ORIGINAL RESEARCH

A Novel Text Message Protocol to Improve Bowel Preparation for Outpatient Colonoscopies in Veterans

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Background: The current gold standard for screening for colorectal cancer is colonoscopy, a procedure that depends on the quality of bowel preparation. In 2016, the Veterans Health Administration introduced Annie, a text message service to improve health care communication with patients. The Minneapolis Veterans Affairs Medical Center conducted a prospective, single center study to measure the impact of Annie text messaging on patient satisfaction and quality of bowel preparation for patients undergoing outpatient colonoscopy.

Methods: Patients undergoing colonoscopy were divided into 2 groups. The control group received standardized patient education and a phone call prior to procedure. The intervention group, consisting of all patients who agreed to enroll, received a 6-day Annie text messaging protocol consisting of key bowel preparation steps that started 5 days prior to their scheduled procedure. Bowel preparation quality was measured using the Boston Bowel Preparation Scale (BBPS) score.

Results: During the study period, 688 veterans were scheduled for outpatient colonoscopy: 484 veterans were in the control group, 204 veterans were in the intervention group, and 126 were surveyed. Annie text messaging instructions were associated with a higher BBPS score (8.2) compared with usual care (7.8); *P* = .007 using independent *t* test, and *P* = .002 using parametric independent *t* test. Patients also reported satisfaction with the Annie text messaging service.

Conclusions: There was a statistically significant improvement in the average BBPS score in veterans receiving Annie text messages compared with the routine care control group for outpatient colonoscopies.

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Colorectal cancer is the third leading cause of cancer-related death in both men and women.[1] Colonoscopy is the current gold standard for screening due to the ability to remove precancerous lesions but remains highly dependent on the quality of bowel preparation.[2] Poor bowel preparation has been associated with impaired adenoma detection as well as increased health care utilization due to the need for a repeat colonoscopy.[3]

Multiple patient factors are associated with increased risk of poor bowel preparation, including age > 60 years, male sex, diabetes mellitus, and presence of a mental health diagnosis, factors that are prevalent among the veteran population.[3-5] Text messages have been shown to improve the quality of bowel preparation by increasing patients' understanding and adherence with the preparation process. Improved adherence with bowel preparation directions is associated with a cleaner colon prior to colonoscopy, leading to a thorough examination. Studies using text messaging instructions prior to colonoscopies have also shown measurable improvement in adenoma detection rate, patient preparation-associated discomfort, and completion of colonoscopy.[6-10]

In 2016, the Veterans Health Administration (VHA) introduced Annie, one of the first automated text messaging services, named after Army Lieutenant Annie Fox, the first woman to receive the Purple Heart for combat. The Annie platform allows for notifications, instructions, and simple data collection. The development of this platform allows VHA practitioners to engage and educate veterans in a similar way to other health care systems using text messaging protocols. Annie text messages have been piloted for the use of hepatitis C treatment, demonstrating promise of improved medication adherence and patient satisfaction.[11] We aimed to develop and pilot the Annie bowel preparation protocol to improve the quality of colonoscopy bowel preparation for outpatients at the Minneapolis Veterans Affairs Medical Center (MVAMC) in Minnesota. A secondary goal included measuring patient satisfaction with the text messaging instructions for outpatient colonoscopy preparation.

METHODS

We conducted a single center, prospective, endoscopist-blinded, study with two 3-month long Plan-Do-Study-Act (PDSA) cycles to improve the text messaging bowel

