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The Utility of Discharge Antibiotics in Pediatric Perforated Appendicitis Without Leukocytosis

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Abstract

Introduction: Optimal management of pediatric perforated appendicitis remains a topic of active investigation. Our institutional clinical practice guideline (CPG) was modified to discontinue antibiotics on discharge for patients with normal white blood cell count (WBC) without left shift. We hypothesized that patients would receive fewer antibiotics without increased complications.

Methods: Patients <18 years old with perforated appendicitis who underwent laparoscopic appendectomy 11/1/2016–5/31/2021 at a tertiary care children's hospital were included. Primary outcome was adverse events: post-discharge surgical site infection (SSI), 30-day emergency department (ED) visits, or readmissions. Outcomes were compared before and after CPG modification. Multivariable regression was performed to identify factors associated with SSI.

Results: There were 113 patients pre and 97 patients post. 23.1% of patients in the pre cohort had an elevated discharge WBC or left shift compared to 18.9% of patients post (p=0.48). Significantly fewer patients were prescribed antibiotics on discharge in the post cohort (70.8% pre vs. 14.4% post, p<0.0001) and for fewer days (2 pre vs. 0 post, p<0.0001). Total antibiotic days decreased significantly (6.1 pre vs. 4.6 post, p<0.0001). There was an increase in post-discharge SSIs on univariate analysis (1.8% pre vs. 9.3% post, p=0.03), ED visits (9.7% pre vs. 19.6% post, p=0.04), and readmissions (5.3% pre vs. 11.3% post, p=0.13). On multivariable analysis, being in the post cohort was not significantly associated with post-discharge SSIs after adjusting for sex,

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symptom duration, initial WBC, and discharge antibiotic duration (OR 0.25, 95% CI 0.04–1.4, p=0.11).

Conclusion: Modification of a pediatric perforated appendicitis clinical practice guideline to discontinue antibiotics on discharge with a normal WBC without left shift was effective in decreasing antibiotic duration. This was associated with an increase in SSIs on univariate analysis which did not persist on multivariable analysis and requires further investigation.

Keywords

pediatric appendicitis; perforated appendicitis; leukocytosis; left shift; antibiotics; clinical practice guideline

Introduction

Acute appendicitis is the most common acute indication for pediatric surgical intervention and has consequently been the subject of a number of studies aiming to identify the optimal post-operative management strategy. Approximately one-third of patients in the pediatric age group have perforated appendicitis.[1] Over time, treatment has shifted from triple antibiotic regimens to dual antibiotic regimens and further evidence suggests that one-time daily dosing of antibiotics is effective.[2] Although historically it was common for patients to receive extended durations of home intravenous antibiotics for perforated appendicitis,[3] standardized clinical practice guidelines (CPGs) have decreased that practice.[4,5] As practice patterns shifted to prescribe oral antibiotics on discharge, several studies have investigated the optimal duration of antibiotics, with some utilizing the white blood cell (WBC) value on the day of discharge to determine duration.[6] However, no studies report on the utility of a left shift in determining the need for further antibiotics.

Despite a prospective observational trial evaluating the safety of discontinuing antibiotics on discharge in patients without leukocytosis,[7] there is evidence that 50% of children with perforated appendicitis still routinely receive antibiotics on discharge.[8] However, recent studies have evaluated prescribing a standardized additional seven days of antibiotics on discharge to all pediatric patients with perforated appendicitis, resulting in a median total antibiotic duration of 11 days compared to 4 days prior to this change, and found that prescribing seven additional days of antibiotics on discharge was associated with fewer post-operative infections and readmissions.[9] It is clear from the literature that post-operative antibiotic treatment of pediatric patients with perforated appendicitis often differs from institution to institution with no clear guidelines.[10] With growing concerns of antibiotic resistance and conflicting benefits of longer-term antibiotic use, more evidence is needed to support the reduction of home antibiotic use in appropriate patients with perforated appendicitis.

As part of a quality improvement initiative, our institutional pediatric perforated appendicitis clinical practice guideline was modified to discontinue antibiotics on discharge in the presence of a normal white blood cell count (WBC) without neutrophilia. We aimed to assess the effect of this practice change on rates of discharge antibiotics. We hypothesized that patients would receive fewer antibiotics without increased adverse events.

