.6%)	16 456 (89.5%)
Perforation (n %)		21 cases (0.0001%)	1 case (0.005%)
Bleeding (n %)		218 cases (0.09%)	8 cases (0.06%)

Bowel preparation quality was assessed according to physician rating; procedures were carried out across a spectrum of hospitals including district, regional and tertiary referral centres. Data capture includes immediate but not delayed complications.

Table 3. Procedure metrics as per performance indicator of colonic intubation (PICI) variables across inflammatory bowel disease (IBD) and non IBD-subtypes.

		Non-IBD	IBD
Cecal intubation (%)		92%	92.6%
Comfort score (GCS, n, %)	1	130 086 (53.5%)	9351 (50.9%)
	2	74 650 (30.7%)	6003 (32.7%)
	3	26 571 (10.9%)	2164 (11.8%)
	4	9583 (3.9%)	724 (3.9%)
	5	2255 (0.9%)	137 (0.7%)
Midazolam dose (mg, mean, SD)		3.5 (2.0)	3.8 (1.9)
Fentanyl dose (μ g, mean, SD)		51.6 (33.5)	58.2 (33.6)

Comfort scores were evaluated according to the modified Gloucester comfort scale.

≥ 3 mg was the main reason for failure to achieve PICI, occurring in 48.5% of the entire cohort and accounting alone for 63.3% of failure to achieve PICI. The odds of achieving PICI, defined as cecal intubation with a comfort score ≤ 2 and midazolam dose ≤ 3 mg, was significantly higher in non-IBD patients compared to IBD patients. CD patients had a significantly lower odds ratio (OR) of achieving PICI compared to non-IBD patients (0.69, 0.65-0.74, $P < .001$). Additionally, male gender, excellent/good bowel preparation, and a non-supervised procedure were associated with a higher OR of achieving PICI.

Within IBD cohorts, male gender was also associated with higher OR of achieving PICI (OR 1.47, 1.35-1.61, $P < .001$). Severe activity was also associated with a significantly lower percentage of achieving PICI (31.8% vs 46.7% classified as burnt out), translating to an OR of achieving PICI of 0.53 (0.38-0.74, $P < .001$) in multivariable analysis. Figure 4 outlines the OR of achieving PICI across a number of variables. We performed stratified regression analysis for male and female patients with similar trends between groups. Notably, CD was

associated with a significantly lower OR of achieving PICI in both male (0.66 [0.58-0.75], $P < .001$) and female (0.78 [0.67-0.89], $P < .001$) IBD patients, as was poor bowel preparation. Supervised procedures were less likely to achieve PICI due to a combination of both higher midazolam usage and higher comfort scores without any significant differences in cecal intubation.

3.2.4. Sub-components of the PICI score in IBD

We performed separate analyses on the individual components of the PICI score, namely CIR, midazolam dose, and comfort score, to determine whether the same predictors of PICI achievement affect its components. These analyses revealed broadly similar patterns, particularly for comfort score and cecal intubation. Notably, cecal intubation was more common in CD, highlighting that the reduction in achieving PICI in this cohort was driven by comfort score and midazolam usage. In all categories, male patients were more likely to achieve desirable results, achieving a lower comfort score, midazolam dose, and even a small but significant increase in CIR (93.5% vs 91.7%). While grade of inflammation was not significantly associated with comfort score or midazolam dose, patients with severe activity were less likely to achieve cecal intubation (73% vs >90% in the other categories). Interestingly, while supervised procedures were associated with not achieving target comfort scores, there was no significant effect on cecal intubation (91.4% vs 92.7%) or midazolam dose in multilevel analysis. Poor bowel preparation was associated with higher comfort scores (OR 0.58 [0.48-0.70], $P < .001$) and reduced cecal intubation (OR 0.32 [0.25-0.4], $P < .001$).

4. Discussion

This is the first study to evaluate the performance of the PICI score tool, which combines the assessment of quality metrics with patient safety and comfort in a distinct IBD cohort of patients who require frequent and accurate endoscopic procedures.

