

Evidence-based Standardization of Constipation Management in the Emergency Department: A Quality Improvement Study

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Introduction: Constipation is a common problem in pediatric patients. Abdominal radiographs (AXRs) are frequently obtained in the pediatric emergency department for diagnosis despite their poor reliability to rule out underlying pathology or prognostic ability to determine the degree of constipation. The goal of this quality improvement (QI) initiative was to standardize the diagnosis and management of constipation in the pediatric emergency department and urgent care in patients ages 6 months to 21 years and decrease AXR use by 20% and sustain this reduction for 12 months. **Methods:** This prospective QI project involved a multidisciplinary team at a large urban pediatric tertiary care center. The study team constructed a key driver diagram and identified interventions, such as creating a standardized evaluation and management algorithm for constipation, using free open-access medical education platforms, incorporating the electronic medical record interface, and expanding educational conferences to include standardized approach and discharge instructions for patients with constipation across all acuity levels. The primary measure of AXR utilization was tracked overtime on a statistical process control chart to evaluate the impact of interventions. **Results:** The percentage of visits for constipation that included an AXR decreased from a baseline of 49.6%–37.1%, a 25% reduction. Length-of-stay, return visits within 7 days, and inpatient admissions remained unchanged by the interventions. **Conclusions:** QI methodology successfully decreased AXR utilization in the evaluation of constipation across a broad spectrum of acuity levels. Further interventions may help to decrease the length of stay and further decrease AXR utilization. (*Pediatr Qual Saf* 2021;6:e395; doi: 10.1097/pq9.000000000000395; Published online March 10, 2021.)

INTRODUCTION

Constipation affects nearly 30% of children and leads to an estimated 2.5 million outpatient

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visits annually in the United States.^{1,2} Children with

constipation are 3 times more likely to have emergency department (ED) visits than children without constipation.³ Although the

diagnosis of functional constipation can be made clinically using the Rome IV criteria, providers obtain abdominal radiographs (AXRs) in the pediatric ED (PED) for diagnosis.^{4,5} This practice occurs despite the guidelines for the diagnosis and management of functional constipation published

by the North American and European Societies for Pediatric Gastroenterology, Hepatology and Nutrition, which specifically recommend against the use of AXRs for diagnosis.⁵

The drivers of overuse of AXRs in the PED for the diagnosis of constipation are multifactorial, stemming from provider uncertainty in the diagnosis, atypical presentation of constipation-related abdominal pain, the need to rule-out emergent diagnoses, or the ease and availability of AXRs. A systematic review that examined the diagnostic utility of radiographs found only 2 studies with high-quality methodology. In these, the 95% confidence intervals of the likelihood ratios for AXRs to diagnose constipation included 1.⁶ Thus, the diagnostic value of AXRs is low.

There are potential negative consequences to using AXRs, which may complicate the PED workflow and

lead to an increased length-of-stay (LOS) or healthcare expenditures.⁷ There is also the risk of diagnostic anchoring on constipation if an AXR is performed and reveals a stool load. Freedman et al⁸ reported that in a retrospective cohort study, the use of AXRs was a risk factor for returning to the ED with a missed diagnosis. AXRs may reassure providers but cannot rule out potentially more serious abdominal pathology.⁹ Effective management of constipation also depends on parental education to ensure effective outpatient pharmacologic treatment. This education includes medications, behavioral modifications, and identification of complications. Providing accurate anticipatory guidance and discharge instructions for parents can lead to successful constipation management in children.¹⁰ Therefore, efforts aimed at improving outcomes for pediatric patients with constipation should not only focus on the care provided in the PED and urgent care (UC) settings but should also include appropriate education on outpatient management and follow-up.

The goal of this quality improvement (QI) initiative was to standardize the diagnosis and management of constipation in the PED and UC in patients ages 6 months to 21 years. This QI initiative aimed to decrease the percentage of patients diagnosed with constipation who receive an AXR by 20% within 12 months and sustain this reduction for 12 months. Also, we formed a standardization committee to: (1) facilitate dissemination of constipation evidence-based treatment; (2) standardize pharmacologic treatment; (3) improve family education on outpatient care and return criteria; and (4) decrease unintended variation in care.

METHODS

Setting and Context

We conducted this QI initiative in a large, academic pediatric hospital with 7 sites, including 2 PEDs, 2 hospital-based UCs, and 3 free-standing UCs, with approximately 170,000 total visits annually. All provider levels work at both PEDs, including residents, pediatric emergency medicine (PEM) fellows, general pediatricians, PEM faculty, and nurse practitioners. General pediatricians and nurse practitioners staff the UCs. Patients may self-present to any PED or UC. PED patients triaged at arrival receive an Emergency Severity Index score of 1–5 before a provider assessment. Patients triaged as low acuity by PED nurses may be directed to the hospital-based UCs after initial arrival. Patients in the UC do not receive an Emergency Severity Index at triage but may be transferred to the ED if acuity requires.

Interventions

A multidisciplinary team comprised providers (attending, fellows, clinical staff, and nurse practitioners), nurses, and a pediatric gastroenterologist met to standardize the diagnosis and management of constipation. We developed a key driver diagram to depict our theory for improvement (Fig. 1) and distributed a needs assessment survey via email to all PEM providers to identify practice patterns and perspectives on the utility of AXR for patients with constipation. The results were collected anonymously and used to tailor education and interventions.

