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Development and Implementation of a Surgical Quality Improvement Pathway for Pediatric Intussusception Patients

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Abstract

Background: Children with intussusception can be admitted or discharged from the emergency department (ED) following enema reduction, but little is known about best practices for surgical follow-up and the need for a return to care. **Methods:** We developed a standardized clinical assessment and management plan (SCAMP) for ileocolic intussusception to enable the discharge from the ED of successfully reduced patients meeting certain criteria with 2 planned follow-up phone calls by surgical personnel after discharge. Outcomes included incidence of complications in discharged patients, bacteremia, the success of follow-up phone calls, rates of recurrent intussusception, and return to care. **Results:** Of the 118 patient encounters treated through the SCAMP in 2 pilot studies from February 2013 to December 2017, 76% met discharge criteria, of whom 88% underwent outpatient management. There were no instances of bowel perforation, necrosis, or death in the discharged group. No patients developed bacteremia despite withholding antibiotics for the indication of intussusception. Sixty-two percent and 59% of patients received 24-hour follow-up phone calls, and 28% and 55% of patients received second follow-up phone calls in pilots 1 and 2, respectively. Of those successfully discharged, 74% did not return to care, 19% returned for recurrent intussusception, and 7% returned for unrelated symptoms. Nearly all patients who returned to care did so through the ED and not the clinic. **Conclusions:** Implementation of the SCAMP demonstrated that patients meeting certain criteria could be safely discharged from the ED, avoid antibiotics, and safely undergo phone-based follow-up for concerns of recurrent intussusception. *(Pediatr Qual Saf 2019;4:e205; doi: 10.1097/pq9.0000000000000205; Published online 30 August, 2019.)*

INTRODUCTION

Available Knowledge

Ileocolic intussusception is the most frequent cause of intestinal obstruction in pediatric patients.[1,2] Nonoperative management via radiologic enema reduction is successful in ~80% of these patients.[2] Historically, patients were observed during a postprocedural hospitalization for 24–48 hours following reduction.[3,4] More recently, an increasing body of literature demonstrates that outpatient management is appropriate for these patients.[3–9] While most studies do not describe any specific follow-up plan, Mallicote et al[8] report a protocol utilizing a single follow-up phone call from the surgical office after discharge.

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Problem Description

Practice patterns in the management of pediatric ileocolic intussusception remain varied, with anywhere from 15% to 90% of patients discharged from the emergency department (ED) following a successful enema reduction.[2] There is also considerable variability in the use of periprocedural prophylactic antibiotics in patients with ileocolic intussusception before enema reduction.[2] It also remains unclear how best to follow patients after discharge from the ED.

Specific Aims

The specific aims of this study were to design and implement a standardized clinical assessment and management plan (SCAMP) to assess all patients who had successfully

reduced ileocolic intussusception and met the criteria for discharge from the ED. We sought to determine complication rates in the discharged group, the need for antibiotics, success of follow-up phone calls by surgical personnel, and optimal management of patients returning to care, including those with recurrent intussusception.

METHODS

Context

We implemented the SCAMP at Boston Children's Hospital (Boston, MA), a quaternary care standalone children's hospital.

Interventions

SCAMP Development. As part of the SCAMP program at Boston Children's Hospital, this project did not require review and approval by institutional review board review. The SCAMP was developed and implemented by a multidisciplinary team, including participants from surgery, radiology, emergency medicine, and nursing. The multidisciplinary team reviewed current clinical practice and literature to develop a pathway to evaluate and treat patients presenting with ileocolic intussusception.

Recruitment. We prospectively enrolled any patient with 6 months to 6 years of age with a positive diagnosis of ileocolic intussusception by abdominal ultrasound into the SCAMP. Exclusion criteria for the SCAMP included unstable blood pressure or heart rate, peritoneal signs, recent abdominal surgery, cystic fibrosis, Henoch-Schönlein purpura, polyp, enteral feeding tube, and non-ileocolic intussusception. Patients who returned to care for recurrent intussusception > 30 days from the initial presentation were reenrolled and counted as a separate unique patient encounter. We enrolled patients over 2 distinct periods. The first pilot study (pilot 1) ran from February 16, 2013, to December 8, 2015. We then received additional support in the form of added personnel for data collection and analysis from the Institute for Relevant Clinical Data Analytics at Boston Children's Hospital and proceeded with a second pilot study (pilot 2) from December 22, 2016, to December 8, 2017.

