

RESEARCH ARTICLE

Quality improvement exercises in Inflammatory Bowel Disease (IBD) services: A scoping review

Katie Ridsdale^{1*}, Kajal Khurana¹, Azizat Temidayo Taslim², Jessica K. Robinson², Faith Solanke², Wei Shao Tung², Elena Sheldon¹, Daniel Hind¹, Alan J. Lobo³

1 School of Health and Related Research, The University of Sheffield, Sheffield, United Kingdom, **2** Medical School, The University of Sheffield, Sheffield, United Kingdom, **3** Sheffield Inflammatory Bowel Disease Centre, Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, United Kingdom

* k.ridsdale@sheffield.ac.uk



Abstract

Objective

Quality Improvement initiatives aim to improve care in Inflammatory Bowel Disease (IBD). These address a range of aspects of care including adherence to published guidelines. The objectives of this review were to document the scope and quality of published quality improvement initiatives in IBD, highlight successful interventions and the outcomes achieved.

Design/method

We searched MEDLINE, EMBASE, CINAHL and Web of Science. Two reviewers independently screened and extracted data. We included peer reviewed articles or conference proceedings reporting initiatives intended to improve the quality of IBD care, with both baseline and prospectively collected follow-up data. Initiatives were categorised based on problems, interventions and outcomes. We used the Quality Improvement Minimum Quality Criteria Set instrument to appraise articles. We mapped the focus of the articles to the six domains of the IBD standards.

Results

100 studies were identified (35 full text; 65 conference abstracts). Many focused on vaccination, medication, screening, or meeting multiple quality measures. Common interventions included provider education, the development of new service protocols, or enhancements to the electronic medical records. Studies principally focused on areas covered by the IBD standards 'ongoing care' and 'the IBD service', with less focus on standards 'pre-diagnosis', 'newly diagnosed', 'flare management', 'surgery' or 'inpatient care'.

Conclusion

Good quality evidence exists on approaches to improve the quality of a narrow range of IBD service functions, but there are many topic areas with little or no published quality

OPEN ACCESS

Citation: Ridsdale K, Khurana K, Taslim AT, Robinson JK, Solanke F, Tung WS, et al. (2024) Quality improvement exercises in Inflammatory Bowel Disease (IBD) services: A scoping review. PLoS ONE 19(3): e0298374. <https://doi.org/10.1371/journal.pone.0298374>

Editor: Valérie Pittet, Center for Primary Care and Public Health, SWITZERLAND

Received: September 14, 2023

Accepted: January 24, 2024

Published: March 7, 2024

Peer Review History: PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: <https://doi.org/10.1371/journal.pone.0298374>

Copyright: © 2024 Ridsdale et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: All relevant data are within the manuscript and its [Supporting Information](#) files.

Funding: The author(s) received no specific funding for this work.

Competing interests: I have read the journal's policy and the authors of this manuscript have the following competing interests: Professor Alan Lobo has acted as a consultant and advisory board member for Takeda Pharma, Janssen and Bristol Myers Squibb. This does not alter our adherence to PLOS ONE policies on sharing data and materials.

improvement initiatives. We highlight successful quality improvement interventions and offer recommendations to improve reporting of future studies.

Introduction

Inflammatory Bowel Disease (IBD), which includes ulcerative colitis (UC) and Crohn's disease (CD), is characterised by inflammation of the gastrointestinal system, significant morbidity, and lifelong medication [1]. In 2017, 84.3 per 100,000 persons suffered from IBD worldwide [2]. Annual healthcare costs in Europe are over £10,000 per prevalent CD case, and over £6000 per prevalent UC case [3]. Guidelines promote optimum healthcare based on medical research findings and expert opinions. For example, The IBD standards [4] were created by IBD UK, a partnership of 17 patient and professional organisations. They outline how care should be high-quality for all patients with IBD, at all stages of their journey, including how care should be organised and managed to achieve this.

However, development of guidelines does not necessarily result in their implementation; guideline adherence is often reported as low. For example, despite guidelines on immunisations for IBD patients, low vaccination rates have been observed in both adult and paediatric groups who receive immunosuppressive treatment [5–7].

Quality Improvement (QI) “attempts to change clinician behaviour and, through those changes, lead to improved patient outcomes” [8], across domains including safety, effectiveness, patient-centredness, timeliness, efficiency, and equity [9]. Quality improvement projects are often local and time-limited [10]. Systematic overviews can help improve planning quality improvement projects by summarising what is already known and where there are evidence deficits [11]. A recent systematic review focused on publications addressing US quality metrics for adult IBD [12]. It found that successful approaches empowered non-physicians, targeted multidisciplinary teams, prompted clinicians using Electronic Medical Records (EMR) and restructured care delivery. Here, we present a broader scoping review of published quality improvement studies from any setting which address IBD care for adults or children.

Scoping reviews can be used to categorise available evidence on a topic and summarise knowledge gaps [13]. In this study, our objectives were to: 1) Characterise published reports of QI interventions in IBD care; 2) Identify high quality, successful studies and their intervention components; and 3) Map the current literature to the IBD Standards, and identify knowledge gaps.

Methods

Protocol

This scoping review was conducted using standard procedures and is reported in accordance with the “Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews” (PRISMA-ScR) statement (S1 Checklist). The protocol was fixed at the beginning of March 2022 (S1 Protocol).

Eligibility criteria

Eligible studies: a) were peer reviewed articles or conference abstracts published between 2009 and 2023 in the English language; b) included people of any age or gender with CD or UC; c) described at least one initiative aimed at assisting, facilitating, or improving the quality of care;

and d) retrospective or prospectively collected baselines and prospectively longitudinal outcome data. Studies were considered ineligible if they were based exclusively on retrospective or cross-sectional data; were based in mixed populations who may not all have IBD (e.g., colorectal surgery); just discussed the process of forming an initiative without gathering data about the project itself; were health economic studies; were review papers; or any studies involving non-human participants. If there were numerous records for a single study, the most comprehensive dataset from that record was used. There were no restrictions on the study setting (e.g. level of healthcare, and urban/rural), location, or country of origin.

Information sources and search

On 2nd June 2023 we searched MEDLINE, EMBASE, CINAHL and Web of Science, with no date restrictions, using thesaurus and free-text terms related to IBD, CD, UC and QI ([S1 Appendix](#)). We also searched Google Scholar and reference lists of included studies.

Selection of sources of evidence

The search results were uploaded to Rayyan [14] and duplicates removed. The title and abstract of each paper were screened for eligibility by at least two reviewers, with disagreements settled by a third.

Data charting and process

Data collection forms were developed, piloted and iteratively modified in Microsoft Excel. The final form reflected domains of the Quality Improvement Minimum Quality Criteria Set (QI-MQCS) instrument [15] and other, topic-specific, fields (see data items). Authors were not contacted for missing data due to the number of studies and time constraints.

Data items

- Study characteristics: country, population (adult/paediatric), number of patients, number of centres, study design (guided by the QI-MQCS handbook [15]).
- The following categories were inductively derived by the team:
 - *Problem* (studies were coded to one category): Preventive Health (sub categories: Vaccination; Screening; VTE Prophylaxis; Mental Health; Pre-treatment Tests); Health Maintenance (sub categories: Medication; Drug Monitoring; Endoscopic Scoring; Enteral therapy; Patient/Family Guidance; Follow-up; Pre-visit Planning Compliance; Treat to Target; Stratified Care; Urgent Care/Triaging; Time to Treatment; Care Co-ordination; Transitional Care); Multiple Quality Measures; Clinician Workload; Clinician Guideline Knowledge; and Costs/Resources.
 - *Intervention* (studies could be coded to more than one category): Provider Education; New Protocol; New Documentation; Informatics; Reminder System; Patient Education; Accountability; and Team Change (e.g. Changes to team structure or composition).
 - *Outcome* (studies could be coded to more than one category): Process outcomes: Protocol/Documentation Adherence; Treatment Rate; Vaccination Rate; Testing Rate; Screening Rate; Steroid Use; Follow-up Rate; Patient Knowledge; and Costs. Clinical outcomes: Remission Rate; Disease Activity; Length of Stay; Patient Satisfaction; Adverse Events; Nutritional Status; Admissions; Readmission; Relapse; Quality of Life; and Pain.

- The stage of the patient journey targeted by the improvement initiative, categorised using the IBD Standards UK system [4]. The standards are separated into 7 sections, which are summarised below. These are further broken down into a number of statements, which can be access on the IBD UK website.
 1. The IBD service: A well-organised and managed local Inflammatory Bowel Disease IBD service is necessary to provide safe, consistent, high quality, personalised care.
 2. Pre-diagnosis: Early and accurate diagnoses allows for treatment and support sooner, and better management.
 3. Newly diagnosed: The right treatment and support should be in place for newly diagnosed patients.
 4. Flare Management: Patients should recognise a flare, and access the right specialist advice and treatment to manage it as quickly as possible.
 5. Surgery: Surgery should be timely, led by surgeons with the right expertise, and with effective multidisciplinary working. Patients should fully understand their options and be offered psychological support.
 6. Inpatient Care: Inpatients should be admitted to a specialist ward with appropriate facilities, should receive a holistic assessment, and be given clear information on discharge.
 7. Ongoing care: As IBD is a fluctuating, lifelong condition, people need ongoing care, including a personalised care plan.

Critical appraisal

At least two reviewers applied the 16-item QI-MQCS instrument [15] to each study, with discrepancies resolved by a third reviewer. Scores were divided into terciles: the four lowest scores (two to five) were ranked as low quality; the five middle scores (six to ten) were ranked as moderate quality, and the four highest scores (eleven to fourteen) were ranked as high quality.

Synthesis

Narrative/tabular summaries and frequency counts were generated for study characteristics, problem, intervention and outcome categories, critical appraisal domains and knowledge gaps. A tabular synthesis was also produced detailing theories of change for high quality studies, including a description of their overarching themes.

Results

Study selection

After the elimination of duplicates, 1515 titles and abstracts were evaluated for eligibility; 1385 were excluded. On review of 148 full texts, 100 studies were included: 35 peer reviewed publications [16–50] and 65 conference abstracts [51–115]. Fig 1 details reasons for rejection. We also searched Google Scholar, and citations from included reports, but all were duplicates of already retrieved articles or did not meet inclusion criteria.

