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Increasing Adherence to Acute Otitis Media Treatment Duration Guidelines using a Quality Improvement Approach

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Abstract

Introduction: This quality improvement initiative aimed to improve American Academy of Pediatrics acute otitis media (AOM) guideline adherence in pediatric urgent care sites by increasing the percentage of patients 2 years and older with AOM who received a short duration (7 days or fewer) of antibiotics from a baseline of 7% to a goal of 50%. **Methods:** This quality improvement initiative was conducted in a network of seven urgent care sites affiliated with a large academic children's hospital. The interventions focused on clinician and family education, clinical decision support, and a discharge template that defaulted to a 7-day duration of antibiotics for patients 2 years and older diagnosed with AOM. The outcome measure was the percentage of patients receiving 7 days or fewer of antibiotics. The process measure was the percentage of prescriptions originating from the new discharge template. A repeat visit for AOM within 30 days from the initial visit was the balancing measure. **Results:** The percentage of patients diagnosed with AOM receiving a short antibiotic course increased from a baseline of 7% to a new centerline mean of 67%, which exceeded the goal. This project resulted in 10,138 antibiotic days being avoided. Eighty-two percent of short-course prescriptions originated from the discharge template. Repeat visits for AOM within 1 month of the initial visit did not increase. **Conclusions:** A quality improvement initiative combining education and clinical decision support improved adherence to AOM treatment duration guidelines and avoided unnecessary antibiotic exposure in a pediatric urgent care network without increasing treatment failures. *(Pediatr Qual Saf 2021;6:e501; doi: 10.1097/pq9.0000000000000501; Published online December 15, 2021.)*

INTRODUCTION

Problem Description

Acute otitis media (AOM) is the second most frequent reason for pediatric urgent care (UC) visits and is the most cited indication for antibiotic prescriptions among children.[1–5] As such, guideline-discordant or unnecessarily long-duration antibiotic choices for AOM contribute substantially to inappropriate antibiotic use in children. Concerns for adverse antibiotic effects, growing antibiotic resistance, and the national emphasis on antibiotic stewardship highlight the increasing importance of appropriate antibiotic prescribing for AOM.[5,6]

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Available Knowledge

The American Academy of Pediatrics (AAP) AOM guidelines, which were updated in 2013 and endorsed by the American Academy of Family Physicians, recommend amoxicillin or amoxicillin-clavulanate (in certain circumstances) as first-line antibiotics for AOM.[7] Further, the guidelines recommend no more than 7 days of antibiotics for patients aged 2 years and older with nonsevere AOM (no severe otalgia or fever ≥ 102.2°F). However, several studies in the past decade demonstrated poor clinician adherence with recommended AOM antibiotic prescribing guidelines, specifically regarding the therapy duration.[8–17] Lack of guideline knowledge and current practice inertia are known barriers for adopting practice guidelines and likely contribute to longer duration AOM prescriptions.[18,19] Frost

et al reported that 54% of children aged 2 years and older received longer duration antibiotics (≥10 days) for AOM. Also, they noted that evaluation in an Emergency Department (ED) or UC was an independent predictor of a longer than necessary antibiotic course.[11] In a retrospective analysis of patients diagnosed with AOM in the Nationwide Children's Hospital (NCH) UC network from August 2018 to July 2019, clinicians chose a first-line antibiotic for 85% of patients with AOM (similarly to Frost and colleagues' finding). However, despite AAP recommendations, NCH UC clinicians prescribed short-duration antibiotics (≤7 days) in only 7% of patients aged 2 years and older with AOM.

Rationale

Quality improvement (QI) initiatives inconsistently improve AOM guideline adherence but seem to be most effective when used as a multifaceted QI approach.[20–22] Modest gains in AOM guideline adherence occur with education campaigns focused on prescriber knowledge, including presentations, email campaigns, workspace posters, and family education with treatment room posters and handouts.[22,23] Additional tools to improve guideline compliance include enhancing the electronic health record (EHR) with clinical decision support (CDS) systems to default clinicians to the recommended treatment choice.[4,21,24,25]

Using the Institute for Healthcare Improvement (IHI) quality improvement methodology, the QI team sought to improve AOM treatment duration guideline adherence by combining educational campaigns and CDS tools to improve antibiotic stewardship.[26]

Specific Aim

The specific aim of this QI initiative was to increase the percentage of patients (age: 2 years and older) with AOM who received a short duration (7 days or fewer) of antibiotics from our baseline of 7% to a target goal of at least 50% within 12 months.