Methods

Setting and Design

This study was designed as a quality improvement project aimed at safely reducing antibiotics in pediatric patients with perforated appendicitis. Following local institutional review board approval (IRB # 935667–5) with a waiver of informed consent, the electronic medical record was queried for all patients with perforated appendicitis between 11/1/2016 and 5/31/2021 at a tertiary care pediatric hospital. Perforated appendicitis was defined as a hole in the appendix, a fecalith in the abdomen, with or without an associated abscess or purulent fluid. Patients were included if they had perforated appendicitis managed with laparoscopic appendectomy. Patients were excluded if they had non-perforated acute appendicitis, gangrenous or suppurative non-perforated appendicitis, perforated appendicitis managed with antibiotics or initial percutaneous drain placement, or if they underwent open appendectomy or interval appendectomy. Open appendectomy patients were excluded as there may be a higher rate of surgical site infections in this patient population compared to laparoscopic appendectomy.[11,12] Patients were managed according to a departmental appendicitis CPG (Figure 1). As our objective was to analyze outcomes of pediatric patients with perforated appendicitis treated on our CPG, we further excluded patients with perforated appendicitis who had intra-operative drains, post-operative drains, or abscess aspirations during the index hospitalization, or re-operations during the index hospitalization, as these patients are considered off-pathway. In these patients, antibiotic management is determined by the clinical course of the patient, rather than the CPG for perforated appendicitis.

This study evaluates the effect of modifying the CPG to discontinue antibiotic use in patients without leukocytosis or neutrophilia on discharge. Patients were classified into pre and post cohorts, with the pre cohort comprised of patients admitted over a 25-month period from 11/1/2016 – 7/31/2019 and the post cohort including patients over a 22-month period from 8/1/2019 – 5/31/2021. All patients in this study were operated on by faculty from the division of Pediatric Surgery, who approved the use and modification of the appendicitis CPG. No changes in pre-operative management, operative technique, or in-hospital post-operative management were implemented during this period.

Clinical Practice Guideline

Upon confirmation of appendicitis diagnosis, patients are started on intravenous (IV) ceftriaxone and metronidazole pre-operatively. Operative evaluation of the appendix is used to determine the post-operative treatment pathway; patients with perforated appendicitis, defined as a hole in the appendix at time of operation, are treated according to the complicated appendicitis pathway. Patients continue to receive intravenous antibiotics while inpatient until meeting discharge criteria as specified in Figure 1. Patients are discharged when they meet discharge criteria, which includes being afebrile for 24 hours, tolerating a diet, pain manageable with oral pain medications or ketorolac, a benign exam, and being ambulatory. On the day of discharge, a complete blood count (CBC) with differential is sent. In the pre cohort, patients with normal CBC results, defined as no leukocytosis and no left shift, received a total of five days of antibiotics, inclusive of inpatient and outpatient doses.

In the post cohort, patients with normal CBC results, defined as a WBC within the normal reference range with no left shift had antibiotics discontinued on discharge. In both the pre and post cohort, patients with abnormal CBC results were discharged with oral antibiotics to complete a total 10-day course.

The CPG was distributed to members of the pediatric surgical team on a monthly basis, including attending pediatric surgeons, surgical residents, and nurse practitioners. The CPG is made available in the form of a resident handbook, as well as via an online portal accessible via QR code. The study was designed and conducted according to the revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0).[13]

Outcome Measures

The primary outcome was a composite outcome of adverse events, which included post-discharge organ-space surgical site infections (SSIs), 30-day emergency department (ED) visits, and 30-day readmissions. We hypothesized that the proportion of patients receiving antibiotics on discharge would decrease with this intervention without an increase in adverse events. We additionally hypothesized that fewer patients would receive discharge antibiotics in the post cohort, and that the total antibiotic duration, inclusive of inpatient and outpatient doses, would decrease. Other secondary outcomes included inpatient antibiotic duration, outpatient antibiotic duration, total antibiotic duration, and hospital length of stay (LOS). Additional information was collected on patient demographics, duration of symptoms prior to presentation, and initial white blood cell (WBC) count. Factors associated with post-discharge SSI were analyzed by comparing patients with and without post-discharge SSIs. Multivariable regression analysis was performed to identify independent predictors of post-discharge SSIs, including factors which were significant on univariate analysis or clinically relevant.

