

Effect of an intensive patient educational programme on the quality of bowel preparation for colonoscopy: a single-blind randomised controlled trial

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ABSTRACT

Objective Preprocedural bowel preparation is necessary for optimal colonoscopy visualisation. However, it is challenging to achieve high-quality bowel preparation among patients scheduled for colonoscopy. This study aims to evaluate the impact of an intensive patient educational programme on the quality of bowel preparation.

Design An assessor-blinded randomised controlled trial was carried out at the outpatient surgical clinic of a tertiary hospital. Patients were randomly assigned to the control group (received standard written and verbal instructions) or the experimental group (received an intensive and structured educational programme). All subjects completed a questionnaire before colonoscopy to assess their compliance, acceptability, and tolerability towards bowel preparation regime. Quality of bowel preparation was determined using the Boston Bowel Preparation Scale (BBPS).

Results A total of 300 subjects who fulfilled the inclusion criteria were recruited. The experimental group had a significantly higher proportion of good quality bowel preparation than the control group (98.7% vs 52.3%, $p<0.001$). The median total BBPS score was also significantly higher in the experimental group (8 vs 5, $p<0.001$). Factors associated with good quality of bowel preparation included educational programme (OR: 22.79, 95% CI: 4.23 to 122.85, $p<0.001$), compliance to bowel cleansing agent (OR: 24.98, 95% CI 3.12 to 199.71, $p<0.001$), very difficult acceptability of preparation (OR: 0.11, 95% CI 0.03 to 0.38, $p<0.001$), tolerability towards bowel preparation (OR: 4.98, 95% CI 1.44 to 17.20, $p<0.011$) and hypomotility drugs (OR: 3.03, 95% CI 0.12 to 0.91, $p<0.05$).

Conclusion An intensive patient educational programme can significantly improve the quality of bowel preparation for colonoscopy.

INTRODUCTION

Colonoscopy is a procedure that allows surgeons to examine the colon to diagnose the disease before further therapeutic interventions can be decided. Bowel preparation

Summary

What is already known about this subject?

- High-quality bowel preparation is a prerequisite for a high-quality colonoscopy.
- Both patient and practitioner can be an integral part of an optimal bowel preparation.
- Interventions with patient education to improve bowel preparation quality yielded mixed results.

What are the new findings?

- Introduction of an intensive patient educational programme as an interventional tool by pharmacists improved patient's compliance, tolerability and acceptability of a split-dose polyethylene glycol regimen.
- A good bowel preparation helps practitioners to perform colonoscopy with ease facilitating, a supreme view of the colon ensuring that the diagnostic and therapeutic value of the procedure become more relevant.

How might it impact on clinical practice in the foreseeable future?

- An intensive patient educational package delivered by pharmacist is consistently efficient in improving patient's compliance to the prescribed regime hence, assuring good quality of bowel preparation.
- An emphasis on strengthening initiatives towards patient educational programme is essential as it is worth the time and effort of both patients as well as the practitioners.

is essential to ensure good visualisation so that a safe and high-quality colonoscopy can be achieved.¹ Poor bowel preparation may contribute to decreased polyp detection and removal, thus leading to missed or delayed diagnosis and treatment. In patients with poor bowel preparation, the procedure might be abandoned in view of an increased risk of complications. As a result, this translates into higher medical costs as the procedure must



