

Supplementary material

Supplementary Table 1 Squires 2.0 Checklist

Title and Abstract	
1. Title	Patient-Centered Approaches to Targeting Incomplete Bowel Preparations for Inpatient Colonoscopies
2. Abstract	<p>Background: A high-quality colonoscopy bowel prep is vital to completing the procedure. Adequate inpatient bowel preparation has been consistently difficult to achieve because of multiple factors. Incomplete bowel prep can lead to repeated colonoscopies, poor patient experience, increased costs, and prolonged hospitalization. This study aimed to develop patient-centered interventions to optimize bowel prep for inpatients undergoing colonoscopy</p> <p>Methods: The Model for Improvement and Donabedian frameworks guided this project. An interdisciplinary team compiled quality improvement tools that identified areas for improvement. Interventions development included a nursing tip sheet for troubleshooting symptoms, a standardized order label and a patient educational placemat. Plan-Do-Study-Act (PDSA) cycles were carried out to test and analyze the effects of the interventions. The project aim was a 30% reduction in incomplete inpatient colonoscopies from poor bowel prep. Process measures included the number of colonoscopy split prep order labels, and placemats used. The balancing measure was the number of repeat colonoscopies.</p> <p>Results: Prior to the intervention, 44% (44/99) of inpatient colonoscopies had poor bowel prep resulting in 10 repeat procedures (10%). Post intervention, 60% (28/47) of the colonoscopies used the standardized label, 66% of physician orders used 2-L split prep, and 80% of patients were provided with the educational placemat. Of the 47 colonoscopies audited post intervention, there was a significant decrease in poor prep (27.7% [13/47], $P=0.038$) for colonoscopies. The percentage of repeated colonoscopies decreased to 4% (2/47).</p> <p>Conclusion: Developing simple and easy-to-use patient-centered interventions can effectively improve colonoscopy preparation for hospitalized patients.</p>
Introduction	
3. Problem Description	In a randomized chart audit conducted from November 2018 to March 2019, we found that 34% (44/128) of all inpatient bowel preparations were rated as poor and 14 colonoscopies were repeated (11%; 14/128).
4. Available Knowledge	Poor-quality inpatient bowel preparation for colonoscopy has been well described and occurs in up to 50% of procedures
5. Rationale	The Model for Improvement and Donabedian conceptual evaluation framework guided this project. With the multidisciplinary team, and mapping we found three areas for improvement. Through surveys of physicians, nurses and patients and using outpatient colonoscopy booklets we created the three interventions for ease of education delivery and reassurance of proper split prep to be ordered.
6. Specific Aims	The aim of this quality improvement (QI) project was to decrease the number of incomplete inpatient colonoscopies as a result of poor bowel preparations, and to improve patient preparation experience through simple and easy-to-use interventions.
Methods	
7. Context	The ward targeted was the GI ward, where they are used to prepping patients for colonoscopy. Moreover, chart review and mapping found areas specific to the UAH where areas could be improved upon.
8. Interventions	<p>-A bowel preparation order label for a 2 L split prep of Golytely® was created to promote order consistency to international standards.</p> <p>-A patient educational paper “placemat” was developed to facilitate standardized education about colonoscopy preparation, including a self-tracking section with the paper placemat placed on the patient’s bedside table during bowel preparation. This tool was initially pilot tested with 6 patients and the feedback obtained was incorporated, resulting in a revised placemat.</p> <p>-To support nursing education a “Nursing Tip” sheet was created to provide strategies for patients who were having difficulty consuming the preparation fluid [Fig. 2]. Two unit managers helped design the nursing tip sheet based on issues that nurses commonly reported.</p>
9. Study of the Interventions	Plan-Do-Study-Act cycles were carried out to test and analyze the effect of the interventions. Surveys pre- and post-intervention were used to assess the attitudes of stakeholders.
10. Measures	The outcome measure was a 30% reduction in incomplete inpatient colonoscopies. The process measures included the monthly number of colonoscopy order labels and placemats used. The balancing measure was the number of repeated colonoscopies.
11. Analysis	Data were collected for analysis through retrospective chart audits, nursing notes, and colonoscopy reports. In addition, surveys were developed on a 5-point Likert scale and completed by patients, physicians and nurses to determine the feasibility and satisfaction of each intervention. Differences between pre- and post-intervention in the quality of preparation for colonoscopies were compared by Fischer’s Exact Test. Charleston Comorbidity Index score and Schmid Fall Risk score between poor and well prepped patients in the post intervention group were compared using the Mann–Whitney U Test. All statistical analysis was conducted with IBM SPSS v26.

