REVIEWS

Effect of educational interventions on inpatient bowel preparation: A systematic review

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Received: May 10, 2022 **Accepted:** August 31, 2022 **Online Published:** March 8, 2023
DOI: 10.5430/jnep.v13n6p33 **URL:** https://doi.org/10.5430/jnep.v13n6p33

ABSTRACT

Colonoscopy is effective in screening for colorectal cancer and diagnosis of gastrointestinal disease. However, the efficacy of colonoscopy is highly dependent on the quality of bowel preparation. Inadequate bowel preparation may result in incomplete colonoscopy, increasing the patient's risk for missed adenomas, repeated procedures, increased cost, and adverse events. Educational interventions have been utilized to improve the quality of bowel preparation, however, a gap in the literature still exists on the most effective type of educational intervention. This literature review aims to examine research studies on the effect of various educational interventions in improving the quality of bowel preparation for inpatients undergoing colonoscopy. A database search was performed using the Preferred Reporting Items for Systematic Reviews and Meta-analysis methodology. The initial search of the databases and other sources identified 92 research studies. The Critical Appraisal Skills Program for qualitative studies checklist was utilized to appraise and summarize the literature selected for final review. After screening and consideration of eligibility criteria, six studies were included in the final review. The most effective educational approach to improve the quality of inpatient bowel preparation was using a smartphone application offering text, visual images, and video for instructions, followed by utilizing an educational booklet about colonoscopy. The studies that did not involve nurses during patient education showed no significant effect.

Key Words: Colonoscopy, Inpatient, Bowel preparation, Patient education

1. INTRODUCTION

Colorectal cancer is the third leading cause of cancer-related deaths in the United States.[1] Colonoscopy effectively screens for colorectal cancer and diagnoses gastrointestinal disease.[2] As a preventive procedure, initial screening is recommended at 45 years and above for average-risk individuals.[3] However, the efficacy of colonoscopy is highly dependent on the quality of bowel preparation, a complex procedure requiring adherence to the prescribed diet and timed consumption of bowel preparation.[4]

The rate of successful colonoscopies ranges from 75 to 87%,[5–7] lower than the recommended 90%-95% target by the U.S. Multi-Society Task Force on Colorectal Cancer.[2] Several factors, such as age, race, comorbidities, the timing of the procedure, the type of bowel preparation used, and patient compliance with preprocedural instructions, may influence the quality of bowel preparation.[8,9] Inadequate bowel preparation, defined as the inability to achieve cecal intubation and mucosal visualization, may result in incomplete colonoscopy.[10] Missed adenomas, repeated procedures, increased cost, and increased risk of adverse events have been linked to incomplete colonoscopy.[11,12]

Among hospitalized patients, the rate of adequate bowel preparation is 55% to 75%.[13,14] Inpatient populations,

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particularly older and debilitated individuals or those who have limited time to follow a standard bowel preparation are at a higher risk for poor bowel preparation. Incomplete colonoscopy among inpatients may result in procedure cancellation, or repeated if the patient is symptomatic. The efficacy of various interventions, such as modification in the timing of administration of bowel preparations, utilization of multiple bowel preparations, and educational interventions for physicians, nurses, and patients have been investigated. Past studies have been inconsistent in showing the effectiveness of educational interventions;[15, 16] however, a systematic review and meta-analysis by Gkolfakis et al. on several interventions showed that educational interventions can improve the quality of inpatient bowel preparation.[13]

In the inpatient setting, nurses are always on the front line and often perform patient education on colonoscopy preparation. This literature review aims to examine research studies on the effect of various educational interventions in improving the quality of bowel preparation among inpatients. An overview of educational interventions and their efficacy when utilized as a single intervention combined with other interventions or resources were examined. Themes, limitations, and clinical implications are also discussed.

2. METHODS

The methodology utilized for this systematic review was the Preferred Reporting Items for Systematic Reviews and Meta-analysis [PRISMA] flow diagram and checklist.[17] Data on the type of interventions, educational content, implementation procedure, measures utilized, and efficacy of the educational intervention in improving bowel preparation were extracted and compared. Results of the adequacy of bowel preparation assessments are summarized in Table 1.