TABLE 1 Veteran Demographics for PDSA 1 and 2

Variables	Total (N = 640)	Control group (n = 453)	Annie group (n = 187)	*P* value
Demographics				
Male sex, No. (%)	612 (95.6)	432 (95.4)	180 (96.3)	.62[a]
Age, mean (SD), y	65.7 (9.5)	66.3 (9.7)	64.2 (9.1)	.009[b]
Age > 60 y, No. (%)	491 (76.7)	357 (78.8)	134 (71.7)	.05[a]
White race, No. (%)	549 (86.5)	396 (87.8)	153 (83.2)	.12[a]
Comorbidities				
Prior abdominal surgery, No. (%)	166 (25.9)	117 (25.8)	49 (26.2)	.29[a]
Impaired mobility, No. (%)	73 (11.4)	55 (12.1)	18 (9.7)	.37[a]
Body mass index, mean (SD)	31.6 (6.4)	31.5 (6.4)	32.0 (6.5)	.33[b]
Body mass index > 25, No. (%)	538 (86.6)	375 (86.0)	163 (88.1)	.48[a]
Diabetes mellitus, No. (%)	184 (28.8)	133 (29.4)	51 (27.3)	.56[a]
Stroke, No. (%)	20 (3.1)	12 (2.7)	8 (4.3)	.28[a]
Dementia, No. (%)	17 (2.7)	11 (2.4)	6 (3.2)	.58[a]
Any neurologic diagnosis, No. (%)	43 (6.7)	27 (6.0)	16 (8.6)	.23[a]
Mental health diagnosis, No. (%)	346 (54.1)	228 (50.3)	118 (63.1)	.003[a]
Cirrhosis, No. (%)	27 (4.2)	22 (4.9)	5 (2.7)	.21[a]
Medications				
Tricyclic antidepressants, No. (%)	18 (2.9)	13 (3.0)	5 (2.7)	.87[a]
Narcotics, No. (%)	60 (9.6)	41 (9.3)	19 (10.3)	.70[a]
Polypharmacy (> 8), No. (%)	230 (36.9)	158 (35.9)	72 (39.1)	.45[a]
No., mean (SD)	7.7 (5.6)	7.8 (5.6)	7.7 (5.5)	.90[b]

Abbreviation: PDSA, Plan-Do-Study-Act.
[a]Pearson χ^2.
[b]2-sample *t* test.

preparation protocol at MVAMC between January 2019 and April 2020. The MVAMC Institutional Review Board determined the quality improvement project was exempt. Veterans who had outpatient colonoscopies scheduled were included. Veterans undergoing inpatient colonoscopies or outpatients who could not be reached to obtain informed consent, lacked text message capability, declined participation, or required extended colonoscopy preparation were excluded. Per MVAMC procedures, extended colonoscopy preparation was provided to patients receiving general or monitored anesthesia care, with a history of poor bowel preparation, or with risk factors for poor preparation as determined by the ordering health care professional (HCP). Standard bowel preparation involves ingestion of 4 L of polyethylene glycol 3350 with electrolytes; extended bowel preparation requires ingestion of an additional 2 L to total 6 L and uses a different set of instructions. Additionally, the patient population requiring extended bowel preparation also includes patients with spinal cord injuries, who often are admitted for assistance with extended preparation. Patients who consented to receiving text messages were placed in the Annie intervention group, and all others were placed in the control group.

The control group received standardized patient education, including a mailed copy of bowel preparation instructions and a phone call from a gastroenterology service nurse about 1 to 2 weeks before the procedure. Current MVAMC standard of care involves a phone call from a nurse to confirm that patients have received the polyethylene glycol preparation solution, the mailed instructions, have an escort and transportation, and to answer any questions. Both the usual care and intervention group received the phone call. During this call, the Annie text messaging bowel preparation protocol was introduced; if the veteran chose to participate, consent and enrollment were completed. At enrollment, patient information was manually extracted from the Computerized Patient Record System (CPRS) and entered into Annie. A brief consent note was entered in the patient's chart acknowledging that text messages are a one-way communication and standard payment rates apply. The intervention group received a 6-day Annie text messaging protocol consisting of key standard bowel preparation steps that started

TABLE 2 Postprocedure Patient Satisfaction Survey Results

Variables	Total	PDSA 1	PDSA 2	*P* value
Survey method, No. (%)	126	90	36	
In-person staff administered	36 (28.6)	24 (26.7)	12 (33.3)	
Telephone	63 (50)	51 (56.7)	12 (33.3)	
Self-administered	27 (21.4)	15 (16.7)	12 (33.3)	
Would receive text messages again, No. (%)	123	89	34	
Yes	115 (93.5)	81 (91.0)	34 (100)	.07[a]
No	8 (6.5)	8 (9.0)	0 (0)	
Text messages were helpful, No.	124	89	35	
Mean (SD)[c]	8.2 (2.4)	7.8 (2.5)	9.1 (1.6)	.001[b]

Abbreviation: PDSA, Plan-Do-Study-Act.
[a]Pearson χ^2 test.
[b]2-sample *t* test.
[c]10-point scale: 1 (not helpful) to 10 (extremely helpful).