METHODS

Context

NCH is a 673-bed tertiary care freestanding academic children's hospital in Columbus, Ohio, and the second-largest children's hospital in the United States.[27] The seven NCH pediatric UC centers include one on-campus site and six off-campus sites in central Ohio with diverse geographic and patient demographics (21%–67% Medicaid coverage). Together, the seven UC sites had 165,589 patient encounters in 2019. The pediatric UC centers are staffed with pediatric urgent care physicians with postgraduate training in general pediatrics. In addition, staffing is supplemented with nurse practitioners with pediatric training or experience and (before April 2020) moonlighting pediatric subspecialist physicians.

Inclusion/Exclusion Criteria

Patients aged 2 years and older evaluated at any of the seven NCH UC centers from August 2018 to November 2020 and prescribed enteral antibiotics for an AOM diagnosis (ICD-10 codes H65.1*, H65.9*, H66.0*, H66.01*, H66.4*, H66.9*, or H67*) were eligible for this QI initiative (Table 1). Patients were excluded if they were older than 18 years or had an additional diagnosis of sinusitis, pyelonephritis, streptococcal pharyngitis, pneumonia, or skin and soft tissue infection that could affect treatment duration.

Interventions

A multidisciplinary task force included UC and infectious diseases physicians, an urgent care lead nurse, a pediatric resident, an Epic (Epic Systems, Verona, Wis.) physician builder, and a QI and data professional. The task force convened in July 2019 to design the QI project. The team developed a key driver diagram by brainstorming barriers and interventions utilizing IHI tools. After finding that drivers revolved around education and CDS, the team utilized IHI Plan-Do-Study-Act cycles to implement the interventions (Fig. 1).[26]

The multifaceted education campaign, which started in October 2019, targeted UC clinicians, nurses, NCH pharmacies, and families to encourage consistent messaging and shared decision-making (Table 2). (**See document 1, Supplemental Digital Content 1,** which shows the educational materials used during this QI project. http://links.lww.com/PQ9/A332.) The QI team utilized IHI's Situation, Background, Assessment, Recommendations tool to present the AAP AOM guidelines by emailing all physicians and nurse practitioners (including moonlighters) who staff the UC centers.[26] The Situation, Background, Assessment, Recommendations detailed

Table 1. Patient Demographic Information for Baseline and Intervention Periods

	Baseline Period (Aug 2018–Sept 2019), n, % (Total = 10,931)	Interventions Period (Oct 2019–Nov 2020), n, % (Total = 7,067)
Age (y)		
2–5	6,999 (64%)	4,615 (65%)
6–17	3,932 (36%)	2,452 (35%)
Gender		
Men	5,608 (52%)	3,590 (51%)
Women	5,225 (48%)	3,426 (49%)
Preferred language		
English	8,684 (80%)	5,644 (80%)
Spanish	715 (7%)	459 (7%)
Somali	565 (5%)	327 (5%)
Nepali	392 (4%)	269 (4%)
Arabic	122 (1%)	96 (1%)
Other	355 (3%)	221 (3%)
Interpreter preferred		
No	9,811 (91%)	6,177 (91%)
Yes	1,022 (9%)	662 (9%)
Insurance		
Medicaid	5,851 (54%)	3,826 (55%)
Commercial	4,439 (41%)	2,797 (40%)
Self-pay/other	543 (5%)	393 (5%)

Demographics other than age not available for all patients.