SCAMP Implementation. Emergency medicine physicians initially evaluated patients who arrived in the ED. General surgery consultation and assessment for study inclusion occurred following a diagnosis of ileocolic intussusception on abdominal ultrasound. A surgical resident accompanied the patient to the radiologic suite, where a pediatric radiologist completed an air contrast enema reduction. The protocol did not require a prereduction dose of IV antibiotics, and duration of symptoms did not factor into this decision. Each attending radiologist performing the study determined the maximum insufflation during the reduction, typically not >120 mm Hg. If the reduction was successful, the patient returned to the ED for reevaluation for discharge home. Patients underwent reduction by repeat air contrast enema if the initial reduction was unsuccessful. If a third attempt was required, the patient exited the SCAMP.

Upon returning to the ED, the patient was reassessed by the surgical team to determine if he/she was clinically stable. Patients with low urine output, lethargy, bloody stools, fever, tachycardia, emesis, or postreduction abdominal pain were deemed not suitable for discharge and were admitted to the surgical service. If stable, patients were given an oral intake challenge and discharged from the ED. In both pilots, ED and/or surgical staff provided education sheets in English, Spanish, or Arabic and conducted in-person teaching with patient families before discharge, including an explanation of intussusception, concerning symptoms, and potential reasons to contact the surgeon or return to the ED.

Telephone follow-up was attempted by the general surgery service, either by surgical outpatient nurse practitioners during weekday follow-up or by inpatient nurse practitioners during weekend follow-up. We defined a successful phone call as a call in which a family member was either directly contacted on the first call or a family member called back after the nurse practitioner left a message. We defined an unsuccessful phone call as a call where a nurse practitioner and patient family member never directly spoke despite nurse practitioners placing a call.

The pilot studies differed in the following ways: during pilot 1, discharged patients were contacted by phone at 24 hours and 7 days after discharge by a surgical nurse practitioner (see Supplemental Digital Content 1 at http://links.lww.com/PQ9/A126). During pilot 2, discharged patients were contacted by phone at 24 hours and 3 days after discharge. The timing of the second follow-up phone call was changed based on the finding that the majority of revisits and recurrences in pilot 1 occurred sooner than 7 days postdischarge. To increase compliance during pilot 2, members of the SCAMP team emailed surgical nurse practitioners reminders about weekend calls.

Our goal for pilot 1 was to have 100% compliance with discharging patients who met criteria from the ED following a successful air contrast enema reduction of ileocolic intussusception. Based on our experience during pilot 1, we added additional goals of 100% compliance for follow-up phone calls at 24-hours and 3-days, and for 100% distribution of family education sheets at the time of discharge from the ED in pilot 2.

Study of the Interventions. To assess the effectiveness of the SCAMP, we sought to compare a pre-SCAMP historical cohort, an initial pilot study (pilot 1), followed by a second pilot study (pilot 2) with an optimized follow-up protocol after a period of review of our initial results. A pre-SCAMP cohort comprising all patients treated for ileocolic intussusception at our hospital during the preceding year, from January 1, 2012, to December 31, 2012, was identified via a review of the

medical record. All patients in this pre-SCAMP cohort were admitted for at least 24 hours for observation after successful air contrast enema reduction. We collected data prospectively for pilot 1 and pilot 2. On-call general surgery residents completed a SCAMP flowsheet after receiving a consultation for ileocolic intussusception by the ED. Clinical information on these patients was then pulled from the medical record at regular intervals by research staff. Surgical nurse practitioners completed a follow-up phone call questionnaire after each phone call and provided this data to research staff (see Supplemental Digital Content 2 and 3 at http://links.lww.com/PQ9/A127 and http://links.lww.com/PQ9/A128 for data collection forms for pilots 1 and 2, respectively). The Boston Children's Hospital Finance Department provided all financial data.