Adherence to the modification of the CPG was assessed. In the pre cohort, CPG non-adherence was defined as patients with normal CBCs (normal WBC with no left shift) and hospital LOS < 5 days receiving no discharge antibiotics, or patients with normal CBCs and hospital LOS ≥ 5 days who received any antibiotics on discharge, as they should have completed their 5-day course as inpatients. In the post cohort, CPG non-adherence was defined as receiving antibiotics on discharge in the presence of a normal CBC (normal WBC without left shift). CPG adherence was additionally assessed for patients with elevated WBC or left shift on discharge. Patients with elevated WBC or left shift should receive a 10-day total course of antibiotics on discharge; non-adherence was defined as receiving less than or greater than 10 days of antibiotics. Overall CPG adherence was defined as having a discharge CBC with differential drawn, and receiving the appropriate total duration of antibiotics as defined in the CPG.

Descriptive statistics were performed. Categorical outcomes are presented as count and percentage and continuous outcomes are presented as median and interquartile range (IQR). Patients in the pre cohort were compared to patients in the post cohort by Fisher's exact test or χ^2 test where appropriate for categorical outcomes, and by Mann Whitney U test for continuous outcomes. Significance was set at $p < 0.05$. Analysis was conducted using statistical software (SAS, version 9.45; SAS Institute Inc).

Results

Baseline Characteristics

A total of 210 patients were included; 113 patients in the pre cohort and 97 patients in the post cohort after excluding patients who were treated off-pathway (n = 31). Reasons for off-pathway treatment included intra-operative drain placement (n = 6), post-operative drain placement for abscess (n = 15), post-operative abscess aspiration (n = 2), post-operative abscess treated with prolonged antibiotics (n = 3), post-operative abscess requiring reoperation (n = 1), prolonged antibiotic treatment for concurrent Fitz-Hugh-Curtis syndrome (n = 1), post-operative bowel obstruction requiring reoperation (n = 1), and re-operation for bowel obstruction and abscess drainage (n = 2), all during the index hospitalization.

Patients were similar in demographics (Table 1). Presenting characteristics were similar, with a median of two days of symptoms prior to presentation in both cohorts ($p = 0.23$). Patients in the pre cohort had higher initial WBC values (18.5 pre vs. 16.3 post, $p < 0.001$).

Overall Results

Hospital length of stay was similar between cohorts (4.5 days pre vs 4.0 days post, $p = 0.13$), as was inpatient antibiotic duration (Table 2). The WBC on discharge was similar between cohorts, with 7.2% elevated in the pre cohort and 6.3% elevated in the post cohort ($p = 1.0$). A left shift was noted in 20.6% of patients pre and in 18.9% post ($p = 0.77$). A total of 23.1% of patients in the pre cohort had either an elevated WBC or left shift on discharge compared to 18.9% of patients post ($p = 0.48$).

Significantly fewer patients received antibiotics on discharge in the post cohort (70.8% pre vs. 14.4% post, $p < 0.0001$). Accordingly, the median duration of antibiotics prescribed on discharge decreased from a median of two days pre to zero days post ($p < 0.0001$). After combining the total inpatient and outpatient duration of antibiotics, patients in the post cohort received a median of 4.6 total days of antibiotics compared to 6.1 days in the pre cohort ($p < 0.0001$).

Adverse Events

The composite primary outcome of adverse events, including post-discharge SSI, ED visit, or readmission, was higher in the post cohort (9.7% pre vs. 19.6% post, $p = 0.05$). There was a higher rate of post-discharge SSIs (1.8% pre vs. 9.3% post, $p = 0.03$) and ED visits within 30 days (9.7% pre vs. 19.6% post, $p = 0.04$). While 30-day readmissions and post-discharge interventions were higher in the post cohort, these differences were not statistically significant (readmissions, 5.3% pre vs.11.3% post, $p = 0.13$; post-discharge interventions, 1.8% pre vs. 5.2% post, $p = 0.25$). Of the patients who returned to the ED in either cohort, 10 were found to have SSIs and all of these patients were readmitted for further management. Four of these patients were managed with antibiotics alone while one underwent abscess aspiration and four had drains placed. One underwent an exploratory laparotomy for a concurrent small bowel obstruction. One additional patient returned to the ED due to a small bowel obstruction which also required an exploratory laparotomy.

