

TITLE: Evaluating an Urgent Care Antibiotic Stewardship Intervention: A Multi-Network Collaborative Effort

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KEY POINTS

Question: What is the effect of a multi-network antibiotic stewardship intervention on inappropriate prescribing rates across urgent care?

Findings: In this quality improvement study that included 15,588 patient encounters, inappropriate prescribing rates for both bronchitis and viral illness were significantly reduced by 39% among clinicians who participated in the intervention. There were no significant reductions in inappropriate prescribing among clinicians who did not directly participate.

Meaning: Implementation of antibiotic stewardship interventions in urgent care centers can substantially decrease inappropriate antibiotic prescribing when implemented across multiple networks, specifically among clinicians directly engaged with the interventions.

ABSTRACT

Importance: Urgent Care Centers (UCCs) have reported high rates of antibiotic prescribing, without supporting diagnoses. Prior antibiotic stewardship studies in urgent care settings have generally been limited to pediatric clinics and diagnoses or conducted within single urgent care networks. Broadly generalizable stewardship efforts targeting common diagnoses across ages, such as bronchitis and viral illnesses, are needed.

Objective: To examine the effectiveness of an antibiotic stewardship intervention on reducing inappropriate prescribing for bronchitis and viral illness in UCCs as part of a multi-network national collaborative.

Design: A quality improvement study comparing inappropriate antibiotic prescribing rates in UCCs after introduction of an antibiotic stewardship intervention using an interrupted time series design, with a 3-month baseline and 9-month intervention.

Setting: The intervention was implemented at 49 UCCs in 27 different networks from 18 states across the United States, including one telemedicine site.

Participants: Urgent care clinicians from a national collaborative of UCCs, all members of the Urgent Care Association.

Intervention: Stewardship interventions included signing of a commitment statement, and a choice of intervention options including: patient education, patient engagement, clinician education, treatment guidelines, and signage/social media materials.

Main Outcomes and Measures: The primary outcome was the percent of urgent care encounters for viral illness or bronchitis with inappropriate antibiotic prescribing, stratified by whether the clinician was a direct participant in the quality improvement study and by diagnosis. Baseline and intervention periods were compared using an interrupted time series with a generalized estimating equation model.

Results: The study included 15,588 patient encounters with a diagnosis of bronchitis or viral illness. The intervention was associated with a 39% decrease in inappropriate antibiotic prescribing (aOR=0.61, 95%CI 0.48-0.77) among participating clinicians compared to baseline. The intervention did not result in a significant change in inappropriate antibiotic prescribing (aOR=1.08, p=0.54) for clinicians who were not directly participating in the study.

Conclusions and Relevance: This antibiotic stewardship intervention was associated with large reductions in inappropriate prescribing among clinicians who participated. Implementing stewardship interventions in UCCs may reduce inappropriate antibiotic prescriptions for common diagnoses; however, direct clinician participation may be necessary, especially in settings with high rates of clinician turnover.

INTRODUCTION

Inappropriate antibiotic prescribing is a main driver of antimicrobial resistance. Most inappropriate antibiotic prescribing occurs in outpatient settings, where approximately 30% of outpatient antibiotic prescriptions are inappropriate.^{1,2} As one of the fastest growing outpatient settings, urgent care centers (UCCs) have a responsibility to evaluate and implement generalizable stewardship interventions to counter high rates of inappropriate antibiotic prescribing rates noted in the past.^{3,4,5,6} Approximately 44% of outpatient antibiotic prescriptions are for acute respiratory conditions; bronchitis and viral illnesses together make up 24% of these acute respiratory conditions.⁷ These two diagnoses are important targets for reducing inappropriate prescribing, especially in outpatient settings.

Outpatient antibiotic stewardship interventions have been associated with decreased antibiotic prescribing.⁸ A recent study showing that implementation of an antibiotic stewardship intervention within a single large urgent care network was associated with reduced rates of inappropriate antibiotic prescribing for respiratory conditions.⁹ Most studies that evaluate antibiotic stewardship in adult populations are conducted in a single network or include a small number of sites.^{9,10,11,12} Other cross-network interventions have either not primarily focused on urgent care centers^{13,14} or are focused largely in the pediatric space.^{15,16,17,18} One study implemented across 20 pediatric urgent care centers observed a 32.5% reduction in inappropriate prescribing for otitis media and pharyngitis, which are diagnoses often targeted by pediatric-focused antibiotic stewardship efforts.^{16,17}

This study seeks to understand the effect of broadly generalizable antibiotic stewardship interventions on a large, geographically diverse set of urgent care centers for common diagnoses of bronchitis and viral illness, across patients of all ages.