Analysis. Fisher's exact test was used to compare hospital admission rates. Chi-square tests were used to compare rates of return to care, recurrent intussusception, and readmission. Independent sample *t*-tests were used to compare charges and total cost. The α value was set at 0.05 a priori, and statistical tests were two tailed. Statistical analyses were performed using SAS Enterprise Guide v. 7.1 (SAS Institute, Cary, N.C.).

RESULTS

Implementation of the SCAMP

In the historical control cohort, 3 patients failed radiologic reduction and required surgery, while the remaining 30 patients were successfully reduced and admitted. In total, 113 unique patients presented to Boston Children's Hospital with ileocolic intussusception during the study period (Fig. 1). Three of these patients returned with recurrent intussusception >30 days from initial reduction, and another patient developed 2 episodes of recurrent intussusception, each >30 days apart. Thus, pilot 1 (n = 89) and pilot 2 (n = 29) comprised of 118 patient encounters. We excluded 1 patient due to the subsequent diagnosis of an intestinal duplication cyst. Overall, 79 of 117 (68%) patient encounters with successful reduction of ileocolic intussusception and who met discharge criteria were discharged from the ED. Of the 7 patients admitted following failed initial air contrast enema, 4 required surgical reduction, while the others spontaneously resolved. Sixteen patients in pilot 1 and 3 patients in pilot 2 failed to meet discharge criteria and were admitted. One patient who failed to meet discharge criteria was admitted to a general pediatric service instead of the surgery service to facilitate workup of syncopal/pre-syncopal episodes. Of those patients who met discharge criteria, 7 patients had