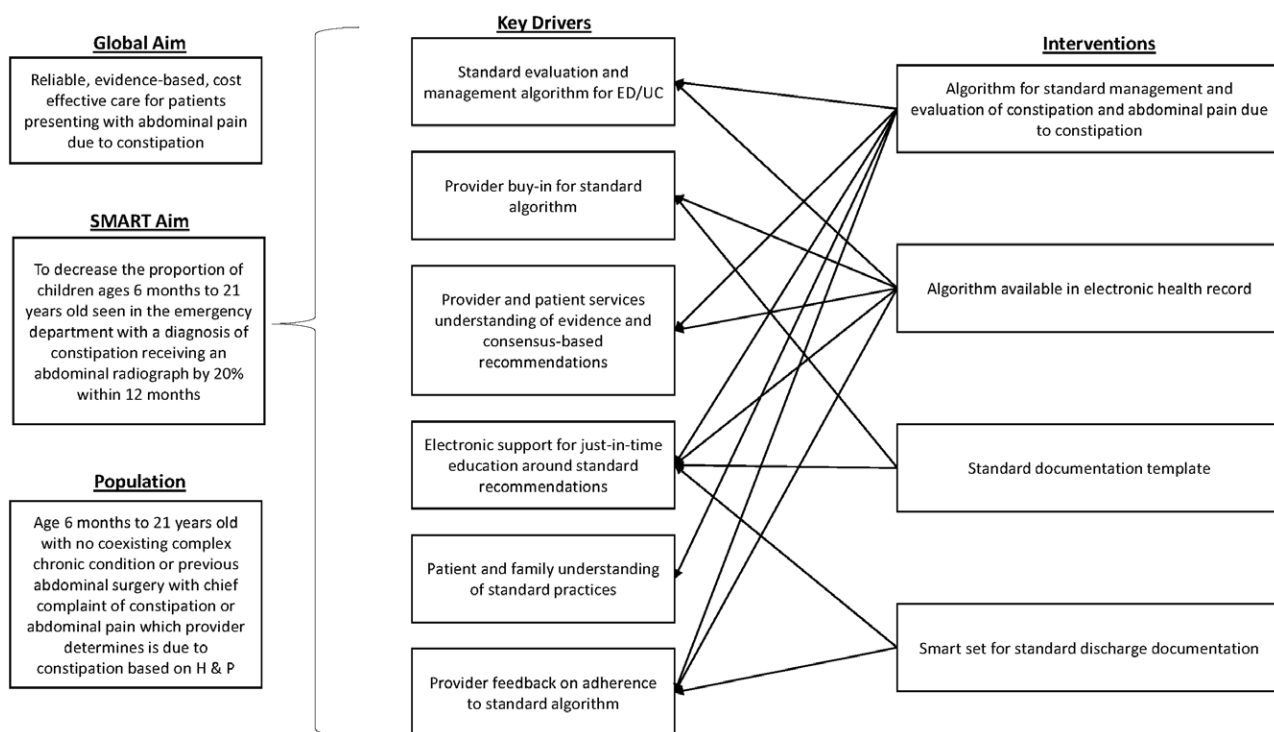


Fig. 1. Key driver diagram.

Theory and Key Drivers

The first key driver focused on developing a clinical algorithm. The team constructed an algorithm to aid providers with essential aspects of the history, physical examination, and red flags when managing a patient with constipation while reminding providers of the poor

utility of AXRs for constipation (Fig. 2). The algorithm provided recommendations for discharged patients, including discharge criteria, outpatient stool cleanout prescription regimens, and anticipatory guidance. If the patient remained in the ED, the algorithm provided management recommendations for patients with severe