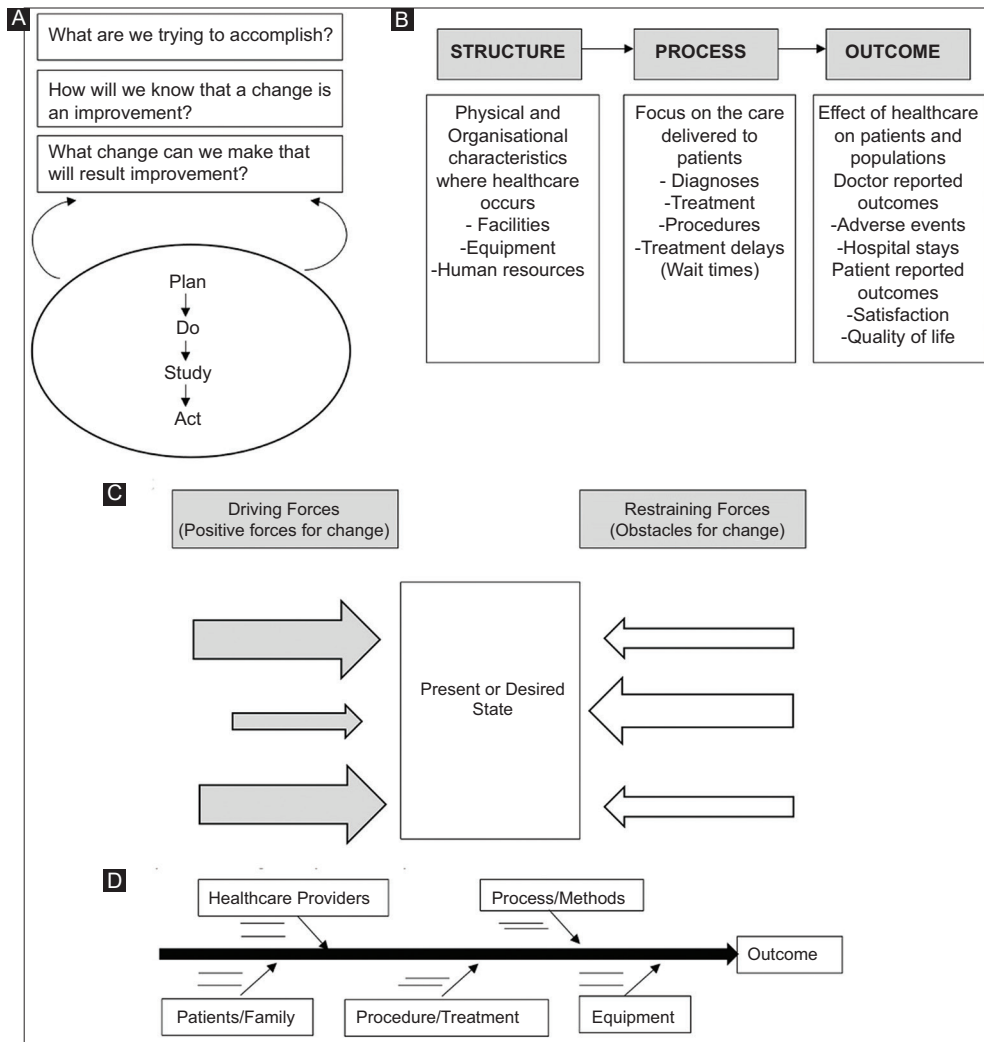
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Supplementary Table 1 (Continued)