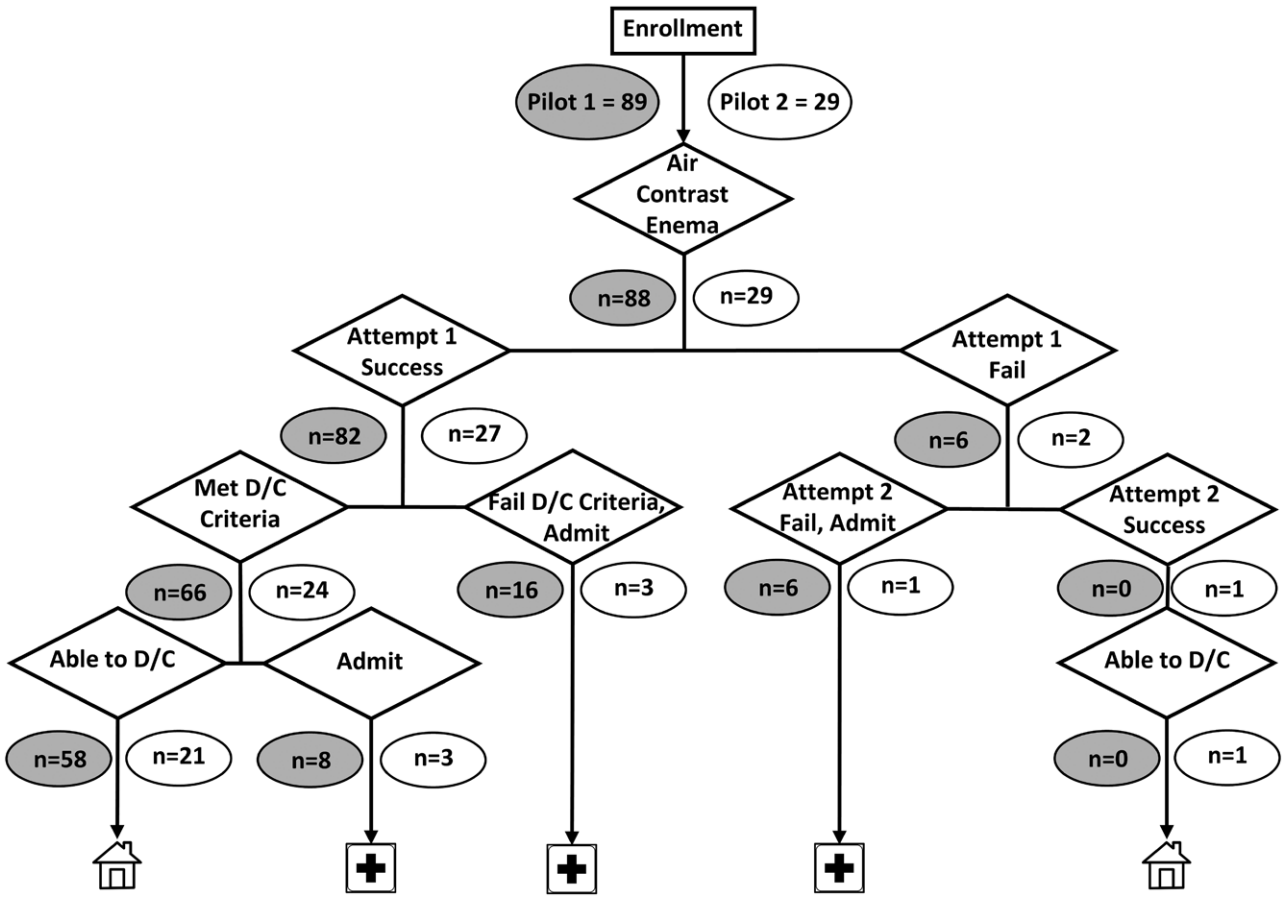

Fig. 1. SCAMP enrollment pathways for pilot 1 (shaded) and pilot 2 (unshaded).

circumstances warranting surgical admission based upon concerns by a physician involved in their care. Patient-related factors (living far from the hospital and preference to avoid discharge overnight) led to 2 patient admissions. There was 1 case of a missed opportunity to discharge, and another case with no documented reason for admission. When compared with the proportion of patients admitted in the pre-SCAMP cohort (100%), significantly fewer patients were admitted during pilot 1 (35%, $P < 0.001$), pilot 2 (24%, $P < 0.001$), and both pilots combined (32%, $P < 0.001$).

Antibiotic Utilization

In the historical control cohort, 3 patients failed radiologic reduction and required surgery, and all 3 received perioperative antibiotics. Of those patients who were successfully reduced, 13% (n = 4/30) of patients received antibiotics for the indication of intussusception per attending preference. No patients enrolled in the SCAMP were given IV antibiotics for the indication of ileocolic intussusception while at our institution. Five patients enrolled in pilot 1 of the SCAMP received IV antibiotics for other indications. Two of these patients failed air contrast enema reduction, were admitted, and received perioperative antibiotics before surgical reduction. One was given antibiotics at an outside facility, and 1 patient had concurrent cholecystitis requiring antibiotics. One patient developed fever and tachycardia following successful air contrast enema reduction and received a dose of IV antibiotics. No growth was documented on subsequent blood culture. One patient received a course of amoxicillin for Streptococcal pharyngitis in pilot 2.

Surgical Service Telephone Follow-up

There was no significant difference in rates of successful 24-hour follow-up phone calls between pilot 1 and pilot 2 (n = 36/58, 62% versus n = 13/22, 59%, respectively, $P = 0.81$), although there was a significant increase in rates of successful second follow-up phone calls from pilot 1 to pilot 2 (n = 16/58, 28% versus. n = 12/22, 55%, respectively, $P < 0.01$) (Supplemental Digital Content 4, available at http://links.lww.com/PQ9/A129). In pilot 1, 2 patient families were advised to return to Boston Children's Hospital during a 24-hour follow-up phone call, both of whom had recurrent intussusception. In pilot 2, 2 patient families were advised during the 3-day follow-up phone call to seek care at a primary care office for symptoms not concerning for recurrence and did not have recurrent intussusception.

Revisits and Recurrence

In the historical control cohort, there were 3 recurrence events while patients were admitted for observation, all within 24 hours of initial reduction. Seven patients returned to the ED after discharge, and none returned for urgent clinic visits. Three of the patients who returned to care were found to have recurrent intussusception, underwent successful reduction, and were admitted again. These outpatient recurrence events all occurred between 24 and 48 hours after initial reduction. Four patients returned to care for reasons unrelated to their previous intussusception. One of these patients was admitted for reasons unrelated to his previous intussusception. The overall recurrence rate was 20% (n = 6/30).