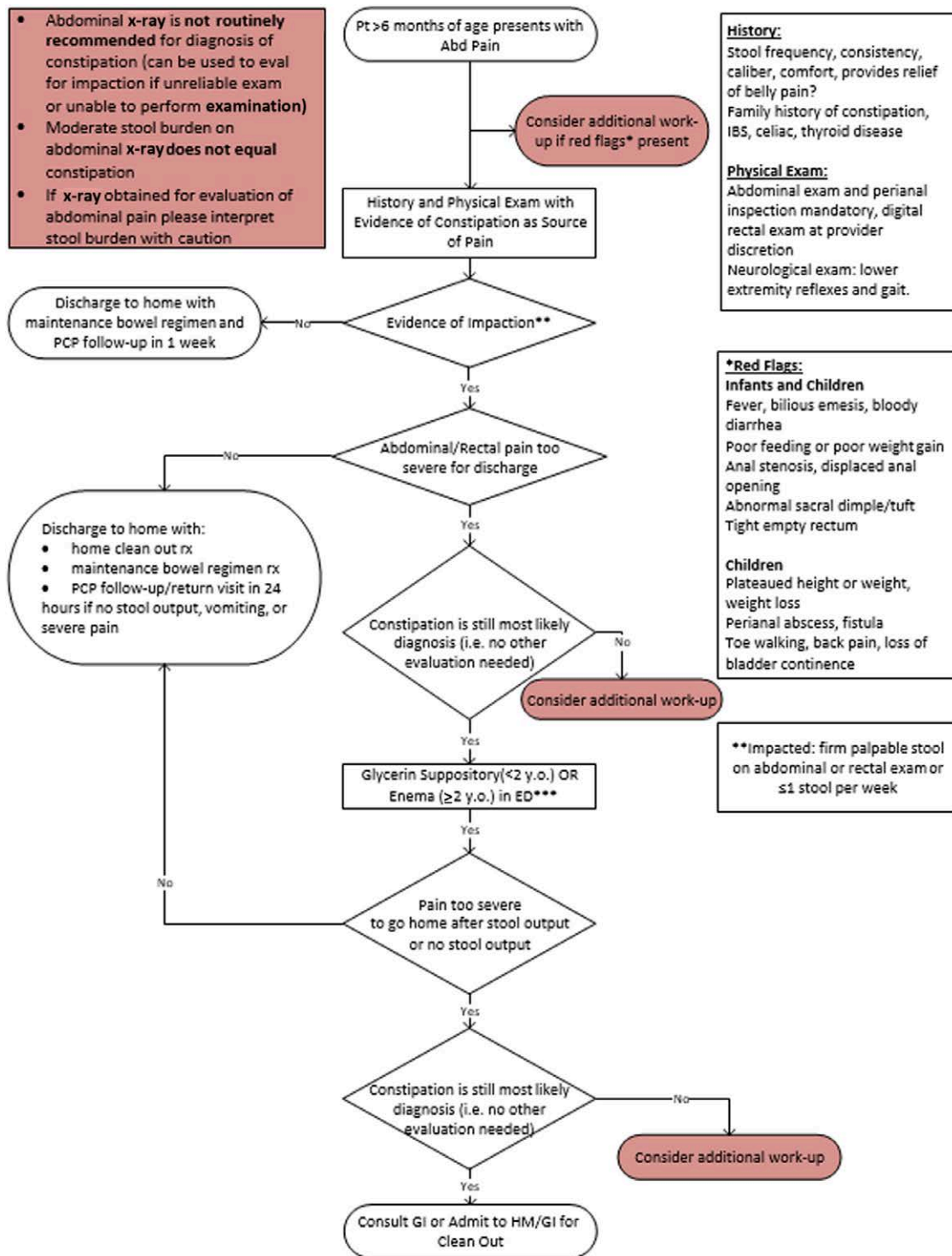


Fig. 2. PED/UC constipation algorithm. *Refers to the red flags noted in the second text box located on the right. **Refers to the definition of impaction. ***This was a separate reminder to providers that patients should not routinely receive medications to aid with enema administration in the emergency department.

pain and/or rectal impaction, and when to consider admission.

The second key driver focused on obtaining provider support for a standardized algorithm. We presented baseline data on the current rate of AXRs at the institution during divisional meetings. The proposed quality initiative was presented at divisional meetings to elicit feedback on the algorithm and implementation.

Dissemination

The third and fourth key drivers focused on the dissemination of consensus-based recommendations to providers. Education was provided to PEM providers starting in January 2019 during monthly divisional meetings and QI updates. Team members educated PEM providers on the recent literature regarding the poor utility of AXRs for constipation, the new algorithm, and medication recommendations. The algorithm and a standardized discharge order-set were made available to providers within the electronic medical record (EMR) in April 2019.

To target rotating residents who may have missed divisional presentations, a PEM faculty member and a pediatric gastroenterologist published a podcast (<http://www.pemcincinnati.com/podcasts/?p=505>) and a blog post (<http://pemcincinnati.com/blog/poopcast/>) discussing the diagnosis of constipation in the PED. This episode was made publicly available on March 13, 2019.¹¹ There were 4,013 unique listens to the podcast and 1,569 unique views to the blog post during the study period. However, the percentage of local providers who downloaded the material is unknown.

Study of the Interventions

We extracted EMR data for patient visits between July 2017 and December 2019. We included patients between 6 months and 21 years of age who had either a primary or secondary *International Classification of Diseases, Tenth Revision* (ICD-10) diagnosis code of constipation. Our initiative focused on patients with the eventual physician diagnosis of constipation, and patients could present with any chief complaint, for example, abdominal pain. As the project aimed to standardize evaluation and treatment in uncomplicated patients, we excluded patients who met Feudtner's complex chronic conditions criteria or had a history of prior abdominal surgery documented in their problem list before the visit.¹² Data extracted from patient visits were reviewed monthly from January 2019 to December 2019. One member of the standardization team organized data into statistical process control charts, which the study team reviewed before interventions (during the development of the key driver diagram) and monthly after that. We reviewed percentages and changes in percentages of each outcome, process, and balancing measures over time. We used the data to refine the key driver diagram and understand the impact of interventions on the primary aim.

We provided updates to PEM providers at quarterly divisional meetings to increase awareness and impact

practice patterns. Providers had the opportunity to give feedback regarding the interventions to team members at divisional meetings or via email.

