Individual QI Projects From Single Institutions

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Improving Prescribing for Otitis Media in a Pediatric Emergency Unit: A Quality Improvement Initiative

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ABSTRACT

Introduction: Acute otitis media (AOM) is a commonly overtreated pediatric diagnosis. The American Academy of Pediatrics (AAP) recommends shorter antibiotic courses and wait-and-see prescriptions (WSPs) for healthy children with mild-to-moderate AOM. Still, clinicians do not consistently prescribe these in pediatric emergency units (EUs). **Methods:** We performed a quality improvement project to improve antibiotic prescribing in a tertiary pediatric EU over 16 months, focusing on shorter prescription durations and WSPs. We assessed AOM management via chart review, then implemented interventions, including clinician education, a guideline card, visual reminders, and updated emails. In addition, we contacted a percentage of families after their visit to assess their child's outcome and parental satisfaction. **Results:** Our baseline data showed that only 39% of patients prescribed antibiotics were prescribed an appropriate duration based on age and estimated AOM severity, and only 3% were prescribed WSPs. Via 2 plan-do-study-act (PDSA) cycles, we increased the percentage of patients who received appropriate antibiotics to an average of 67%, sustained for >6 months. Follow-up phone calls suggested no difference in satisfaction or need for nonroutine follow-up care based on prescription length. We did not see a substantial increase in WSPs. **Conclusions:** AOM management in our children's hospital's EU was often inconsistent with AAP guidelines. Two PDSA cycles improved the rate of appropriate duration antibiotics, and follow-up phone calls suggested no difference in satisfaction or need for nonroutine follow-up care based on prescription length. The next steps involve developing an order set and implementing individualized feedback.

INTRODUCTION

Acute otitis media (AOM) is a common diagnosis, with 60% of children experiencing at least 1 episode by age 3, even in the postpneumococcal vaccine era.[1] Clinicians commonly prescribe 10-day courses of antibiotics. However, natural history shows self-resolution in over 70% of cases in children ≥2 years.[2–4] Excessive antibiotic use has important consequences, including cost,[2] side effects,[3] bacterial resistance,[4] and microbiome disturbance.[5]

The 2013 American Academy of Pediatrics (AAP) AOM guidelines recommend shorter antibiotic courses, including 7 days for children 2–5 years old and 5–7 days for children ≥ age 6 who have mild or moderate AOM.[6] The literature supports shorter course antibiotics for children with nonsevere AOM. For example, numerous studies have shown equivalence in outcomes for 5 versus 10 days of antibiotics for children ≥ age 2.[7–14] Most of these studies did not stratify for severity when comparing antibiotic course lengths. However, there were some situations in which a 10-day course of antibiotics did seem to be superior (specifically, otorrhea or recurrent AOM).[11,15] Of relevance, a recent study showed the feasibility of improving prescription duration in an urgent care (UC) without an increase in 30-day return visits.[16]

Another approach to reducing antibiotic use recommended by the AAP AOM guidelines is wait-and-see

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prescriptions (WSPs). In this scenario, the clinician instructs the parent/caregiver only to fill the prescription if their child fails to improve within 2–3 days.[6] WSPs have been successfully implemented in primary care physician (PCP) offices,[15,17,18] and, more recently, in emergency units (EUs).[19] Data on efficacy and acceptability are encouraging. For example, studies suggest that, for children ≥ 2 years, parents perceived similar improvement with WSPs or immediate prescriptions. Moreover, WSPs did not lead to extra PCP/EU visits, phone calls, or missed work days for parents.[20] A prospective study also suggested that WSPs do not increase mastoiditis rates.[21]

Avoiding routine prescriptions of antibiotics for AOM in children over 2 is among the top 5 suggestions for preventing intervention overuse in pediatrics.[22] Nevertheless, studies show that 30%–90% of AOM treatment in pediatric EUs does not follow the 2013 AAP guidelines. Two common deviations from the guidelines are excessive antibiotic durations and immediate prescriptions when WSPs would be appropriate.[2,23,24] Barriers to optimal AOM management include lack of knowledge of guidelines, habits, lack of time to explain WSPs, the perception that families want immediate antibiotics, or concern for complications of untreated AOM.[25]

Overall, studies support the effectiveness of shorter treatment and WSPs in children ≥ age 2.[3,26–30] Thus, the objectives of this quality improvement (QI) project were to (1) increase the percentage of patients ages ≥ 2 years prescribed antibiotic course durations consistent with the AOM AAP guidelines from 39% to 85%, and (2) increase the percentage of patients age ≥ 2 years with AOM not prescribed immediate antibiotics (WSP or no prescription) from 3% to 20% by August of 2021.