2.1 Search strategy

Studies focused on the effects of educational interventions to improve the quality of bowel preparations among inpatients were primarily considered. PubMed, CINAHL, Medline, Scopus, and Cochrane Library searched for relevant studies from 2011 to 2021. The search strategies were designed specifically for each database with assistance from a librarian with expertise in search methodology. Medical subject headings (MeSH) utilized during the search include "colonoscopy," "inpatient," "bowel preparation," and "patient: education."

2.2 Eligibility criteria

The identified literatures were refined using the following inclusion criteria:

1) Published on or after 2011 to capture current practices on patient education related to bowel preparation for inpatient colonoscopy
2) Inpatient participants
3) Patient education as an intervention
4) Done in and outside the United States but written in the English language

Exclusion criteria include:

1) Studies published before 2011
2) Outpatient participants
3) Patient education was not utilized as an intervention
4) Not written in the English language

3. RESULTS

An initial search of the databases identified 92 research studies. After a preliminary review of titles, 71 articles were excluded, including reviews, surveys, duplicates, and studies with interventions focused on bowel preparation, order sets, and predictors of inadequate bowel preparation. A review of abstracts from 21 studies excluded eight more studies, including five utilizing outpatient participants and three using standardized order sets and volume of purgatives as interventions. Thirteen articles were reviewed in full-text form, and seven were excluded because the participants were from an outpatient population. No additional studies were identified that fit the inclusion/exclusion criteria after hand-searching the references of the six full-text articles and after searching for articles that subsequently cited any of the six articles. The Critical Appraisal Skills Program[18] checklist for randomized controlled trials was utilized to validate the basic study design, methodology, and literature results selected for final review. After screening and considering the eligibility criteria, six studies were included in the last review (see Figure 1).

Research selected for this review includes three studies implemented in Asia,[14, 19, 20] two in Europe,[21, 22] and one in North America.[23] All of the studies were quantitative and experimental. Participant characteristics were similar between control and intervention groups within each study. Randomization was noted across studies except for the study by Lee et al.[19] See Table 1 for a detailed description of each study included for review.

3.1 Education as intervention

Educational intervention was noted as the primary intervention across studies. Two studies implemented enhanced nurse education training on bowel preparation.[19, 20] Verbal patient instructions and education were employed in five studies, and participants were allowed to ask questions at the end of the session.[14, 19–22] Written instructions were given to patients in four studies, each utilizing different methods: utilization of

a validated booklet on preparing for colonoscopy,[23] smartphone application,[14] instruction sheet,[22] and visual education flyer with images of adequate bowel preparation.[19] See Table 2 for further details.

3.2 Educational content

Patients across studies consistently presented information about colonoscopy, diet, and bowel preparation regimens. Visual images of diet and coloration of bowel output were provided in a study by Guardiola-Arévalo et al. and Guo et al. The latter also utilized videos on preparing purgatives. Possible adverse events were specified in three studies,[14,19,20] while the rest were not set in the inclusion of information on adverse effects and management (see Table 2).[21–23]