Measures

The primary process measure was the percentage of visits with a primary or secondary diagnosis of constipation with an AXR performed. Additional process measures were the percentage of patient visits with a diagnosis of constipation who were (1) discharged home with a prescription for polyethylene glycol or (2) admitted. As a balancing measure, we tracked the percentage of patient visits with a diagnosis of constipation who were discharged home but returned to the PED within 7 days and required admission. We used LOS as a balancing measure for the intervention's efficacy to decrease unnecessary resource utilization (increased in-room time in the ED/UC).

Analysis

We interpreted the data using statistical process control charts to evaluate the association of interventions with significant changes in our measures over time. The rules of interpretation of a Shewhart chart were used to identify special cause variation.^{13,14} P-charts were constructed for 4 of the measures: percentage of visits with AXR performed, percentage of visits with polyethylene glycol prescriptions, percentage of visits admitted from ED/UC, and percentage of visits with a return to ED/UC within 7 days. X-bar and S charts were constructed to evaluate the mean LOS for patients discharged from the PED.¹⁴

The Institutional Review Board at the Cincinnati Children's Hospital Medical Center determined this study to be a QI initiative and exempt from review.

RESULTS

Provider Needs Assessment Survey

All 104 PEM attendings, fellows, and clinical staff received the survey with 58 respondents. Most respondents (98%) felt "confident" or "somewhat confident" in identifying symptoms. In examining why providers obtain AXRs, 67% stated they obtain AXRs to "rule out other pathology" or "demonstrate the stool burden to parents." Despite disseminating a standardized outpatient disimpaction regimen to local primary care providers in 2015 by the Cincinnati Children's Hospital Medical Center gastroenterology department, 29% of PEM providers reported prescribing nonrecommended cleanout regimens. Nearly half of surveyed providers (48%) felt that discharge counseling was the most challenging part of constipation management.

Visit-level Measures

There were a total of 7518 included-patient-visits between July 2017 and December 2019. Of those visits, 5194 (69%) were to the PED, and 2324 (31%) were to

UC locations. The median age of patients seen for constipation was 6.8 years (interquartile range 3.5–10.8). Male patients accounted for 47% of visits. A total of 3470 patient visits (46.1%) were seen by PEM faculty. Patients seen by clinical staff and nurse practitioners accounted for 33.8% and 17.8% of total visits, respectively.

The percentage of visits for constipation with AXRs performed decreased from a baseline of 49.6% to 37.1% (Fig. 3). Special cause variation was demonstrated in October 2018, shortly after the distribution of the needs assessment survey. The lower baseline was sustained through December 2019. AXRs decreased from a baseline of 54.3% to 41.1% in the PED, and from a baseline of 40.1%–26.6% in the UC locations (see **Supplemental Digital Content 1**, which describes percentage of patient visits with constipation discharged from PED only in whom an AXR was obtained each month (P-Chart). LCL, lower control limit; UCL, upper control limit; **Supplemental Digital Content 2**, which describes percentage of patient visits with constipation discharged from UC only in whom an AXR was obtained each month (P-Chart). LCL, lower control limit; UCL, upper control limit, <http://links.lww.com/PQ9/A250>). The percentage of visits with outpatient prescriptions written for polyethylene glycol increased from 44.3% to 50.1% (Fig. 4). Again, a special cause variation

was demonstrated shortly after the needs assessment survey, leading to a sustained increase of outpatient prescriptions over the study period. The average monthly LOS remained constant over the study period at 197.8 minutes (Fig. 5). The percentage of visits readmitted within 7 days of the index visit remained unchanged at 0.78% (Fig. 6).

DISCUSSION

Before this QI project, 49.6% of visits for constipation received AXRs. Using QI methodology, the percentage of AXRs performed during patient visits for constipation decreased to 37% (a reduction of 25%), which continued for 12 months. This reduction would prevent 376 AXRs per year at our institution’s clinical volume. There was no significant change in LOS or return visits with an admission within 7 days. There was 1 data point outside of both the upper and lower control limits for LOS. This special cause variation was likely related to seasonal variation in overall department volumes and LOS; shorter LOS occurred during the summer months (July 2017, 2018, and 2019), which are characteristically associated with lower volumes and shorter LOS, while longer LOS occurred during winter months (January 2018 and December 2019) during which overall volumes are characteristically higher, and