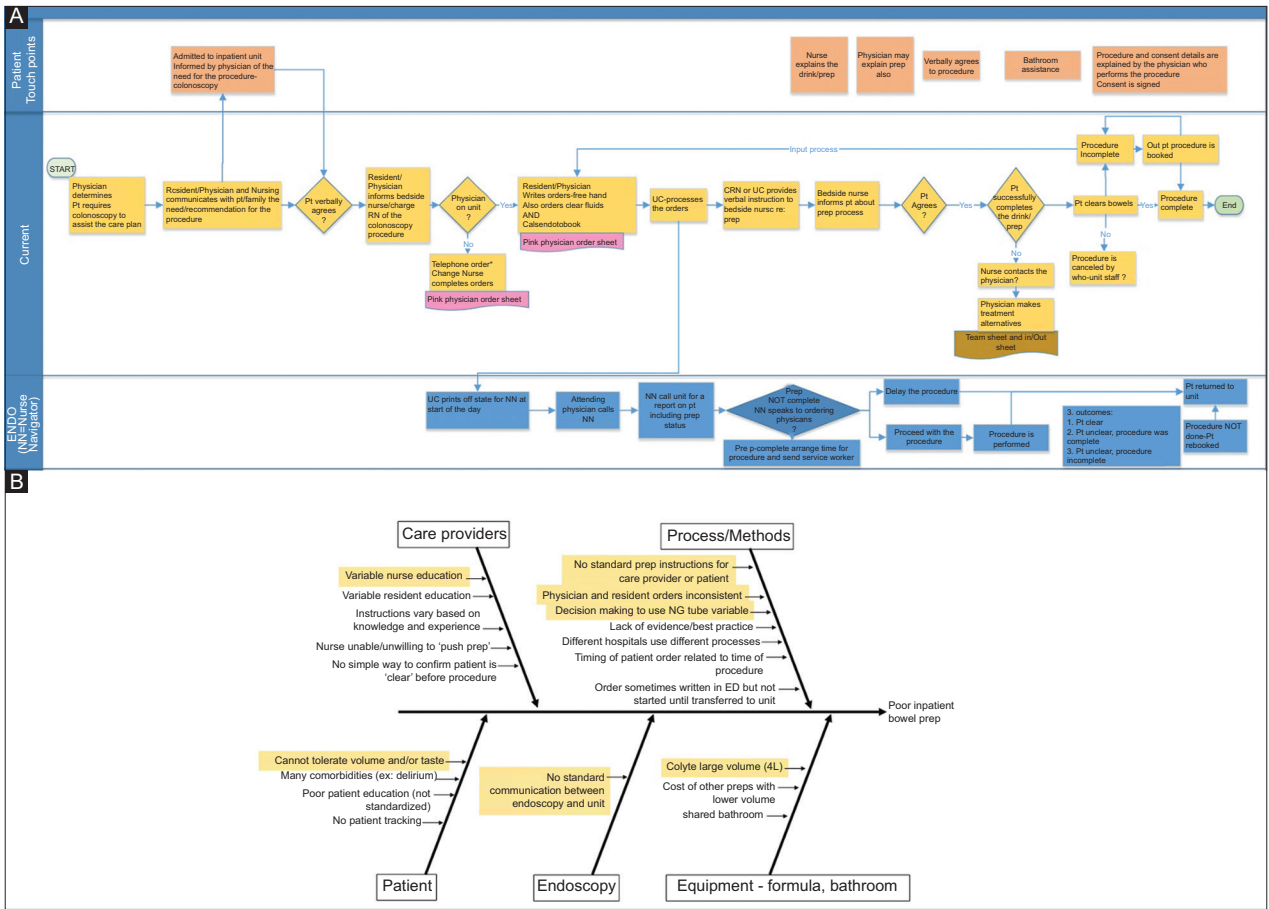
Title and Abstract	
12. Ethical Considerations	We completed the ARECCI ethics screening tool and the score was “minimal risk”; thus, no formal ethics board review was required as per local organizational policies.
Results	
13. Results	<p>A total of 128 colonoscopies were audited prior to intervention and 66 colonoscopies post intervention. After removal of those with no comments on colonoscopy prep on the procedure notes, 99 colonoscopies prior to intervention and 47 colonoscopies post intervention were analyzed. Prior to the intervention, 44% (44/99) of inpatient colonoscopies reported poor prep, resulting in 10 repeat procedures (10%; 10/99). Of the repeated procedures, the most common indication for colonoscopy was lower GI bleeding (4/10) and the most common reason for repeated colonoscopy was poor prep (8/10 repeated procedures). The interventions did not have to be adjusted during the PDSA cycles.</p> <p>Post intervention, approximately 60% (28/47) of the colonoscopies used the standardized order label and 66% (31/47) of physician orders used the 2-L split prep. A total of 80% of patients were provided with the placemat at their bedside. Of the 47 colonoscopy reports audited post intervention, 27.7% (13/47) had poor bowel prep and 72.3% (34/47) had good prep. There was a significant reduction in poor bowel preparation compared to pre intervention (P=0.038).</p> <p>As regards the balancing measure, there was a reduction in the number of repeat colonoscopies from 10% (10/99) to 4% (2/47). Notably, only 1/2 repeated colonoscopies post intervention was due to poor prep, compared to 8/10 of the repeated procedures prior to the intervention (P=0.27). Lower GI bleeding was the most common indication for colonoscopy in the patients who had poor preparation but did not have a repeat colonoscopy.</p> <p>There was no significant difference in Charleston comorbidity index scores, age or Schmid Fall Risk scores between patients with good or poor bowel preparation or pre/post intervention. However, on subgroup analysis comparing good and poor bowel preparation either pre or post PDSA intervention, there were significantly more men with poor preparation in the pre-PDSA group (P=0.029) and significantly higher Schmid Fall Risk Score for patients with poor preparation in the post-PDSA group (P=0.048) [Table 3]. A total of 59% of the surveyed patients found the placemat helpful, 100% of surveyed physicians indicated that they would use the standardized label, and 100% of surveyed nurses perceived the nursing tips sheet to be helpful.</p>
