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Concise Communication

A multifaceted antimicrobial stewardship intervention to improve antibiotic utilization and prescribing for sinusitis in a large primary care network

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Abstract

A quality improvement project was implemented across a large primary care network to decrease antibiotic use and improve guideline-concordant therapy for acute sinusitis. The multifaceted intervention included education, EHR decision support, and individual prescriber feedback with peer comparison. The program was associated with improvements in guideline-concordant prescribing.

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Introduction

Acute sinusitis accounts for approximately 5 million outpatient visits annually across the United States.[1] Although 98% are self-limited viral illnesses, with minority(0.5–2%) representing bacterial infection,[2] acute sinusitis remains a common and unnecessary reason for prescribing antibiotics. Despite national guidelines for diagnosis and treatment,[3] studies report antibiotics are prescribed in 77–83% of outpatient visits for sinusitis,[1] with most not meeting diagnostic criteria.[4] A bundled quality improvement project was implemented for improving overall antibiotic utilization and guideline-concordant antibiotic use for sinusitis in a 45-practice primary care network.

Methods

The American Academy of Otolaryngology—Head and Neck Surgery Foundation (AAO-HNS) guideline[3] and local antibiograms were used to develop best practices for diagnostic criteria and first-line antibiotic selection for adults (age ≥18) with sinusitis, followed by a bundled intervention including clinician education, electronic health record (EHR) support tools, education materials, and peer-benchmarked prescribing feedback. Education was provided in a 15-minute network-wide educational session and supplemented with written materials. An EHR order set was introduced for decision support at point of prescribing, inclusive of guideline-concordant antibiotic recommendations and non-antibiotic care options (Supplemental Figure 1). Patient education materials were provided via EHR patient portal (Supplemental Figure 2). Each clinician received letters (Supplemental Figure 3) benchmarking their antibiotic prescribing against network and national metrics. A pre/postintervention, quasi-experimental, multi-practice design evaluated the interventions. Observation periods were 9/1/2022-11/30/2022 (baseline prescribing), education-only (9/1/2023–11/30/2023) comprised of education and EHR tool introduction, and postintervention (12/1/2023–2/29/2024) following prescribing feedback. A two-pronged primary outcome of antibiotic prescriptions for any indication/100 visits and guideline-concordant antibiotic selection for indication of acute bacterial sinusitis was examined. Prescriptions for amoxicillin, doxycycline, amoxicillin-clavulanate, cefpodoxime, or cefdinir indicated for sinusitis were considered guideline-concordant. Respiratory quinolones, while guideline-concordant, were a 3rd-line alternative and omitted from order sets to align with systemwide CDI (*Clostridium difficile* infection) reduction goals.[3]

Eligible patients (age ≥18 with an index sinusitis antibiotic prescription whose provider appeared in both periods) were randomly selected for chart review: one prepost pair per provider,

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Mike Sportiello and Colin Samoriski are contributed equally.

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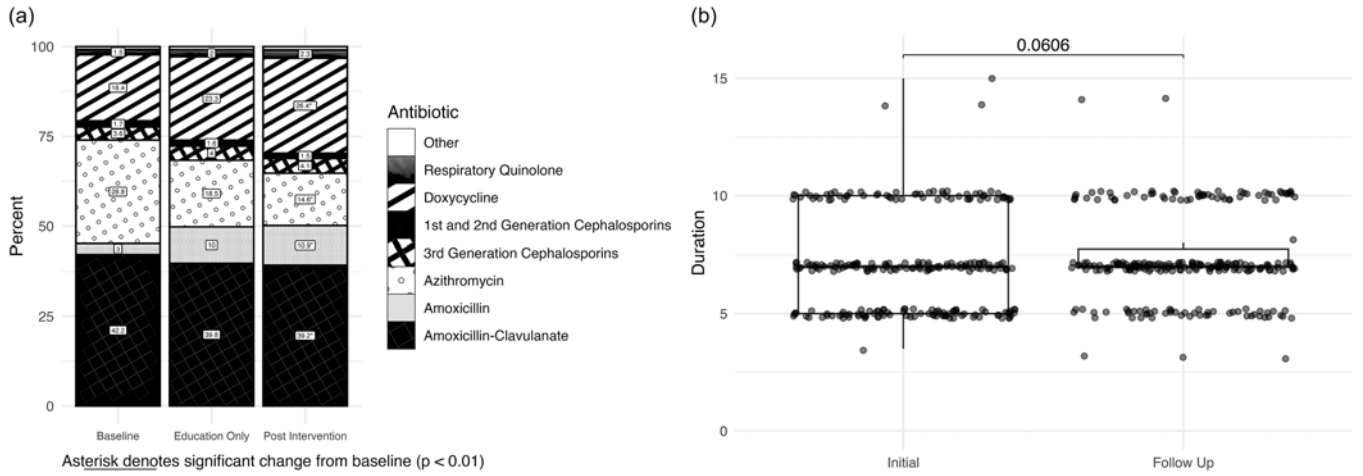