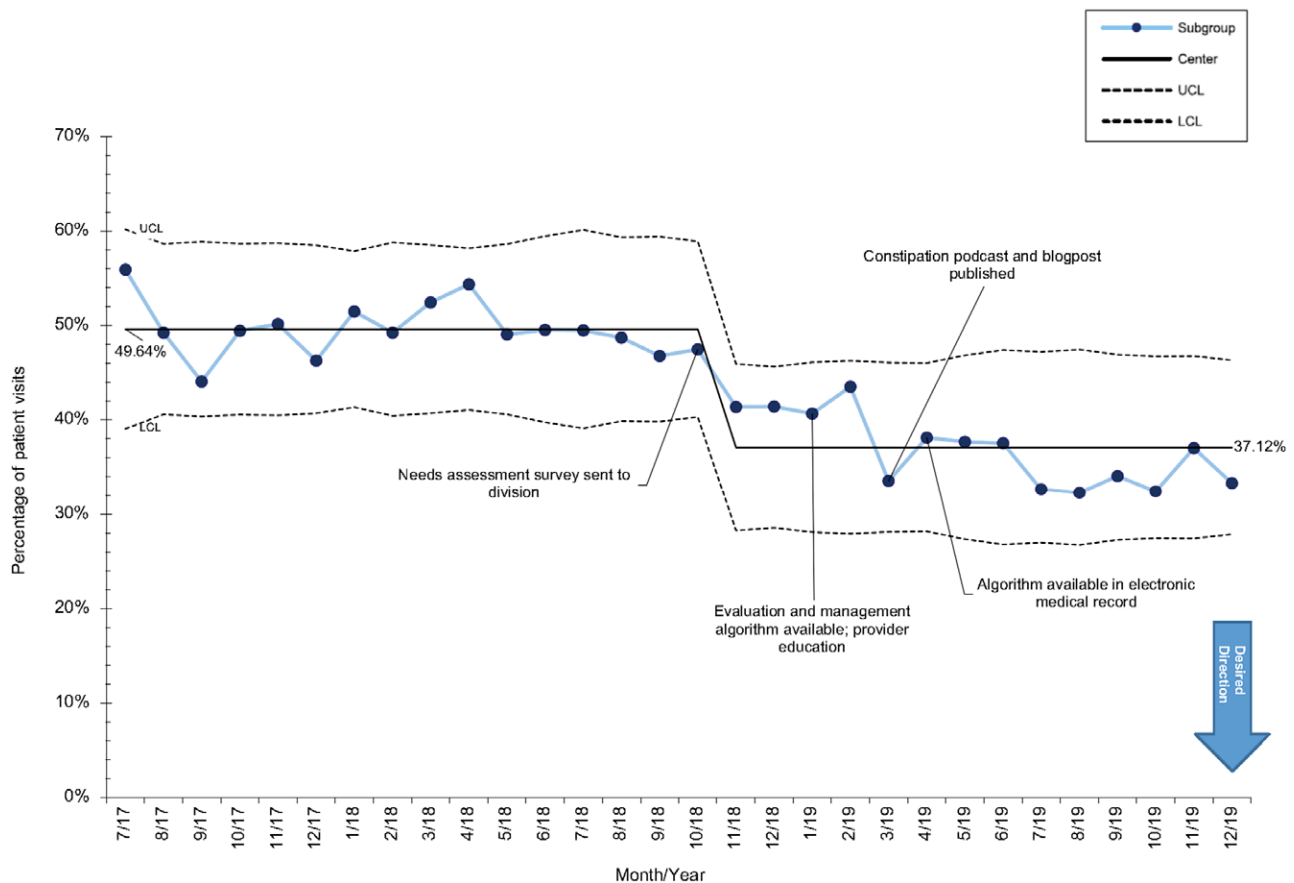


Fig. 3. Percentage of patient visits in the PED/UC with a diagnosis of constipation in whom an abdominal x-ray was obtained each month (P-Chart). LCL, lower control limit; UCL, upper control limit.