5 days before the scheduled procedure. Details of the text message script are available in the Appendix.

On the day of the colonoscopy, veterans in the intervention group were surveyed in the waiting room about their experience receiving the text messages and soliciting feedback for improvement or surveyed via telephone call within 3 days of their procedure. Patient satisfaction was quantified with a scale from 1 (low) to 10 (high), including questions about how helpful the texts were in relation to total number, timing, and content of messages as well as whether veterans would like to receive the text messages again for future procedures.

We reviewed individual charts and collected Boston Bowel Preparation Scale (BBPS) scores to determine adequate preparation. BBPS assigns a score of 0 to 3 for the right, transverse, and left colon applied upon withdrawal after flushing and suctioning have been completed.[12] Adequate preparation is considered a total score of ≥ 6 with no segment scoring < 2. This method of preparation assessment is preferred due to its ability to account for difference in preparation quality among colonic segments, well-defined scoring characteristics, and several studies validating its use showing inter- and intraobserver reliability.[12] Follow-up studies have shown validity of the BBPS when compared with relevant outcomes such as polyp detection rate and recommended timing for repeat procedure.[13] Variables associated with poor bowel preparation (ie, gender, prior abdominal surgery, impaired mobility, high body mass index, diabetes mellitus, stroke, dementia, any neurologic diagnosis, cirrhosis, smoking, polypharmacy [> 8 active medications], and narcotic or tricyclic antidepressant medication use) were also collected through chart review.[3-5] We note that immobility was defined by *International Classification of Diseases* (*ICD*)*-9* and *ICD-10* codes and prescriptions for assistive devices (ie, canes, wheelchairs, 4-wheeled walkers).

Veterans assent to be enrolled in Annie. After enrollment, veterans must text back a specific word response to an initial text message to receive the protocolized messages from the Annie program. A contact phone number to the gastrointestinal nurse line was provided for questions during business hours. The start date for the text message protocol is 6 days prior to the procedure date. If a patient rescheduled their colonoscopy, the Annie database was updated manually.

Statistical Analysis

We used both Pearson χ^2 test and 2-sample *t* test analyses to compare demographic information and patient satisfaction scores between the control and intervention groups. We compared continuous BBPS scores between Annie intervention vs control group using parametric and nonparametric independent *t* tests using the Mann-Whitney U test. We repeated this analysis controlling for both mental health diagnoses and age using linear regression. We were unable to survey 61 of the 187 veterans who received Annie text messages.

RESULTS

During PDSA cycles 1 and 2, 640 veterans were scheduled for outpatient colonoscopy: 453 veterans were in the control group; 187 veterans were in the intervention group, of which 126 were surveyed. A significant percentage of veterans declined participation because they felt like they did not need reinforced education; others were not eligible for Annie due to requirement for extended bowel preparation, cancelled colonoscopy, inability to physically read text messages, or lack of cell phone.

The mean (SD) age was 65 (8) years; 184 (28.8%) had a diabetes mellitus

diagnosis, and the mean (SD) body mass index was 31.6 (6.4). The Annie group was slightly more likely to have mental health diagnoses and lower age compared with the control group (Table 1). Annie text messaging instructions were associated with a higher BBPS score (8.2) compared with usual care (7.8); *P* = .007 using independent *t* test, and *P* = .002 using parametric independent *t* test. Differences between Annie and control groups remained significant after controlling for age and mental health diagnoses (*P* = .04)

Patient Feedback

We collected feedback from veterans after each PDSA cycle to identify areas for improvement by both in-person and telephone surveys. Based on feedback from PDSA cycle 1, we decreased the total number of text messages to create a more succinct set of instructions. The most frequently requested change involved timing the text messages to align with the exact morning a specific instruction should take place.

Patient satisfaction with the Annie text messaging service was high. All veterans from PDSA cycle 2 wanted to receive the text messages again for future procedures, a significant improvement from PDSA cycle 1 (Table 2). Veterans most appreciated the factors of convenience and brevity; they felt much pride that their VA was making technologic advancements.