Figure 1. Shifts in antibiotic selection and treatment duration for indication of sinusitis following intervention. Percentage of antibiotics prescribed for sinusitis (1a) shifted away from azithromycin and amoxicillin-clavulanate with corresponding proportional increases in amoxicillin and doxycycline. Although median course duration was unchanged (7 d), IQR (interquartile range) reduction from 5 to 0.75 days postintervention ($P = .0606$) suggests consolidation of prescribing behavior around a single duration rather than shift toward shorter courses.

with a second pair selected for 50 of 200 providers, yielding 250 pre and 250 postintervention patients with no period overlap, each provider contributing one or two patients per period. Sample size was calculated to provide 80% power ($\alpha = 0.05$) to detect a 10% absolute improvement in diagnostic appropriateness assuming 40% baseline.[4,5] Charts were independently reviewed in pairs (two residents or resident and medical student) with infectious diseases adjudication of discrepancies. Primary outcomes were diagnostic appropriateness per AAO-HNS criteria, antibiotic selection, and treatment duration (≤7 d). Secondary outcomes were treatment failure (course extension or retreatment >72 h postcompletion), antibiotic complications (side effects requiring discontinuation, CDI), and healthcare utilization beyond prescription-originating practice, within course or 30 days of antibiotic completion.

The quality improvement project was exempt from IRB review. Data were analyzed in R v4.4.3, Rstatix v0.7.2, GraphPad, Excel v4210, and SAS v9.4. A generalized linear mixed model was generated to account for correlation between repeated provider data and analysis for variance (ANOVA) for interaction. Healthcare utilization and antibiotic-related adverse outcomes were assessed descriptively.

Results

Extraction of prescribing data yielded 23,048, 23,370, and 18,885 any-indication antibiotic prescriptions from baseline, education-only, and postintervention periods, respectively, with acute bacterial sinusitis as most frequent prescribing indication (21–23%) across periods. Overall antibiotic prescribing rate was 13.6/100 visits at baseline, increasing to 16.6/100 visits during education-only period (RR 1.22[95% CI, 1.17–1.28], $P < .001$), and decreasing to 12.9/100 visits postintervention (RR 0.78[95% CI, 0.75–0.81], $P < .001$), with relative decrease of 0.7/100 visits (RR 0.95[95% CI, 0.90–1.00], $P = .06$) baseline to postintervention.

Rate of guideline-concordant antibiotic selection for sinusitis increased from baseline 69.6% to 80% during education period (RR 1.15[95% CI, 1.09–1.21], $P < .001$), and to 83.1% post-intervention (RR 1.19[95% CI, 1.13–12.6], $P < .001$). Prescribing (Figure 1a) shifted away from azithromycin ($P < .001$[95% CI, −0.153–(−0.12)]), and amoxicillin-clavulanate ($P = .037$[95% CI, −0.04–(−0.0001)]), with corresponding increases in amoxicillin ($P < .001$[95% CI, 0.066–0.088]) and doxycycline ($P < .001$[95% CI, 0.06–0.10]).

Secondary chart review demonstrated improved diagnostic criteria utilization supporting antibiotic prescriptions for sinusitis, from 52.8% to 63.6% ($P < .001$), a 10.8% absolute and 20.4% relative increase. Although median duration was unchanged (7 d pre/post), IQR (interquartile range) reduction from 5 to 0.75 days postintervention ($P = .0606$) suggests increased harmonization of prescribing behavior around a single duration (Figure 1b). Within the chart review cohort, prescriptions exhibiting complete appropriateness of diagnostic criteria, antibiotic selection, and treatment duration increased significantly from 28.4% to 40.8% ($P < .001$).

No significant difference in healthcare utilization, sinusitis complications, or antibiotic-associated adverse events was observed (Table 1).