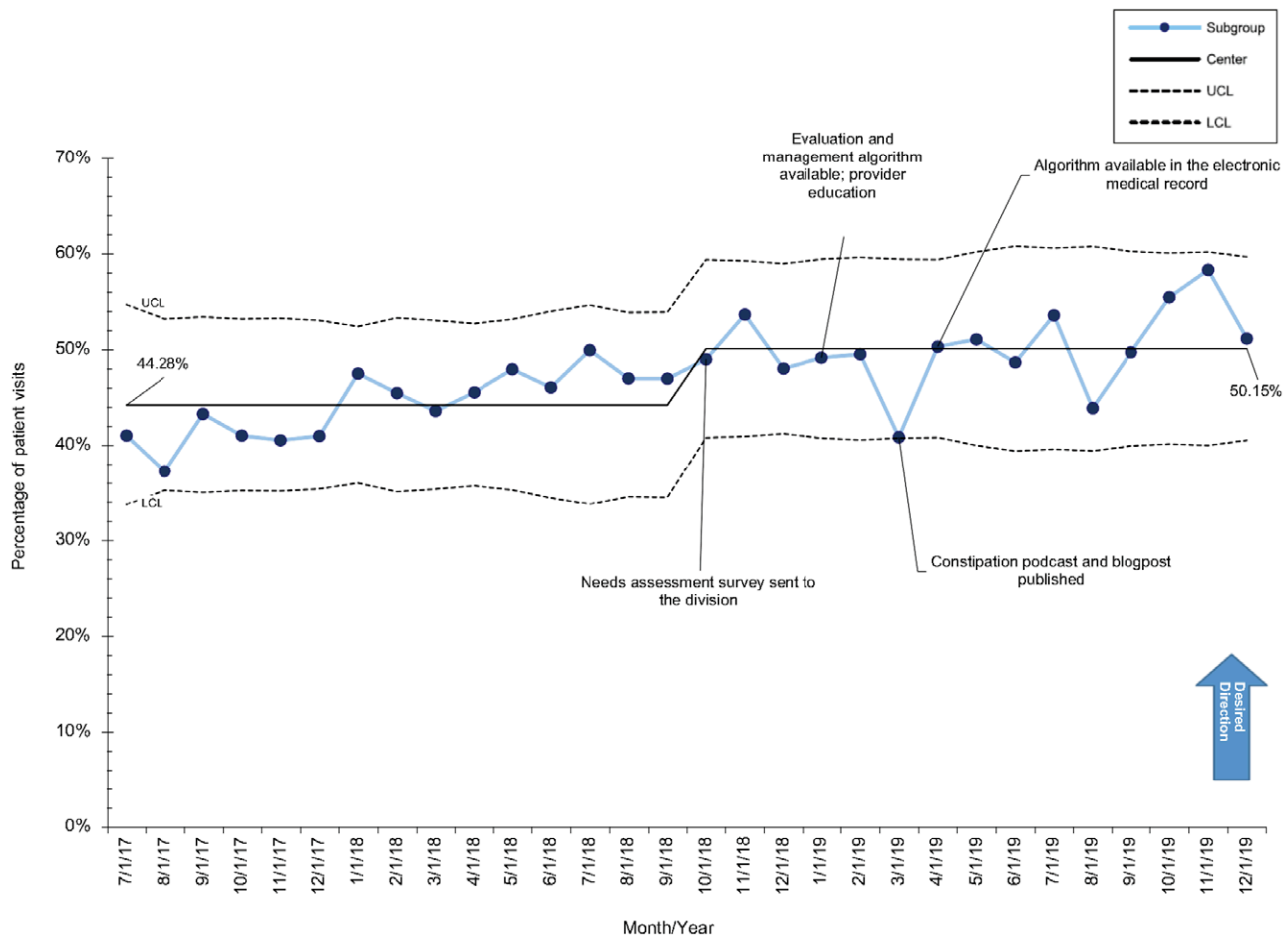


Fig. 4. Percentage of patient visits with constipation discharged from PED/UC with a polyethylene glycol prescription each month (P-Chart). LCL, lower control limit; UCL, upper control limit.

LOS is longer. We did not demonstrate any decreased LOS despite decreasing AXR rates. It is possible that obtaining an AXR is relatively efficient at our institution and has a lower effect on LOS than overall ED volume.

We conducted a provider survey to understand current practices within the division. The majority of providers were confident in diagnosing constipation clinically but used AXRs to rule out other diagnoses and reassure families. However, deciphering the stool burden on AXRs is unreliable, and patients with severe alternate diagnoses may have normal AXRs.⁸ The misconception that an AXR visually demonstrates constipation to parents can cause providers and families to be falsely reassured. Providers may anchor on constipation, especially if other diagnoses related to the chief complaint are not ruled out.⁸ Furthermore, the survey revealed that most providers were uncomfortable discussing evidence-based care instructions at discharge. The etiology of this discomfort is unclear but may represent a knowledge deficit of appropriate care, which this initiative addressed by providing standardized pharmacologic recommendations for stool cleanouts and maintenance dosing. Behavioral interventions are also necessary for many children, which may be difficult for emergency providers to offer based on limited time with a

family in the acute setting. Using these survey results, the study team achieved the goals of this study through several educational and implementation strategies.

The special cause variation demonstrated for both the decreased rate of AXRs and increased rate of outpatient prescriptions occurred after providers responded to the needs assessment survey. The diffusion of innovation theory dictates that behavior change begins with awareness of the innovation.^{15,16} Providers may have adjusted their practice after becoming aware of this study. The institution frequently employs QI interventions, which may influence providers to “buy-in” early and change their practice. However, the sustained changes noticed over the subsequent 12 months are likely due to the study interventions rather than assessing providers’ practice patterns alone. Although the trend in increasing outpatient prescriptions beginning in April 2018 suggests a change in local practice, this change was potentially enhanced through our standardization work.

A recent QI initiative by Ferguson et al¹⁷ reduced AXR rates for constipation from 62% to 24% over 12 months. However, their study only included low-acuity patients, and their interventions were limited to educational conferences and data sharing. In a study comparing 60-day