DISCUSSION

To our knowledge, this is the first report of using Annie at a VAMC for colonoscopy bowel preparation improvement. We found a statistically significant improvement in the average BBPS in those receiving Annie text messages compared with the routine care control group. We also found high levels of patient satisfaction with most patients requesting to receive them again for future procedures.

The clinical significance of a BBPS of 7.8 vs 8.2 is unclear, although any score > 6 is considered to be adequate. However, subjectively speaking, the higher the BBPS the cleaner the colon, and theoretically the easier it is to see small or flat polyps. Future steps could include calculating adenoma detection rates for those enrolled in the Annie program vs the control group.

We have received inquiries regarding potential program implementation at other facilities. Success and sustainability of the program will require long-term commitment and ideally protected time for staff. It is helpful to remember that for each person who chooses to enroll in the intervention, the program currently requires that a brief consent note is placed in the patient's chart. Thus, depending on the facilities' resources, it is ideal for one staff member to be the designated lead to help oversee, troubleshoot, and train additional personnel. Surveys can be intermittently used to obtain feedback for improvement but are not required for sustainability.

Automated text messaging is a promising addition to medicine for clinical education and communication. Future studies should examine the clinical significance (ie, adenoma detection rates) of text messaging bowel preparation protocols.

Limitations

Our study has several limitations. First, this was a single center study, thus generalizability is limited. MVAMC represents a predominantly White, male, and rural population. Second, data are likely an underestimation of the true impact of intervention, because results do not account for patients who were turned away on day of procedure (typically still reporting brown stools at time of check-in for procedure) due to poor preparation or aborted procedures secondary to poor preparation. Only about one-third of the 640 veterans opted to receive Annie text messages.

Studies have shown veterans are willing to use technology for health care; however, access to technology and lack of training remain barriers to use.[14] This has been most robustly studied at the VA in veterans experiencing mental illness and homelessness. Targeted strategies to improve veteran adoption of technology within their health care include supplying veterans with cell phones and paid data plans and providing training on specific technology-based resources.[15-17]

Future improvement for the Annie platform should include improved integration with CPRS. Integration will facilitate automatic import of key information such as mobile phone number or colonoscopy

procedure date. Unfortunately, this is not currently an automated process, and the manual workload of staff limits sustainability. Since our study ended, the Annie database now allows an "event date" to be programmed in to center the text message series around. This will be entered at the time of Annie enrollment and eliminate manual activation of the protocol. The issue of updating information for rescheduled procedures remains.

CONCLUSIONS

There is increasing evidence that automated text messaging is a promising addition to medicine for clinical education and communication. It continues to gain traction as a readily available and acceptable option, and many patients are willing to incorporate the technology platform into their care plan. We found high patient satisfaction with our protocol, and Annie patients had cleaner bowel preparations compared with control patients. Our study supports the use of text message reminders as an effective intervention for improving patient adherence with bowel preparation instructions. We suspect that creation of a text messaging protocol designed for patients requiring outpatient extended bowel preparation will yield great benefit. As technology continues to improve, future implementation of Annie text messaging will become increasingly seamless within the field of gastroenterology and beyond.

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Disclaimer

The opinions expressed herein are those of the authors and do not necessarily reflect those of *Federal Practitioner,* Frontline Medical Communications Inc., the US Government, or any of its agencies.

Ethics and consent

The study was deemed exempt by the Minneapolis Veterans Affairs Medical Center Institutional Review Board.

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APPENDIX Text Message Script for PDSA Cycles 1 and 2

CYCLE 1

DAY 1

8:00AM Annie here! You will be receiving text messages with your prep instructions for your upcoming colonoscopy. If you have any questions, please call [number].
8:30AM Annie here! If you have not received your prep instructions, call [number] and leave a message with your name, last 4 of social, and a return phone number.
9:00AM Follow the mailed instructions carefully & use the text instructions as reminders. A good bowel prep is needed to examine your colon completely. Thanks. Annie

DAY 2

8:00AM If you take a blood thinner medication (warfarin/Coumadin/Plavix/clopidogrel), call your practitioner to see if it can be stopped 5 days before your exam. Thanks. Annie
8:30AM If you have diabetes & usually check your blood sugar, you may need to check it more frequently while taking the prep. Have a great day. Annie
9:00AM Annie here! The day of your colonoscopy you must bring an adult with you to drive you home or ride with you on public transportation, including the county van.