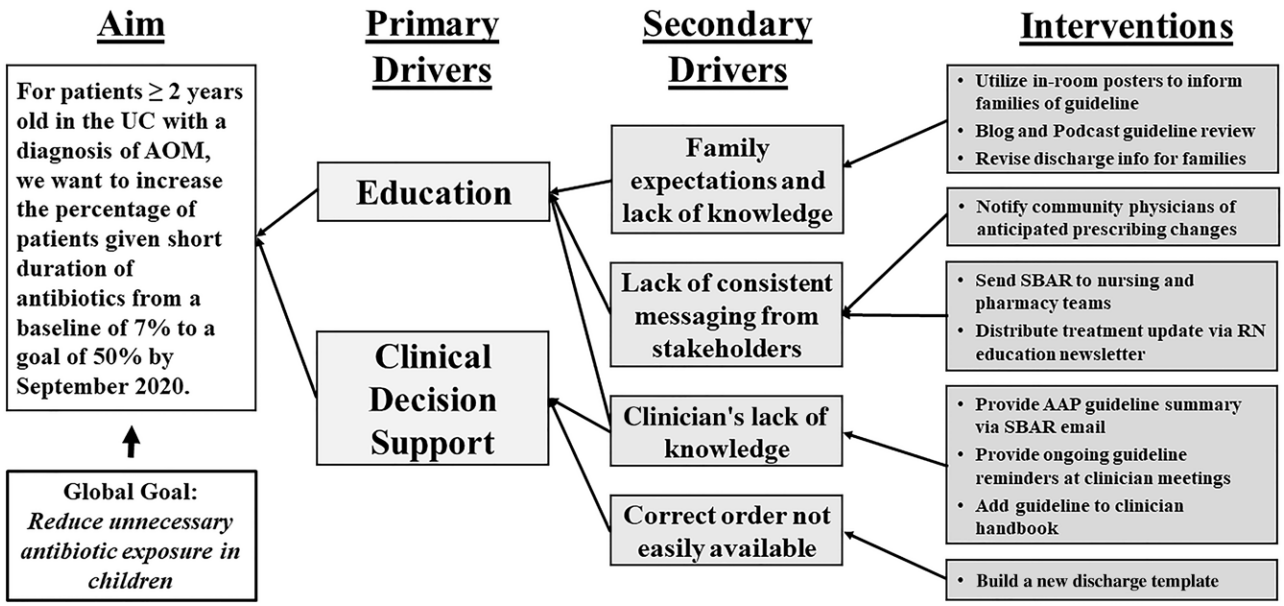

Fig. 1. Key driver diagram detailing the project aim, drivers, and interventions.

the AAP AOM recommendations for treatment duration, internal current prescribing trends, and improvement opportunities. NCH pharmacy staff and UC nurses received a similar Situation, Background, Assessment, Recommendations communication for awareness of the expected change in prescribing patterns. In addition, a family-oriented poster in all UC examination rooms emphasized the benefits of shortened antibiotic courses for nonsevere AOM, including decreased risk of antibiotic side effects and resistance, reduced cost, and increased family convenience.

The QI team recognized that a single education initiative was unlikely to create lasting improvements. Clinician turnover and the known memory bias of improved recall with repeated information, known as the spacing effect, were also addressed.[28] In November 2019, the team added a summary of this QI initiative to the UC handbook given to new clinicians/moonlighters. Bimonthly physician meeting QI status reviews included details of this initiative. In February 2020, family education efforts continued by reviewing AOM prescribing guidelines using the NCH blog and podcast, Pediacast.[29,30] The blog post was viewed 2,217 times, and the podcast education was repeated within two podcast episodes with 6,013 unique listeners representing 50 US states and 64 countries. The QI team concurrently distributed a review of the AOM prescribing guidelines and a link to the blog post to community pediatricians via a social media group to help answer families' questions regarding the change in AOM treatment duration. The social media group with community pediatricians contains over 300 members and is maintained by physician liaisons between NCH and community pediatric practices. In May 2020, education interventions were completed by updating the UC AOM home instructions given to patients/caregivers at the time of discharge, highlighting the appropriateness of shortened antibiotic course durations in patients aged 2 years and older.

A new electronic discharge template was created for any patient receiving a diagnosis of AOM to enhance CDS within the EHR. This discharge template went live in December 2019. In addition, for patients aged 2 years and older, preferred antibiotic choices were listed with a default duration of 7 days instead of the previous 10 days. Although the AAP guidelines suggest a treatment period of 5–7 days for children 6 years and older old with nonsevere AOM, the QI team opted to default to seven days for all children aged 2 years and older for simplicity.