Twelve patients came to the ED for abdominal pain, nausea, vomiting, or diarrhea, with five patients readmitted for supportive management. Eight patients returned for acute cystitis (n = 1), constipation (n = 5), Clostridium difficile infection (n = 1), or intolerance of an antibiotic prescribed as a pill, requiring change to an oral solution (n = 1); two patients with constipation were admitted. One patient presented with abdominal pain and fevers and was treated with antibiotics for presumed SSI but no imaging was performed so a definitive diagnosis of SSI could not be made.

Factors Associated with Post-Discharge SSI

Patients who developed SSIs after discharge were more commonly male (90.9% of SSIs vs. 61.3% of patients without SSI, p = 0.06) and had a lower initial WBC (14.7 vs. 17.0, p = 0.03). There was no significant difference in duration of symptoms (median 1.5 days in patients with SSIs vs. 2.0 days in patients without, p = 0.16), operative time (median 55 minutes SSI group vs. 52 minutes, non-SSI group, p = 0.27). More patients who did not develop SSIs were discharged with antibiotics, but this difference was not statistically significant (45.7% vs. 27.3%, p = 0.35). The total antibiotic duration did not differ between these groups (5.0 days in patients who developed SSIs vs. 5.7 days in patients without, p = 0.85).

Multivariable Analysis of Predictors of Post-Discharge SSI

To further evaluate predictors of SSI, a multivariable analysis was conducted adjusting for factors which were significant on univariate analysis (sex, initial WBC), or clinically relevant (symptom duration, discharge antibiotic duration). No independent predictors of post-discharge SSI were noted with the exception of higher initial WBC count which approached statistical significance (OR 1.2, 95% CI 1.0–1.4, p = 0.07). Being in the post cohort was associated with a lower odds of post-discharge SSI, although this did not reach statistical significance (OR 0.25, 95% CI 0.04–1.4, p = 0.11).

CPG Adherence

As the CPG change in this study period pertained to patients with normal CBCs at time of discharge, we evaluated adherence to this decision point of the guideline. In the pre cohort, 53.8% of patients with normal discharge CBCs received a total of five days of antibiotics, as indicated by the CPG (43/80 patients with normal CBCs). Of the 37 patients who did not receive the appropriate duration of antibiotics, the majority (n = 26) received greater than a total of 5 days of antibiotics, receiving a median of 6 total days. Ten patients had received > 5 days of antibiotics while inpatient but received antibiotics on discharge for a median of 2.8 additional days, totaling a median of 9.5 days of antibiotics. One patient received a total of 4 days of antibiotics only. In the post cohort, adherence to this aspect of the CPG increased to 95.9%, with 70/73 patients with normal discharge CBCs receiving no further antibiotics upon discharge (p < 0.0001 compared to pre cohort, Table 5). The three patients who did not receive antibiotics in line with the protocol all received additional discharge antibiotics despite having a normal discharge CBC.

Compliance for discharge antibiotics for patients with leukocytosis was poor in both cohorts; patients in the pre cohort were more likely to receive the instructed 10 total days of

antibiotics, but this was not statistically significant (n = 2/8, 25.0% pre vs. n = 0/6, 0% post, p = 0.47). In the pre cohort, half of patients with leukocytosis received more than 10 total days while two patients received less than 10 total days of antibiotics. In the post cohort, none of the 6 patients with elevated WBC received a total of 10 day of antibiotics with the majority (n=5) receiving greater than 10 total days and one patient receiving 9 days.

Patients with an isolated left shift with no leukocytosis were analyzed separately to assess adherence to this aspect of the CPG. In both pre and post cohorts, a left shift with or without leukocytosis, indicates that the CBC is abnormal and a 10-day total course of antibiotics should be prescribed. An isolated left shift, without leukocytosis, was seen in 27 patients (n = 16 pre, n = 11 post). Of these, only eleven patients received a 10-day total course of antibiotics; the majority (n = 16/27, 59.3%) did not. Adherence to this aspect of the CPG was higher in the pre cohort (n = 10/16 or 62.3% pre, n = 1/11 or 9.1% post, p = 0.008). The overall median total antibiotic duration for patients with isolated left shift who were not prescribed 10 total days of antibiotics was 7 days. However, no patients with an isolated left shift developed a post-discharge SSI.