METHODS

Context

This project took place in the St. Louis Children's Hospital (SLCH) EU, a tertiary care EU serving approximately 50,000 patients annually and staffed by attending physicians (in pediatric and adult emergency medicine and pediatric hospital medicine), trainees, and advanced practice providers (nurse practitioners and physician assistants).

Interventions

We assembled a multidisciplinary team including members from the stakeholder groups listed above, an infectious diseases physician trained in QI methodology, a fellowship-trained pediatric hospitalist, and a data analyst with expertise in QI work.

We designed interventions based on a literature review[25] and key drivers (Fig. 1). We implemented 5 interventions for our first plan-do-study-act (PDSA) cycle (August 2020 to November 2020). These interventions included the following: (1) We created a comprehensive guideline card with a flowchart for assessing and treating AOM to help clinicians determine appropriate prescribing options based on age, signs, and symptoms. (**Supplemental Digital Content 1**, which shows guideline card for the evaluation and management of acute otitis media, ***http://links.lww.com/PQ9/A446***.) (2) We added a quick-select button in the discharge amoxicillin prescription for a 5-day duration, in addition to the existing 7- and 10-day buttons, to reinforce 5 days as a reasonable duration. (3) The team provided 20–40 minute education sessions on the diagnosis and management of AOM. These presentations were given to pediatric residents, EU nurse practitioners and physician assistants, pediatric hospitalists, and pediatric emergency medicine faculty and fellows. In addition, we gave presentations once per year per group during time set aside for recurring didactics, and the presentations were customized to each group. (4) We created easily insertable text templates for clinicians to use in their notes and in the patient instructions explaining why the patient qualified for a WSP and explaining to the family when to fill their prescription. (5) Signs were placed near EU clinician stations with reminders to consider 5–7-day prescriptions for nonsevere AOM, and a checklist of the steps involved in prescribing WSPs. For our second PDSA cycle (November 2020–July 2021), we initiated monthly progress/reminder emails to EU clinicians that included graphs of our progress on the project.

Study of Interventions

We included all patients seen in the SLCH EU ≥ 2 years old seen during our study period who had a diagnosis code including the word "otitis." From there, we excluded patients with a diagnosis of otitis externa, medical complexity (defined as craniofacial abnormalities, cochlear implants, immunocompromised/immunosuppressed, Trisomy 21, completely unvaccinated, or tracheostomy-dependent), concurrent diagnosis of other bacterial illness, ear tubes in place, or previously prescribed antibiotics within 10 days. Otitis media with effusion was not excluded.

The data elements collected to determine AOM severity included maximum temperature (Tmax), pain severity (determined by clinician documentation), otorrhea, purulence behind the tympanic membrane (TM), and symptom duration. AOM severity was determined using criteria based on the 2013 AAP guidelines.[6] We considered any patient with Tmax ≥ 39 °C or evidence of TM perforation to be "definitely severe"; patients with at least one of Tmax between 38.5 °C and 39 °C, ear pain/tugging, and symptom duration ≥ 48 hours to be "possibly severe," and all others to be "likely nonsevere." WSPs were determined based on clinician documentation in the EU note or after-visit summary.

The team collected baseline data via chart review on the number of diagnoses of nonsevere otitis media in children ≥ 2 years of age in the SLCH EU per month, the number of children prescribed antibiotics, and antibiotic duration.

