Effect of Education by Messaging Software on the Quality of Bowel Preparation for Colonoscopy

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To the Editor: Colonoscopy is currently the most commonly used method for the examination and treatment of intestinal diseases. High-quality bowel preparation is a prerequisite for colonoscopy and usually results in successful colonoscopy regarding diagnostic accuracy, procedural safety, and cost-effectiveness. At present, 9–67% of bowel preparations do not meet colonoscopy standards. Because most of the doctors or nurses in our country have a heavy workload and thus insufficient time to fully explain the details of bowel preparation to the patients, many patients are only told how to obtain bowel preparation medications along with basic bowel preparation instructions or are given a brochure about standard bowel preparation when they make their endoscopic examination appointment.[1] However, many patients are not able to prepare appropriately without fully understanding the bowel preparation details, and hence, the quality of bowel preparation is often low. In the past few years, WeChat (Weixin in Chinese version, Tencent Ltd., China) has become one of the most popular messaging software applications (apps) on cell phones. The WeChat public number has a multifunctional background interface, allowing service providers to communicate via texts, deliver multimedia content, and chat online with all subscribers. As a representative of modern messaging software, WeChat naturally has the potential to link patients with their health providers.[2] Here, we have performed a prospective, randomized controlled study to compare the quality of bowel preparation for colonoscopy in patients receiving standard education as compared to those using the WeChat public number for bowel preparation education. We tested the hypothesis that the WeChat public number could enhance the quality of colonoscopy by improving the adequacy of bowel preparation.

This prospective, endoscopist-blinded, randomized controlled study was conducted in the No. 1 Hospital of Yangtze University. Between June 2015 and May 2016, patients aged 18–75 years who were scheduled for outpatient screening colonoscopy were enrolled. The study was approved by the Institutional Review Board of Yangtze University. All enrolled patients were randomly assigned to either the WeChat group or control group. At the time of scheduling the colonoscopy appointment, all patients received standard instructions for bowel preparation. They received verbal explanations delivered by well-trained medical practitioners and a booklet with clear, written instructions that they could read at home. The control group received no further education. In addition to receiving the verbal instructions and the booklet, all patients in the WeChat group were asked to scan the quick response code of our WeChat public number by WeChat app on their mobile phone and subscribe to our WeChat public number. Thus, the patients in the WeChat group could browse the detailed and vivid information on the bowel preparation and colonoscopy examination via our WeChat public number. They were also encouraged to ask questions by sending direct messages through the WeChat platform if they encountered any issues. Moreover, multimedia messages, with detailed information on bowel preparation, were automatically pushed to patients' WeChat app 2 days before the colonoscopy. All patients were prescribed a low-volume preparation regimen based on 3 L polyethylene glycol 4000 (Shutaishen Pharmaceutical Co., China). Two experienced endoscopists (each having performed more than 1000 prior colonoscopies) were blinded to patients group assignment. Before start of the study, the principal study investigator briefly explained the study context and the ratings of the Boston Bowel Preparation Scale (BBPS) scoring system to the participating endoscopist's.[3] Before each colonoscopy, patients were interviewed by one investigator who was not involved in the colonoscopy procedure and was blinded to random group assignment. Demographic data (including age, sex, marital status, body mass index, educational background, family history of colorectal cancer, history of previous colonoscopy, and history of abdominopelvic surgery), recalled details of food type before and on the day of colonoscopy, confirmation that purgatives were ingested, adverse events, sleep quality, score on self-rated anxiety scale (SAS), and willingness to repeat bowel preparation were

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recorded. During the colonoscopy procedure, quality of bowel preparation, cecal intubation time, withdrawal time, colonoscopic findings, and visual analog scale (VAS) of pain for all patients were recorded by another investigator, who was also blinded to group assignment. All analyses were performed using the SPSS software (version 19.0; IBM Corp., Armonk, New York, USA). Baseline characteristics, as well as primary and secondary outcomes, were evaluated by intention-to-treat (ITT) analysis. Patients who canceled their appointment after randomization were excluded in the per protocol (PP) population. The Chi-squared test or Fisher's exact test was used to assess categorical variables as appropriate. Continuous variables were described as the means with standard deviation and analyzed with Student's t-test. Comparisons among three groups were performed using the Cochran–Mantel–Haenszel Chi-squared test or one-way analysis of variance. The logistic regression model was performed to identify factors associated with inadequate bowel preparation. A value of $P < 0.05$ indicated statistical significance.

A total of 1524 patients, aged 18–75 years, undergoing outpatient, unsedated colonoscopy were assessed: 448 patients with exclusion criteria were excluded from the study; 1076 were randomized to either the WeChat group ($n = 542$) or the control group ($n = 534$). After randomization, 29 patients in the WeChat group and 21 in the control group canceled their colonoscopy appointments due to personal reasons, and two patients in the WeChat group and six patients in the control group canceled their colonoscopy examination because of "bad" bowel preparation. Finally, 511 patients in the WeChat group and 507 in the control group underwent unsedated colonoscopy. There were no significant differences between the groups about baseline clinical or demographic characteristics [Supplementary Table 1]. No serious complications or adverse events occurred during the study.