DAY 3

8:00AM Bring your adult driver with you to the clinic. If you come to the clinic without another adult, your exam will be cancelled. All the best. Annie
8:30AM Annie here! To prepare for your upcoming colonoscopy, if you take iron and/or fiber supplements, stop taking them 5 days before the colonoscopy.
9:00AM Annie here! Start a low fiber diet 3 days before the exam. Avoid raw fruits/vegetables, whole wheat/high fiber foods, popcorn, salad greens, nuts/seeds, and beans.

DAY 4

8:00AM Start a clear liquid diet at noon 2 days before your exam. No red liquids or red Jell-O. Thanks . Annie
8:30AM Annie here! Food allowed: clear juice (apple/white grape), clear broth, hard candy, fruit ice, coffee/tea (no milk/creamer), fruit ice, clear sodas, regular gelatin.
9:00AM Foods not allowed: any whole or solid foods, juices with pulp or nectars, alcoholic beverages, or milk and dairy products. Thank you. Annie

DAY 5

8:00AM Annie here! Continue the clear liquid diet until 2 hours before the exam. Drink 8 to 10 glasses of clear liquids throughout the day & evening. No red liquids.
8:30AM Annie here. Start drinking Golytely at 6pm THE DAY BEFORE YOUR EXAM. Fill the gallon jug with water to the fill line and shake until powder is dissolved.
9:00AM Hi, Annie here! When drinking Golytely (Colyte), take 1 glass every 10 minutes until ½ gallon is gone— this will take 1 hour.

DAY 6

8:00AM It's Annie again. SAVE THE OTHER ½ GALLON OF PREP to drink over 1 hour the day of your exam, finishing it exactly 6 hours BEFORE your exam time.
8:30AM Annie here! The morning of exam, take daily meds with water. If you take insulin/diabetes meds, hold the morning dose until after the procedure & check your blood sugar.
9:00AM Hi, you're doing great! Don't drink anything 2 hours before your exam. Annie

DAY 7

8:00AM Annie here! Your exam is at [location] at [time]. Check your appointment date and time. Call [number].
8:00AM Annie here! Your exam date is [date, time] at the [place]. Please call [number] if you have questions.

CYCLE 2

DAY 1

You will receive text messages for your prep instructions for your upcoming colonoscopy. If you did not receive your prep instructions, call [number]. Thanks, Annie

Follow the mailed instructions carefully & use the text instructions as reminders. A good bowel prep is needed to examine your colon completely. Thanks, Annie

DAY 2

If you take a blood thinner medication (warfarin/Coumadin/Plavix/clopidogrel), call your practitioner to see if you can stop 5 days before your exam. Annie

You MUST bring an adult to your exam to drive you home or ride with you on public transportation (including county van) or your exam will be cancelled. Annie

DAY 3

5 days before the colonoscopy, stop taking iron and/or fiber supplements. 3 days before, start a low fiber diet. Refer to paper sheet for foods to avoid. Annie

DAY 4

At 12 noon, 2 days before your exam, start a clear liquid diet. Drink 8 to 10 glasses of clear liquids throughout the day & evening. No red liquids/Jell-O. Annie

DAY 5

Annie here. At 6pm, THE DAY BEFORE YOUR EXAM, start drinking Golytely. Fill the gallon jug with water to the fill line and shake until the powder is dissolved.

Hi, Annie here. When drinking Golytely, take 1 glass every 10 minutes until 1/2 gallon is gone—this will take 1 hour.

DAY 6

It's Annie again. SAVE THE OTHER 1/2 GALLON OF PREP, you will drink it over 1 hour the day of your exam, finishing it exactly 6 hours BEFORE your exam time.

Annie here. The morning of exam, take daily meds with water. If you take insulin/diabetes medications, hold the morning dose until after the procedure & check your blood sugar.

DAY 7

Don't eat or drink anything 2 hours before your exam, at [place]. Check your appointment time. Call [number] if you have questions. Annie

Abbreviation: PDSA, Plan-Do-Study-Act.