Discussion

A multimodal intervention of provider education, EHR tools, and prescription feedback with peer comparison to improve antibiotic utilization and antibiotic prescribing for sinusitis was associated with improved guideline-concordant antibiotic selection, use of diagnostic criteria, and a trend toward harmonized treatment durations across a large network of primary care practices. Despite improvements, the trifecta of appropriate diagnosis, antibiotic selection, and guideline-concordant duration remained elusive in 59.2% of sinusitis prescriptions on postintervention chart review.

The quality improvement bundle was associated with shifts in prescribed antibiotic classes to match the AAO-HNS recommendations,[3] with decreased macrolide and anaerobic spectrum for sinusitis. Decreasing exposure to anaerobically active antibiotics (such as amoxicillin-clavulanate) may limit adverse microbiome effects and lead to improved outcomes and side effect profiles.[6,7] Importantly, shifts in antibiotic selection pre/postintervention were not associated with increased safety concerns within the chart review cohort.

Major strengths of the study include sample size, combined with multilayer analytic design and robust approach to assessment of primary and secondary outcomes. Although not powered to detect differences in low-event rate complications like allergic

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Table 1. Comparison of sinusitis antibiotic therapy complications pre-and post-intervention

Complications of antibiotic therapy	Pre-intervention (*n*,%)	Post-intervention (*n*,%)	*P*-value
Health care contact outside prescribing office*	**12(4.8)**	**22(8.8)**	**0.0031**
Urgent care	4(1.6)	7(2.8)	0.5443
Emergency department	5(2)	9(3.6)	0.0708
Hospital admissions	3(1.2)	6(2.4)	0.5038
Reason for visit/admission			
Sinusitis complication	4(1.6)	6(2.4)	0.7514
Adverse antibiotic reaction	1(0.4)	2(0.8)	1.0000
Unrelated to treatment	7(2.8)	13(5.2)	0.0214
Adverse reaction requiring early antibiotic discontinuation	**5(2)**	**8(3.2)**	**0.1753**
GI upset	3(1.2)	4(1.6)	1.0000
Skin reaction	1(0.4)	1(0.4)	1.0000
Hospitalization	1(0.4)	0	1.0000
Reason not specified	0	2(0.8)	0.4990
Yeast Infection	0	1(0.4)	1.0000

*during therapy or within 30 days of treatment conclusion.
**a 72 hour cutoff was used to distinguish extension and retreatment.
***Fisher exact test used for sample size < 5.

reactions or treatment failure, the manual chart review cohort was sufficiently powered to resolve differences in appropriate diagnostic criteria use, a quality improvement finding of robust significance in this study. Similar rates of adverse clinical outcomes pre/postintervention (Table 1) are hypothesis-generating for larger studies.

Limitations include single healthcare-system setting and non-randomized observational design, though large sample size improves generalizability. Evaluating long-term sustainability merits further study.[8] The ramp-up education-only period was included to coincide with months of baseline data collection to moderate seasonality effects and to illustrate multimodal impact relative to the two-pronged primary outcome. Notably, sinusitis prescriptions relative to overall prescribing remained unchanged across periods. Assessment of prescribing data can be difficult if prescribers engage in diagnosis-shifting to avoid negative feedback. Interestingly, while guideline-concordant antibiotic selection for sinusitis improved during education-only period with sustained gains postfeedback, improvements in overall antibiotic utilization required both education and peer comparison interventions. Expansion in utilization between baseline and education periods is likely attributable to nationwide escalations in antibiotic use/misuse post COVID-19 pandemic,[9] highlighting the need for active stewardship efforts to counteract adverse trends in antimicrobial prescribing.

Our chart review sub-analysis design captures diagnostic *appropriateness* rather than diagnostic *accuracy* across all encounters, analogous to a "prescribing appropriateness audit" - a practical construct used by stewardship programs to assess prescription justification rather than classification appropriateness of all sinusitis-related visits.[10] Our methodology biases estimates conservatively, with observed improvement likely representing a lower bound for population-level effects.

In conclusion, a multifaceted bundled intervention including education, EHR decision support and communication tools, and individual prescriber feedback with peer comparison was associated with decreased rates of antibiotics prescribed/100 outpatient visits with improved antibiotic utilization for sinusitis, increasing appropriate use of diagnostic criteria and selection of first-line antibiotic agents among antibiotic-prescribed patients, without noted adverse impacts.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/ash.2026.10751.

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