be postponed or alternative investigations need to be arranged.²

Suboptimal bowel preparation is common among patients in Asia, Europe, America, and Middle Eastern countries. Almost one-third of patients who underwent colonoscopy were found to have poor bowel preparation.³ Essentially, poor bowel preparation is considered to be a universal problem. There are two important determinants of the quality of bowel preparation, that is, practitioner and patient. From the practitioner point of view, the choice of bowel cleansing agents or purgatives and the dosing regimen (split or single dose) may influence the bowel preparation quality. Current guidelines recommend a split-dose regimen as it is associated with better bowel cleansing and higher patient tolerance than single dose.^{4,5} In terms of cleansing agents, the split-dose polyethylene glycol (PEG) regimen has better patient compliance, preference, and acceptance when compared with split-dose regimen of hyperosmotic solution (sodium phosphate).⁶ Yet, the uptake of split-dose bowel cleansing regimen is still low in most countries. This can be attributed to patient-related factors such as their reluctance to rise early in the morning to consume the last dose prior to colonoscopy and fear of bowel movement during travelling to hospital.⁷ Thus far, the split dose of PEG have demonstrated a good safety profile despite the need to ingest a large volume of unpalatable solutions.⁸ Regardless of the dosing regimen, patients must also comply with the bowel preparation instructions including dietary modifications and ingestion of prescribed purgative. In a study involving 300 patients who underwent colonoscopy for cancer screening, Nguyen and Wieland found that as high as 86.7% had inadequate bowel preparation because they failed to complete the bowel preparation or they did not fully follow the instructions. These findings were similar to a local study consisting of 501 patients, whereby non-compliance to the instructions was associated with a 4.76 higher risk of poor bowel preparation.⁹

Current clinical evidence has demonstrated that patient educational programme can be effective in ensuring patient compliance and the adequacy of bowel cleansing. The European Society of Gastrointestinal Endoscopy recommends that both oral and written information about bowel preparation should be delivered to the patients by healthcare professionals as the combination of oral and written instructions is an independent predictor of the adequacy of bowel cleansing as compared with only written instructions. Pharmacists are the last healthcare professionals who the patients come into contact within a healthcare setting. Their role cannot be underestimated in patient education, especially on proper medication use. Pharmacists do not merely talk to patients, but also educate them and ensure that learning has taken place.^{10,11} The quality of bowel preparation is also improved when dedicated printed materials such as booklets or visual aids are used for patient education.⁴ Printed educational materials have been incorporated in many aspects of care to improve patients'

knowledge, satisfaction, and adherence to treatment, as well as to stimulate self-care. It is highly recommended to use educational materials such as booklets developed by health professionals as a reinforcement tool for verbal communication in healthcare service delivery.^{12,13} According to Aldridge, the incorporation of figures or illustrations would facilitate the understanding of health messages, especially in explaining difficult concepts to patients. Furthermore, colourful educational booklets are attractive and thus be able to pique the interest of targeted patient groups. Collectively, printed educational material enhances the understanding and absorption of the important information that healthcare professionals would like to deliver to the patients.¹⁴

Although there are compelling evidences supporting the effectiveness of patient education for bowel preparation, the translation of such knowledge or evidence into real practice is really challenging in our population. In Malaysia, the current model of care adheres to international guidelines to optimise patient's bowel preparation. Nonetheless, under the best of circumstances, only 55% of patients achieved good bowel preparation quality.¹⁵ Almost 1 out of 2 patients have poor bowel preparation, and past studies specifically addressed this problem by providing different bowel cleansing agents to improve outcomes. The role of intensifying the educational component with a simplified regimen may therefore mitigate non-adherence issue in Malaysia.

Demographically, Malaysia comprises of Malays as the majority followed by Chinese and Indians and culturally is reflective of South East Asian populations. Malaysian's medical care is largely a public healthcare system apart from private healthcare system. All Malaysians have access to medical care at any government hospitals and clinics at a very minimum cost which includes doctor's consultation, laboratory investigation and medications. Despite all this incentives and subsidies, issue of non-adherence is indeed a recognised problem among patients of South Asian origin as reported by Kumar *et al.*¹⁶ Patients tend to have a range of health beliefs which may influence adherence to medicines. This is in parallel with Aziz *et al*'s finding that motivation is one of the reasons for adherence in both subsidised and self-paying patients. Motivation, defined as 'the psychological forces or energies that impel a person towards a specific goal' is an essential element for adherence because it influences behavioural changes.¹⁷ There is a pressing need to investigate the role of patient education as an interventional model to enhance adherence to bowel preparation regime which remains the mainstay of a successful colonoscopy

In short, evidence in the literature has shown that bowel preparation quality is strongly closely associated with the type of bowel cleansers, dosage regime, and the enhancement with some form of educational package. In this study, we hypothesised that a structured and intensive patient educational model delivered by pharmacists will improve bowel preparation quality for outpatients scheduled for colonoscopy. For the purpose of this study,

a validated booklet was¹⁸ adapted to the needs of the local population. The main contents included illustrations on low residue food and drinks based on the local cuisine, clear instructions on bowel cleansing agent preparation and timing, management of untoward effects of PEG, and concomitant drug precautions including interruption of hypomotility agents.