Characteristics of sources of evidence

Of the 100 included studies (see references and more information in [S1 Dataset](#)), the country was unknown in five cases; the remainder were conducted in the US (n = 77), the UK (n = 11),

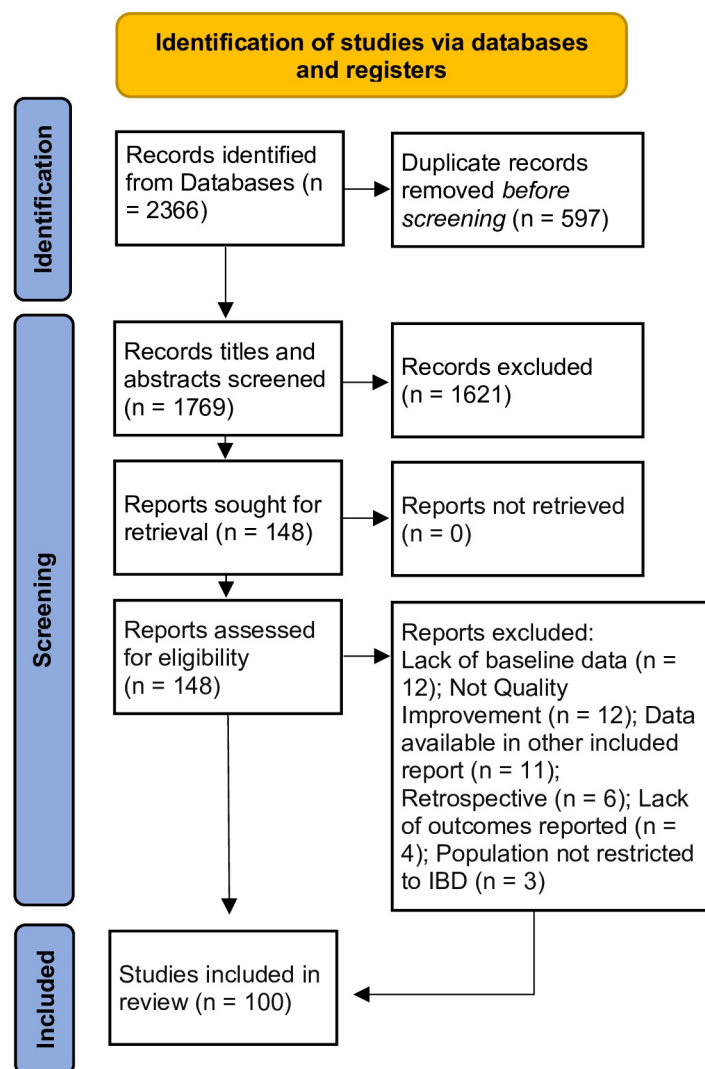


Fig 1. Flow diagram illustrating study identification and exclusion in this review as recommended by PRISMA SCR [116].

<https://doi.org/10.1371/journal.pone.0298374.g001>

Israel (n = 2), Singapore (n = 2), Australia (n = 1), Belgium (n = 1), and Italy (n = 1). Twenty-six reports involved adults, 44 were on a paediatric population, and the population was unclear in 30. Seventy-two studies were single centre; 10 did not state the number of centres. Other studies ranged from 2 to 38 centres. Study designs were 'pre-post' (n = 92); time series (n = 4); observational cohorts (n = 2); individually-randomised (n = 1) and cluster-randomised (n = 1) controlled trials.

Problem/intervention/outcome categories

The quantity of papers which address each problem, intervention and outcome category are shown in Table 1. The problems addressed are broken down into adult and paediatric studies in Fig 2. Process outcomes were reported 124 times, whereas clinical outcomes were reported 50 times. Sixty-three studies reported only process outcomes.

Table 1. Quantity of identified Inflammatory Bowel Disease quality improvement papers (n = 100) categorised into problems, interventions and outcomes.

Problem	N	Intervention	N	Outcome	N
Multiple quality measures	21	New Protocol	51	Process outcomes (n = 124)	
Vaccination	15	Provider Education	47	Protocol/Documentation Adherence	30
Screening*	12	Informatics	44	Treatment Rate	21
Medication	11	Reminder System	19	Screening Rate	19
Drug Monitoring	6	New Documentation	18	Vaccination Rate	18
VTE Prophylaxis	5	Patient Education	15	Testing Rate	13
Enteral Therapy	3	Accountability	7	Steroid Use	8
Follow-up	3	Team Change	4	Follow-up Rate	7
Patient/Family Guidance	3			Costs	5
Urgent Care/Triaging	3			Patient Knowledge	3
Mental Health	2			Clinical outcomes (n = 50)	
Pre-treatment tests	2			Adverse Events	10
Stratified Care**	2			Remission Rate	9
Endoscopic Scoring	2			Disease Activity	6
Time to Treatment	2			Admissions	6
Clinician Workload	2			Length of Stay	6
Pre-Visit Planning Compliance	1			Patient Satisfaction	5
Treat to Target	1			Nutritional Status	3
Transitional Care	1			Readmission	2
Care Co-ordination	1			Relapse	1
Clinician Guideline Knowledge	1			Quality of Life	1
Costs/Resources	1			Pain	1

Each paper was categorised into only one problem, but may be assigned multiple intervention/outcome categories.

*Screening included bone health (n = 4), *Clostridioides difficile* (n = 2), anaemia (n = 2), vitamin D (n = 1), nutrition (n = 1) iron deficiency (n = 1), and social determinants of health (n = 1).

**Stratified care included primary sclerosing cholangitis (n = 1) and obesity (n = 1).

<https://doi.org/10.1371/journal.pone.0298374.t001>

Critical appraisal of included studies

Most full-paper reports in this review (32 out of 35) were rated between 10 and 14 on the QI-MQCS (Fig 3). Research only available as conference abstracts scored between 2 and 10, due to reporting limitations.

The following items were reported well in the 35 full-text articles: Organisational Motivation (n = 35), Data Source (n = 35), Timing (n = 35), Limitations (n = 34), Intervention Rationale (n = 33) Intervention Description (n = 32), Organisational Characteristics (n = 31), and Implementation (n = 30). Other items were reported more poorly: Organisational Readiness (n = 27), Adherence/Fidelity (n = 26), Sustainability (n = 24), Comparator (n = 22), Study Design (n = 16), Spread (n = 16), Health Outcomes (n = 12), Penetration/reach (n = 7).

The five lowest reporting items for the 65 conference abstracts were: Health Outcomes (n = 13), Comparator (n = 11), Organisational Readiness (n = 7), Spread (n = 7), Limitations (n = 3), and Penetration/Reach (n = 3).

Knowledge gaps

When mapping the studies to the areas of improvement defined by the IBD Standards [4], studies most commonly focussed on problems relating to 'The IBD service' (n = 41) or 'Ongoing care' (n = 40). There were gaps in QI research into the areas of 'Newly Diagnosed Patients'

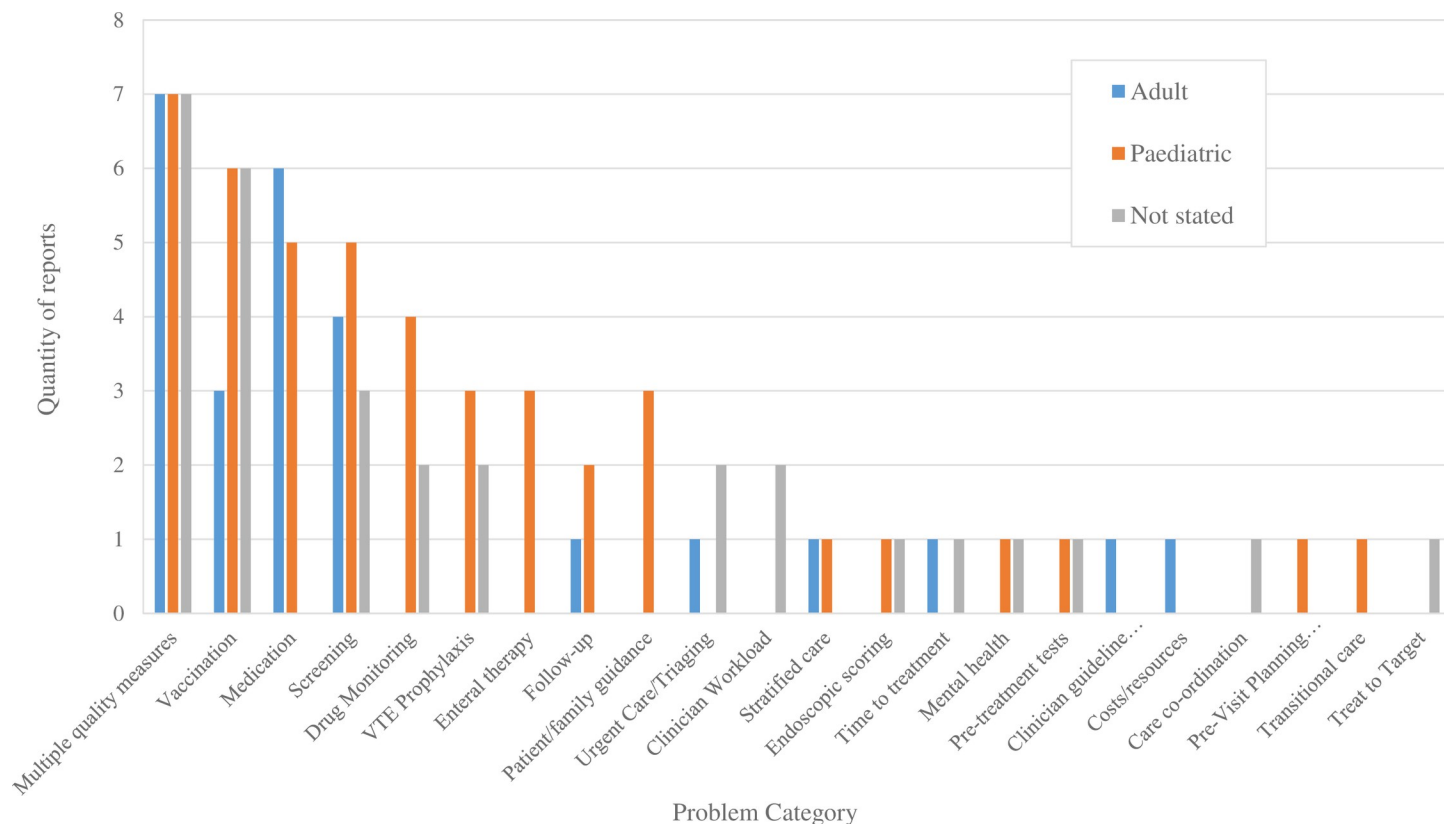


Fig 2. The categorised problems addressed by Inflammatory Bowel Disease quality improvement reports (n = 100), separated into adult/paediatric populations. 26 studies reported an adult population, 44 reported a paediatric population, and the population was not stated in 30 studies.