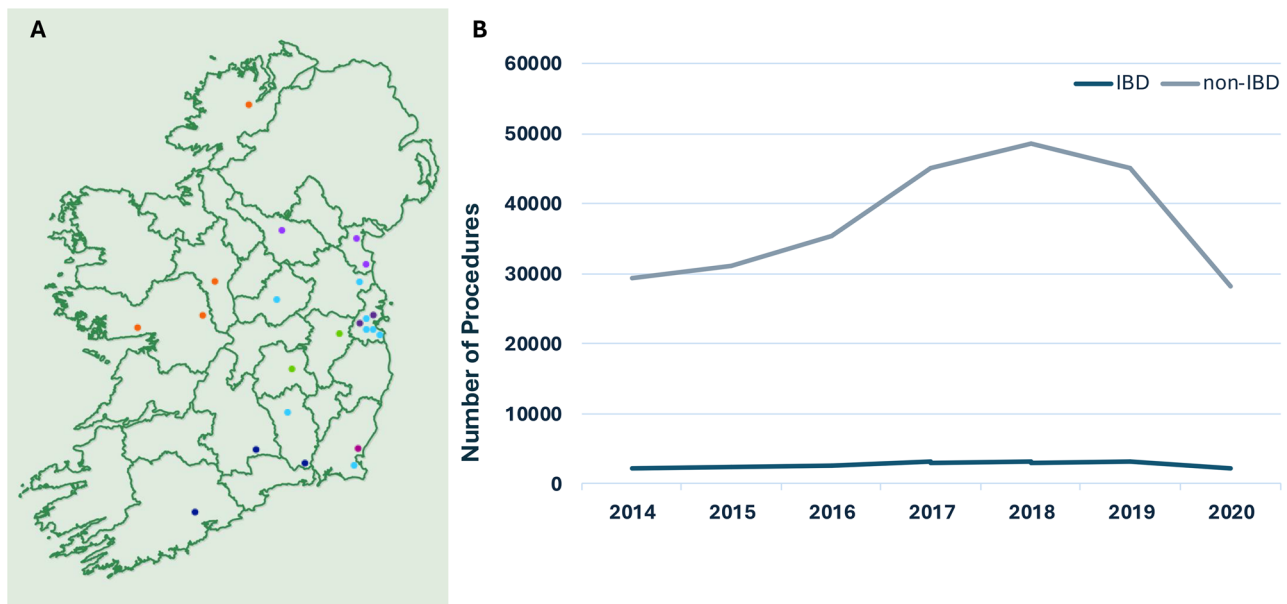


Figure 2. (A) Twenty-four hospitals across Ireland contributed to the data from 2014 to 2020. (B) Number of inflammatory bowel disease (IBD) and non-IBD procedures over time.

Despite the rise of emerging non-invasive monitoring tools, colonoscopy remains the most important and effective tool in the assessment and management of patients with IBD. Earlier age of diagnosis, chronic disease course, and the increasing focus on mucosal healing in IBD patients require repeat endoscopic assessment over their lifetime.⁷ In addition, detecting dysplasia in surveillance endoscopy for IBD requires a commitment to a longer time slot with targeted mucosal evaluation to ensure the adequacy of the procedure.¹⁷ Over the past 15 years, numerous national and international committees and task forces have been established to improve the quality of services in endoscopy and IBD.^{1,18–21} However, until recently, endoscopy as it pertains to patients with IBD has been overlooked.

The recent ESGE consensus statement on performance measures in colonoscopy for patients with IBD has highlighted and addressed key deficiencies in caring for patients with IBD. As a result, IBD-dedicated key performance measures that should be reached in daily endoscopy practice were defined, including completeness of procedure, adequate bowel preparation, photo documentation, biopsies, use of standardized endoscopic activity scores, and the adoption of high-definition and chromoendoscopy techniques.

In our dataset, the overall CIR was correctly achieved. While biopsy and photo-documentation rates almost met ESGE recommendations, documented ileal intubation fell significantly below the recommended standard of 80% in the Irish population. In addition, the target of adequate bowel preparation of >90% was not met. Inadequate assessment due to poor preparation or failure to achieve ileal evaluation could lead to the need for repeated procedures, potentially impacting the overall tolerability for IBD patients.

Moreover, endoscopic disease activity scores were sub-optimal, underscoring the need for dedicated training to optimize disease assessment and management. The European Crohn's and Colitis Organization (ECCO) has developed a comprehensive endoscopic training platform that includes modules on effectively scoring endoscopy activity in IBD. The module platform has been considered as part of the

National IBD Research Network (INITIATIVE) to promote the use of validated endoscopic scoring systems for IBD patients, ensuring consistency and standardization across Ireland. These initiatives are essential to continue to expand the understanding of what high-quality endoscopy looks like in IBD, with the incorporation of measures beyond the standardized KPIs. These include the use of validated and standardized scoring and classification systems in addition to sedation adequacy, and endoscopy-based audit and patient-centered indicators such as patient-reported experience measures (PREMs), which can play a critical role in capturing key aspects of comfort, communication and post-procedural satisfaction.