METHODS

This randomised controlled trial (RCT) was conducted at the outpatient surgical clinic of a tertiary referral hospital. Patients scheduled for colonoscopy were recruited for this study. Written informed consents were obtained from all the subjects enrolled in the study on confirmation of their colonoscopy date. This study protocol received approval from the Medical Review and Ethics Committee and was registered with the Malaysian National Medical Research Registry (NMRR-14-1716-22378). The study materials were funded by Institute for Clinical Research (formerly known as Clinical Research Centre), National Institute of Health, Malaysia, and there was no sponsorship from the company of the bowel cleansing agent used in this study.

Patients

This is a prospective, randomised, two-armed, single-blinded RCT. Patients more than 18 years old scheduled for an elective colonoscopy at the surgical outpatient clinics were recruited into this study. They must be able to provide written informed consent. Those with previous operations involving bowel resection, suspected or diagnosed bowel obstruction, perforation or ileus, or those with colon disease or were pregnant or breastfeeding were excluded.

During the clinic visit, the subjects were randomised to the control group (received standard practice of written and verbal instruction) or experimental group (received intensive patient educational package (PEP)). The randomisation was conducted using a sealed opaque envelope with allocation ratio of 1:1. The envelopes were randomised by using computer-generated random numbers. The investigator would keep the randomisation key locked until the recruitment of the last patient. All subjects were reminded not to discuss with their endoscopists, nurses, or investigators about their assigned preparation.

All patients were prescribed three sachets of PEG (Beaufor IPSEN Industrie). Each sachet contained 64g polyethylene glycol 4000, 5.7g anhydrous sodium sulfate, 1.7g sodium bicarbonate, 1.5g sodium chloride, 0.8g potassium chloride, and 0.1g saccharin sodium. It was given as a split dose (2+1 regimen taken a day prior and on the morning of procedure day).

Intervention

The experimental group received an intervention in the form of a structured and comprehensive PEP on the recruitment day. The PEP comprised of thorough and

detailed explanation using an instruction leaflet (from manufacturer) together with an illustrated booklet. Patients in the control arm received the instruction leaflet only along with brief explanation from the staffs in the surgical clinic. This educational booklet is available in two languages: English and Malay. The English version was translated (backward and forward and forward and backward) by two independent institutions. Patients received PEP individually (one to one) from a trained pharmacist. The instructions provided guidance to the patients on the PEG split regimen. The educational session emphasised on five main points; proper diet intake preceding colonoscopy, appropriate bowel preparation regimen, the right time to ingest the purgatives, the management of any side effects, and interruption of certain medications.

Patients were given 15–20 min of education about the importance and rationale of bowel preparation with the aid of the clear illustrations in the modified and validated booklet. As for the preparation towards colonoscopy, patients were also provided explicit instructions using graphical tables on how to commence a low-residue diet for 2 days before the colonoscopy. The use of figures or visual aids to showcase the food and drinks allowed before the procedure served to explain the concepts in a simplified manner and it was able to improve the patients' understanding of core messages. The colourful educational booklet also managed to attract the interest of the target group, leading to an easier understanding of the information delivered. The timing of purgative ingestion was emphasised and patients were advised to consume adequate clear fluids for hydration. Numerous ways and means were recommended to overcome palatability issues or any untoward effects associated with PEG ingestion. Moreover, charts on concomitant medications and hypomotility agent management were also included in the booklet to elucidate the points made in the text.

Data collection

On the day of the procedure, all subjects were required to fill up a 1-page modified Mayo Tolerability Questionnaire prior to the colonoscopy to assess their compliance, tolerability, and willingness to repeat the procedure, if needed. The questionnaire consisted of data on bowel movement patterns before the commencement of purgatives, compliance with preparation instruction, willingness to repeat the procedure, untoward effects experienced during the preparatory period, and overall tolerability towards the bowel preparation regimen.