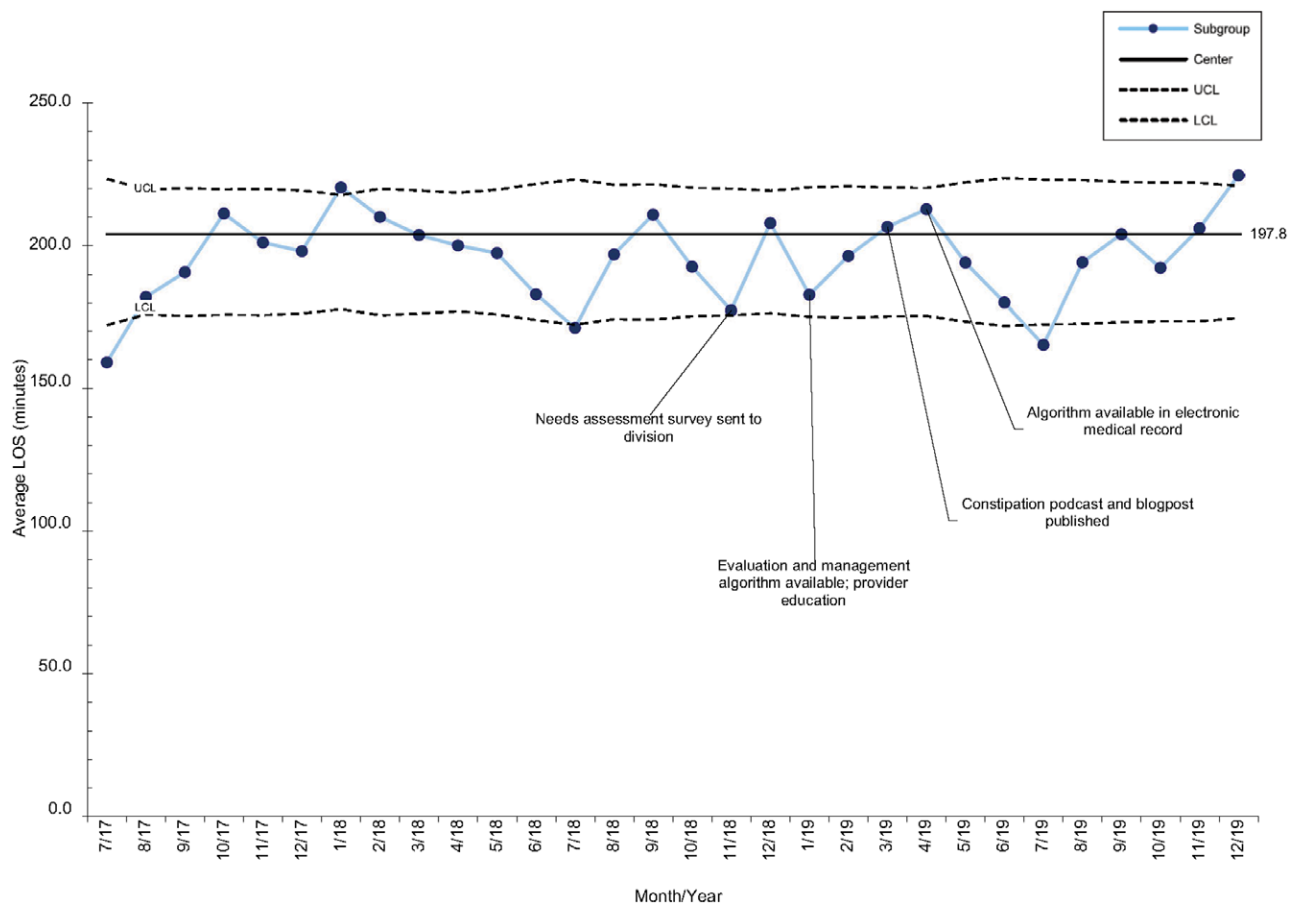


Fig. 5. Average monthly LOS for patients discharged from the PED with a diagnosis of constipation (X-bar Chart). LCL, lower control limit; UCL, upper control limit.

periods before and after, Kurowski et al¹⁸ demonstrated that a year-long educational intervention decreased the rate of AXRs and increased digital rectal exam rates. Compared to these studies, our initiative utilized more diverse interventions, and we conducted the study in a less homogeneous and more clinically acute population. We implemented other interventions, including a standardized algorithm, a blog article and podcast episode, an EMR interface, and expanded educational conferences with a standardized approach and discharge instructions for patients with constipation across all acuity levels. These interventions ensured that providers were educated on the utility of AXRs and had user-friendly tools to reference during patient-encounters. The goal was to provide standard criteria for using AXRs to decrease unintended variation (variation not indicated by patient factors, but instead by provider preference or risk-aversiveness). An AXR may be useful in some instances, especially in patients with complex medical histories who may present with atypical symptoms of constipation or in patients who appear more ill.⁹ The higher acuity of our patient population can explain why we could not lower AXR rates as dramatically as Ferguson et al.¹⁷ However, this study showed the rate of AXRs could be significantly reduced among patients with constipation regardless of the acuity level.

Abdominal pain can be worrisome for parents. For instance, parental reporting of quality of life scores were lower for constipated patients than those with cancer.^{3,19,20} These findings make appropriate management of constipation essential to patient and family satisfaction. The provider survey results revealed a significant knowledge gap regarding evidence-based discharge instructions and outpatient management for patients with constipation. Providers may feel compelled to demonstrate a radiographic stool burden to parents to justify the diagnosis in a tangible way that provides reassurance. However, this is not a reliable means to accomplish these aims. Discussing the rationale for diagnosis, evidence-based management, and providing effective anticipatory guidance can help parents understand the diagnosis of constipation and why the recommended therapies are warranted. Providing clear and evidence-based education can help parents adhere to appropriate outpatient management strategies, improving family satisfaction and quality of life.²¹

This study had several limitations. First, it only included patients diagnosed with constipation. This restriction may miss patients assigned other ICD-10 codes, such as *generalized abdominal pain*, even if the provider thought they had constipation. Given the limitations in EMR extracted data, the study population may include patients