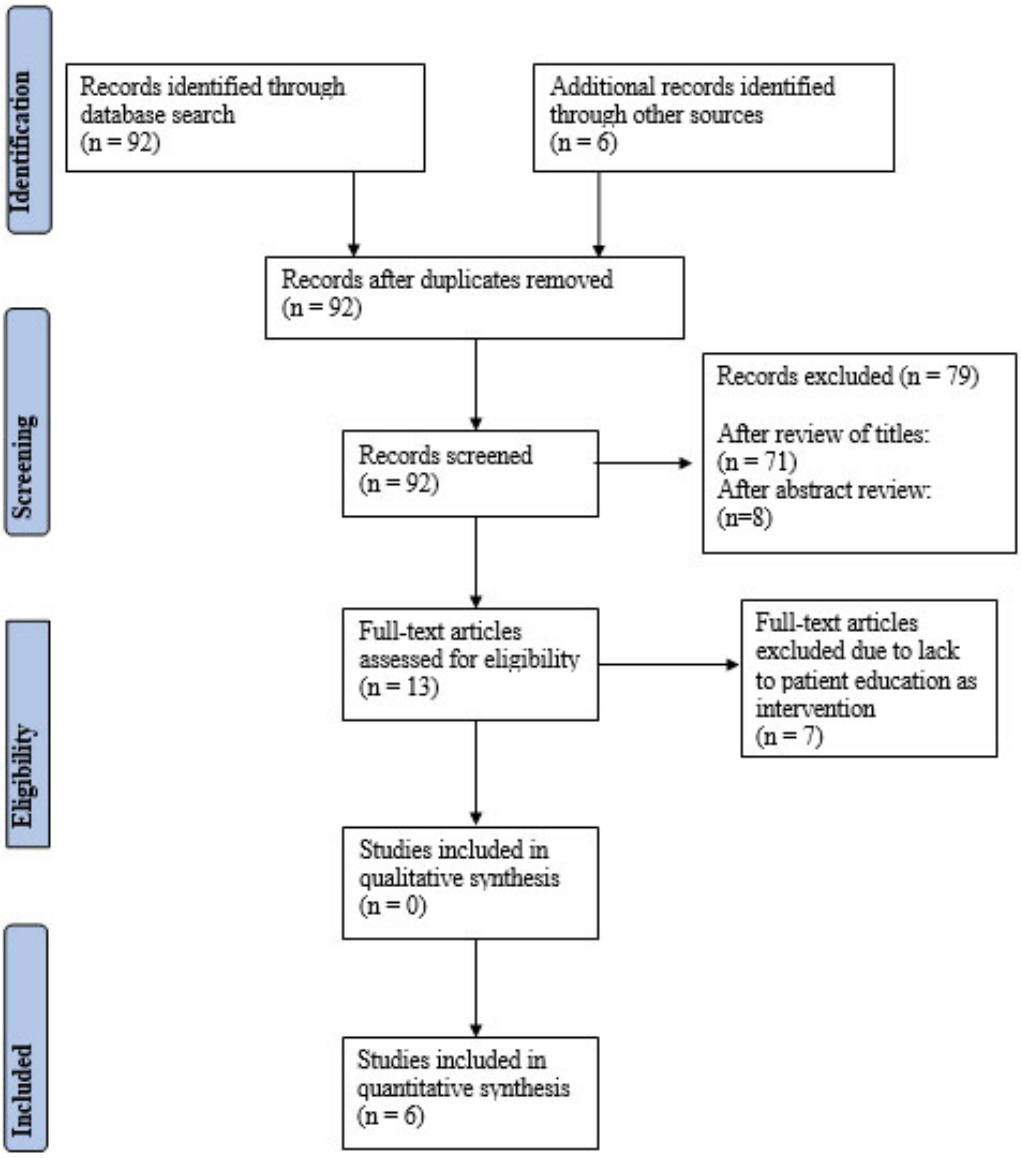

Figure 1. PRISMA flow diagram

3.3 Implementation procedure

There was a wide variation in the time interval between the initiation of educational intervention and schedule of the procedure. Although all the interventions were implemented at least a day before the procedure, Guo et al. provided the patients with a booklet or had patients download a smartphone application at 8 AM of the day before the procedure, Ergen et al. provided patients with information booklets by 6 PM on the evening before the procedure, and Guardiola-Arévalo et al. provided written instructions to patients 48 hours before the procedure.