Table 2. Interventions Completed through the Course of this Quality Improvement Study with Date, Target Audience, and Brief Intervention Summary

Date	Key Driver	Target Audience	Interventions
Oct 2019	Education	Clinicians, nurses, pharmacists, families	Email education, family posters
Nov 2019	Education	Clinicians	Added to handbook, bimonthly updates
Dec 2019	Clinical decision support	Clinicians	Discharge template started
Jan 2020	Clinical decision support	Clinicians	Discharge template default age corrected
Feb 2020	Education	Families, community pediatricians	Blog post, podcast, social media post
May 2020	Education	Families	Discharge instructions updated

Clinicians could opt out and manually override the duration in two ways. First, within the 7-day prescription, clinicians could type in 10 days to recalculate the dispensed amount. Alternatively, clinicians could expand a collapsed section of antibiotics for 10 days entitled "10-day dosing for severe otalgia and/or temp ≥102.2°F" (consistent with AAP recommendations), which was positioned below the default 7-day list. (**See document 2, Supplemental Digital Content 2,** which shows Discharge Order Set for children aged ≥ 2 with preferred and alternative antibiotics defaulted to 7 days. http://links.lww.com/PQ9/A333.)

Measures

At the start of the QI initiative, the NCH QI services department generated a retrospective report for baseline data (August 2018 through July 2019) from the EHR of all patients who met the inclusion criteria. QI services also developed an ongoing monthly report, which was tracked from August 2019 through November 2020.

The outcome measure was the percentage of patients aged 2 years and older diagnosed with AOM who received antibiotics for 7 or fewer days. The process measure was the percentage of short-duration AOM antibiotics prescribed using the AOM discharge template. Finally, the balancing measure was the percentage of patients diagnosed with AOM who returned to our UC or ED network with a repeat diagnosis of AOM more than 7 days but fewer than 30 days from the initial UC visit.

Analysis

Statistical process control analysis consisted of Shewhart *P*-charts to plot the monthly percentage of patients receiving the recommended treatment course, return visits, and AOM discharge template usage. Nelson's rules were applied to identify special cause variation in the control charts and define sequential process stage means to demonstrate improvement throughout the project.[31] Reporting of this QI initiative followed the Standards for Quality Improvement Reporting Excellence 2.0 guidelines.[32] NCH's institutional review board determined that this analysis was not research involving human subjects and did not require board review or approval.

RESULTS

From August 2018 through November 2020, a total of 17,998 patients met inclusion criteria (Table 1). The baseline period included 10,931 patients, and 7,067 patients were enrolled after initiating interventions. The percentage of patients diagnosed with AOM receiving a short antibiotic course increased from a baseline of 7% to a new centerline mean of 67% (Fig. 2). Special cause variation was noted with eight consecutive data points above our baseline, leading to a centerline shift. Over the entire period, amoxicillin was the most common antibiotic prescribed, accounting for 13,322 prescriptions (74.4%), followed by cefdinir (2,639 prescriptions, 14.7%) and amoxicillin-clavulanate (1,888 prescriptions, 10.5%). Azithromycin was rarely prescribed before or after our interventions (60 prescriptions, 0.3%).

While analyzing our Plan-Do-Study-Act cycles, the QI team recognized the new discharge template initiated in December 2019 inadvertently defaulted to a 10-day antibiotic duration for patients less than 4 years. This default was corrected in January 2020 to 10-days only for patients less than 2 years. In March 2020, the total patient encounters substantially declined due to the onset of the COVID-19 pandemic, but the percentage of patients receiving short-course antibiotics remained constant.

Compared with prescribing 10-day antibiotic courses for 93% of patients with AOM (as in the baseline period), the increased use of shortened antibiotic courses prevented 10,138 total antibiotic days over 14 months (October 2019 through November 2020). Of the short-duration antibiotic prescriptions, 82% were generated using the discharge template once the age error was corrected and clinicians became more aware of the template (Fig. 3). The 10-day duration antibiotic list from the order set was utilized 37 times during our intervention period. As a balancing measure, patients presenting for a repeat AOM visit within 30 days did not change from the baseline of 3.2%. However, there was an increase in variance due to a lower census after the start of the COVID-19 pandemic (Fig. 4).