<https://doi.org/10.1371/journal.pone.0298374.g002>

(n = 10), 'Inpatient Care' (n = 9) and 'Flare Management' (n = 8), and a distinct paucity of research into 'Pre-Diagnosis' (n = 1) and 'Surgery' (n = 1). 9 papers did not map to any areas defined by the IBD Standards.

Description of initiatives

All 30 papers that were rated as 11 or higher during critical appraisal (all of which were full papers) reported successful initiatives. This included papers focussing on the following problems:

- Preventive Health: Vaccination, and Screening (Bone health, nutrition, anaemia and *C. difficile*);
- Health Maintenance: Medication, Drug Monitoring, Enteral Therapy, Follow up, and Pre-visit Planning Compliance;
- Adherence to multiple quality measures (process and health outcome measures chosen as quality indicators, derived from American College of Gastroenterology guidelines [17], physician quality reporting system performance measures [18, 25], National Quality Strategy priorities [26], European Crohn's and Colitis Organisation guidelines, or discussions between paediatric IBD centre representatives, policy makers and administrators [50]).
- Clinician Guideline Knowledge;

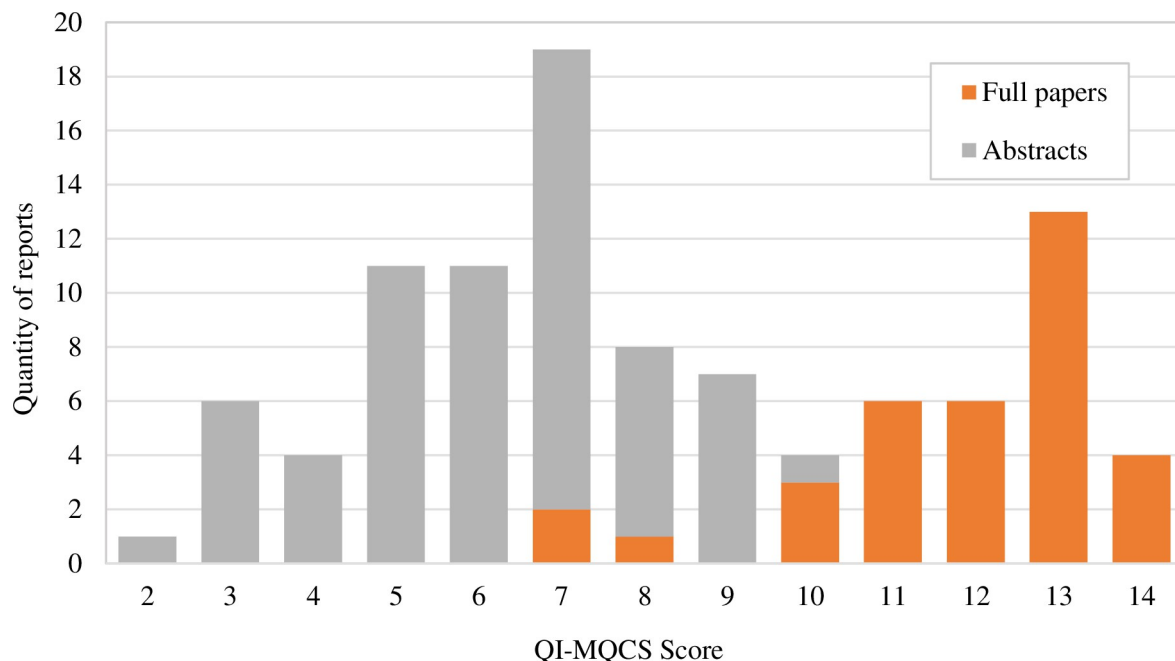


Fig 3. QI-MQCS [15] score for published Inflammatory Bowel Disease quality improvement reports included in this review (n = 100). Reports are split into full texts (n = 35) and conference abstracts (n = 65). Maximum possible score is 16.

<https://doi.org/10.1371/journal.pone.0298374.g003>

These 30 articles could be grouped into 3 overarching themes: Workload and workflow; Guidelines and standards; and Education and Information. Details of the intervention components and outcomes of the 30 ‘high quality’ papers are included in [Table 2](#). Intervention components and outcomes of all 35 full texts and 65 conference abstracts can be found in [S1 Dataset](#).

Discussion

We performed an extensive search of the published literature on QI initiatives in IBD, screened a large quantity of articles and identified 100 studies across a variety of settings, between 2010 and 2023. Studies covered a range of problem areas but some areas are under-represented. High quality studies successfully demonstrated improvements through a variety of interventions. Conference abstracts provide useful insights but the lack of information hinders their replication. Intervention success was measured using a wide variety of outcome measures; more frequently in process outcomes than clinical outcomes. This may be unsurprising; though clinical outcomes are ultimately the QI target for improvement, process outcomes may give a more direct indication of the impact of the QI initiative, as they are less likely to be influenced by external factors [117].

Implications for patients, clinicians and policy makers

QI is a ‘bottom-up’ process that strongly relies on regional norms and the knowledge base of local clinicians. Despite efforts to standardise care, there still appears to be variation in clinical practice, much of which is unwarranted [118]. This review complements the more focused work of Fudman and colleagues [12] in offering a broader evidence base for improvement strategies in IBD. From that review and our own, there is now a sound evidence base for improvement approaches to several problems. Some interventions were complex, such as formation of a new rapid access clinic [24] or creating new job roles [12, 23], but many studies

Table 2. Intervention components and outcomes of Inflammatory Bowel Disease quality improvement reports rated high quality by the QI-MQCS (n = 30), organised by problem category.

Problem category	Reference	Overarching theme	Intervention components	Outcomes
Pre-visit Planning compliance	Dykes et al 2017 [21]	Guidelines and standards	Summarised evidence into guidelines; Checklist tested on sample patients; Automated form pulling data from EMR.	Patients receiving complete bundle increased from 0% to ~100%; ~70% now receiving pneumococcal vaccine.
Clinician Guideline Knowledge	Weizman et al, 2021 [49]	Education and information	Educational iPad video for hospitalised patients summarising inpatient management guidelines; accessible throughout hospitalisation.	Higher trust in physician at discharge and 6 months in intervention group ($p < 0.05$); higher satisfaction at discharge in intervention group ($p < 0.05$) but not sustained at 6 months; more tuberculosis skin testing within 48 hours in ($p = 0.013$); no significant differences in length of stay or colectomy.
Clinician Workload	Ewelukwa et al, 2018 [23]	Workload and workflow	Scribes assisted with documentation during clinic visits; Posters and discussions raised awareness of scribe clinics.	Patient satisfaction increased from 6.8 to 9.2 ($p < 0.01$); Appointment length decreased by 13.5 minutes ($p < 0.05$); Revenue increased 536% over scribe salary.
Costs/resources	Fofaria et al, 2019 [24]	Workload and workflow	Patient questionnaires to gauge interest in out of hours clinics and telephone monitoring; Information campaign on benefits of telephone clinics using posters for patients and posters/meetings for clinicians and emergency department staff.	Percentage of eligible patients transferred to telephone clinics increased from 17.6% to 59.3% using in-clinic discussion method. Patient satisfaction scores remained high and non-inferior to baseline scores.
Drug Monitoring	Guido et al, 2020 [28]	Guidelines and standards	Established local standard of care; created database; infliximab therapy plans built into EMR to automatically trigger lab orders; email reminder system; updated pre-visit planning process to manually review patients and updated templates.	Post-induction therapeutic drug monitoring increased from 43% to >80% ($p < 0.001$); infliximab therapeutic drug monitoring increased from 59% to 82% ($p < 0.01$); 36% of levels $< 5 \mu\text{g/mL}$.
	Hellmann et al, 2021 [30]	Guidelines and standards	Designed care algorithm for parent education on infliximab doses; education for providers; updated pre-visit planning process to review patients weekly and feedback to whether providers adhered to the guideline; best practice alerts in EMR to recommend dose adjustment for low levels.	Percentage of patients with level $\geq 5 \mu\text{g/mL}$ and checked in 12 months improved from 73% to 80% in 6 months ($p < 0.01$) and 88% at 1 year; sustained remission improved from 62% to 75%.
	Kelly et al, 2019 [33]	Guidelines and standards	Created Standard Operating Procedure (SOP) for paediatric infliximab infusions; Pre-infusion safety checklist; Education sessions for nurses on SOP and checklist; Checklist and SOP refined based on feedback.	Median safety checklist completion increased from 46% to 81% in one unit ($P < 0.05$) and 91% to 95% in another unit ($P < 0.05$); Laboratory screening adherence increased from 81.8% to 95.2% ($P < 0.001$).
Enteral therapy	Shaikhkhalil et al, 2018 [46]	Guidelines and standards	Standard Exclusive Enteral Nutrition algorithm developed and iteratively refined; calorie/fluid table to determine formula needs; education session for providers; talking points for discussions with patients/families; weekly rounds to review patients.	Exclusive Enteral Nutrition utilisation increased from <5% to ~50% ($p < 0.01$); 71% of patients completing ≥ 8 weeks of achieved remission; in patients completing there were significant reductions in disease activity.
Follow-up	Prendaj et al, 2019 [41]	Workload and workflow	Research coordinator called patients monthly to schedule appointments; made clinic appointments for infliximab patients on the same day as their infusion; educated physicians on recommended visit frequency and educated patients that guidelines recommend visits twice a year.	Median documented visits within 200 days increased from 64% to 83% ($p < 0.0001$). Increase sustained for 1 year.
	Savarino et al, 2016 [43]	Workload and workflow	Pre-visit planning for patients with upcoming visits; team made care recommendations for patients with active disease; then expanded over cycles to include patients with mild/moderate disease and more providers.	Clinical remission rate increased from 77% to 83% over 12 months. 78% of providers found recommendations helpful.
	Choe et al, 2021 [20]	Workload and workflow	Implemented urgent scheduling slots for IBD patients with wait times > 2 weeks; dedicated IBD clinic scheduler booked follow-ups; provided education to inpatient gastrointestinal team on contacting scheduler for patients needing timely follow-up	Mean wait time decreased from 40.4 days to 21.9 days after intervention, but change not statistically significant ($p = 0.408$). Only two responses to patient satisfaction survey limited interpretation.
Medication	Gupta et al, 2019 [29]	Workload and workflow	Offered external infusion options; created standard order sets to facilitate ordering process; established post-infusion nurse communication protocols; educated providers and patients on external infusion options.	Significant increase in patients offered external infusions (7% to 48%, $p < 0.0001$); Significant increase in patients receiving external infusions (7% to 30%, $p < 0.0001$).
	Kaimakliotis et al, 2021 [32]	Education and information	Brief educational lecture and pocket guide on stepwise approach to analgesia provided to internal medicine and emergency medicine residents; re-education every 3 months.	Inpatient opioid use decreased from 43.4 mg to 7.7 mg morphine equivalents ($p < 0.01$); discharge prescriptions decreased from 3.7% to 0% ($p = 0.03$); Length of stay decreased from 5.3 to 3.7 days ($p < 0.04$); 90-day readmissions decreased from 25% to 7% ($p < 0.04$); there was no significant difference in pain scores.