Discussion	
14. Summary	<p>The introduction of standardized label, nursing tip sheet and patient educational placemat led to a significant decrease in poorly prepared colonoscopies.</p> <p>Strengths of this project include the extensive pre-project information gathering to contextualize the problem of poor bowel preparation through surveys and chart audits. In addition, using a multidisciplinary team of physicians, nursing staff, managers and a QI specialist allowed for various perspectives and experiential knowledge to be shared regarding inpatient bowel preparation. In addition, our target unit was the GI unit, which has more patients who require colonoscopy compared to other units, and where staff are more knowledgeable about this procedure than those in other units, such as internal medicine or cardiology</p>
15. Interpretation	Implementing patient-centered education tools led to a decrease in colonoscopies with poor prep. Similar results have been reported with other educational tools.
16. Limitations	Study limitations included a non-validated survey, the absence of bowel preparation rating in the colonoscopy reports, as 27% did not comment on the prep, and the lack of a pre-intervention patient satisfaction survey. In addition, we measured whether the placemat was given or not and surveyed whether patients found it helpful; however, we did not evaluate any teaching the nurses provided around the placemat
17. Conclusions	<p>Future studies will focus on the sustainability of the placemat for hospitalized patients, the nursing tip sheet, as well as cost analysis. The UAH will implement an electronic medical record, therefore the bowel preparation physician order will become automated and standardized at the 2 L split prep.</p> <p>We anticipate that these interventions can be easily adopted by other hospital units with less experience regarding colonoscopy bowel preparation. The placemat is easy to read for both patients and nursing staff and is inexpensive to distribute. In addition, prior literature on optimizing colonoscopy preparation has all highlighted education as a key and beneficial factor to support bowel preparation. By implementing these interventions, we can improve both patient experience and health outcomes for the hospitalized patient population undergoing colonoscopy.</p>
Other Information	
18. Funding	This work was supported by Alberta Health Services Quality Innovation Fund