DISCUSSION

The multifaceted QI project interventions directly increased adherence to national AOM prescribing guidelines in a pediatric UC network. While short-duration antibiotic prescriptions increased after initiating an education campaign, the combined approach with CDS electronic discharge templates led to enhanced improvement. As a result, the percentage of patients receiving short-duration prescriptions for AOM increased to a new mean of 67%, which exceeded the target of 50%. The initial goal was set conservatively as a substantial improvement from baseline while allowing for clinician discretion when longer treatment durations are indicated.

AOM is the most common indication for pediatric antibiotic prescriptions, representing a significant target area for antibiotic stewardship. Venekamp et al found that one adverse event occurred for every 14 children treated with antibiotics for AOM, highlighting the importance of limiting antibiotics when possible.[5] Avoiding 10,138 antibiotic days without increasing repeat visits demonstrated that the initiatives safely decreased unnecessary antibiotic use. Appropriate narrow-spectrum antibiotic choice remained consistent, and improvement in shorter course durations was not attributed to an inappropriate increase

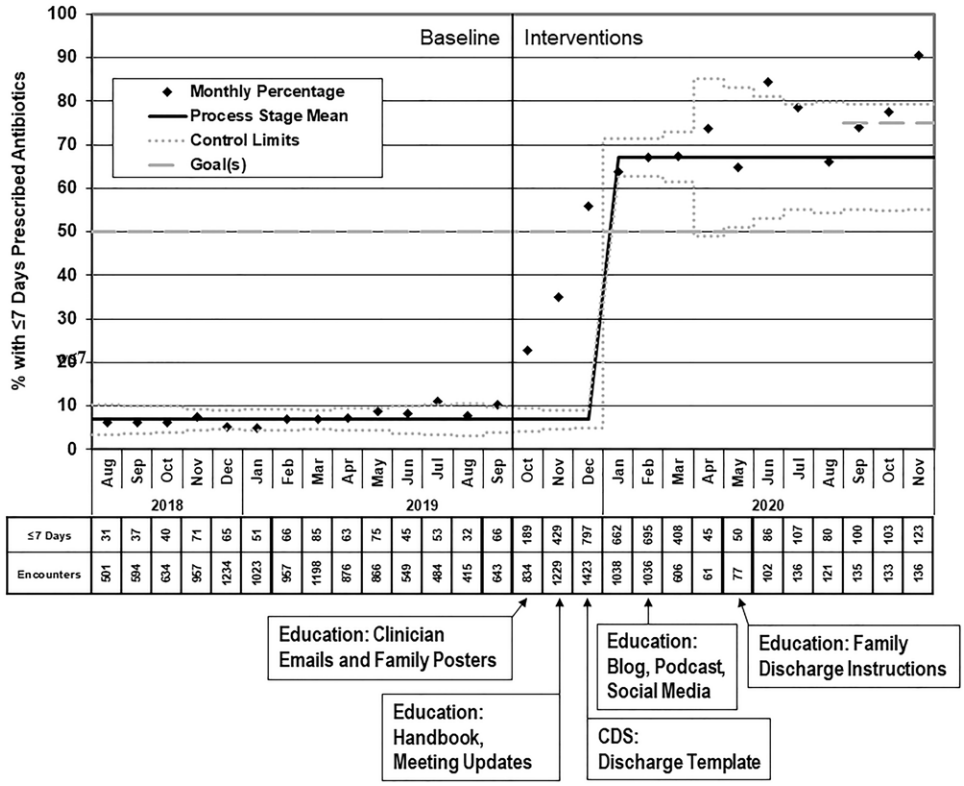

Fig. 2. The Shewhart *P*-chart demonstrates the percentage of patients prescribed seven or fewer days of antibiotics. Arrows identify the timing of two key interventions as well as the onset of the COVID-19 pandemic.

in standard 5-day azithromycin prescriptions. The success of this QI initiative prompted the NCH ED to adopt the AOM discharge template, expanding the antibiotic stewardship efforts to another large patient population.