Overall CPG compliance rose significantly in the post cohort, from 48.7% pre (n = 55/113) to 73.2% post (n = 71/97, p = 0.0004). There was no significant association with CPG non-compliance and post-discharge SSI development. SSIs occurred in 3.6% of patients who were not CPG compliant (n = 3/84) compared to 6.4% of patients who were compliant (n = 8/126, p = 0.53).

Discussion

In this study of pediatric patients with perforated appendicitis at a tertiary care pediatric hospital, modifying a clinical practice guideline for the post-operative treatment of appendicitis was effective in reducing home antibiotic use with no significant increase in post-discharge SSIs after adjusting for potential confounding factors. The rate of discharge antibiotic prescriptions decreased from 70.8% to 14.4% before and after CPG modification ($p < 0.0001$), and the median discharge antibiotic duration decreased from two days to zero days ($p < 0.0001$). Rates of post-discharge SSIs were low in both cohorts, but were higher in the post cohort on univariate analysis (9.3% post vs. 1.8% pre, p = 0.03). Higher rates of ED visits were also seen following CPG modification, likely related to the increase in SSIs (19.6% vs. 9.7%, p = 0.04). Male sex was associated with post-discharge SSI on univariate analysis, but on multivariable analysis, only higher initial WBC approached significance as an independent predictor of post-discharge SSIs (OR 1.2, 95% CI 1.0–1.4). The post cohort was not an independent predictor of post-discharge SSIs. Importantly, adherence to this modification of the protocol for patients with normal discharge CBCs rose drastically from 53.8% to 95.9% in the post cohort ($p < 0.0001$). The poorest adherence was seen in patients with isolated left shifts, who infrequently received antibiotics despite the CPG, but no SSIs occurred in these patients, indicating that an isolated left shift may not be an important clinical predictor of need for additional antibiotics.

Optimal post-operative management of pediatric perforated appendicitis has continued to evolve over time. As a result of numerous studies, route of antibiotic administration has

shifted from long durations of home intravenous antibiotics to prescribing oral antibiotics on discharge, with no difference in post-operative infection rates and lower rates of treatment failure and repeat hospital presentation in oral antibiotic cohorts.[3,14] More recently, the need for post-discharge antibiotics has been assessed by several groups with varying results. A study of the American College of Surgeons NSQIP- Pediatric Appendectomy Pilot (NSQIP-P) database found that 57% of pediatric patients with perforated appendicitis were prescribed oral antibiotics on discharge, finding lower odds of organ-space SSI compared to children not receiving oral antibiotics on discharge.[8,9] Additionally, a single-center retrospective study investigated the effect of standardizing seven additional days of oral antibiotics on discharge, regardless of inpatient duration, and found decreased rates of organ-space SSI and readmissions.[9]

However, other groups have studied the effects of shifting in the opposite direction, toward fewer antibiotic doses. Some have found that discharge prior to post-operative day five without antibiotics in patients without leukocytosis was not associated with higher rates of SSIs.[7] Another group studied this question and mirrored these findings, that discontinuing antibiotics on discharge if no leukocytosis was associated with shorter antibiotic duration and no change in SSIs rates.[6] The same group has since shifted to eliminating the use of discharge leukocytosis in their CPG and studied the effects of discontinuing antibiotics on discharge in patients meeting clinical discharge criteria, regardless of post-operative length of stay, finding a significant reduction in antibiotic use without an increase in SSIs or readmissions.[15] These findings, in conjunction with the data presented in this study, potentially support limiting post-discharge antibiotic use in patients without leukocytosis. However, further research is needed to identify which patients benefit from continuing antibiotics at the time of discharge. Although we noted an increase in SSIs after reducing our rate of post-discharge antibiotic prescriptions, this did not persist on multivariable analysis adjusting for potential confounders. The presence or absence of leukocytosis on discharge may not be the best marker for patients at risk of post-discharge SSIs.

The optimal duration of post-operative and post-discharge antibiotics remains unknown. A recent systemized review of published CPGs for pediatric appendicitis found significant variation in this practice, ranging from no discharge antibiotics for all patients to a 10-day total course. However, as several studies have found no increase in SSIs or adverse events in patients with shorter discharge antibiotic durations (0–7 total days), the available evidence supports a shortened or even eliminated post-discharge antibiotic course in many cases. The results from our study also support these findings, with the caveat that some children will develop SSIs and identifying these children at highest risk is an area of ongoing research. Further prospective randomized study is needed to fully evaluate the safety of discharging children with perforated appendicitis with no further antibiotics.