Colonoscopies were performed by one of the three surgeons. All the surgeons had at least 5 years of experience and had conducted at least 200 colonoscopies. They were blinded to the randomisation assignment of the patients. At the end of the colonoscopy, the quality of bowel preparation would be evaluated with the validated Boston Bowel Preparation Scale (BBPS). Traditionally, bowel cleansing quality was marked subjectively using terms such as excellent, good, fair, poor, and



inadequate. Under the BBPS system, a four-point scoring system is used to categorise the quality of the three main colonic regions, namely the right side (the cecum and ascending colon), the transverse section (the hepatic and splenic flexures), and the left side (the descending colon, sigmoid colon, and rectum). Numerical points were assigned for each segment as below: 0, unprepared colon segment; 1, major residual stool or opaque liquid; 2, minor residual staining; and 3, entire mucosa easily visible. The total BBPS score would range from 0 to 9, with the contribution of segment score from each of the three regions of the colon (range: 0 to 3). A higher score would reflect good quality bowel cleansing and clear identification of the number, location, and size of polyps. This scale has been proven to be well correlated with procedural outcome including caecal intubation rate and polyp detection.¹⁹

Outcome measures

The primary endpoint of the study was the bowel preparation quality based on the BBPS. A good bowel preparation quality was defined by a BBPS score of ≥ 5 . The number and size of polyps or adenoma detected during colonoscopy were also recorded. Secondary endpoints included patient self-reported data on the measures towards bowel preparation regime, namely compliance to the prescribed regime, acceptability, and tolerability to side effects experienced during the preparation.

Sample size calculation

To calculate the required sample size, we referred to the results of a previous study which compared the score between the control group and the intervention group that was provided with an educational booklet. To detect an absolute 15% difference in the overall bowel cleansing proportion between the two arms with a two-sided significance level of 0.05% and 80% power, this study required 260 patients. Adjusting for a 20% dropout rate, the sample size calculated was 312 patients or 156 per arm.

Statistical analysis

Data analysis was performed using Statistical Package for Social Sciences, V.21 software. Intention-to-treat analysis was conducted to evaluate primary and colonoscopy findings from all subjects. All numerical data in this study were tested for normality using Shapiro-Wilk test. The demographic data were summarised with descriptive statistics. Comparison of demographic parameters among subjects in the two arms was performed using Student's t-test for parametric data, Mann-Whitney test for non-parametric data, and Pearson's χ^2 test for categorical data.

The quality of bowel preparation was dichotomised to good (≥ 5) and poor (< 5) based on the BBPS score. Comparisons of good/poor bowel preparation quality between two arms were measured using Pearson's χ^2 test. Independent risk factors associated with good/poor bowel preparation were analysed using logistic regression analysis. Compliance and acceptability between the

Table 1 Baseline characteristics of the study participants

	Control arm (n=151)	PEP arm (n=149)	P value
Age (y), mean+SD	57.6+15.7	58.0+13.6	0.889
Gender, male, n (%)	82 (54)	81 (54)	0.992
BMI (kg/m ²)	24+3.1	24+3.2	0.637
Education level, n (%)			
Primary school	46 (30.5)	29 (19.5)	0.076
Secondary school	68 (45.0)	82 (55.0)	
Tertiary studies	37 (24.5)	38 (25.5)	
Colonoscopy indication, n (%)			
Screening	58 (38.7)	60 (51.2)	0.842
Symptoms	93 (61.3)	89 (48.8)	
Comorbidities, n (%)			
Cardiovascular disease	63 (41.7)	77 (51.7)	0.084
Endocrinology	42 (27.8)	45 (30.2)	
Others	46 (30.5)	27 (18.1)	
Constipation, n (%)	9 (6.0)	13 (8.8)	0.057
Types of medications, n (%)			
Hypomotility	29 (19.2)	37 (24.8)	0.239
Non-hypomotility	122 (80.8)	112 (75.2)	

BMI, body mass index; PEP, patient educational package.

groups were compared using Pearson's χ^2 test. Tolerability to the regimen was summarised descriptively. Statistical significance was taken at a p value of < 0.05 .