Previous data have also shown that colonoscopy is safe for IBD populations, with a minimal risk of complications.¹⁰ A large population-based study in Sweden involving data from >150,000 patients with IBD demonstrated no significantly increased risk of perforation or bleeding in IBD compared to non-IBD patients.²² Our data have also confirmed a low rate of procedure-related complications.

While reassuring, these safety data discount the perceptions and comfort of the patient experience, which remain inadequately addressed even in the current ESGE guidelines.

However, the updated BSG Guidelines on Colorectal Surveillance Colonoscopy in IBD have introduced patient comfort as an essential KPI measure to adopt.^{23,24}

IBD patients often experience increased discomfort at every stage of the endoscopy journey. They experience higher pre-procedure anxiety and discomfort,^{12,25,26} higher procedure-related pain,^{11,27,28} and longer procedure time, and they require higher levels of sedation.^{13,14,29} Friedman et al identified procedural discomfort, embarrassment, or a previous negative experience at colonoscopy as significant contributors to non-adherence to surveillance colonoscopy in IBD patients.³⁰ Similarly, a nationwide study in France demonstrated the low acceptability of colonoscopy and sigmoidoscopy compared to less invasive tools among 923 patients with IBD.³¹ Indirect evidence also highlights the importance of patient comfort

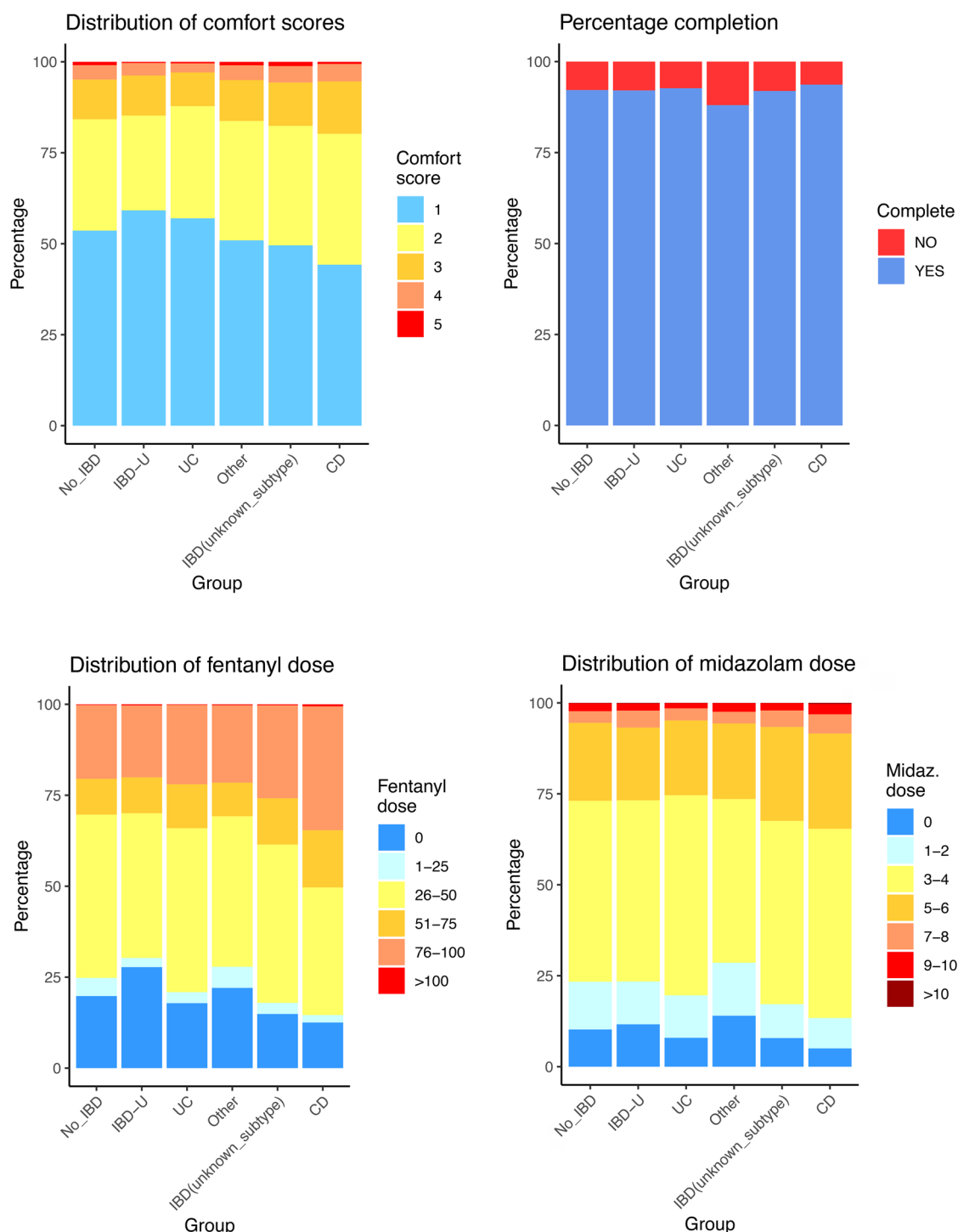


Figure 3. Cecal intubation rate (CIR), Gloucester comfort score, and midazolam and fentanyl rates across Crohn's disease (CD), ulcerative colitis (UC), inflammatory bowel disease unclassified (IBD-U), and non-IBD cohorts.