Although there are many studies evaluating effects of a CPGs for pediatric appendicitis, few report on CPG adherence, which is an important factor in interpreting the results. Some report low adherence, with 15% adherence to the overall CPG and 49% adherence to the recommended antibiotic duration.[16] Another study reported overall CPG adherence at 55% but found no difference in post-operative SSIs in patients whose treatment did not adhere to the CPG.[17] In our case, adherence to the modified aspect of our CPG, pertaining to patients

with normal discharge CBCs, rose significantly to 96% in the post cohort. However, other unchanged aspects of our CPG, such as a longer antibiotic course for patients with a left shift, had poor adherence. To our knowledge, there are no studies in the literature which evaluate the utility prescribing discharge antibiotics for patients with an isolated left shift without leukocytosis. As this was the aspect of our CPG with the poorest adherence, this merits further study to determine if an isolated left shift is a marker of increased risk of post-discharge infection.

Limitations

Our study has several limitations. It is a single center retrospective study, which limits its generalizability. Our reported SSI rate is quite low and must be interpreted in the context of the study design, which aimed to study only patients who were treated according to our CPG thereby excluding patients who develop an SSI during the index hospitalization. While the rate of post-discharge SSI increased in the post cohort, the post cohort was not an independent predictor of post-discharge SSIs after adjusting for potential confounders. This finding may be limited by our overall cohort size and will need to be monitored closely. Our rates of SSIs are similar to those in the literature which range from 1.6% to 20.7%.[6,9,15,17,18] Lastly, CPG adherence was variable. While reasons for this were not captured in the data in the electronic medical record, variable CPG adherence was at least partially due to the multi surgeon practice in an academic setting which necessitates constant reeducation for rotating trainees and providers. These levels of overall CPG adherence are, however, consistent with studies in the literature.[17]

Conclusion

Modification of an institutional clinical practice guideline for pediatric patients with perforated appendicitis was associated with significant reductions in post-discharge antibiotic prescriptions without a significant increase in post-discharge surgical site infections or returns to the hospital after adjusting for confounders. Identifying pediatric patients with perforated appendicitis who may safely be discharged without further antibiotics requires further research. The utility of prescribing discharge antibiotics for children with a left shift without leukocytosis additionally requires further prospective evaluation.