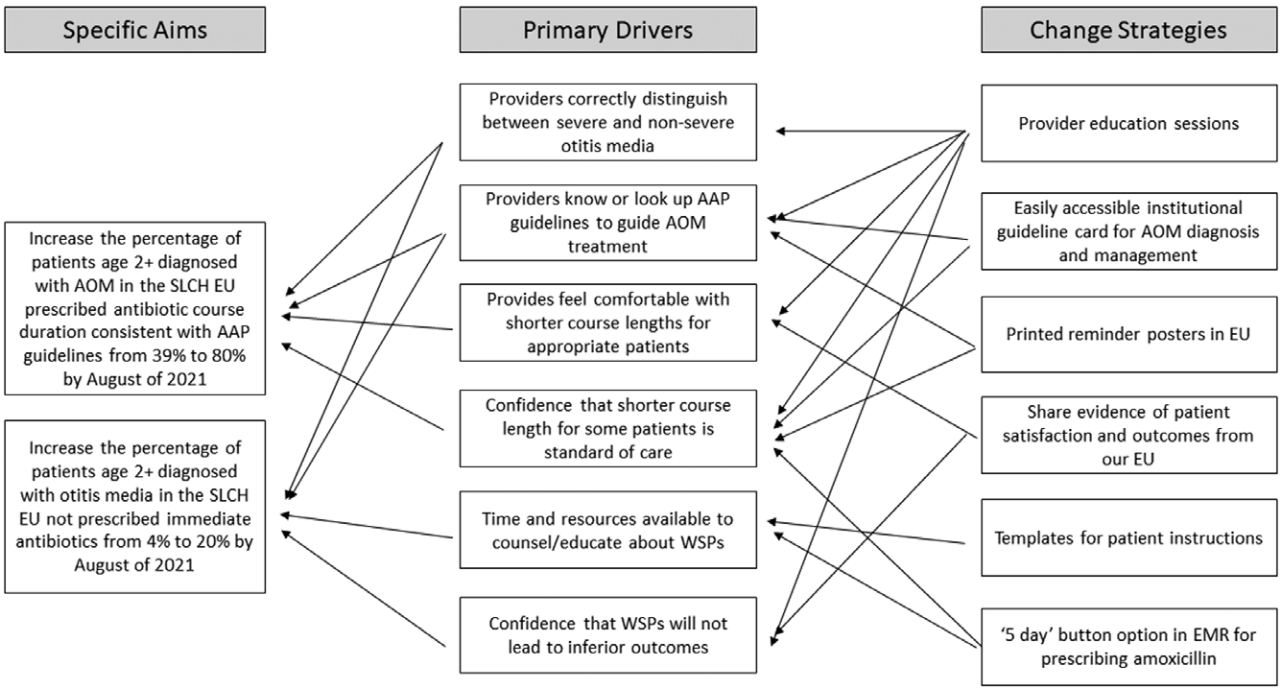

Fig. 1. Key driver diagram for improving antibiotic prescribing for AOM.

We also obtained baseline data for patients seen and discharged from the SLCH EU between May 1, 2019, and July 31, 2020. Four individuals did chart reviews. The principal investigator (PI) reviewed a random subsample of ~20% of these charts to check for accuracy and consistency. In addition, the PI was in regular contact with chart reviewers to answer questions and ensure coding consistency.

We reviewed charts monthly during our intervention period from August 1, 2020, to December 31, 2021. To assess our balancing measures of parental satisfaction and need for nonroutine follow-up care, we called all patients offered a WSP and a convenience sampling of approximately 25% of all other patients (quasi-random based on patient ID with the intent to balance between shorter and longer duration prescriptions) within 4–6 weeks post-EU visit to assess for satisfaction with EU care and whether they required further AOM-related medical care. We attempted to call each family twice.

Measures

Our primary outcome measures were: (1) percentage of patients with prescriptions of an appropriate length (7 days for a child aged 2–5; 5–7 days for a child ≥ 6 years; or 10 days for any child with severe AOM) as determined by chart review, and (2) the percentage of children with nonsevere AOM who were not given immediate antibiotic prescriptions. Balancing measures included parental satisfaction with EU care and the need for nonroutine follow-up care. We assessed these measures via phone call using a standardized phone script. (**Supplemental Digital Content 2**, which shows parent phone survey instrument, ***http://links.lww.com/PQ9/A445***.) We assessed parental satisfaction on a 5-point Likert scale and the need for nonroutine follow-up care by asking whether the child had seen other clinicians regarding AOM since their index EU visit. For example, we considered follow-up for an ear recheck without new or persistent symptoms routine. In contrast, we considered any repeat visit to an EU or UC nonroutine, as well as follow-up visits for new or persistent symptoms.

Analysis

Our data were analyzed using R v.3.5.2 (R Foundation for Statistical Computing). We plotted prescription length and WSP rates monthly on a p-chart. We calculated initial centerlines based on our 14-month baseline data collection period and identified special cause variation based on at least 8 consecutive points above or below the centerline. For our follow-up data obtained via phone, we compared responses from patients who were prescribed longer- (>7 days) versus shorter-duration (5–7 days) antibiotics using chi-squared tests. In addition, we assessed the effect of race and ethnicity on appropriate duration and nonimmediate prescriptions using chi-squared tests and multiple test corrections for race.