(Continued)

Table 2. (Continued)

Problem category	Reference	Overarching theme	Intervention components	Outcomes
	Morris et al, 2022 [38]	Education and information	Education on biosimilars for providers, including presentations, information sheets, process map and frequently asked questions sheets; for inpatients, a clinical pharmacist was consulted before patient started on IV anti-Tumour Necrosis Factor drugs to allow them to review preferred product on insurance plan; enrolled eligible patients in co-payment assistance programs.	Biosimilar utilisation increased from 1% to 96% ($p < 0.001$); estimated cost savings of \$381,000 (average sales price) and \$651,000 (wholesale acquisition cost) over 20 months; No significant difference in clinical outcomes.
	Sandberg et al, 2019 [42]	Workload and workflow	Created standardised order set to simplify infusion orders; transitioned eligible patients to 60 min rapid infusions after initial doses; eliminated 30 min post-infusion observation time; pharmacy installed pass-through window to improve efficiency of infusion preparation.	Average door-to-door time decreased from 279 min to 151 min; estimated 128 min per patient freed per year; no adverse events with rapid infusions.
	Kozlicki et al, 2023 [34]	Workload and workflow	Dashboard integrated the electronic health record and pharmacy claims database to identify patients on biologics needing updated labs before next refill due; speciality pharmacists reviewed dashboard and messaged nurses via electronic health record if patient labs were required; messages were sent 4 weeks in advance	Frequency of treatment gaps decreased from 80% to 32%; median gap length decreased from 21 days to 11 days.
	Ong et al, 2022 [39]	Workload and workflow	Educational tutorials, information leaflets and workflow map to guide physicians on eligibility criteria; implemented accelerated 1 hour infliximab infusion protocol for eligible patients; shifted infliximab collection from distant pharmacy to nearby pharmacy.	Mean infliximab infusion time reduced by 47% (142min to 75min, $p < 0.001$); total time spent in infusion centre reduced by 52% (214min to 106min, $p < 0.001$); 3 mild infusion reactions out of 152 infusions (2%).
Multiple quality measures	Bensinger et al, 2019 [18]	Workload and workflow	Implemented a note template with prepopulated sections for Physician Quality Reporting System measures; order set with one-click access to vaccines, bone density scans, tuberculosis, hepatitis B testing; patient education handout on vaccinations, bone health, cancer screening, tobacco cessation added to after-visit summary provided to patient.	Significant increases in documentation rates of influenza immunization (19–59%, $p < 0.001$), pneumococcal immunizations (2–38%, $p < 0.001$), tobacco cessation (28.6–77.8%, $p = 0.049$); sustained improvements at 1 year.
	Greene et al, 2015 [25]	Education and information	Four accredited educational activities for physicians: web-based private audit feedback session, two interactive online videos and a 20-page monograph on quality improvement and evidence based approaches.	No significant differences for overall adherence to any of the Physician Quality Reporting System IBD quality measures, but low performing gastroenterologists showed significantly greater improvement on adherence to 4 measures after education compared to high performers.
	Yogev et al, 2021 [50]	Guidelines and standards	21 Israeli paediatric IBD centres participated in national quality improvement program with monthly anonymous feedback on performance; position papers published mid-study on use of faecal calprotectin and anti-TNF levels.	Significant increase in: obtaining anti-TNF levels (66% to 87%, $p = 0.005$); faecal calprotectin utilization (63% to 71%, $p = 0.008$); bone density testing (53% to 68%, $p = 0.002$). Significant improvement in: calprotectin < 300 mg/mg (60% to 66%, $p = 0.015$); composite endpoint of inflammation resolution (36% to 53%, $p = 0.007$).
	Benjamin et al, 2023 [17]	Workload and workflow	Patient questionnaire to educate on increased risk of vaccine-preventable illnesses, skin cancers, osteoporosis, cervical cancer and mental health problems, and identify deficiencies; paper order sheet for health maintenance orders, entered into EMR after visit; case management log to track patients seen, orders placed, and patient follow-through.	Ordered health maintenance item increased from 20% to 100%; completion rate unchanged; mean patient engagement score increased from 3.0 to 4.6.
Screening	Smith et al, 2023 [48]	Guidelines and standards	Education of gastrointestinal division on iron deficiency/iron deficiency anaemia (ID/IDA) algorithm created by IBD team & haematologist; copies of algorithm placed in clinical spaces & EMR; iron studies added to diagnostic checklist used by IBD nurse coordinators; EMR smart tools created to facilitate ordering iron studies.	Screening rates increased from 20% to $> 90\%$ ($p < 0.001$); Of those screened, 88% had ID/IDA; 77% with ID/IDA treated within 30 days.
	Lambl et al, 2019 [35]	Guidelines and standards	Daily cleaning with bleach and ultra violet terminal room disinfection; guidelines and order set changes to restrict clindamycin and fluoroquinolones; modified testing algorithm to reduce inappropriate polymerase chain reaction tests.	<i>C. difficile</i> rate declined 55.5% ($p = 0.002$); high-risk antibiotic use declined 88.1% ($p < 0.001$); antibiotic restrictions associated with 20.6% infection decline.
	Gold et al, 2022 [27]	Guidelines and standards	Implemented malnutrition screening program using modified Malnutrition Universal Screening Tool; recommendations for high risk patients; smart tool and smart phrase built into EMR.	Significant increase in number screened (3% to 63%, $p < 0.01$); significant increase in micronutrient testing for high risk patients (0% to 63%, $p < 0.01$); small non-significant increase in dietician referrals (33% to 37%, $p = 0.9$).

(Continued)

Table 2. (Continued)

Problem category	Reference	Overarching theme	Intervention components	Outcomes
	Shah-Khan et al, 2019 [45]	Education and information	Education lecture for providers; flyer summarising guidelines posted in provider area; EMR prompt for providers to consider ordering bone mineral density screening.	Bone mineral density screening rate significantly increased from 10.8% to 81.8% ($p < 0.01$).
	Breton et al, 2021 [19]	Guidelines and standards	Multidisciplinary team created paediatric evidence-based care pathway for ID/IDA; EMR dashboard created tracking anaemia screening, iron deficiency screening, iron supplementation; providers received individualised monthly reports from dashboard data.	Iron deficiency screening increased from 31.7% to 63.6%; treatment rates increased from 38.2% to 49.9%; anaemia prevalence decreased 35.8% to 29.7% ($p = 0.003$).
Urgent care/ triaging	Melmed et al, 2021 [37]	Workload and workflow	Formed multidisciplinary care teams; reserved urgent slots in clinics; proactive communication with high-risk patients; educated patients on seeking urgent care.	System wide improvement in multiple measures: need for urgent care, hospitalisations, CT scan utilisation, steroid use, opioid use ($p < 0.05$) (18–50% relative reductions).
Vaccination	Parker et al, 2013 [40]	Education and information	Education form on needed vaccines given to patients; vaccines offered and given at same visit by nurse.	Influenza vaccination increased from 54% to 81% ($p < 0.001$); pneumococcal vaccination increased from 31% to 54% ($p < 0.001$).
	Shores et al, 2019 [47]	Guidelines and standards	Implemented customised EMR prompts requiring action on influenza vaccination; educated providers on using prompts and importance of vaccination; had providers demonstrate prompt use in second year.	Documented vaccination improved from 10% to 39% in year 1 and 61% in year 2 ($p < 0.001$); vaccine counselling for unvaccinated patients improved from 27% to 77% by year 2 ($p < 0.001$).
	McNicol et al, 2022 [36]	Guidelines and standards	Created standardised 3-dose hepatitis B vaccine protocol and workflow for clinic and infusion centre; nurse training and competency assessment on vaccine; pre-visit planning to order vaccines and serologies in EHR before visits; engaged multi-disciplinary stakeholders through meetings and trainings.	Proportion of eligible patients who received hepatitis B vaccine dose 1 increased from 7% to 100%, sustained for over 12 months ($p < 0.05$); proportion of patients who completed 3-dose vaccine series increased from 0% to 82%; 92% demonstrated hepatitis B seroprotection after 3 doses.

All reports in this table scored 11–14 using the QI-MQCS tool. See [S1 Dataset](#) for details on reports which scored below 11. EMR = Electronic Medical Record; IBD = Inflammatory Bowel Disease.