RESULTS

Patient characteristics

A total of 312 patients were prospectively enrolled and randomised to the control group (n=156) and PEP group (n=156). Out of 156 subjects in the control group, 154 of them completed colonoscopy whereas in the interventional group, only 150 of them managed to complete the procedure. Five and seven patients were excluded from the control and experimental groups, respectively, because of the cancellation of colonoscopy, technical difficulties, and pathological findings on colonoscopy. Hence, 300 subjects with completed colonoscopy examination up to the ileocaecal valve were analysed for bowel preparation quality. There was no significant difference in the demographic characteristics between the two groups (table 1).

The outcome of PEP on bowel preparation quality and patient-related factor

In the analysis of the primary outcomes, good bowel preparation quality was found in 98.7% patients of the experimental group compared with only 52.3% of patients in the control group ($p < 0.001$ table 2). Similarly, more polyps were detected in the experimental

Table 2 Effect of PEP on the outcome of bowel preparation and patient-related factors

	Control arm (n=151)	PEP arm (n=149)	P value
BBPS score >5, n (%)	79 (52.3)	147 (98.7)	<0.001*
BBPS score, median	5	8	<0.001†
Right (ascending colon) score, n (%)	1	2	<0.001†
Transverse colon score, n (%)	2	3	<0.001†
Left (descending colon) score, n (%)	2	3	<0.001†
Presence of polyps, n (%)	19 (12.6)	64 (42.3)	<0.001*
No of polyps, n (%)			<0.001*
1	6 (4.0)	29 (19.6)	
2	2 (1.3)	4 (2.7)	
>2	11 (7.3)	31 (20.9)	
Compliance: able to complete, n (%)	129 (85.4)	144 (96.6)	<0.001*
Acceptability: ease of ingestion, n (%)	50 (33.1)	133 (89.3)	<0.001*
Tolerability: moderate to severe, n (%)			
Unpleasant taste, n (%)	104 (68.9)	27 (18.1)	<0.001*
Nausea/vomiting, n (%)	49 (32.5)	20 (13.4)	<0.001*
Bloating, n (%)	90 (59.6)	105 (70.5)	0.048*
Abdominal pain/cramps, n (%)	49 (32.5)	20 (13.4)	<0.001*
Lack of sleep, n (%)	62 (41.1)	42 (28.2)	0.019*
Willingness to repeat regime, n (%)	118 (79.1)	149 (100.0)	<0.001*

*Pearson χ^2 test.

†Mann-Whitney U test.

BBPS, Boston Bowel Preparation Scale; PEP, patient educational package.

group ($p < 0.001$). Patients in the experimental group (96.6%) also recorded significantly higher compliance to bowel preparation regime ($p < 0.001$) as compared with the control group (85.4%). They were found to have significantly higher acceptability to the bowel preparation regime in which 89.3% of them reported that bowel preparation regime as 'easy' ($p < 0.001$). All the patients in the experimental group were willing to repeat the same bowel preparation process in the future as opposed to only 79.1% subjects in the control group ($p < 0.001$). With regard to the possible side effects from PEG regime, there were significantly less unpleasant taste ($p < 0.001$), gastric fullness/bloating ($p = 0.048$), lack of sleep from excessive bathroom visits ($p = 0.019$), nausea/vomiting ($p < 0.001$), and abdominal pain/cramps ($p < 0.001$) in the experimental group. This indicated a better tolerability towards the bowel preparation regime among the subjects who received PEP.

Factors associated with good quality bowel preparation

Logistic regression analysis was performed to identify the predictors of good bowel preparation quality.