Ethical Considerations

Our institutional review board determined that this QI project was exempt from human subjects review. We obtained verbal consent from parents to participate in the phone survey at the time of the phone call.

RESULTS

For our baseline data, we reviewed 642 charts, excluded 72 based on our exclusion criteria, and thus included

570 in the baseline analysis (Table 1). During the baseline data collection period, 68% (388/570) of charts met the criteria for nonsevere AOM. Only 39% (250/570) of patients were prescribed appropriate duration antibiotics when considering both estimated severity and patient age. Of patients with likely nonsevere AOM, 1% (5/570) were not prescribed antibiotics, and 3% (13/570) were prescribed WSPs.

After starting our interventions, we reviewed 488 charts over 16 months. We excluded 43 based on our exclusion criteria and included 445 in our analyses. The percentage of patients who met the criteria for "severe" AOM did not change significantly between our preintervention and postintervention periods (P = 0.14). Through our first 2 PDSA cycles, we increased the percentage of appropriate antibiotics to 67%. We identified 2 centerline shifts corresponding to the months following our first and second PDSA cycles. This change has been sustained for 6 months without further intervention since our last reminder email in July 2021 (Fig. 2). With an increase of 28% of patients with nonsevere AOM receiving 5–7 days of antibiotic therapy, we estimate a minimum of 246 fewer antibiotic days during the intervention period. No significant differences based on race or ethnicity concerning prescription duration or nonimmediate prescribing were seen.

We did not see a substantial increase from baseline concerning nonimmediate prescribing (Fig. 3). The COVID-19 pandemic, which coincided with our initial study dates, impacted the number of patients seen in our EU in general and, specifically, the number of patients diagnosed with AOM. Due to these low initial volumes, we extended our intervention for 4 additional months. EU volumes began to rebound to their prepandemic levels in the spring of 2021. Regarding our balancing measures, we called 127 families, and 67 (15% of our overall charts) completed the follow-up survey. (**Supplemental Digital Content 3**, which shows demographics for patients who completed the follow-up survey, ***http://links.lww.com/PQ9/A447***.) There was no difference in satisfaction (P = 1.0), resolution of symptoms by the time of the phone call (P = 0.39), or need for nonroutine medical visits (P = 0.29) for patients prescribed shorter (5–7 days) versus longer (>/= 8 days) antibiotic durations. Of note, 4 families whose children were prescribed WSPs completed the follow-up survey. All 4 filled their prescriptions. None needed follow-up visits at an EU or UC, and all stated they were "very satisfied" with their care.

Table 1. Patient Demographics

Characteristic	Baseline, N = 570	Intervention, N = 445	*P*
Age, y, median (IQR)	3.94 (2.69–6.24)	3.52 (2.49–5.48)	0.017*
Male sex, n (%)	298 (52)	230 (52)	0.900
Race, n (%)			
African American	452 (79)	337 (76)	0.012*
White	82 (14)	91 (20)	
Other or unknown	36 (6)	17 (4)	
Ethnicity, n (%)			
Hispanic	26 (5)	25 (6)	0.703
Non-Hispanic	541 (95)	419 (94)	
Unknown	2 (0.4)	1 (0.2)	
AOM severity, n (%)			
Severe	115 (20)	108 (24)	0.137
Nonsevere	455 (80)	337 (76)	

*Statistically significant difference between patient populations.

DISCUSSION

The SLCH EU evaluates many children ≥ age 2 with AOM. Management of these patients is often inconsistent with AAP guidelines concerning WSPs and shorter-duration antibiotics for nonsevere AOM. This finding is consistent with other studies of AOM management in children's hospital EUs in the last 5 years.[2,23,24] The problem is pervasive enough that overprescribing for AOM has gotten attention as an area in need of QI initiatives.[22,31] We did not reach our goals of 85% appropriate duration antibiotics. However, we improved prescription durations for children ≥ 2 years old via low-cost interventions, including education, guideline card development, minor electronic medical record (EMR) adjustments, visual reminders, and email feedback. These changes are similar to those seen in other similar studies[16] and were sustained for 6 months of continued monitoring after we discontinued update emails or promotional activities. The improvement also persisted despite the drop and rebound in EU volumes related to the COVID-19 pandemic.