<https://doi.org/10.1371/journal.pone.0298374.t002>

employed less time and resource intensive approaches, such as educational sessions. Common interventions included: patient educational handouts; different forms of learning sessions aimed at providers; posters or flyers in clinics; improvement of the pre-visit planning processes; standardised order sets; enhancements to the EMR system; and updates to, or development of new, decision aids and guidelines. Most of the published interventions were carried out in single centres, therefore to ensure the findings can be replicated, centres should consider specific differences between published studies and their own units [10]. High quality studies are identified in Table 2, with interventions which could be incorporated directly into services. These fall into overarching themes describing guidelines and standards, workload and workflow, and education and information. Services may also gain insights and ideas for QI by reviewing the remaining studies listed in the [S1 Dataset](#); though there may be less detail published on these projects.

Different interventions were successfully implemented targeting similar problem areas. For example, Parker. *et al* [40] developed a vaccination update paper form with educational information for patients, which improved influenza vaccination rates by 27% and pneumococcal vaccination rates by 23%. Shores. *et al* [47] improved documented paediatric influenza vaccination rates by 51% by implementing a new EMR system that allowed prompts and automated letters to patients, and educating nurses and providers about this system and the importance of documentation. Guido. *et al* [28] improved therapeutic drug monitoring of post-induction anti-TNF levels from 43% to over 80% in under a year and sustained this for a further year, by establishing a local standard of care, creating a database, implementing therapy plants into the EMR, developing a reliable reminder system for order entry and follow-up, and updating the pre-visit planning process. Hellmann. *et al* [30] increased the proportion of infliximab infusion

plans that had an appropriate drug level rechecked from 61% to 83% in one year through PDSA cycles involving education, development of an algorithm, feedback from providers, and EPIC software enhancements to flag abnormal levels and automate rechecking.

How to describe the pattern of attention in included studies?

Studies from paediatric centres account for just under half the studies included and extend the breadth of areas of practice addressed in studies included in this review. Categories were more restricted in studies which stated an adult population, though the spread is similar if studies which did not state their population are assumed to be on adults. The intervention categories we have used are by necessity broad. Therefore, although a particular overarching area may be represented, important facets may not. For example, approaches to improve vaccination practice are represented from adult and paediatric centres but important implications relating to use of Janus kinase inhibitors are not. Studies most frequently address adherence to multiple quality measures, vaccination and medication. Those relating to medication frequently address issues of biologic medication and its administration. The rapid proliferation of new agents in IBD has not been reflected in quality improvement studies to examine their optimum use.

There are few initiatives focussed on the 'pre-diagnosis' or 'surgery' phase of the patient journey, as well as underrepresentation of the newly diagnosed, urgent care, and inpatient care phases. Interestingly, key themes where high quality studies were not identified include those addressing patient experience and what matters to individual patients, team structure and appropriateness of drug-or surgical-treatment; for example the timing or sequencing of such treatments. Given pressures on in-patient and out-patient services, changes that impact on clinician workload are scarcely addressed.

Recommendations for future QI research

Non-publication of QI studies, publication in abstract form, or inadequate reporting in peer reviewed articles, all represent a substantial barrier to the dissemination of initiatives demonstrating good practice—and therefore their adoption. During critical appraisal, full text papers regularly failed to report on: the proportion of eligible units who participated (Penetration/Reach); health related outcomes; the potential, tools, or evidence of rollout to other units (Spread); the study design; and the sustainability or potential for sustainability (for example by reference to organisational resources or policy changes required). Although it is a critical appraisal tool, we recommend the use of the QI-MQCS, to supplement the Standards for Quality Improvement Reporting Excellence (SQUIRE) checklist [119], when reporting improvement initiatives. This would improve reporting of context-specific conditions that might affect knowledge translation to other settings, improving the ability to replicate findings at other centres.

Significant gaps have been identified, where new work is needed and which should meet standards for high quality studies. We recommend the development of improvement initiatives based on geographically-specific guidelines and formal IBD care quality criteria [120].

Limitations

The main limitation of our review is that it is restricted to published improvement initiatives, which might not be representative of all QI initiatives. Our use of Fan and colleagues' [8] definition of quality improvement restricted our scope to exercises targeting clinicians which reported baseline and prospective follow-up data. Furthermore, our search strategy may have missed published articles that did not use QI terminology, but were by our definition eligible QI studies. The inclusion of studies published in abstract was an attempt to increase included

studies, but Fig 3 demonstrates that the assessed quality of such studies is less than those published in full. In addition, there is inevitably some overlap between problem categories, whereby an intervention might fit into more than one. We dealt with this by allocating the category with best fit.

Conclusions

Good quality evidence exists for approaches to improving the quality of some IBD service functions, but this addresses only a narrow range and there are many topic areas with little or no published quality improvement initiatives. Successful interventions have been made but a wide range of areas are not represented. Use of the QI-MQCS to supplement the SQUIRE checklist would improve reporting of future studies.

Supporting information

S1 Checklist. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist.

(DOCX)

S1 Protocol. Scoping review protocol (fixed in March 2022).

(DOCX)

S1 Appendix. Search strategy for scoping review on quality improvement initiatives in Inflammatory Bowel Diseases.

(DOCX)

S1 Dataset. Published Inflammatory Bowel Disease quality improvement studies identified in scoping review (n = 100). Abbreviations: US = United States; UK = United Kingdom; Paed = Paediatric; N/S = Not Stated; NA = Not Applicable; IBD = Inflammatory Bowel Disease; QI-MQCS = Quality Improvement Minimum Quality Criteria Set (critical appraisal tool); EMR = Electronic Medical Record. *Study is only available as conference abstract, not full text report.

(DOCX)

Author Contributions

Conceptualization: Daniel Hind, Alan J. Lobo.

Investigation: Katie Ridsdale, Kajal Khurana, Azizat Temidayo Taslim, Jessica K. Robinson, Faith Solanke, Wei Shao Tung, Elena Sheldon, Daniel Hind.

Project administration: Katie Ridsdale, Kajal Khurana, Daniel Hind.

Supervision: Katie Ridsdale, Elena Sheldon, Daniel Hind, Alan J. Lobo.

Visualization: Katie Ridsdale.

Writing – original draft: Katie Ridsdale, Kajal Khurana.

Writing – review & editing: Katie Ridsdale, Kajal Khurana, Azizat Temidayo Taslim, Jessica K. Robinson, Faith Solanke, Wei Shao Tung, Elena Sheldon, Daniel Hind, Alan J. Lobo.

References

1. Hazel K, O'Connor A. Emerging treatments for inflammatory bowel disease. *Ther Adv Chronic Dis*. 2020; 11. <https://doi.org/10.1177/2040622319899297> PMID: 32076497
2. Alatab S, Sepanlou SG, Ikuta K, Vahedi H, Bisignano C, Safiri S, et al. The global, regional, and national burden of inflammatory bowel disease in 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet Gastroenterol Hepatol*. 2020; 5(1):17–30. [https://doi.org/10.1016/S2468-1253\(19\)30333-4](https://doi.org/10.1016/S2468-1253(19)30333-4) PMID: 31648971
3. Linschoten RCA, Visser E, Niehot CD, Woude CJ, Hazelzet JA, Noord D, et al. Systematic review: societal cost of illness of inflammatory bowel disease is increasing due to biologics and varies between continents. *Aliment Pharmacol Ther*. 2021; 54(3):234–48. <https://doi.org/10.1111/apt.16445> PMID: 34114667
4. IBD Standards. IBD UK [Internet]. [cited 2022 Aug 17]; Available from: <https://ibduk.org/ibd-standards>
5. Narula N, Dhillon AS, Chauhan U, Marshall JK. An Audit of Influenza Vaccination Status in Adults with Inflammatory Bowel Disease. *Can J Gastroenterol*. 2012; 26(9):593–6. <https://doi.org/10.1155/2012/158362> PMID: 22993728
6. Vermeire S, Van Assche G, Rutgeerts P. Vaccination and infection prevention in inflammatory bowel disease. *F1000 Med Rep*. 2010; 2:80. <https://doi.org/10.3410/M2-80> PMID: 21170370
7. Wasan SK, Calderwood AH, Long MD, Kappelman MD, Sandler RS, Farraye FA. Immunization Rates and Vaccine Beliefs Among Patients with Inflammatory Bowel Disease: An Opportunity for Improvement. *Inflamm Bowel Dis*. 2014; 20(2):246–50. <https://doi.org/10.1097/01.MIB.0000437737.68841.87> PMID: 24374881
8. Fan E, Laupacis A, Pronovost PJ, Guyatt GH, Needham DM. How to use an article about quality improvement. *JAMA*. 2010; 304(20):2279–87. <https://doi.org/10.1001/jama.2010.1692> PMID: 21098772
9. Berwick DM. A User's Manual For The IOM's 'Quality Chasm' Report. *Health Aff (Millwood)*. 2002; 21(3):80–90. <https://doi.org/10.1377/hlthaff.21.3.80> PMID: 12026006
10. Dixon-Woods M. How to improve healthcare improvement—an essay by Mary Dixon-Woods. *BMJ*. 2019; i5514. <https://doi.org/10.1136/bmj.i5514> PMID: 31575526
11. Grimshaw J. Systematic reviews of the effectiveness of quality improvement strategies and programmes. *Qual Saf Health Care*. 2003; 12(4):298–303. <https://doi.org/10.1136/qhc.12.4.298> PMID: 12897365
12. Fudman D.I., Perez-Reyes A.E., Niccum B.A., Melmed G.Y., Khalili H. Interventions to Decrease Unplanned Healthcare Utilization and Improve Quality of Care in Adults With Inflammatory Bowel Disease: A Systematic Review. *Clin Gastroenterol Hepatol*. 2021; 20(9). <https://doi.org/10.1016/j.cgh.2021.08.048> PMID: 34481951
13. Khalil H, Tricco AC. Differentiating between mapping reviews and scoping reviews in the evidence synthesis ecosystem. *J Clin Epidemiol*. 2022; 149:175–82. <https://doi.org/10.1016/j.jclinepi.2022.05.012> PMID: 35636593
14. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. *Syst Rev*. 5(1):210. <https://doi.org/10.1186/s13643-016-0384-4> PMID: 27919275
15. Hempel S, Shekelle PG, Liu JL, Danz MS, Foy R, Lim YW, et al. Development of the Quality Improvement Minimum Quality Criteria Set (QI-MQCS): a tool for critical appraisal of quality improvement intervention publications. *BMJ Qual Saf*. 2015; 24(12):796–804. <https://doi.org/10.1136/bmjqs-2014-003151> PMID: 26311020
16. Battat R, Galati JS, Lukin D, Chabouni F, Sockolow R, Carter J, et al. A Quality Improvement Initiative Is Associated With Reduced Time to Administer Biologics and Small Molecules and Emergency Room Visits in Inflammatory Bowel Disease. *J Clin Gastroenterol*. 2022; 56(3):e176–82. <https://doi.org/10.1097/MCG.0000000000001535> PMID: 35180182
17. Benjamin L, Gianelis K. Using American College of Gastroenterology Guidelines to provide effective health maintenance for patients with inflammatory bowel disease. *J Am Assoc NURSE Pract*. 2023 Jan; 35(1):86–92. <https://doi.org/10.1097/JXX.0000000000000798> PMID: 36525528
18. Bensinger A, Wilson F, Green P, Bloomfield R, Dharod A. Sustained Improvement in Inflammatory Bowel Disease Quality Measures Using an Electronic Health Record Intervention. *Appl Clin Inform*. 2019; 10(05):918–26. <https://doi.org/10.1055/s-0039-3400293> PMID: 31801173
19. Breton J, Witmer CM, Zhang Y, Downing M, Stevenson J, McDermott J, et al. Utilization of an Electronic Medical Record-integrated Dashboard Improves Identification and Treatment of Anemia and Iron Deficiency in Pediatric Inflammatory Bowel Disease. *Inflamm Bowel Dis*. 2021; 27(9):1409–17. <https://doi.org/10.1093/ibd/izaa288> PMID: 33165613