Supplementary Table 2 Carlson Comorbidity score [10] and Schmid Fall risk score [11]

Score	Carlson Comorbidity Score	Schmid Fall Risk Score
Components	Age- -50-59 (1) -60-69 (2) -70-79 (3) ->80 (4) 1- -Myocardial infarction -Congestive heart failure -Peripheral vascular disease -Dementia -Cerebrovascular disease -Chronic lung disease -Connective tissue disease -Ulcer -Chronic liver disease 2- -Hemiplegia -Moderate/severe kidney disease -Diabetes -Diabetes with complications -Tumor -Leukemia -Lymphoma 3- Moderate or severe liver disease 6- -Malignant tumor -Metastasis -AIDS	Mobility -Ambulates with no gait disturbance (0) -Ambulated or transfers with assistive devices (1) -Ambulated with unsteady gait and no assistance (1) -Unable to ambulate or transfer (0) Mentation -Alert, orientated X3 (0) -Periodic confusion (1) -Confusion at all times (1) -Comatose/unresponsive (0) Elimination -Independent in elimination (0) -Independent with frequency or diarrhea (1) -Needs assistance with toileting (1) -Incontinence (1) Prior Fall History (within 6months) -Yes (before admission) (1) -Yes (During admission) (2) -No (0) -Unknown (0)
Interpretation	Higher score equates to higher estimated 10-year mortality	Score 3 or more: Patient at risk for falls and fall prevention interventions should be implemented



Supplementary Figure 1 (A) Model for improvement- Adapted from Langley *et al* [8]. (B) Donabedian's framework for health care improvement- Adapted from Donabedian [9]. (C) Force field analysis indicating driving and restraining forces contributing to present or desired state. The size of the arrow for a specific force indicates the strength of that force's contribution. (D) Fishbone analysis provides a pictorial view of the key stakeholders, equipment and process measures that contribute to an outcome of interest. The goal of fishbone analysis is to identify areas to target for possible improvement



Supplementary Figure 2 (A) Process mapping of inpatient colonoscopy prep for this project. (B) Fishbone analysis of this project

Inpatient Bowel Prep Project Survey - Nursing

How easy is it to understand and follow colonoscopy prep orders?

1 2 3 4 5
Not easy Very easy

How comfortable are you explaining and education patients on prep?

How do you document how much prep a patient has taken?

Teamsheet
 Verbal communication
 Nursing notes
 No where
 Other

If chose other, please specif method used:
Your answer _____

Do you know what to do if your patient is having a hard time prepping? (ie. nauseous, non-compliant, elderly, confused, etc.)

1 2 3 4 5
I don't know I definitely know

Did you find the placemat helpful to deucate the patient?

1 2 3 4 5
Not helpful Very helpful

How likely are you to use placemat resource in the future?

1 2 3 4 5
Very unlikely Very likely

Did you use the Bowel prep 'Tips' sheet?

Yes
 No

Did you find the Bowel prep 'Tips' sheet helpful?

1 2 3 4 5
Not helpful Very helpful

Inpatient Bowel Prep Project Survey - Patients

To improve our services, we would like your feedback regarding your bowel prep experience. We value your honest response. The information will be used for improvement purposes only. The survey should take approximately 3 minutes to complete. Your responses will be kept confidential and completely anonymous.

Do you agree to participate?

Yes
 No

Date
Day, month, year

Have you had a colonoscopy before?

Yes
 No

If yes, how many colonoscopies have you had?
short-answer text

How clearly did you understand the bowel prep process?

Clearly
 Somewhat clearly
 Unclear

Did you refer to the placement information during the bowel prep process?

Yes
 No

How easy is it to understand and follow the placemat guide?

1 2 3 4 5
Not easy Very easy

Did you that the placemat helped you with the bowel prep?

1 2 3 4 5
Not helpful Very helpful

After reading the placemat, do you understand what "being ready for a colonoscopy" or "being clear" means?

Yes
 No
 Somewhat

Do you think the placemat would be helpful if you needed to have a bowel prep again?

1 2 3 4 5
Not helpful Very helpful

Did you self-track the amount of colyte you drank on the placemat during the bowel prep?

Yes
 No

Did you feel like you were well supported during the bowel prep process?

Yes
 Somewhat
 No

Inpatient Bowel Prep Project Survey - Attending Physicians/Residents

What prep do you order typically?

Split 2L PO QHS and PO QAM
 4L PO QHS 11/20
 Other

If you chose other, please specify below:
Your answer _____

Please explain why this is your preferred prep order:
Your answer _____

Did you find the colonoscopy bowel prep order stiker easy to use?

Yes
 Somewhat
 No

How many pages (from the Unit staff) were received regarding complicated prep/misunderstandings with prep/incomplete prep?

<5
 5-10
 >10

How likely are you to use the colonoscopy bowel prep order sticker if it was available?

1 2 3 4 5
Very unlikely Very likely

Supplementary Figure 3 Surveys used for physicians/residents, nursing staff, and patients