Importantly, we saw no differences in parental satisfaction between longer- and shorter-duration antibiotics or between WSPs and immediate prescriptions. This method of assessing long-term satisfaction via follow-up phone interviews is unique compared to other similar studies.[16,25] Additionally, there were no differences in the resolution of symptoms by the time of the phone call or the need for nonroutine follow-up care for children who received shorter versus longer duration antibiotics. This finding is similar to previous studies, which found equivalent outcomes with 5–7-day courses compared with 10-day courses for children ≥ age 2,[7,14] and no increase in return visits.[16] This observation suggests that shorter prescription lengths do not adversely impact patient outcomes or experience. However, our study was not adequately powered to detect rare adverse outcomes.

Our success in increasing appropriate duration prescriptions is similar to that reported in a recent QI project in an UC setting.[16] The present study shows feasibility in a different setting. Other strengths of the present study include that our chart review allowed for differentiating between patients with nonsevere versus severe AOM, and our follow-up phone call strategy allowed us to assess for parental satisfaction and acute care visits to all sites, including those sites outside of our health system.

Our interventions to promote increased WSPs were less successful. This result is similar to Sun et al,[25] which raised rates of nonimmediate antibiotic prescriptions in a pediatric EU from 6.4% to only 11.1% postintervention. Another recent study in a pediatric EU raised WSP