20. Choe MY, VanGraafeiland B, Parian A. Improving Follow-ups With Gastroenterologists Utilizing an Appointment Scheduling Protocol in Inflammatory Bowel Disease: A Quality Improvement Project. *Gastroenterol Nurs*. 2021; 44(5):E91–100. <https://doi.org/10.1097/SGA.0000000000000635> PMID: 34411015
21. Dykes DMH, Jean MR, Morgan P, Hill D, Williams E, Opipari-Arigan L, et al. Improving health maintenance supervision in a paediatric IBD clinic. *BMJ Open Qual*. 2017; 6(2):e000012. <https://doi.org/10.1136/bmjopen-2017-000012> PMID: 28959775
22. El-Matary W, Dufault B. Quality improvement in paediatric inflammatory bowel disease: the Manitoba experience. *Acta Paediatr*. 2016; 105(9):e440–2. <https://doi.org/10.1111/apa.13490> PMID: 27240726
23. Ewelukwa O, Perez R, Carter LE, Fernandez A, Glover S. Incorporation of Scribes Into the Inflammatory Bowel Disease Clinic Improves Quality of Care and Physician Productivity. *Inflamm Bowel Dis*. 2018; 24(3):552–7. <https://doi.org/10.1093/ibd/izx078> PMID: 29462396
24. Fofaria RK, Barber S, Adeleke Y, Woodcock T, Kamperidis N, Mohamed A, et al. Stratification of inflammatory bowel disease outpatients by disease activity and risk of complications to guide out-of-hospital monitoring: a patient-centred quality improvement project. *BMJ Open Qual*. 2019; 8(3):e000546. <https://doi.org/10.1136/bmjopen-2018-000546> PMID: 31428704
25. Greene L, Sapir T, Moreo K, Carter JD, Patel B, Higgins PDR. Impact of Quality Improvement Educational Interventions on Documented Adherence to Quality Measures for Adults with Crohn's Disease. *Inflamm Bowel Dis*. 2015; 21(9):2165–71.
26. Greene L, Moreo K. Quality improvement education to improve performance on ulcerative colitis quality measures and care processes aligned with National Quality Strategy priorities. *BMJ Qual Improv Rep*. 2015; 4(1):u208829.w3554. <https://doi.org/10.1136/bmjquality.u208829.w3554> PMID: 26732044
27. Gold S, Kohler D, Philippou A, Rabinowitz L, Manning L, Keefer L, et al. Feasibility and impact of a quality improvement initiative to screen for malnutrition in an Inflammatory Bowel Disease clinic. *Clin Nutr ESPEN*. 2022 Dec; 52:371–6. <https://doi.org/10.1016/j.clnesp.2022.09.019> PMID: 36513478
28. Guido AJ, Crandall W, Homan E, Dotson J, Maltz RM, Donegan A, et al. Improving Post-induction Anti-tumor Necrosis Factor Therapeutic Drug Monitoring in Pediatric Inflammatory Bowel Disease. *J Pediatr Gastroenterol Nutr*. 2020; 70(1):48–54. <https://doi.org/10.1097/MPG.0000000000002486> PMID: 31503216
29. Gupta SR, Crandall WV, Donegan A, Johnson M, Drobnic B, Oates M, et al. A Quality Improvement Approach to External Infliximab Infusions in Pediatric Inflammatory Bowel Disease. *J Pediatr Gastroenterol Nutr*. 69(5):544–50. <https://doi.org/10.1097/MPG.0000000000002422> PMID: 31219936
30. Hellmann J, Etter RK, Denson LA, Minar P, Hill D, Dykes DM, et al. Quality Improvement Methodology Optimizes Infliximab Levels in Pediatric Patients with Inflammatory Bowel Disease. *Pediatr Qual Saf*. 2021; 6(3):e400. <https://doi.org/10.1097/pq9.0000000000000400> PMID: 33977189
31. Jackson B, Begun J, Gray K, Churilov L, Liew D, Knowles S, et al. Clinical decision support improves quality of care in patients with ulcerative colitis. *Aliment Pharmacol Ther*. 2019; 49(8):1040–51. <https://doi.org/10.1111/apt.15209> PMID: 30847962
32. Kaimakliotis P, Ramadugu A, Kang J, McGorisk T, Polick A, Votta-Velis E, et al. Targeted housestaff intervention reduces opioid use without worsening patient-reported pain scores and improves outcomes among patients with IBD: the "IBD pain ladder". *Int J Colorectal Dis*. 2021; 36(6):1193–200.
33. Kelly MM, Turner BS, Kappelman MD, Lee EJ, Gulati AS. Implementation and Evaluation of a Standard Operating Procedure for Pediatric Infliximab Infusions. *Pediatr Qual Saf*. 2019; 4(1):e137. <https://doi.org/10.1097/pq9.0000000000000137> PMID: 30937417
34. Kozlicki M, Lynch B, Donoho T, Nichols P, Zuckerman AD. Development and implementation of a laboratory monitoring dashboard to reduce treatment gaps in inflammatory bowel disease. *Am J Health-Syst Pharm AJHP Off J Am Soc Health-Syst Pharm*. 2023; 80(Supplement_2):S55–61. <https://doi.org/10.1093/ajhp/zxac354> PMID: 36434785
35. Lambi BB, Altamimi S, Kaufman NE, Rein MS, Freeley M, Duram M, et al. Leveraging Quality Improvement Science to Reduce C. difficile Infections in a Community Hospital. *Jt Comm J Qual Patient Saf*. 2019; 45(4):285–94. <https://doi.org/10.1016/j.jcjq.2018.10.006> PMID: 30527394
36. McNicol M, Donegan A, Hawa K, Boutzoukas A, Drobnic B, Oates M, et al. Improving Hepatitis B Vaccination Rates among At-risk Children and Adolescents with Inflammatory Bowel Disease. *Pediatr Qual Saf*. 2022 Jul; 7(4).
37. Melmed GY, Oliver B, Hou JK, Lum D, Singh S, Crate D, et al. Quality of Care Program Reduces Unplanned Health Care Utilization in Patients With Inflammatory Bowel Disease. *Am J Gastroenterol*. 2021; 116(12):2410–8. <https://doi.org/10.14309/ajg.0000000000001547> PMID: 34797226
38. Morris GA, McNicol M, Boyle B, Donegan A, Dotson J, Michel HK, et al. Increasing Biosimilar Utilization at a Pediatric Inflammatory Bowel Disease Center and Associated Cost Savings: Show Me the Money. *Inflamm Bowel Dis*. 2022; 28(4):531–8. <https://doi.org/10.1093/ibd/izab110> PMID: 34037215