The results of the univariable and multivariable logistic regression analysis are shown in table 3. The factors included in the analysis were treatment group, types of medication, compliance, acceptability, and tolerability. The univariable analysis indicated that the experimental group (OR: 67.0, $p < 0.001$), compliance (OR:

18.7, $p < 0.001$), acceptability (OR: 18.7, $p < 0.001$), and tolerability (OR: 36.7, $p < 0.001$) were significantly associated with good bowel preparation for colonoscopy. The odds of having a good quality bowel preparation for PEP subjects were 22.8 times higher than that of subjects under standard care after adjusted for compliance, acceptability, tolerability, and types of medications (OR: 22.79, $p < 0.001$). The multivariable analysis revealed that compliance to medication (OR: 25.00, $p = 0.002$), use of hypomotility agent (OR: 3.03, $p = 0.031$), very difficult acceptability of medication (OR: 0.11, $p < 0.001$) and tolerability (OR: 4.98, $p = 0.011$) were significantly associated with good bowel preparation for colonoscopy. There was no significant difference between the two groups in terms of race, gender, marital status, age, body mass index, appointment waiting time, comorbidities, or educational status.

DISCUSSION

Poor patient adherence to the bowel preparation instructions remains one of the major obstacles to proper colorectal cancer screening. Our study showed that most patients complied with split-dosing regimen and completed the preparation with ease. There was demonstrable willingness to rise early on the morning of the day of procedure to complete the last dose of the bowel preparation. This was consistent with the study by

**Table 3** Logistic regression analysis of factors for a good bowel preparation quality

Characteristics	Univariable			Multivariable		
	OR	95% CI	P value	OR	95% CI	P value
Treatment group						
Control arm	1	Reference	–	1	Reference	–
PEP arm	66.99	16.009 to 280.305	<0.001*	22.79	4.227 to 122.850	<0.001*
Compliance						
No	1	Reference	–	1	Reference	–
Yes	18.7	6.764 to 51.700	<0.001*	24.98	3.124 to 199.710	0.002*
Acceptability						
Easy	1	Reference	–	1	Reference	–
Not easy but slightly difficult	0.12	0.055 to 0.245	<0.001*	0.64	0.640 to 0.252	0.347
Very difficult	0.02	0.006 to 0.042	<0.001*	0.11	0.029 to 0.375	0.001*
Tolerability						
Not or less tolerated	1	Reference	–	1	Reference	–
Tolerated	36.68	12.894 to 104.388	<0.001*	4.98	1.444 to 17.203	0.011*
Types of medicine						
Hypomotility	1	Reference	–	1	Reference	–
Non-hypomotility	1.59	0.873 to 2.909	0.129	3.03	1.105 to 8.327	0.031*

*Pearson χ^2 test.

PEP, patient educational package.

Khan *et al* who reported that split-dose bowel preparation resulted in higher patient satisfaction scores and cleansing scores compared with single-dose bowel preparation.²⁰ Furthermore, improved patient compliance towards bowel preparation completion increased the efficacy of the colonoscopy in detection of cancerous polyps.²⁰ As for tolerability towards the bowel preparation regime, patients in experimental arm of our study were able to tolerate the 2 days of low-residue diet prior to colonoscopy along with clear fluid intake to ensure adequate hydration. They also complied with the proper administration timing of purgatives and understood the interruption in hypomotility medication administration.

Patients' compliance to the prescribed bowel preparation regime is an important determinant of bowel preparation quality. In fact, some patients reported that the bowel preparation prior to colonoscopy is more challenging than the procedure itself. Patients acceptance and tolerance towards the prescribed bowel preparation regimen would ultimately produce a supreme field of view during colonoscopy. For surgeons, good visualisation of the colon enhances the diagnostic ability as it improves the lesion detection rate. Regardless of the type of bowel cleansing agents used, one of the best ways to achieve the desired outcome in bowel preparation is through a structured educational session to the patients.³ An intensive educational package was a useful tool to improve their knowledge and understanding of the rationale of bowel preparation.

In our study, the patient educational model consisted of visual aid that is, booklet with clear and colourful pictorial diagrams that emphasised the critical points of dietary restriction, adequate hydration, split-dose regime, hypomotility agent interruption, self-assessment, and management of adverse effects associated with PEG. This educational package was explained explicitly by trained pharmacists during the clinic visit. Printed educational materials served as a reinforcement tool for verbal communication to improve patients' knowledge, satisfaction, adherence to treatment, and to stimulate self-care.^{12 13} The booklet is an invaluable instrument to facilitate health education and its administration can provide a platform of discussion among healthcare professionals and patients. For colonoscopy, an educational booklet can be a relevant, inexpensive, and valuable material to motivate patients to comply with the bowel preparation regime.