The majority of patients in both pilot 1 and pilot 2 did not return to care, and there was no significant difference in rates of return to care between these groups (64% versus 77%, respectively, $P = 0.25$). All patients who returned to care did so via the ED, except for 2 patients in pilot 1 who returned to the clinic (Fig. 2). Readmission rates decreased from pilot 1 to pilot 2, although this difference was not significant (n = 12/58, 21% versus n = 3/14, 14%, respectively, $P = 0.47$). Rates of recurrence and readmission as delineated by follow-up category are shown in Table 1. The majority of recurrences in both pilot studies occurred after 24 hours, and none occurred after 72 hours (see Supplemental Digital Content at for Table 1). Overall, only 1 patient had recurrent intussusception requiring surgical intervention. No patients experienced bowel perforation or necrosis.

Relationship between Follow-up Phone Calls and Return to Care

Rates of return to care were significantly higher among patients who were successfully contacted by phone 24 hours after discharge in pilot 1 compared with pilot 2 (n = 14/36, 39% versus n = 1/13, 8%, respectively, $P = 0.04$) (Fig. 3A). There was no significant difference in rates of return to care between pilot 1 and pilot 2 among patients who did not receive a successful 24-hour follow-up phone call (n = 0/3, 0% versus n = 1/2, 50%, respectively, $P = 0.4$) or where a follow-up phone call was not attempted (n = 1/13, 8% versus n = 0/4, 0%, respectively, $P = 1$). There was no significant difference in rates of return to care between pilot 1 and pilot 2 among patients who received a successful second follow-up phone call (n = 4/16, 25% versus n = 1/12, 8%, respectively, $P = 0.25$), failed to receive a successful second follow-up phone call (n = 2/7, 29% versus n = 0/4, 0%, respectively, $P = 0.4$), or where surgical personnel failed to place a second follow-up phone call (n = 1/21, 5% versus n = 0/3, 0%, respectively, $P = 1$) (Fig. 3B).

Patient Education

The SCAMP mandated all patients receive a family education sheet at discharge detailing basic information about intussusception, instructions on worrisome signs, and ways to contact the surgery clinic. During pilot 1, we did not record whether the families received the intussusception family education sheet. In pilot 2, almost all families successfully reached the 24-hour follow-up phone call reported that they received the education sheet (n = 12/13, 92%).

Financial Impact

We compared financial measures for the combined SCAMP pilot groups with a cohort representing all patients with