Colonoscopy outcomes and quality of bowel preparation are shown in Table 1. In the ITT analysis of the colonoscopy outcome and quality of bowel preparation, the proportion of patients with bowel preparation quality that was sufficient for colonoscopy in the WeChat group and control group were 489/542 (90.2%) and 469/534 (88.2%), respectively. In the PP analysis, the proportion was 489/511 (90.2%) and 469/507 (88.2%), respectively. There were no significant differences between the WeChat group and control group regarding the ITT analysis ($P = 0.209$) and the PP analysis ($P = 0.051$). There were 22 (4.3%) patients with incomplete colonoscopy in the WeChat group, including 15 patients who experienced technical difficulty and seven patients with very poor preparation. There were 38 (7.5%) patients with incomplete colonoscopy in control group, including 19 patients for technical difficulty and 19 patients for very poor preparation. The WeChat group had significantly fewer incomplete colonoscopies than the control group ($P = 0.039$). Successful cecal intubation was achieved in 95.7% (489/511) of patients in the WeChat group and 92.8% (469/507) in the control group, with statistically significant differences between the groups ($P = 0.033$). Cecal insertion time of WeChat group (7.2 ± 4.6 min) was shorter than the control group (9.1 ± 4.8 min), and this difference was statistically significant ($P = 0.036$). However, there were no significant differences in withdrawal time between the two groups ($P = 0.957$). There were significant differences in BBPS score between the WeChat group and the control group ($P < 0.05$). The WeChat group had higher BBPS total score (7.1 ± 1.2 min) than the control group (6.3 ± 1.4 min), and this difference

Table 1: Colonoscopy outcomes and quality of bowel preparation

Items	WeChat group	Control group	P
Adequate bowel preparation, n (%)			
ITT analysis	489/542 (90.2)	469/534 (88.2)	0.209
PP analysis	489/511 (95.7)	469/507 (92.8)	0.051
Incomplete colonoscopy, n (%)	22 (4.3)	38 (7.5)	0.039
Technical difficulty	15	19	
Very poor preparation	7	19	
Cecal intubation rate, % (n/N)	95.7 (489/511)	92.8 (469/507)	0.033
Cecal insertion time, mean ± SD (min)	7.2 ± 4.6	9.1 ± 4.8	0.036
Withdrawal time, mean ± SD (min)	7.2 ± 1.2	7.4 ± 1.1	0.957
BBPS score, mean ± SD			
Right side	2.2 ± 0.5	2.0 ± 0.6	0.043
Transverse	2.6 ± 0.5	2.0 ± 0.6	0.014
Left side	2.3 ± 0.5	2.0 ± 0.5	0.037
Total	7.1 ± 1.2	6.3 ± 1.4	0.045
Colonoscopic findings, n			0.040
ADR	146	89	0.004
IBD	22	17	0.098
Cancer	43	39	0.894
Early cancer	13	5	<0.001
Advanced cancer	30	34	1.245
Diverticula	12	13	0.786
Inflammation	87	82	0.647
SMT	21	17	0.041
Other	33	30	0.538

ITT: Intention-to-treat; PP: Per protocol; SD: Standard deviation; BBPS: Boston Bowel Preparation Scale; ADR: Adverse drug reaction; IBD: Inflammatory bowel disease; SMT: Submucosal tumor.

was statistically significant. Compared with control group, the WeChat group showed significantly better bowel preparations at each segment (2.3 ± 0.5 vs. 2.0 ± 0.5, $P < 0.05$ for left side; 2.6 ± 0.5 vs. 2.0 ± 0.6, $P < 0.05$ for transverse; and 2.2 ± 0.5 vs. 2.0 ± 0.6, $P < 0.05$ for right side). After adjustment for multiple comparisons, a significant difference remained between the two groups about colonoscopic findings ($P = 0.040$). Adverse drug reaction, inflammatory bowel disease, and submucosal tumor were more frequent in the WeChat group as compared to the control group ($P < 0.05$). There were no significant differences between the two groups regarding other colonoscopic findings, including diverticula, inflammation, colorectal cancers, and other lesions ($P > 0.05$). However, the number of early cancers detected in WeChat group was significantly higher than in the control group (13 vs. 5, respectively, $P = <0.001$). As shown in Supplementary Table 2, compared to the control group, there were better sleep quality, lower SAS scores, fewer events of incomplete compliance, fewer adverse events, lower VAS of pain during the colonoscopy, and more patients willing to repeat bowel preparation in the WeChat group ($P = 0.031$, $P = 0.044$, $P = 0.021$, $P = 0.034$, and $P = 0.013$, respectively).