Table 1. Studies included for review

Article	Date, Location, & Setting	Purpose/Question	Design	Sample Size (Intervention/ Control)	Control Intervention	Treatment Intervention	Control Intervention Given to Treatment Group?	Individual Delivering Patient Education	Findings
Ergen, et.al., (2016)	October 2013 to March 2014; USA; single site	Evaluate the effect of an educational booklet on quality of bowel preparation in a group of hospitalized patients	Randomized controlled trial	45/40	Standard of care (SOC)	Educational booklet	Yes	Booklet provided to patient by nurse	Significant difference in the rate of adequate bowel preparation between intervention and control group (62% vs. 35%, P = .012)
Guardiola-Arevalo, et.al., (2019)	February 2016 to January 2017; Spain; single site	Investigate whether a visual educational leaflet improved the level of cleanliness achieved in hospitalized patients undergoing colonoscopy	Prospective, randomized, endoscopist-blinded study	66/70	Standard of care (SOC)	Visual educational leaflet	Yes	Leaflet provided to patient by researcher	No significant difference in the rate of adequate bowel preparation between intervention and control group (21.4% vs. 27.2%, P = 0.43)
Guo, et.al., (2019)	October 2017-March 2018; China; single site	Explore whether educational information delivered via a medical smartphone app in conjunction with verbal and written instructions, compared with traditional booklet-based and verbal instructions, could improve the quality of bowel preparation for hospitalized patients undergoing colonoscopy	Prospective, single-blinded, randomized controlled trial	145/148	Brochure given the day before procedure and verbal instructions from a nurse	Use of smartphone app to educate patient regarding colonoscopy, bowel preparation, and diet before procedure. Includes images rating bowel preparation and videos on how to prepare purgative.	Yes	Nurse	Significant difference in the rate of adequate bowel preparation between intervention and control group (77.2% vs. 56.8%, P < .001)
Lee, et.al., (2015)	July 2013 to January 2014; Korea; single site	Evaluate the impact of nurse education on the quality of bowel preparation on inpatients	Prospective, double-blinded, non-randomized controlled study	103/102	SOC	Instructions from nurses trained on diet, bowel preparations, BBPS, and possible adverse events from bowel preparation.	Yes	Nurse	Significant lower rate of inadequate bowel preparation between intervention and control group, suggesting better quality of bowel preparation (31.1% vs. 58.8%, P < .001)
Liu, et.al., (2020)	March 2019-March 2020; China; single site	Investigate whether enhanced education of ward nurses could improve bowel preparation quality in inpatients undergoing colonoscopy	Randomized controlled study	89/101	Instructions from a nurse who did not undergo enhanced education.	Instructions from nurses trained on diet, bowel preparations, BBPS, and possible adverse events from bowel preparation.	Yes	Nurse	Average bowel preparation significantly higher in treatment group (83.1% vs. 69.3%, P = .026)
Trianta-fyllou, et.al., (2021)	Greece; Four tertiary centers	Impact of specific verbal instructions on the quality of inpatients bowel preparation and factors associated with preparation failure	Prospective, randomized, single-blinded study	149/151	Standard of care (SOC)	Scripted verbal instructions	Yes	Nurse	No significant difference in the rate of adequate bowel preparation between intervention and control group (69.8% vs. 62.1%, P < .19)

Table 2. Mode of patient education and educational content summary

	Mode of Patient Education				Educational Content				
Study, year	**Verbal**	**Written**	**Visual Images**	**Video**	**Information About Colonoscopy**	**Diet**	**Purgative Regimen**	**Possible Adverse Events**	**Image of Adequate Bowel Output**
Ergen, et.al., (2016)	Yes	Yes	Not specified	No	Yes	Yes	Yes	Not specified	Not specified
Guardiola-Arevalo, et.al., (2019)	Yes	No	Yes; educational leaflet given 48 hours before procedure	No	Yes	Yes	Yes	Not specified	Yes
Guo, et.al., (2019)	Yes	Yes	Yes; Via smartphone app	Yes; Via smartphone app	Yes	Yes	Yes	Yes	Yes
Lee, et.al., (2015)	Yes; by RNs with enhanced training	No	No	No	Yes	Yes	Yes	Yes	No
Liu, et.al., (2020)	Yes; by RNs with enhanced training	No	No	No	Yes	Yes	Yes	Yes	No
Triantafyllou, et.al., (2021)	Yes	Yes	No	No	Yes	Yes	Yes	No	No

3.4 Measures on quality of bowel preparation

The Boston Bowel Preparation Scale (BBPS) was utilized in five out of six studies.[14, 20–23] BBPS is a scale for assessing the quality of bowel cleanliness in each of the three colon segments during colonoscopy procedures.[24] According to Lai et al., the intraclass correlation coefficient (a measure of interobserver reliability) for BBPS scores was 0.74, and the weighted kappa (a measure of intra-observer reliability) for scores was 0.77 (95% CI, 0.66-0.87).[25] The quality of bowel cleanliness is rated from 0 (inadequate) to 3 (excellent), with an overall perfect score of 9. On the other hand, Lee et al. utilized the Ottawa Bowel Preparation Scale (OBPS). Like BBPS, OBPS measures colon cleanliness in each of the three colon segments, but scores range from 0 (excellent) to 4 (inadequate). In addition, it also scores the fluid quantity before washing or suctioning, with scores ranging from 0 (small volume) to 2 (large volume) for the total colon. In a reliability and validity study, the Pearson correlation coefficients for interobserver ratings were superior for the OBPS 0.89, with an intraclass correlation coefficient of 0.94 (95% CI: 0.91-0.96). All the studies measured colon cleanliness during the colonoscopy procedure (see Table 3).[26]