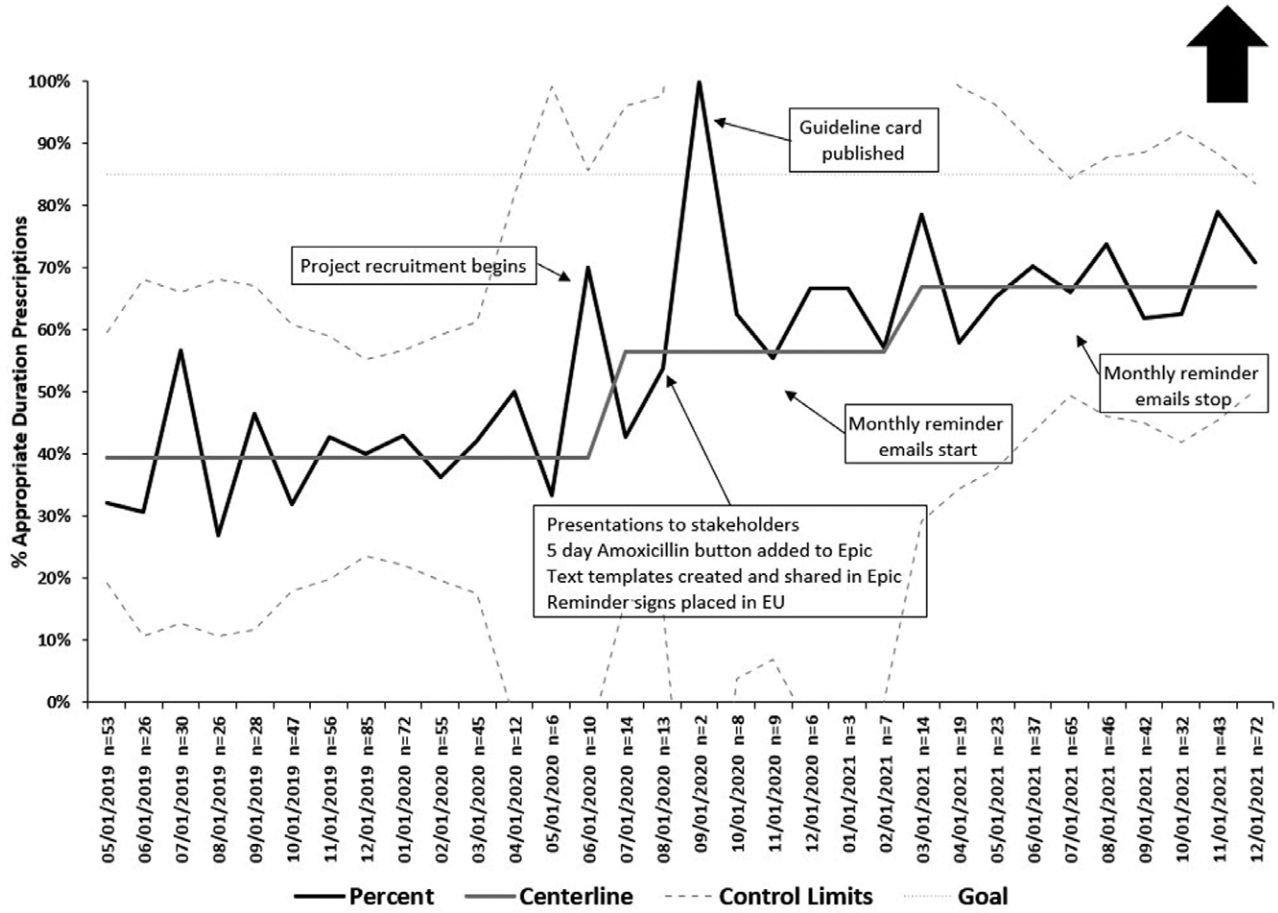

Fig. 2. P-chart demonstrating the percentage of patients ≥2 years of age diagnosed with AOM who received appropriate duration prescriptions by the month.

rates more consistently, using similar interventions to the present study, although they began with a lower baseline (0.5%–pre-intervention to 7.9% post-intervention.).[32] Several possible reasons may explain why WSP rates did not substantially increase with our interventions. First, our interventions may have been insufficient to overcome the 2 main barriers to prescribing WSPs identified by clinicians and previous literature[25]: the time required to explain the process and perception of parental desire for antibiotics. There is much support in the literature for the safety and acceptability of WSPs,[17,19,20] which we shared in our educational sessions. Nevertheless, explaining this evidence to parents takes time. We attempted to decrease the time requirement by providing EMR dot phrases to increase charting efficiency, but these would not have helped to decrease verbal counseling time. An additional component of the time barrier could be related to taking the time to look up our guideline card and follow the flowcharts for diagnosis and prescribing. Experienced clinicians in a busy EU may have been more likely to prescribe based on their habits of treating with 10 days of immediate antibiotics, despite visual reminder cards and education sessions. There also may have been concern about the lack of follow-up for patients seen in the EU, despite highlighting in our education sessions that a benefit of WSPs is that parents can treat their child without a follow-up visit if needed.

Another possibility is that, after our education sessions, clinicians were less likely to diagnose AOM in children with cold symptoms and mildly erythematous TMs. As we only reviewed charts for children diagnosed with some form of "otitis," we would not have been able to capture these children, who might be diagnosed with upper respiratory tract infections or viral illnesses. Thus, we would have been unable to add them to our denominator when looking for patients who, after our intervention, were not prescribed antibiotics but might have been prior. Anecdotally, some of our frontline clinicians expressed that they were more discerning in diagnosing AOM after our educational sessions.

Interestingly, all 4 of the families given WSPs that we reached for follow-up reported filling their prescriptions. This observation is a deviation from previous literature showing that families usually fill WSPs approximately 30% of the time.[19,33] Given the small number of families offered WSPs who we could reach for follow-up, we cannot draw clear conclusions based on our findings. However, if this finding is replicated in a future larger study, more work will be needed to identify effective