Using a broad and recurrent education campaign helped with reducing barriers for all stakeholders. Practice changes might lead to resistance from families and other medical professionals if clinicians do not provide education regarding the evidence behind the new prescription duration. By targeting both prescribers and families, the education facilitated shared decision-making and provided families with an opportunity to discuss treatment duration. Updating pharmacists, nurses, and community pediatricians on AOM guidelines and expected prescribing changes helped create consistent messaging and built trust in a UC setting where continuity is rarely possible. Repeating education for clinicians helped account for staff turnover and optimizing the spacing effect (information recall is improved when repeated at different times), and overcoming the bias of the Hawthorne effect (transient alteration in behavior when being observed).[28,33]

Our approach and results contrast with Celind et al, who noted that education alone did not improve adherence to AOM guidelines.[23] Their project design included only a brief education campaign (over 2 months) and targeted clinicians only. In comparison, ours took place over 8 months (with ongoing bimonthly reviews) and involved both families and multiple medical professionals. These variances in project design could, in part, explain the differences in results. However, their education campaign also involved full adherence to AOM guidelines rather than our project's sole focus on treatment duration, which may account for the adherence gains in our simplified approach.

Utilizing a discharge template for CDS helped overcome practice inertia and prescribing habits by making the default choice the recommended duration. In reviewing behavioral economics approaches to QI uptake, Stevens highlights using an opt-out approach to make the preferred choice effortless.[25] Although our CDS tool does indicate preferred antibiotic choice, given our high rates of guideline-concordant antibiotic choice at baseline, this project targeted treatment duration.

Forrest et al found that while a CDS tool improved AOM guideline adherence, including individual clinician feedback provided no additional benefit.[4] In contrast, Ebben and colleagues concluded that combining implementation strategies (specifically, education with audit and feedback) was sufficient for improving general guideline adherence in ED settings.[20] Although our project did not offer individual clinician feedback, the group received bimonthly QI data review updates to visualize progress collectively. While individual audits and feedback are effective and recommended by the Centers for Disease Control core elements of outpatient stewardship, this combined implementation strategy focused on education