Table 3. Summary of primary outcomes by preparation scale

Study, year	**Boston Bowel Preparation Scale**		**Ottawa Bowel Preparation Scale**	
	Outcome: Score ≥ 6 (intervention/control)	***p*-value**	**Outcome: Score ≤ 6 (intervention/control)**	***p*-value**
Ergen, et.al., (2016)	62%/35%	$p = .012$		
Guardiola-Arevalo, et.al., (2019)	21.4%/27.2%	$p = .43$		
Lee, et.al., (2015)			31.1%/58.8%,	$p < .001$
Guo, et.al., (2019)	77.2%/56.8%	$p < .001$		
Liu, et.al., (2020)	83.1%/69.3%	$p = .026$		
Triantafyllou, et.al., (2021)	69.8%/62.1%	$p < .19$		

3.5 Effect of education on bowel preparation

Among the studies selected, four (4) out of six (6) showed significant results based on the educational approach. The most effective approach with the strongest *p*-value ($p < .001$) was the smartphone app which utilized text, visual images, and video for instructions. The second most effective was using an educational booklet, with a *p*-value of $p = .012$. The booklet used for inpatients was an adaptation of a colonoscopy manual validated and tested for the outpatient population. On the other hand, studies showing no significant effect ($p > .05$) includes utilization of an educational leaflet, given to patients

by a researcher 48 hours before the procedure[21] and using scripted instructions given by physicians at the bedside as their approach.[22] Therefore, this review of articles indicates that the best educational approach is utilizing visual aid with instructions provided by a nurse while allowing patients to ask questions (see Table 3).

4. Discussion

Inadequate bowel preparation remains a challenge, particularly among hospitalized patients. In addition to following a complex bowel preparation regimen, inpatients may have existing comorbidities and concurrent medications, predisposing them to inadequate preparation. When preparing patients for colonoscopy, education interventions have shown effectiveness in the quality of bowel preparation for inpatients. However, a gap still exists in identifying the most effective educational intervention. The positive effect of educational interventions in this review is congruent with the results from previous studies.[16] Although the significance of educational interventions to improve the quality of bowel preparation has been noted,[14, 19, 20, 23] the number of research that could be utilized to corroborate the results is currently limited. There are still relatively few studies specific to improving bowel preparation, especially on the type of educational intervention.

Nurses hold essential roles in the hospital setting. By the very nature of their profession, nurses work closely with patients. According to Butler et al., intensive care unit patients spend about 86% of the time with nurses than all other healthcare providers in hospitals.[27] An integral part of nurses' work is providing patient education. For inpatients scheduled for a colonoscopy, nurses may help patients understand what the procedure entails, emphasizing the importance of following diet restriction and bowel preparation, and explaining what to expect during recovery. The positive outcomes of studies that utilized nurses to educate patients demonstrate the significance of nursing in health care, especially in the hospital setting.[14, 19, 20, 23]

Nurses are constantly present in the inpatient setting, serving as educators at the beside. Their frequent interaction with patients ma have played a role in patients achieving adequate bowel preparation.

4.1 Limitations

The research studies reviewed had some limitations that influenced the generalizability of the results. Limited sampling was common, as most participants were recruited from only one institution or hospital. The verbal information content may be variable as most were delivered by different healthcare personnel. Patient compliance with interventions, including reading of written materials and consumption of bowel preparation, could have affected the effectiveness of interventions but was not discussed across the studies. Finally, all the studies used only one kind of bowel preparation and preparation scale.

4.2 Future direction

Further investigations are needed to identify a specific type of visual aid to improve bowel preparation before colonoscopy. It would also be valuable to assess the effect of implementing a standardized process and educational content. A larger organization with multiple entities could increase sampling and provide confirmation and improve the generalizability of the results.

5. Conclusion

The review of the most current literature shows that the most effective educational approach to improving inpatient bowel preparation is using a smartphone application offering text, visual images, and video for instructions. Using an educational booklet about colonoscopy has also shown improvement in the quality of bowel preparation and can be considered for inpatients undergoing colonoscopy. The studies that did not involve nurses in educating patients did not show a significant effect. This review highlights the role of nurses in patient education to achieve effective bowel preparation. Adequate bowel preparation is crucial in preparing for colonoscopy procedures. Successful colonoscopies reduce the incidence of missed adenomas, risk of adverse events, repeat procedures, and cancellations while increasing patient satisfaction.

Conflicts of Interest Disclosure

The author declares that there is no conflict of interest.

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