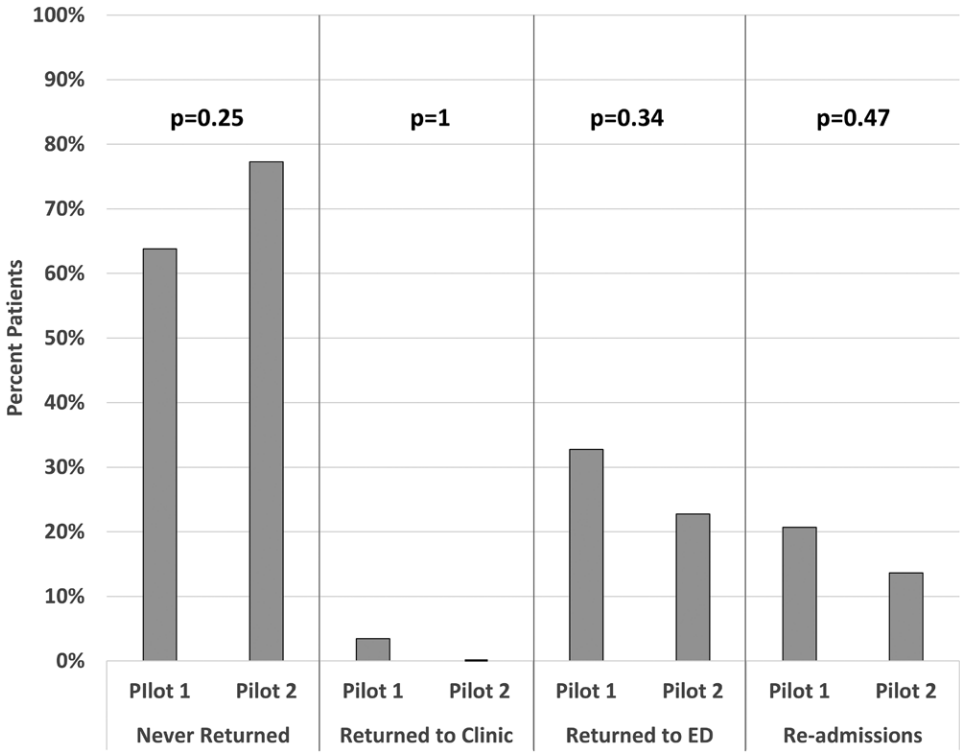

Fig. 2. Percent of patients in pilot 1 (n = 58) and pilot 2 (n = 22) who were initially discharged from the ED and never returned to care, returned for an urgent clinic visit or ED visit, or were readmitted.

Table 1. Time to the Recurrence of Intussusception if within 30 Days of Initial Presentation (as measured by time to return to care) for Each Episode of Recurrence in Pilots 1 and 2 Combined

	Total		Pilot 1		Pilot 2	
	N	Recurrent intussusception n (%)	N	Recurrent intussusception n (%)	N	Recurrent intussusception n (%)
Patients discharged from ED	80	15 (19)	58	13 (22)	22	2 (9)
Never returned	54	0 (0)	37	0 (0)	17	0 (0)
Returned to clinic	2	1 (50)	2	1 (50)	0	0 (0)
Readmitted	0	—	0	—	—	—
Returned to ED	24	14 (58)	19	12 (63)	5	2 (40)
Readmitted	15	12 (80)	12	10 (83)	3	2 (67)

ileocolic intussusception who presented to Boston Children's Hospital in 2012, the year preceding implementation of the SCAMP, as a historical control. Financial records were not available for 3 patient encounters in the SCAMP group. Mean total hospital charges were lower in the SCAMP group (n = 115) compared with the pre-SCAMP group (n = 32), but this difference was not significant ($6,197 ± SD $8,352 versus $9,485 ± $10,816, respectively, $P = 0.07$). Mean total hospital costs were significantly lower in the SCAMP group compared with the pre-SCAMP group ($3,066 ± $4,649 versus $5,471 ± $5,648, respectively, $P = 0.01$).

DISCUSSION

Given the high successful discharge rate and lack of major complications in the discharged group, these findings appear consistent with other groups that discharging patients following radiologic reduction is appropriate for the majority of pediatric patients with uncomplicated ileocolic intussusception meeting criteria.

Rice-Townsend et al have previously demonstrated wide variation in the utilization of antibiotics from 1.4% to 93.2% of patients.[2] Other studies have demonstrated a lack of bacteremia from enteric pathogens after enema reduction and a lack of impact on fevers and outcomes with the utilization of antibiotics.[11,12] Given these previous findings and the current results of our prospective pathway implementation showing that patients can safely avoid antibiotics without any documented case of sepsis, we assert that antibiotics are not necessary for the routine management of ileocolic intussusception.

One of the most important features of the SCAMP is the phone-based follow-up by surgery team members. We believe surgical follow-up is key, and the surgical