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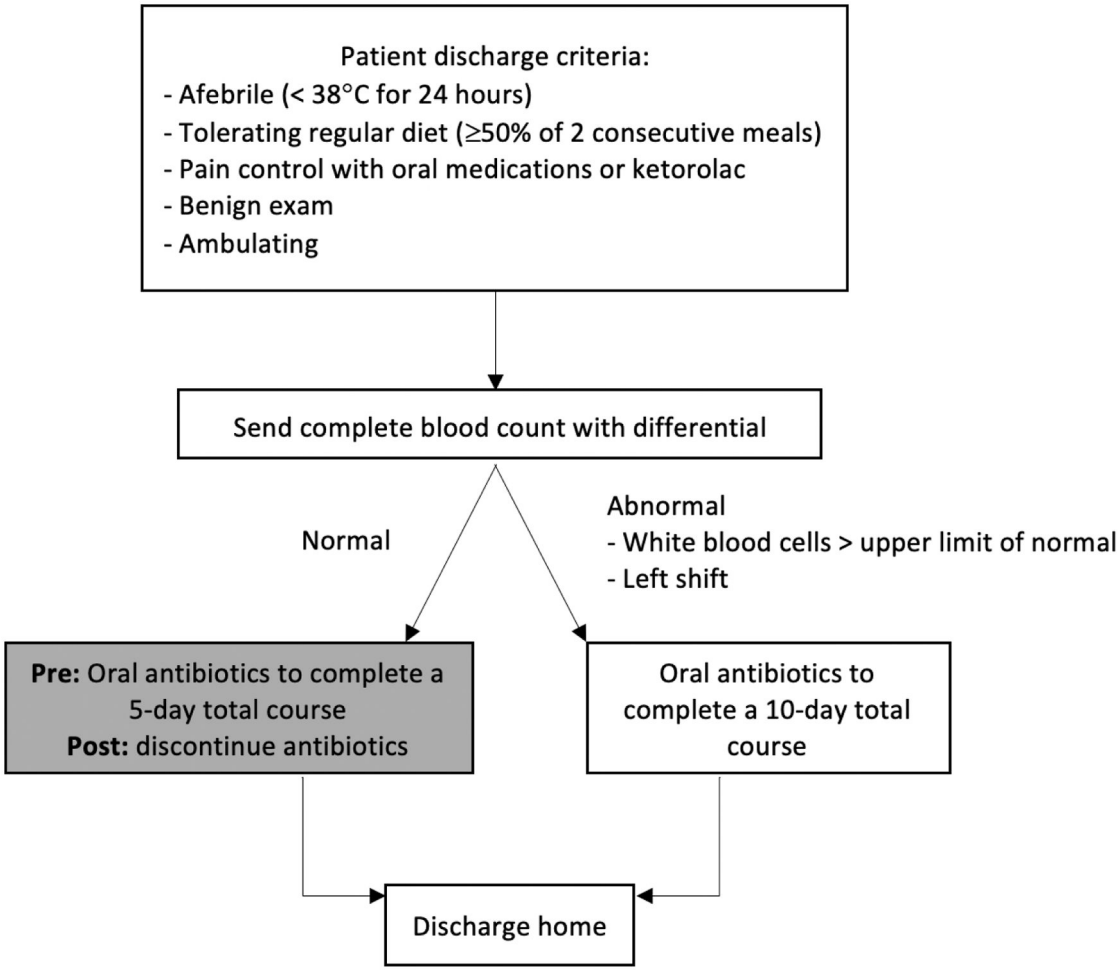

Figure 1: Pediatric Appendicitis Clinical Practice Guideline.

The gray box represents the CPG modification analyzed in this study. Patients in the pre cohort who had a normal complete blood count (CBC) would be prescribed oral antibiotics to complete a total 5-day course. Patients in the post cohort had antibiotics discontinued at time of discharge in the setting of a normal CBC.

Table 1:

Baseline characteristics of pediatric patients presenting with perforated appendicitis pre- and post-CPG change.

Variable	Pre n = 113	Post n = 97	p-value
Age, years: median (IQR)	8.9 (6.2–11.4)	9.2 (6.7–12.3)	0.44
Sex, male: n (%)	69 (61.1)	63 (65.0)	0.56
Transfer: n (%)	91 (80.5)	80 (82.5)	0.72
Days of symptoms, median (IQR)	2.0 (1–3)	2.0 (1–3)	0.23
Initial WBC ($x10^3/mm^3$), median (IQR)	18.5 (14.8–21.9)	16.3 (14.0–18.2)	0.003
OR length, minutes: median (IQR)	58 (48–69)	49 (41–58)	<0.001

IQR: interquartile range; WBC: white blood cell count; OR: operating room.

Table 2:

Outcomes of pediatric patients presenting with perforated appendicitis pre- and post-CPG change.

Variable	Pre n = 113	Post n = 97	p-value
LOS, days: median (IQR)	4.5 (3.2–5.8)	4.0 (3.0–5.6)	0.13
Inpatient antibiotic duration, days: median (IQR)	4.3 (3.1–5.7)	4.0 (3.0–5.6)	0.30
Discharge WBC ($x10^3/mm^3$), median (IQR)	8.9 (7.7–10.9)	9.2 (7.3–10.7)	0.77
Discharge WBC elevated, n (%)	8/111 (7.2) *	6/96 (6.3) *	1.0
Discharge PMNs ($x10^3/mm^3$): median (IQR)	6.0 (4.4–7.6) *	5.6 (4.4–7.6) *	0.93
Discharge left shift, n (%)	21/102 (20.6) *	17/90 (18.9) *	0.77
Elevated discharge WBC or left shift, n (%)	24/104 (23.1)	17/90 (18.9)	0.48
Discharged with antibiotics, n (%)	80 (70.8)	14 (14.4)	<0.0001
Discharge antibiotic duration, days: median (IQR)	2.0 (0–4)	0.0 (0–0)	<0.0001
Total antibiotic duration, days: median (IQR)	6.1 (5.4–9.6)	4.6 (3–6.3)	<0.0001
Post-discharge SSI, n (%)	2 (1.8)	9 (9.3)	0.03
Post-discharge intervention, n (%)	2 (1.8)	5 (5.2)	0.25
30-day ED visit, n (%)	11 (9.7)	19 (19.6)	0.04
30-day readmission, n (%)	6 (5.3)	11 (11.3)	0.13

IQR: interquartile range; WBC: white blood cell count; PMNs: polymorphonuclear lymphocytes; SSI: surgical site infection; ED: emergency department.