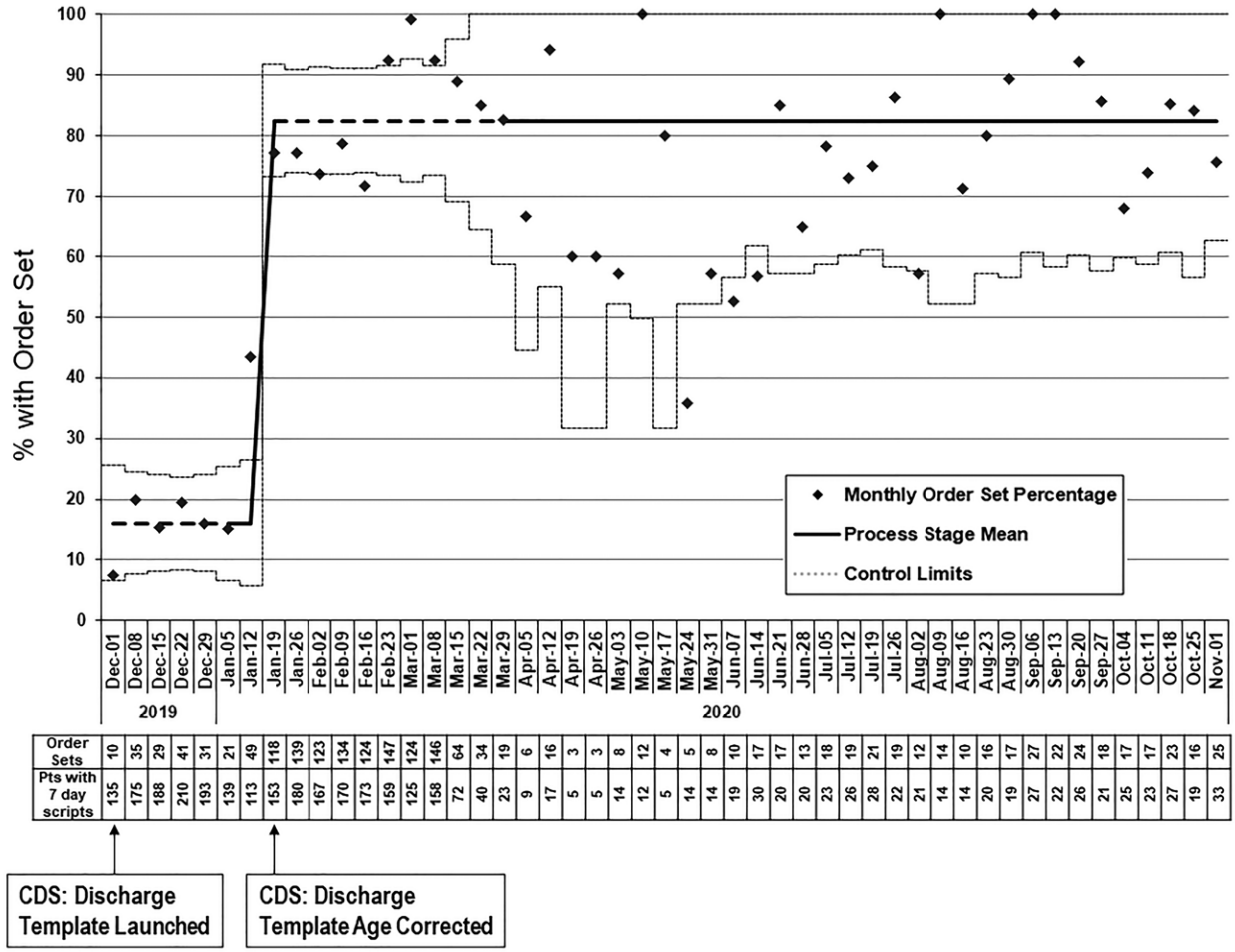

Fig. 3. The Shewhart *P*-chart showing the short-duration antibiotic prescriptions for AOM. Once the default age was corrected, 82% of short-duration antibiotics originated from the discharge order set template.

and CDS with group feedback is less resource-intensive and still proved to be beneficial.[34] While this initiative cannot decipher the relative impacts of education, CDS, and collective feedback, 18% of short-duration prescriptions were not generated using our discharge template; therefore, CDS alone cannot account for all the improvement in guideline adherence.

Several studies have examined AOM guideline adherence in ED populations, both in the United States and internationally. Still, this project is the first published report conducted in a pediatric UC setting.[9,15,17,22,23] This initiative may not be generalizable to all UC centers because ours took place in an extensive academic UC network with a sophisticated EHR and robust QI support. However, these education interventions could be easily replicated to any group of clinicians without significant expense or difficulty. Similarly, designing a simple discharge template like the one used for this project should be a relatively easy modification in many EHRs.

This QI project had several limitations. First, the AAP AOM guidelines suggest an initial option for analgesia with watchful waiting rather than antibiotic treatment for children 2 years and older with nonsevere AOM.[7] However, given a lack of continuity and difficulty with follow-up within the UC network, this approach would be challenging. Second, this project did not categorize patients as severe or nonsevere AOM to ascertain for whom 10-day antibiotic duration would have been recommended. No reports in the literature describe the percentage of severe AOM cases that should be treated with more prolonged antibiotic use. Because some clinical indications make a 10-day duration appropriate, the QI team would never expect 100% of patients to receive a shortened duration. The goal increased to 75% of patients with AOM receiving short-duration antibiotics after surpassing the initial goal of 50%. Clinician data demonstrated that long-duration prescriptions were primarily coming from only a few prescribers suggesting that the long-duration prescriptions were not representative of severe AOM (as not all patients with severe AOM would see only a few clinicians) but rather individual prescribing patterns. Third, the balancing measure tracked repeat visits to our UC and ED network but did not capture patients returning to their medical home or other outside facilities.