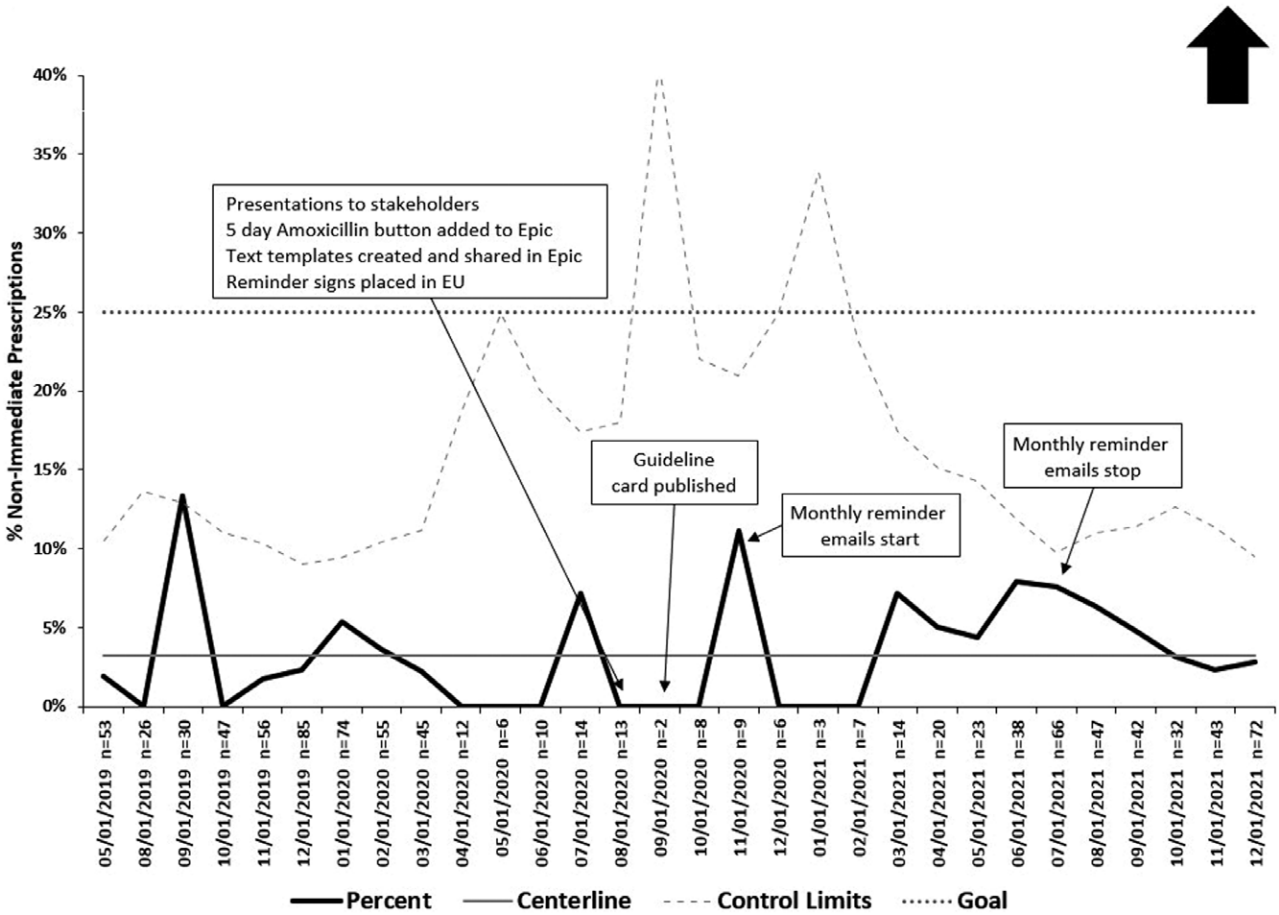

Fig. 3. P-chart demonstrating the percentage of patients ≥2 years of age diagnosed with AOM who received nonimmediate antibiotic prescription (WSPs + observation without antibiotic prescription) by the month.

interventions to overcome parental hesitancy toward watchful waiting.

Additional PDSA cycles would be helpful to further improve AOM management in our EU. A potentially helpful intervention could be building a discharge order set for AOM, which would include recommendations for first-line antibiotics, default to shorter prescription lengths based on age, and prompt clinicians to consider WSPs by providing prewritten WSP discharge instructions when the diagnosis of "acute otitis media" is selected. We could also consider implementing individualized feedback to motivate clinicians. Additional important areas of inquiry include the effect of language preference and insurance status on AOM management.

This QI project has several limitations. Notably, we based our control chart on AOM severity determined via chart review, which may not reflect all the nuanced information clinicians use for clinical decisions. This possibility could have led to a misclassification of severity. Second, the sample size for our follow-up phone calls would be insufficient to assess for rare adverse outcomes. Finally, this intervention was performed in a single children's hospital EU, where advanced practice providers and pediatric residents primarily saw patients with AOM. Expansion to other centers would be useful in assessing responses to interventions in other locations or with different types of clinicians.

CONCLUSIONS

Given the ubiquity of AOM diagnoses in children, decreasing antibiotic prescribing for this diagnosis can have a large impact both on a population level (eg, decreasing antibiotic resistance and health care expenses) as well as for individuals (eg, decreasing antibiotic side effects, microbiome disturbances, and individual costs). Our interventions were low cost and would be easy to implement in various settings, particularly as EMR use has become common and more easily customizable. The impact of these interventions has been sustained after we stopped interventions. In the future, we would like to continue improving our antibiotic prescribing practices and bring these interventions to other EUs and UCs in our hospital network that provide pediatric care.

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