The effectiveness of colonoscopy depends on the quality of bowel preparation. Many researchers have shown that improved education and maximized patient compliance during the preparatory period will enhance the efficacy of bowel preparation.[4] Till date, there are many studies reporting various methods of bowel preparation instruction, such as education with cartoons, education by telephone, and short message service (SMS). These methods can effectively improve bowel preparation for colonoscopy.[5] However, interventions involving education with booklets, cartoon visual aids, or educational video clips are not suitable for patients with poor compliance, as they are not able to proactively remind patients of the importance of proper bowel preparation. Furthermore, if there are any issues in the preparation process, these methods do not allow patients to communicate with the medical workers in real time. Moreover, interventions involving education by telephone and SMS can only transmit audio or text information, and some patients still cannot fully understand the details of the bowel preparation. We have established the professional WeChat public number for bowel preparation. The WeChat public number can provide a variety of information about bowel preparation, including text, pictures, video, and other forms, so patients can more fully understand this information for easier bowel preparation. As such, WeChat provides patients not only text information about bowel preparation but also vivid multimedia information about bowel preparation. In addition, the WeChat public number can push multimedia messages to patients' mobile terminals and encourage patients to pay attention to the relevant bowel preparation information. At the same time, patients can communicate with doctors online directly through the WeChat public number on the bowel preparation. In our study, there were apparent differences in the quality of bowel preparation outcome between the two groups. Compared to the control group, the quality of bowel preparation of the WeChat group was improved according to measures such as BBPS score, cecal intubation rate and cecal insertion time, and rate of completed colonoscopy. Furthermore, there were more colonoscopic findings among the WeChat group as compared to the control group,

especially in early cancer detection. We conclude that our guide for bowel preparation under the WeChat public number is better than routine methods. The WeChat public number can help patients to more fully understand the details of bowel preparation and can improve patient compliance and the quality of bowel preparation outcome and decrease the adverse events.

In addition, the WeChat public platform improved patients' compliance. Compared to the control group, we observed better sleep quality, lower SAS score, lower incomplete compliance, less adverse events, and lower VAS of pain in the WeChat group. Because our guide under the WeChat public number can improve both patient compliance and the quality of bowel preparation outcome, and decrease the adverse events, there were more patients willing to repeat bowel preparation in the WeChat group as compared to the control group.

In conclusion, the WeChat public number has a multifunctional background interface, allowing service providers to communicate via text, deliver multimedia content, and chat online with all subscribers. The WeChat public platform can emphasize the importance of bowel preparation for colonoscopy and teach patients the proper bowel preparations methods to reach complete colonoscopy.

Supplementary information is linked to the online version of the paper on the Chinese Medical Journal website.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Baseline characteristics of the study population

Characteristics	WeChat group (*n* = 511)	Control group (*n* = 507)	P
Age, mean ± SD (years)	51.2 ± 18.5	50.7 ± 17.9	0.290
Sex			
Male	269	254	0.417
Female	242	253	
BMI, mean ± SD (kg/m^2)	21.9 ± 3.8	21.7 ± 4.1	0.187
Marital status, *n*			
Married	362	347	0.864
Unmarried	149	160	
Grade of education, *n*			
Elementary school or less	103	105	0.368
High school	261	273	
College or higher	147	129	
Family history of intestinal diseases, *n*	39	43	0.619
Symptoms, *n*			
Constipation	99	89	0.169
Diarrhea	97	101	
Abdominal pain	106	98	
Abdominal bloating/discomfort	91	85	
Hematochezia	77	70	
Physical examination	30	46	
Other	11	18	
Comorbidities, *n*			
Hypertension	61	77	0.075
Coronary artery disease	45	50	
Diabetes	26	23	
Other	32	41	
None	347	316	

SD: Standard deviation; BMI: Body mass index.

Supplementary Table 2: Patient's feeling during the process of bowel preparation

Items	WeChat group	Control group	P
Sleep quality, *n*			
Same	378	288	0.031
Worse than usual	133	219	
SAS score, mean ± SD	31.58 ± 8.89	49 ± 7.12	0.044
Incomplete compliance, *n*			
Not split-dose	1	15	0.021
Incorrect diet restriction	16	36	
Drinking <80% dose	9	22	
Adverse events, *n*			
Nausea/vomiting	52	69	0.034
Abdominal pain	11	24	
Abdominal bloating/discomfort	57	73	
Other	24	37	
VAS of pain, mean ± SD	3.32 ± 1.40	4.39 ± 1.93	0.041
Willingness to repeat bowel preparation, *n* (%)	363 (71.0)	264 (52.1)	0.013

SAS: Self-rated anxiety scale; SD: Standard deviation; VAS: Visual analogue scale.