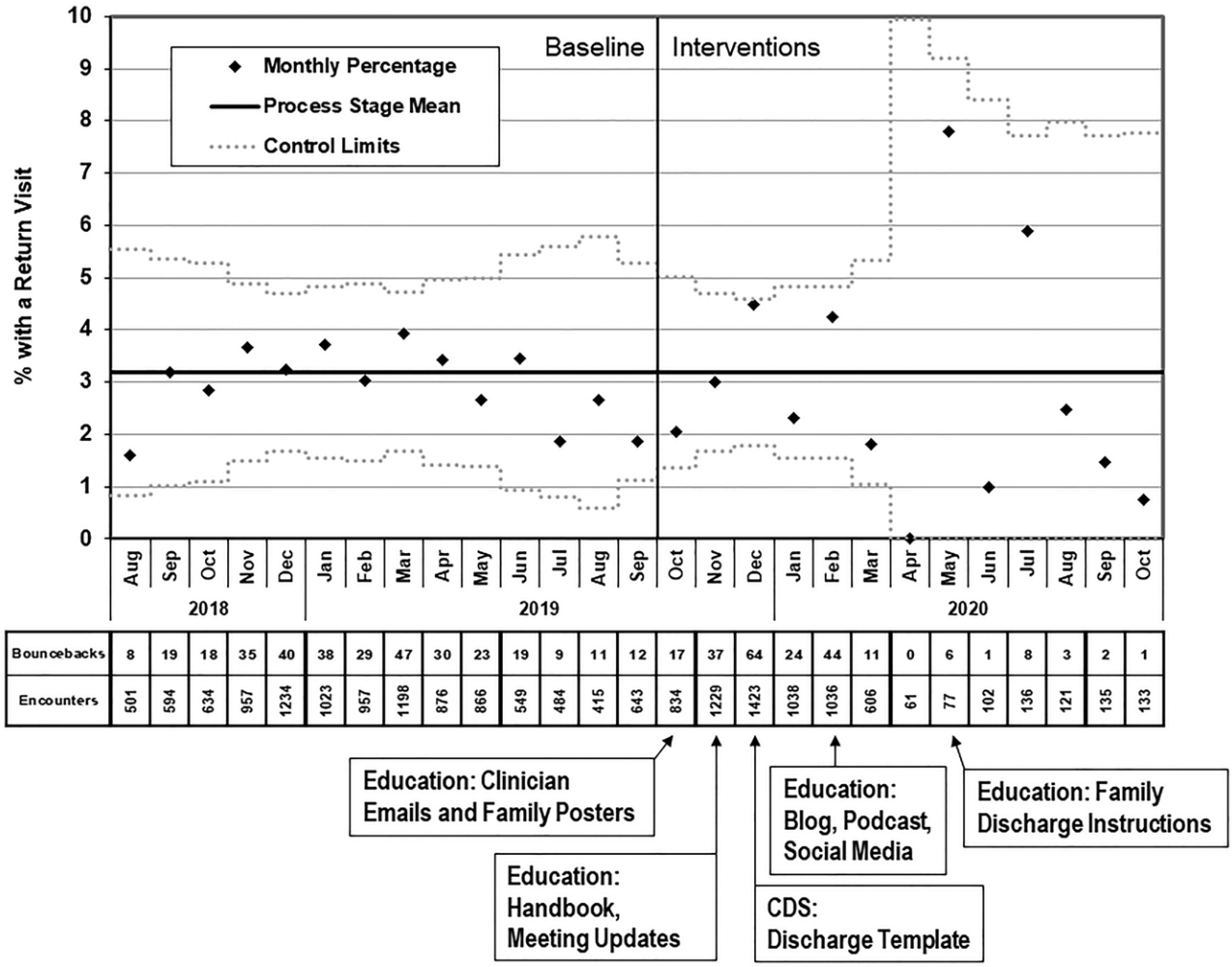

Fig. 4. Return visits with a diagnosis of AOM did not increase after initiating interventions, shown on this Shewhart *P*-chart. This balancing measure included any patient who re-presented within our UC or ED network within 30 days with another diagnosis of AOM. Increased variance is due to lower patient census after the onset of the COVID-19 pandemic.

The next steps could include adding individualized clinician feedback and implementing watchful waiting in the UC network. Sun and colleagues demonstrated short-term gains in watchful waiting adherence in an ED setting using a multifaceted approach, which could be replicated in a UC setting.[22] Future studies of AOM should address the proportion of severe AOM, which would better inform QI goals aimed to decrease excessive antibiotic duration. Direct follow-up with patients to assess return visits to any medical facility (not just sites within a network) would also provide a complete balancing measure in future studies.

CONCLUSIONS

A quality improvement project using education and clinical decision-support improved adherence to AOM treatment duration guidelines in a pediatric urgent care network. Shorter treatment courses avoided over 10,000 antibiotic days over 14 months with no indication that using shorter antibiotic courses led to increased treatment failures.

DISCLOSURE

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

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