during endoscopy, emphasizing the need for adequate sedation to improve tolerance of both current and future procedures.¹⁷

Patient comfort and safe sedation are essential to ensure a high-quality endoscopic examination and improve compliance with repeated endoscopic examinations. Our data evaluate a novel composite endpoint in endoscopy for IBD (PICI score), which could enable a greater focus on achieving quality improvement targets in IBD endoscopy without compromising

patient safety, comfort, or tolerability. The PICI was first developed for use at the practice level, and when assessed in a non-IBD setting, it was achieved in 54.1% of procedures. The main factors associated with higher PICI were older age, male sex, adequate bowel preparation, higher training status, unit accreditation, greater annual volume, and positive fecal occult blood as a procedure indication.¹⁵ Here, we utilize the PICI score as a proxy for quality colonoscopy in IBD patients, in addition to other key indicators. We adapted the PICI

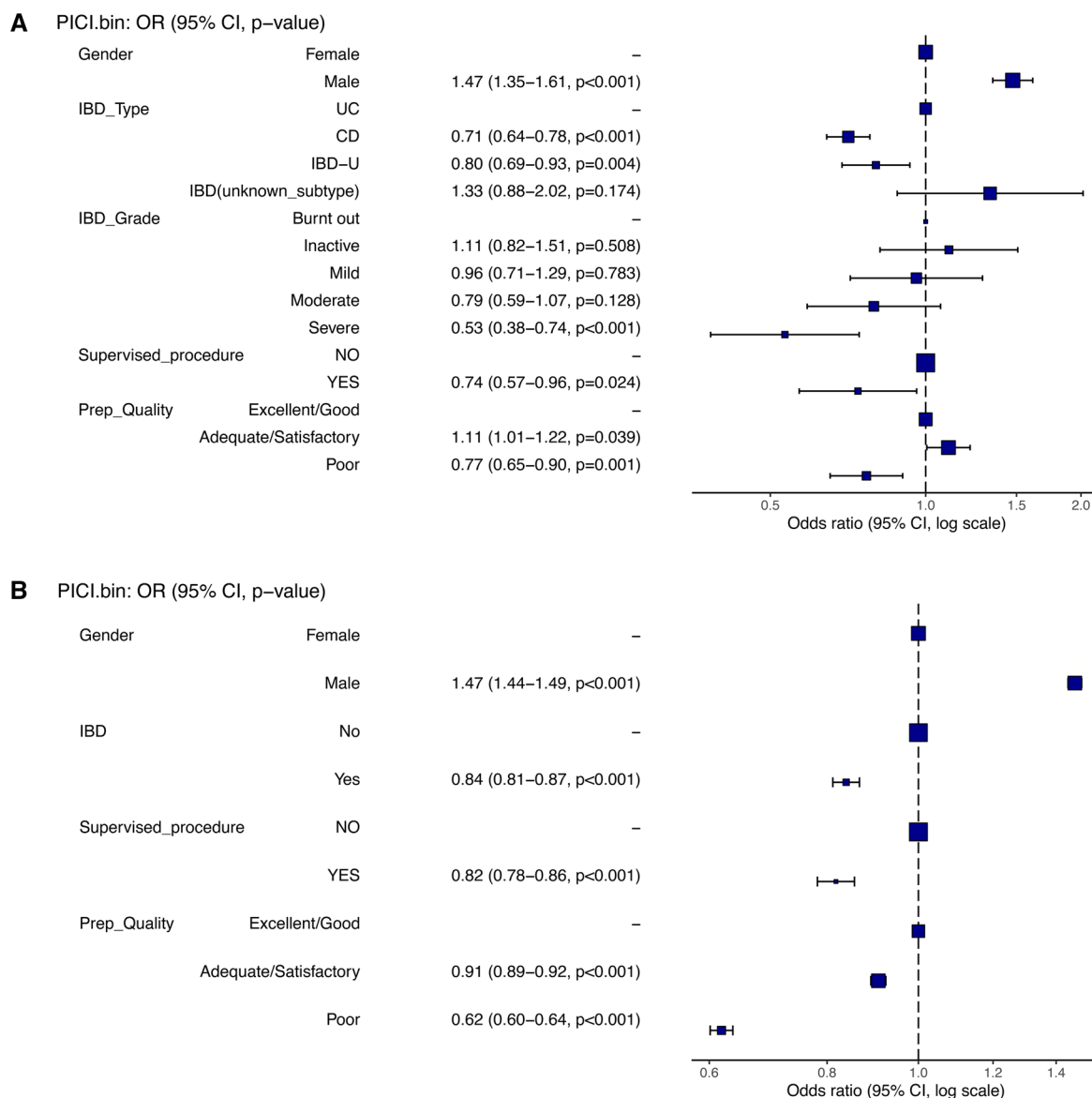


Figure 4. Logistic regression analysis: or of achieving performance indicator of colonic intubation (PICI) across different variables in (A) combined inflammatory bowel disease (IBD) and non-IBD cohorts and (B) IBD cohorts.

framework to generate a binary patient-level outcome to offer insights into individual predictors of achieving components of a high-quality colonoscopy.

Overall, our study showed a significantly reduced likelihood of achieving PICI defined by cecal intubation with a nurse-assisted comfort score of ≤ 2 and midazolam dose of ≤ 3 mg in IBD patients compared to the non-IBD population. Notably, PICI rates were similar between non-IBD and UC patients, but significantly lower in CD patients. This can be explained by the procedure length associated with CD endoscopy (eg, need for ileal intubation) or concomitant perianal disease and previous surgery, which can significantly increase procedure-related discomfort.

Similarly to prior studies, male sex was associated with higher PICI, while poor bowel preparation and the need for supervision understandably impacted lower PICI, the later was possibly explained by longer procedure times and reduced endoscopic skill level.

Considering IBD-related factors, the presence of severe disease activity was linked to a lower OR of achieving PICI, suggesting that colonic inflammation and overall disease burden could negatively affect the tolerability of the procedure.

To our knowledge, this is the first large-scale study to assess key quality metrics specific to IBD endoscopy and the first to examine composite patient experience metrics. The extensive sequential data collection is critical for monitoring and improving the overall quality of endoscopic procedures. By refining these processes, we can reduce the likelihood of patients avoiding colonoscopy due to prior negative experiences, thereby minimizing the risk of loss to follow-up and preventing potential disease-related complications.