* Notes: Two patients in the pre cohort and one patient in the post cohort did not have a discharge CBC sent. Nine patients pre and seven patients post did not have differentials sent, so PMN values were not available.

Table 3:

Factors associated with post-discharge surgical site infection (SSI).

	SSI n = 11	No SSI n = 199	p-value
Age, years: median (IQR)	9.0 (6.2–10.5)	9.1 (6.5–11.8)	0.51
Sex, male: n (%)	10 (90.9)	122 (61.3)	0.06
Transfer: n (%)	7 (63.6)	164 (82.4)	0.13
Days of symptoms, median (IQR)	15 (1–2)	2 (1–3)	0.16
Initial WBC ($x10^3/mm^3$), median (IQr)	14.7 (10.8–16.0)	17.0 (14.6–20.5)	0.03
OR length, minutes: median (IQR)	55 (49–71)	52 (44–64)	0.27
LOS, days: median (IQR)	5.0 (4.0–5.8)	4.0 (3.0–5.8)	0.23
Inpatient antibiotic duration, days: median (IQR)	5.0 (4.0–5.8)	4.0 (3.0–5.7)	0.19
Discharge WBC ($x10^3/mm^3$), median (IQR)	8.9 (7.3–11.1)	9.0 (7.5–10.8)	0.99
Discharge WBC elevated, n (%)	1 (9.1)	13/196 (66.3)	0.54
Discharge PMNs ($x10^3/mm^3$): median (IQR)	5.5 (4.2–7.1)	5.8 (4.4–7.6)	0.71
Discharge left shift, n (%)	1 (9.1)	37 (20.4)	0.70
Elevated discharge WBC or left shift, n (%)	1 (9.1)	40 (21.9)	0.46
Discharged with antibiotics, n (%)	3 (27.3)	91 (45.7)	0.35
Discharge antibiotic duration, days: median (IQR)	0 (0–3.5)	0 (0–3)	0.45
Total antibiotic duration, days: median (IQR)	5.0 (4.1–10.8)	5.7 (4.6–7.9)	0.85

IQR: interquartile range; WBC: white blood cell count; OR: operating room; LOS: length of days; PMNs: polymorphonuclear lymphocytes.

Table 4:

Multivariable regression analysis of factors associated with post-discharge surgical site infection (SSI).

Factor	Odds ratio	95% Confidence Interval	p-value
Sex			0.12
Male (reference)	--	--	
Female	5.5	0.7–46.5	
Symptom duration	1.5	0.8–3.0	0.21
Initial WBC	1.2	1.0–1.4	0.07
Discharge antibiotic duration	0.9	0.7–1.2	0.55
Pre vs Post Cohort			0.11
Pre (reference)	--	--	
Post	0.25	0.04–1.4	

WBC: white blood cell count.

Table 5:

Clinical Practice Guideline Adherence.

Variable	Pre n = 113	Post n = 97	p-value
Obtained CBC with differential, n (%)			0.79
Yes	102 (90.3)	90 (92.7)	
No, no CBC	2 (1.8)	1 (10)	
No, no differential	9 (8.0)	6 (6.2)	
Normal discharge CBC, appropriate antibiotic duration prescribed, n (%)	43/80 (53.8)	70/73 (95.9)	<0.0001
Elevated discharge WBC, 10-day total antibiotic duration	2/8 (25.0)	0/6 (0)	0.47
Isolated left shift without leukocytosis, 10-day total antibiotic duration	10/16 (62.3)	1/11 (9.1)	0.008
Overall CPG adherence	55/113 (48.7)	71/97 (73.2)	0.0004

CBC: complete blood count; WBC: white blood cell count; CPG: clinical practice guideline.