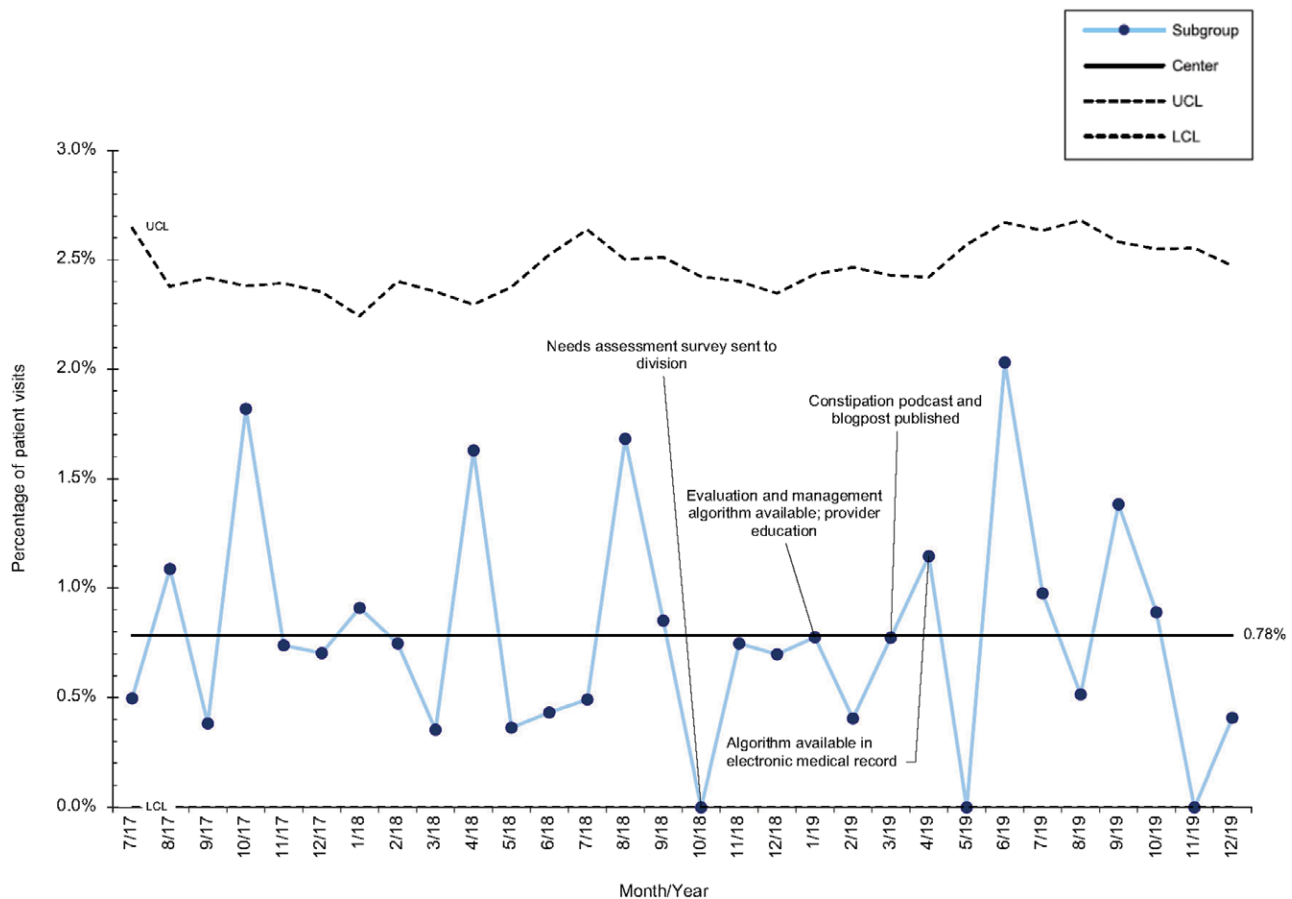


Fig. 6. Percentage of patient visits readmitted within 7 days after discharge from the PED with a diagnosis of constipation (P-Chart). LCL, lower control limit; UCL, upper control limit.

with complex chronic conditions or previous abdominal surgeries if providers did not document these diagnoses during the encounter in question. Although our primary balancing measure (return visits) did not change, we cannot be sure that the reasons for return and admission were not affected by our study, for example, if readmission rates stayed constant but readmission due to missed appendicitis increased. We performed this study at a single large academic center with resources that allowed several educational interventions that may not be easily implemented at other institutions. Also, as this was a QI initiative with several interventions, we cannot be sure which intervention has the most significant outcome on our primary goal. For example, although we provided standardized discharge instructions, we do not know how often they were used or how families received them, and whether they allowed providers to avoid AXRs. Finally, patients may have presented to another UC or ED in the community for admission within the 7 days following their initial evaluation. We believe that the likelihood of patients presenting to other facilities with significant complications or missed significant diagnoses is relatively low because this study occurred at a large, tertiary, academic children's hospital with a 3-state catchment area. It is the only hospital in the region that admits children.

CONCLUDING SUMMARY

Implementing a collaborative QI project decreased the percentage of AXRs during visits by pediatric patients for constipation, without a significant change in LOS or rate of 7-day return visits leading to admission. After providing a needs assessment survey to determine critical areas of improvement, a diverse array of educational interventions not only decreased AXR use but helped with provider education and outpatient management for families. Retrieving further data from respondents such as provider type/role and years of experience may lead to additional targeted interventions.

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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