With that in mind, clinicians should take note of the evolving role of the pharmacist as an educator in the healthcare environment. Alkhawajah and Eferakeya reported that when both physicians and pharmacists explained about the use of medication, patients found that pharmacists provided a much clearer instruction than physicians.¹¹ This was echoed by Robinson who stated that the pharmacist-as-educator model represents an interesting and unique opportunity for practical and impactful patient care. Teaching is intended to induce learning and provide the learner with the capability

to perform actions that he or she has not previously accomplished.¹⁰ By linking outcomes to the educational process, our study proved that pharmacy educators can train patients to achieve the desired outcome.

Patient-related factors (acceptability and tolerability) can also affect the quality of bowel preparation. This study showed that a significantly higher proportion of subjects who received intensive educational intervention had better tolerability and acceptability towards the PEG regime. It was postulated that by imparting knowledge through an education programme, patients would possess a better understanding and learn how to adhere to the timing of purgative ingestion, manage any undesirable side effects from PEG and be aware of the technique to improve the palatability of PEG solution. Improvement in tolerability and acceptability might maximise compliance to bowel preparation regime, thus improving the bowel preparation quality. In this study, patients who were given the intensive educational programme had better compliance and demonstrated higher quality of bowel preparation as reflected by the statistically higher BBPS score and polyps detection rate than the control group. This finding was similar to a previous study in which the enhanced-intervention group (counselling session and written instructions) fared significantly better in terms of bowel cleanliness for colonoscopy.²¹

Furthermore, this study pinpointed several factors associated with good bowel preparation including patients' compliance, acceptability, and tolerance to bowel preparation regimen. If patients did not appreciate the importance of the preparation, confused about the precolonoscopy diet, or not confident in following the instructions, it could have resulted in suboptimal bowel preparation.²² Empowering patients with the right information to appreciate the value of compliance to bowel preparation instruction enables them to be well prepared for the procedure. Education also helps them to overcome their fear associated with bowel preparation and to improve their confidence in following the instructions for bowel preparation.

Our novelty of intervention is an educational package which is a validated tool tailored to our population. This model is reproducible with local modification and can be implemented in a standardised manner. While the implementation of a structured educational model requires additional pharmacists resources, the positive outcome for colonoscopy far outweighs the cost of procedure cancellation or misdiagnosis. Moreover, higher adherence rate translates to increased rate of therapeutic interventions within one visit to endoscopy room. Ting *et al* found that pharmacists who were equipped with the skills in pharmaceutical education or behavioural intervention could provide better intervention with less cost consumption.²³ Similar educational intervention model to enhance medication adherence is practiced in other South East Asian countries,^{24 25} hence application of this standardised model can be introduced with minimum cost for a positive outcome in bowel preparation.

There are several limitations to the study. First, it was conducted in a single referral centre and thus the results may not be generalisable to other population. Further multicentre research can be conducted with a larger group of patients, especially those undergoing sedated outpatient colonoscopy to confirm the study findings. Second, self-reported data by patients are subject to biases and limitations.

In conclusion, a pharmacist-led patient educational intervention tool revealed better compliance by patients to bowel preparation and improved colonoscopy outcome for surgeons and patients.

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Contributors SJ conceived the research idea. SJ and CKC developed the study methodology. SJ, CYT, JML, WLL, CHK, II, ZYO, MRI and CKC planned the experiment. SJ, CYT, JML, WLL, CHK, II, ZYO and MRI carried out the study implementation and the study intervention. SJ, CYT, JML, WLL and CHK collected the study data. CKC performed the statistical analysis and interpretation. SJ, CYT, JML, WLL, CHK, CKC involve in manuscript drafting, writing and editing. All authors discussed the results and commented on the manuscript and final approval of the manuscript.

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