39. Ong W.C., Lim M.S., Chan E., Lim T.C.T., Lim T.G., Chan W. A quality improvement project reduces time spent at an inflammatory bowel disease infusion center with accelerated infliximab infusion protocol. *JGH Open*. 2022; 6(7):470–6. <https://doi.org/10.1002/jgh3.12776> PMID: 35822121
40. Parker S, Chambers White L, Spangler C, Rosenblum J, Sweeney S, Homan E, et al. A Quality Improvement Project Significantly Increased the Vaccination Rate for Immunosuppressed Patients with IBD: *Inflamm Bowel Dis*. 2013; 19(9):1809–14.
41. Prendaj E, Thomas S, Tomer G. Population Management: A Tool to Improve Timely Care in Pediatric and Young Adult Patients with Inflammatory Bowel Disease. *Gastroenterol Res Pract*. 2019; 2019:1–7. <https://doi.org/10.1155/2019/4702969> PMID: 31396273
42. Sandberg KC, Lucien JN, Stoll D, Yanney E, Mezoff A. Decreasing Door-to-Door Times for Infliximab Infusions in a Children's Hospital Observation Unit. *Pediatr Qual Saf*. 2019; 4(1):e131. <https://doi.org/10.1097/pq9.000000000000131> PMID: 30937413
43. Savarino JR, Kaplan JL, Winter HS, Moran CJ, Israel EJ. Improving Clinical Remission Rates in Pediatric Inflammatory Bowel Disease with Previsit Planning. *BMJ Qual Improv Rep*. 2016; 5(1):1–5. <https://doi.org/10.1136/bmjquality.u211063.w4361> PMID: 27559471
44. Selinger CP, Parkes GC, Bassi A, Limdi JK, Ludlow H, Patel P, et al. Assessment of steroid use as a key performance indicator in inflammatory bowel disease—analysis of data from 2385 UK patients. *Aliment Pharmacol Ther*. 2019; 50(9):1009–18. <https://doi.org/10.1111/apt.15497> PMID: 31595533
45. Shah-Khan SM, Cumberledge J, Shah-Khan SM, Gannon K, Kupec JT. Improving bone mineral density screening in patients with inflammatory bowel disease: a quality improvement report. *BMJ Open Qual*. 2019; 8(3):e000624. <https://doi.org/10.1136/bmjopen-2019-000624> PMID: 31523738
46. Shaikhkhalil AK, Boyle B, Smith J, Dotson JL, Donegan A, Kim SC, et al. Using Quality Improvement to Increase Utilization of Enteral Therapy in Pediatric Crohn Disease: Results and Outcomes. *J Pediatr Gastroenterol Nutr*. 2018; 66(6):909–14.
47. Shores D, Wilson L, Oliva-Hemker M. Utilizing Information Technology to Improve Influenza Vaccination in Pediatric Patients With Inflammatory Bowel Disease. *Gastroenterol Nurs*. 2019; 42(4):370–4.
48. Smith J, Jacobson-Kelly A, Donegan A, Boyle B, Maltz R, Michel H, et al. Diagnosis and Treatment of Iron Deficiency and Anemia in Youth With Inflammatory Bowel Disease. *J Pediatr Gastroenterol Nutr*. 2023 Mar; 76(3):313–8. <https://doi.org/10.1097/MPG.0000000000003673> PMID: 36730097
49. Weizman AV, Bressler B, Seow CH, Afif W, Afzal NM, Targownik L, et al. Providing Hospitalized Ulcerative Colitis Patients With Practice Guidelines Improves Patient-Reported Outcomes. *J Can Assoc Gastroenterol*. 2021; 4(3):131–6. <https://doi.org/10.1093/jcag/gwaa019> PMID: 34061122
50. Yogev D, Shosberger A, Nehemia C, Harel S, Yerushalmy-Feler A, Ledder O, et al. Monitoring Enables Progress: A Nationwide Quality Improvement Program in Children With Crohn's Disease. *J Pediatr Gastroenterol Nutr*. 2021; 73(2).
51. Aslam S, Abraham J, Bradley G. Improving utilization of proactive anti-TNF therapeutic drug monitoring: a quality improvement initiative. *J Pediatr Gastroenterol Nutr*. 2019; 69(Sup 2).
52. Axelrad JE, Shah BJ. Clostridium difficile Infection in Inflammatory Bowel Disease: A Nursing-Based Quality Improvement Strategy. *J Healthc Qual Off Publ Natl Assoc Healthc Qual*. 38(5):283–9. <https://doi.org/10.1097/JHQ.000000000000002> PMID: 26042744
53. Ayers M, Mahajan L, Anani A, Collyer E. Immunization rates for PPSV23 (Pneumovax) in immunocompromized pediatric patients with inflammatory bowel disease: room for improvement. *J Pediatr Gastroenterol Nutr*. 2016; 63:Sup 2.
54. Bauman L, Hemperly A, Choi L, Yu E, Nidhi G, Kumar S, et al. Improving transition service delivery to adolescents and young adults with inflammatory bowel disease at an academic medical center. *J Pediatr Gastroenterol Nutr*. 2021; 73(S1):S81–3.
55. Beard JI, Kahloon A. Slowly but Surely: One Clinic's Path to Improvement in the Health Maintenance Quality Measures of the Inflammatory Bowel Disease Population. *Off J Am Coll Gastroenterol ACG*. 2020; 115:S407.
56. Berinstein J, Greenberg G, Cohen-Mekelburg S, Higgins PD. Clinical coordination and intense proactive monitoring to improve utilization of resources and reduce expenditures in high-risk IBD patients (CAPTURE IBD): A randomized, controlled quality improvement trial. *Gastroenterology*. 2021; 160(6):S-156-S-157.
57. Bhesania N, Mahajan L, Cohen M, Kaplan B. Improving influenza vaccination rate in patients with inflammatory bowel disease on adalimumab: A quality improvement project. *J Pediatr Gastroenterol Nutr*. 2019; 69(Sup 2).
58. Bledsoe AC, Quinn K, Genere JR, Hansel SL, Raffals LH, Kane SV. Improving venous thromboembolism prophylaxis in patients hospitalized with inflammatory bowel disease: A quality improvement initiative. *Gastroenterology*. 2020; 158(6):S–108.

59. Bond A, Davies K, Stansfield C, Owen K, Lal S, Soop M. Optimisation of patients prior to IBD related resection using a quality improvement methodology. *Gut*. 2018; 67(Sup 1):A231–A231.
60. Budhathoki R, Forges-Voigt C, Sosa M, Langshaw A. Improving compliance to important laboratory work during biologic infusion: A quality improvement project. *J Pediatr Gastroenterol Nutr*. 2021; 73:S91–2.
61. Casini R, Blaufuss T, Reddy M. Endoscopic scoring to assist in the management of pediatric inflammatory disease. *J Pediatr Gastroenterol Nutr*. 2017; 65(2):S1–359.
62. Caudle D, Yarger E, Abernathy LY, Sandberg K. Diagnosis to treatment of inflammatory bowel disease. *J Pediatr Gastroenterol Nutr*. 2019; 69(Sup 2).
63. Chadokufa S, Huggett B, Kiparissi F, Terry S, Shah N, Lindley K, et al. ImproveCareNow (ICN) as a quality improvement (QI) tool in a paediatric inflammatory bowel disease (pIBD). *J Crohns Colitis*. 2014; 8:S405.
64. Cheng T, Kreitman K, Stowe C, Waters B, Baidoo L. Improving the vaccination rates for immunosuppressed patients with inflammatory bowel disease. *Gastroenterology*. 2022; 162(3):S84–5.
65. Cho J, Feder R, Rowan K, Chancay M, Fazzari M. Educational Value of an IBD Inpatient Order Set. *Am J Gastroenterol*. 2016; 111(Sup 1):S330–1.
66. Coenen S, Weyts E, Vermeire S, Ferrante M, Noman M, Ballet V, et al. Effects of introduction of an inflammatory bowel diseases nurse position on the quality of delivered care. *J Crohns Colitis*. 2016; 10(Sup 1):S497–8.
67. Crandall W, Kappelman M, Colletti RB, Denson L, Duffy LF, Grunow J, et al. Improved Outcomes in a Quality Improvement Collaborative for Pediatric Ulcerative Colitis. *Gastroenterology*. 2010; 138(5):S–29.
68. Danielewicz M, Shah SA. Enhancing Access to Urgent Care in IBD in a Community Practice: 672. *Am J Gastroenterol*. 2017; 112:S374.
69. Dolan C, Mudarri S, Hirsch R, Jonas M, Dybowski S, Arnold J, et al. Improving multidisciplinary education for patients with newly diagnosed inflammatory bowel disease (IBD). *J Pediatr Gastroenterol Nutr*. 2021; 73:S340–1.
70. Duckworth L., Molleston J., Tica S., Davis T., Saini S., Samson C. A quality improvement project to prevent venous thromboembolic events in inflammatory bowel disease. *J Pediatr Gastroenterol Nutr*. 2022; 75(Supplement 1):S233–4.
71. Fritz, Julia, Cabrera, Jose, Walia, Cassandra. Improving nutritional surveillance and supplementation in children with inflammatory bowel disease. *J Pediatr Gastroenterol Nutr*. 2016;63(2):S1–415.
72. Gleeson S., Buckley P.M., McCarthy D.J., Sugrue K., O'Grady D.J., O'Sullivan C., et al. Development and introduction of a pre-clinic screening, triage system and virtual consultations for patients with Inflammatory Bowel Disease: A nurse led quality improvement project (QIP). *J Crohns Colitis*. 2023; 17(Supplement 1):i1046–7.
73. Goldstein RS, Bhatt A. Increasing Herpes Zoster Vaccination Rates in a High Risk IBD Population. *Gastroenterology*. 2021; 160(6):S–86.
74. Gorti H, Shelnut D, Prasad M. Improving Vaccination Rates in Patients With Inflammatory Bowel Disease. *Off J Am Coll Gastroenterol ACG*. 2020; 115:S636.
75. Hans AK, Farino V, Nwafor B, Laisamma J, Prasad M. A Quality Improvement Project to Improve Lab Safety Monitoring in IBD Patients on Immunomodulators Using the Veterans Affairs IBD Dashboard and a Multidisciplinary Team. *Am J Gastroenterol*. 2021; 116(Sup 1):S458.
76. Hasan F., Pryce K., Puopolo G., Fiori K., Tomer G. Screening for social determinants of health in paediatric patients with inflammatory bowel disease in the outpatient setting: a quality improvement initiative. *J Pediatr Gastroenterol Nutr*. 2022; 75(Supplement 1):S80.
77. Huggett B, Chadokufa S, Lindley K, Shah N, Kiparissi F, Elawad M, et al. Improvement of patient's disease activity in paediatric inflammatory disease (pIBD) after adoption of Improve Care Now (ICN) quality improvement (QI) tool. *J Crohns Colitis*. 2014; 8(Sup 2):S415–6.
78. Hyams K., Kennedy J., Green C., Mattoo S. A simple tool improves adherence to bone protection guidelines for inflammatory bowel disease. *Gut*. 2022; 71(Supplement 1):A49–50.
79. Iqbal Sara, Paine Elizabeth. Immunization Rates in Inflammatory Bowel Disease Patients at the G.V. (Sonny) Montgomery VA Medical Center. *Am J Gastroenterol*. 2019; 114(1):S1589–S1589.
80. Juakiem W, Gancayco J. Impact of Quality Improvement Interventions on Adherence to Quality Measures for Adults With Inflammatory Bowel Disease. *Gastroenterology*. 2018; 155(1):e41–2.
81. Keith C, Kuo HC, Knight T, Maclin J, Jester T. Use of Quality Improvement Process to Increase Influenza Vaccination in Pediatric Inflammatory Bowel Disease Patients. *Gastroenterology*. 2018; 154(1):S65.