Some limitations need to be acknowledged. The high prevalence of missing data among IBD type and disease activity may have hampered overall analysis. Moreover, details on disease characteristics, such as disease extent, disease duration, previous surgery, procedure time, and previous endoscopic

experience, would have helped stratify the analysis and identify further factors potentially influencing the overall quality and tolerability of the procedure. Furthermore, the examination of individual endoscopist KPIs would have added valuable insights, rendered unfeasible due to data protection issues. The Gloucester comfort score assessed as part of the study has been demonstrated to be a reliable measure of procedural tolerance during endoscopy, but patient-reported outcomes would ideally have been used to improve the objectivity and completeness of comfort assessment during endoscopy. It is also acknowledged that although sedation dosage was used as a surrogate maker for procedural discomfort, it is also influenced by the endoscopist's anticipation of patient distress, particularly in patients with IBD undergoing repeated procedures. We acknowledge the arbitrary nature of a >3-mg dose for midazolam as part of the PICI score. Midazolam dose should take into account multiple parameters including age, body mass, and gender, and although higher doses may be safe in younger patients, there are data demonstrating lower doses of midazolam are associated with reduced adverse effects and physiological changes even in younger patients, and therefore targeting a lower dose where possible may be beneficial in all patients.³²

In conclusion, the PICI score is an effective tool for assessing quality metrics, patient safety, and comfort in IBD endoscopy. Further data to support and develop quality improvement targets in IBD endoscopy, in particular those that combine both existing KPIs and patient-reported outcomes, are needed going forward. Furthermore, investment in the dissemination and incorporation of these measures into routine clinical practice is required. Efforts should be made to optimize procedural standards, minimize patient discomfort, and consistently implement quality improvement targets to improve long-term patient management.

Author Contributions

G.A.D. and F.J.: conceptualization. A.M.C.C., S.P., A.M., G.C., E.S., J.L., C.O.M., and L.E.: Conceptualization—supporting. F.J. and A.L.: data curation and writing—original draft. F.J., A.L., I.Z., M.I., and G.A.D.: writing—reviewing and editing.

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Conflicts of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data availability

The data that support the research findings are available upon reasonable request to the corresponding author. Data are not publicly available due to privacy and ethical restrictions.

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