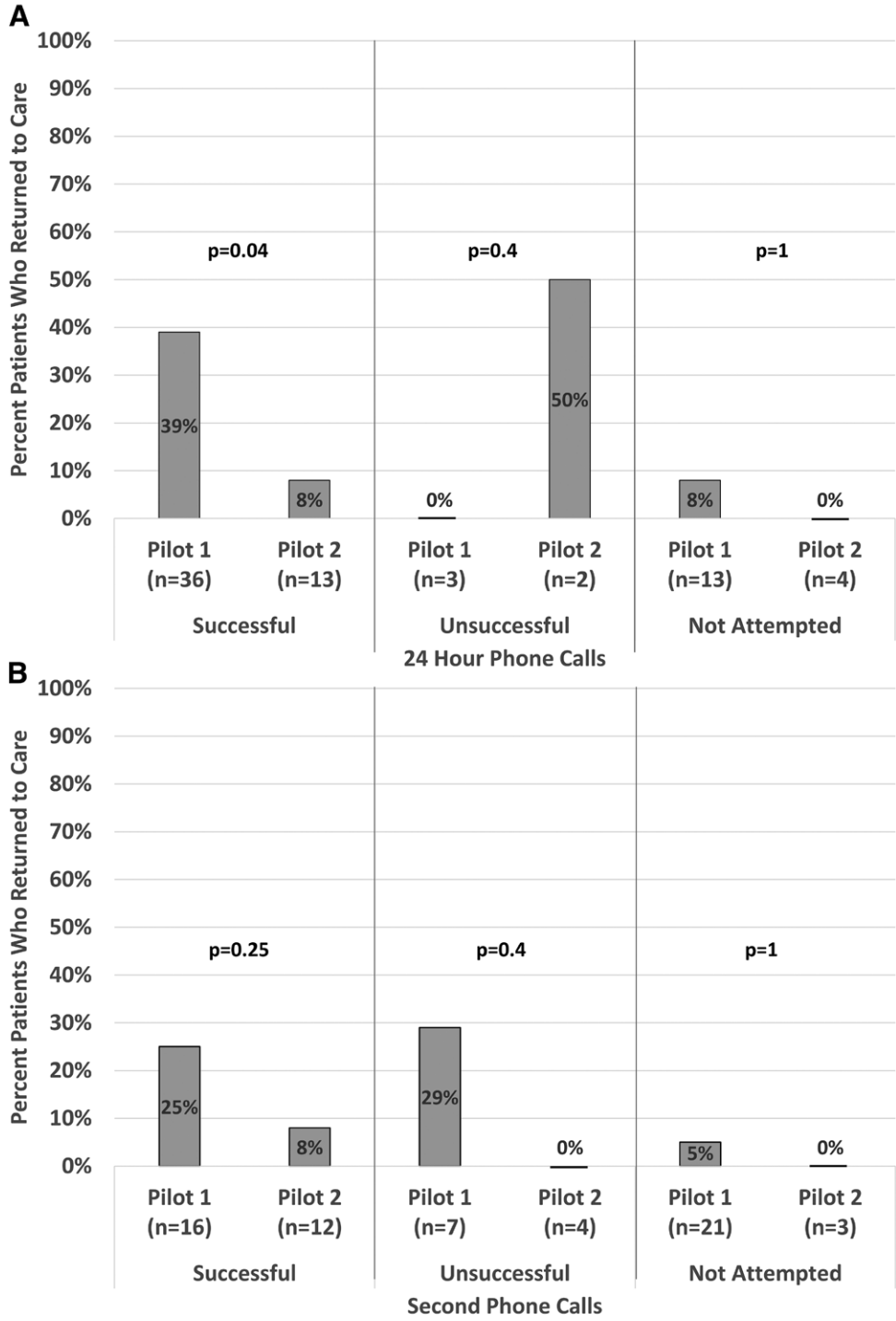

Fig. 3. Outcomes of follow-up phone calls. A, Relationship between 24-hour follow-up phone calls and return to care for pilot 1 and pilot 2. B, Relationship between 7-day follow-up phone calls and return to care for pilot 1 and 3-day follow-up phone calls and return to care for pilot 2.

team is best suited to direct patients to the appropriate follow-up, whether to an outpatient clinic or the ED. With findings from pilot 1, we were able to develop a second iteration of the SCAMP with alterations to improve outcomes and compliance.[13] Neither follow-up protocol appeared to effectively redirect patients to return to the clinic instead of the ED. This finding may reflect a baseline percentage of patients who continue to manifest ongoing abdominal symptoms at variable times after discharge.

The rate of recurrent intussusception in the current study was 18%, which is higher than other previously published series, which range from 2% to 15%.[8,10] One possible explanation is that in the previous series, investigators admitted

patients following reduction. Inpatient recurrence events may not be counted the same way as outpatient recurrence events that would require a return to care. Indeed, when we counted both in-house recurrence and postdischarge recurrence in the historical control cohort of our study, the rate of recurrence was 20%, comparable with the recurrence rate in the combined pilots. We do not believe that the high rate of recurrence was due to incomplete initial reduction, as all procedures occurred in the presence of attending pediatric radiologists who follow accepted criteria for reduction. These include documentation of reflux of air into the distal small bowel on fluoroscopy after reduction, a palpable drop in pneumatic pressure at the time of the complete reduction, and presence of increased air in the distal small bowel loops on post-procedure radiograph compared with pre-procedure radiograph.