82. Koumoutsos I, Kotha S, Warner B, Berry P. Setting up an integrated service for PSC-IBD patients: a quality improvement project. *Gastroenterol Serv*. 2018; 67(Sup 1):A245–6.
83. Levine AE, Chi LY, Sobczyk P, Bousvaros A, Trenor CC, Zitomersky N. Risk Stratification to Increase Venous Thromboembolism Prophylaxis in Pediatric Inflammatory Bowel Disease. *Gastroenterology*. 2019; 156(3):S50–1.
84. Lee Ann, Eid Emely. Providing fellows-in-training with education on inflammatory bowel disease health maintenance to improve the quality of care in our healthcare system. *Am J Gastroenterol*. 2014; 109 (Sup 2).
85. Lendner N., Perry S., Moses J., Sferra T., Young D. Standardizing steroid weaning protocols for patients with inflammatory bowel disease. *J Pediatr Gastroenterol Nutr*. 2022; 75(Supplement 1): S419–20.
86. Lin V, Gogenur S, Pachler F, Fransgaard T, Gogenur I. Risk Prediction for Complications in Inflammatory Bowel Disease Surgery: External Validation of the American College of Surgeons' National Surgical Quality Improvement Program Surgical Risk Calculator. *J Crohns Colitis*. 2023; 17(1):73–82. <https://doi.org/10.1093/ecco-jcc/ijac114> PMID: 35973971
87. Maisa Abdalla, Jennifer Lewis, Ashok Shah, Lawrence Saubermann, Thomas Werth, Arthur DeCross. The Performance of an Electronic Interactive Flow Sheet to Improve Preventive Health Care in Inflammatory Bowel Disease Patients. *Inflamm Bowel Dis*. 2014; 20(Sup1):S57–9.
88. Mansoor S, Costantino J, Molle-Rios Z. Development of Care Pathway for Initiation of Enteral Nutrition Therapy for Pediatric Crohns Disease-Single Center Quality Improvement Initiative. *Inflamm Bowel Dis*. 2017; 23(1):S74–5.
89. Mathew J, Thomas S, Samaha R, Prendaj E, Tomer G. The Influenza Vaccination and Pediatric Inflammatory Bowel Disease. *Gastroenterology*. 2019; 156(6):S–616.
90. McConnell RA, Patel R, Sharpton SR, Velayos F, Mahadevan U. Improving the Quality of Inpatient Ulcerative Colitis Management: Promoting Evidence-Based Practice and Reducing Care Variation. *Gastroenterology*. 2017; 152(5):S90–1.
91. Morency P., Bowditch S., Pawar A., Say D. Developing screening guidelines for thromboembolism prophylaxis in children with inflammatory bowel disease. *J Pediatr Gastroenterol Nutr*. 2022; 75(Supplement 1):S74–5.
92. Navarro F., Rivera J., Turner D. Reliable data collection for quality improvement in children with inflammatory bowel disease. Small academic centre experience. *J Pediatr Gastroenterol Nutr*. 2022; 75 (Supplement 1):S80–1.
93. Pasquarella C, Frawley J, Raig K, Selvakumar PKC, Mahajan L. Naspghan nutrition prize quality improvement in pediatric inflammatory bowel disease: A successful strategy to improve disease-specific knowledge in patients and parents. *J Pediatr Gastroenterol Nutr*. 2017; 65(Sup 2):S210–1.
94. Patel N, Ali S, Burgis J, Stekol E, Isman C, Rodriguez L, et al. Approaching obesity in pediatric inflammatory bowel disease: a quality improvement initiative. *J Pediatr Gastroenterol Nutr*. 2021; 73:s416–7.
95. Penninti Pranav, Patel Chirag, Coss Elizabeth. Improving inflammatory bowel disease care: A quality improvement project for venous thromboembolism prophylaxis. *Am J Gastroenterol*. 2019; 114.
96. Perlman M, Elmaoued R, Ganguli K, Israel E. Quality improvement: Using the PUCAI in the care of pediatric patients hospitalized with ulcerative colitis. *J Pediatr Gastroenterol Nutr*. 2019; 69(Sup 2).
97. Prendaj E, Thompson J, Tomer G. Improving Screening of Vitamin D Status in Pediatric Inflammatory Bowel Disease Patients. *Gastroenterology*. 2017; 152(5):S435.
98. Raj Priya, Ivanhoe Lauren, Zbranek Madilyn, Fegan-Bohm Kelly. Implementing annual depression screening for adolescents with IBD using the PHQ-9A tool. *J Pediatr Gastroenterol Nutr*. 69(Sup 2):2019.
99. Reich J, Zanchetti D, Wasan S, Miller H, Noronha A, Ardagna E, et al. A Quality Improvement Intervention Significantly Improved Influenza and Pneumococcal Vaccination Rates in Patients With Inflammatory Bowel Disease (IBD): 2206. *Off J Am Coll Gastroenterol*. 2014; 109:S640.
100. Rudra S, Grossman A, Downing M, Hillman J, Ashcroft K, Puma A, et al. Improving Influenza Vaccination in Pediatric Inflammatory Bowel Disease: A Quality Improvement Initiative. *Gastroenterology*. 2021; 161(1):e32.
101. Saffouri G, Weber N, Singh S, Pardi D, Loftus EV, Kane S. Screening for bone health in patients with inflammatory bowel disease: A quality improvement project through point-of-care informational patient handouts. *Am J Gastroenterol*. 2015; 110(Sup 1):S821.
102. Salem G, Ali IA, Grossen A, Bitar H, Kastens D. Bridges to Excellence (BTE) Quality Indicators in Inflammatory Bowel Disease (IBD) in Gastroenterology Fellows' Clinic at the University of Oklahoma Health Sciences Center: A Quality Improvement Project. *Gastroenterology*. 2020; 158(6):S-105-S-106.

103. Scherl EJ, Fajardo KI, Simone L, Carter J, Sapir T, Yang, Stevie, et al. A quality improvement initiative to reduce insurance-related delays in patient access to biologic therapies for inflammatory bowel disease. *Am J Gastroenterol*. 2019; 114:S374–5.
104. Shakweh Eathar, Middleton Paul, Ahmad Omer, Dart Robin, McGuire Joshua, Kader Rawen, et al. An intervention bundle leads to quality improvement in endoscopic reporting of ulcerative colitis. *Gut*. 2021; 70(Sup 1):A119–20.
105. Singh A., Midha V., Mahajan R., Verma S., Kakkar C., Grover J., et al. Evaluation of Nutritional Characteristics Reveals Similar Prevalence of Malnutrition in Patients with Ulcerative Colitis and Crohn's Disease. *Dig Dis Sci*. 2023; 68(2):580–95. <https://doi.org/10.1007/s10620-022-07652-z> PMID: 36064826
106. Smith CF, Lunn H, Wong G, Nicholson BD. Optimising GPs' communication of advice to facilitate patients' self-care and prompt follow-up when the diagnosis is uncertain: a realist review of 'safety-netting' in primary care. *BMJ Qual Saf*. 2021; 31(7):541–54.
107. Subramanian S.K., Thomas A.R., Ramani A., Tsen A., Wadhwa V., Bhatt A., et al. Bone health monitoring and management in inflammatory bowel disease patients in the gastroenterology specialty clinic. *Gastroenterology*. 2022; 162(7 Supplement):S–115.
108. Sussman L., Merdan O., Qualia C. Improving outcomes for pediatric patients with inflammatory bowel disease receiving biologic agents. *J Pediatr Gastroenterol Nutr*. 2022; 75(Supplement 1):S235.
109. Tse CS, Elfanagely Y, Tanzer JR, Manudhane A, Rupawala A, Fine SD. Reduction of Chronic Steroid Use in Patients Discharged for Inflammatory Bowel Disease Flares: A 28-Month Quality Improvement Study. *Gastroenterology*. 2021; 161(1):e33.
110. Ta A, Etter R, Berkly S, Enderle L, Farrell P, Colman R, et al. Humira level 8 looking great: A quality improvement study on optimizing therapeutic drug monitoring for patients with IBD on treatment with adalimumab (Humira). *J Pediatr Gastroenterol Nutr*. 2021; 73:S414–5.
111. Talmadge C, Lewis G, Gold B, Gomez S, Reed B, Dykes D. Depression Screening in a Pediatric IBD Center. *Gastroenterology*. 2020; 158(3):S101.
112. Turner D, Nehemia C, Yerushalmy-Feler A, Assa A, Slae M, Kori M, et al. A nationwide quality improvement program in children with Crohn's disease improves outcomes within 12 months. *J Crohns Colitis*. 2019; 13(Sup 1):S361.
113. Viganò C, Meucci G, Saibeni S, Cortelezzi CC, Amato A. Quality in IBD Care: Measure, Educate and Improve. A Real-Life Survey. *Gastroenterology*. 2016; 150(4):S800.
114. Walker T, Thomas A, Wade FG, Jacques J, Ciorba MA, Deepak P, et al. Enhancing Utilization of Therapeutic Drug Monitoring in Inflammatory Bowel Disease Correlates with Improved Outcomes. *Gastroenterology*. 2019; 156(6):S-1140-S-1141.
115. Walker T, Thomas A, Cushing K, Bennett M, Badillo R, Sayuk G, et al. Improving Vaccination Adherence in Inflammatory Bowel Diseases. *Gastroenterology*. 2019; 157(1):e35.
116. Tricco A C., Lillie E, Zarin W, K. O'Brien K, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med*. 2018;467–73. <https://doi.org/10.7326/M18-0850> PMID: 30178033
117. Mant J, Hicks N. Detecting differences in quality of care: the sensitivity of measures of process and outcome in treating acute myocardial infarction. *BMJ*. 1995 Sep 23; 311(7008):793–6. <https://doi.org/10.1136/bmj.311.7008.793> PMID: 7580444
118. Weissman S, Goldowsky A, Mehta TI, Sciarra MA, Feuerstein JD. Are Quality Metrics in Inflammatory Bowel Disease Rooted in Substantial Quality Evidence? A Systematic Review. *J Crohns Colitis*. 2021; 15(2):326–34.
119. Ogrinc G, Mooney SE, Estrada C, Foster T, Goldmann D, Hall LW, et al. The SQUIRE (Standards for Quality Improvement Reporting Excellence) guidelines for quality improvement reporting: explanation and elaboration. *Qual Saf Health Care*. 2008; 17(Sup 1):i13–32. <https://doi.org/10.1136/qshc.2008.029058> PMID: 18836062
120. Fiorino G, Danese S. The new frontier: Certifying quality standards in the inflammatory bowel disease care. *United Eur Gastroenterol J*. 2021; 9(7):745–7.