Limitations

It is important to consider the limitations of our findings. This study only explores SCAMP implementation at a single institution, and thus, results might not be generalizable to all settings or populations. Some populations may present unique barriers to successful implementation, including language barriers which make family education a challenge, or lack of reliable phone contact with families. Patients in urban settings may be able to return to care more easily than patients in rural settings in the event of recurrent disease, altering the risk versus benefit analysis for these populations. Furthermore, adding outpatient phone calls to the responsibilities of surgical personnel may not be realistic in all settings.

CONCLUSIONS

Through the iterative development of a SCAMP for ileocolic intussusception, we demonstrate that the vast majority of patients can be safely and successfully treated without antibiotics and discharged from the ED following reduction of ileocolic intussusception. Those discharged should be contacted by surgical team members to assess symptoms and direct patients to appropriate follow-up depending upon their ongoing symptoms. Future studies should aim to determine follow-up strategies encouraging patients to seek care through the clinic instead of the ED when appropriate. We are also considering ways to improve follow-up and education among patients discharged from the ED, possibly using other technologies to communicate in real-time with medical personnel, such as phone-based applications.

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DISCLOSURE

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

REFERENCES

1. Tate JE, Simonsen L, Viboud C, et al. Trends in intussusception hospitalizations among US infants, 1993–2004: implications for monitoring the safety of the new rotavirus vaccination program. *Pediatrics*. 2008;121:e1125–e1132. doi:10.1542/peds.2007-1590.
2. Rice-Townsend S, Chen C, Barnes JN, Rangel SJ. Variation in practice patterns and resource utilization surrounding management of intussusception at freestanding children's hospitals. *J Pediatr Surg*. 2013;48:104–110. doi:10.1016/j.jpedsurg.2012.10.025.
3. Bajaj L, Roback MG. Postreduction management of intussusception in a children's hospital emergency department. *Pediatrics*. 2003;112(6 Pt 1):1302–1307.
4. Gilmore AW, Reed M, Tenenbein M. Management of childhood intussusception after reduction by enema. *Am J Emerg Med*. 2011;29:1136–1140. doi:10.1016/j.ajem.2010.08.009.
5. Whitehouse JS, Gourlay DM, Winthrop AL, et al. Is it safe to discharge intussusception patients after successful hydrostatic reduction? *J Pediatr Surg*. 2010;45:1182–1186.
6. Al-Jazaeri A, Yazbeck S, Filiatrault D, et al. Utility of hospital admission after successful enema reduction of ileocolic intussusception. *J Pediatr Surg*. 2006;41:1010–1013.
7. Chien M, Willyerd FA, Mandeville K, et al. Management of the child after enema-reduced intussusception: hospital or home? *J Emerg Med*. 2013;44:53–57.
8. Mallicote MU, Isani MA, Roberts AS, et al. Discussion of: "Hospital admission unnecessary for successful uncomplicated radiographic reduction of pediatric intussusception". *Am J Surg*. 2017;214:1208–1209.
9. Beres AL, Baird R, Fung E, et al. Comparative outcome analysis of the management of pediatric intussusception with or without surgical admission. *J Pediatr Surg*. 2014;49:750–752.
10. Raval M V., Minneci PC, Deans KJ, et al. Improving quality and efficiency for intussusception management after successful enema reduction. *Pediatrics*. 2015;136:e1345–e1352. doi:10.1542/peds.2014–3122.
11. Somekh E, Serour F, Goncalves D, et al. Air enema for reduction of intussusception in children: risk of bacteremia. *Radiology*. 1996;200:217–218.
12. Al-Tokhais T, Hsieh H, Pemberton J, et al. Antibiotics administration before enema reduction of intussusception: Is it necessary? *J Pediatr Surg*. 2012;47:928–930.
13. Farias M, Jenkins K, Lock J, et al. Standardized Clinical Assessment And Management Plans (SCAMPs) provide a better alternative to clinical practice guidelines. *Health Aff (Millwood)*. 2013;32:911–920.