METHODS

Ethics

The George Washington University institutional review board waived informed consent for this quality improvement study (NCR224504). The Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) reporting guidelines were followed (Supplemental Table 2).

Study Setting

Participating centers in the quality improvement study included urgent care centers with membership in the Urgent Care Association (UCA) from different urgent care networks across the United States. UCC clinician participation was coordinated by the UCA, a trade association for urgent care, with a membership of over 4,000 UCCs.

Study Population

Clinicians from each site randomly selected 30 charts to submit per month per UCC with a diagnosis of either bronchitis or viral illness and entered de-identified data into a study REDCap database via direct entry surveys or through data uploads. Clinicians reviewed charts chosen at random from the entire UCC where they worked, and not solely charts from their own patients. Patient encounters were included if they had a diagnosis of bronchitis or viral illness. Encounters with concurrent diagnoses that could warrant an antibiotic were excluded from the analysis (Supplemental Table 1).¹⁵

De-identified data included demographic information, diagnosis, whether or not an antibiotic was prescribed, prescription type (a prescription to be filled immediately at the UCC, to be picked up by the patient after the visit, or to be picked up if symptoms worsened after the visit), what antibiotic was prescribed, the duration and frequency of the prescription, and concurrent

diagnoses. The research team provided daily chart tracking numbers to aid data collection for participating clinicians, and tools such as a comprehensive data dictionary were used to ensure correct chart extraction into the REDCap database.

Study Design

The Urgent Care Association (UCA) recruited participants by sending out invitations via email and other forms of electronic communication such as newsletters, inviting centers to participate in the quality improvement study. The 12-month study included 3 months of baseline (pre-intervention) data collection (September 2021 to November 2021) and 9 months of intervention (December 2021 to August 31 2022), broken into two study periods: the baseline period and intervention period.

The antibiotic stewardship intervention consisted of three plan-do-study-act (PDSA) cycles. During the first PDSA cycle which occurred at the culmination of the baseline period, participating clinicians signed the UCA/College of Urgent Care Medicine (CUCM) Antibiotic Stewardship Commitment Statement.¹⁹ The second and third PDSA cycles occurred in the third and fifth months of the intervention period, respectively, and required participating centers to choose an intervention strategy to implement at their center including patient education handouts, patient engagement materials (videos, articles, letter templates, etc.), clinician education, treatment guidelines, and signage/social media materials. Materials were offered in both English and Spanish and are publicly available (Supplemental Table 1).¹⁹ Each site was able to choose the intervention to implement for their given UCC setting.

All participants committed to active participation in data collection, implementing stewardship efforts, attendance at four webinars, and continuous feedback for the entire study period. Subject matter of the webinars included a review of national data, site presentations, highlight of a specific intervention, quality improvement education, data updates, and a questions and answers session. Site-specific inappropriate antibiotic prescribing rates were also

provided to each site on a monthly basis. Clinicians noted during the chart extraction whether the selected patient encounter involved a clinician directly participating in the study, or a clinician not actively participating in the quality improvement study.

As an incentive for active participation, clinicians were offered Maintenance of Certification (MOC) credits from the American Board of Internal Medicine and the American Board of Pediatrics which coincided with submission of the final project evaluation. Active participation was defined as attendance at a minimum of four webinars during the 9-month intervention period, active participation in the implementation of the selected interventions, and participation in feedback and evaluation mechanisms. Live webinars were held each month to review data collection progress, aggregate results, and to discuss successes and challenges of the study.

Intervention Outcomes

Information was collected on how the antibiotic was prescribed to the patient with three options: a prescription to be filled immediately at the UCC, to be picked up by the patient after the visit, or to be picked up if symptoms worsened after the visit. Antibiotic prescribing was defined as inappropriate if the clinician indicated yes to any of these three options. The primary outcome measure for this study was inappropriate antibiotic prescribing for bronchitis and viral illness diagnoses. Basic demographic information was also extracted from the patient chart. The primary study outcome was the change in inappropriate prescribing for bronchitis or viral illness diagnoses, comparing baseline (September to November 2022) and intervention periods (December 2022 to August 2023).

Data Analysis

Data was exported from REDCap to SAS version 9.4 for statistical modeling. Demographic characteristics for the encounters were compared using a chi-squared test. A

Mann-Kendall test was used to detect trends in antibiotic prescribing across the two study periods. Measured in months, the trends were analyzed for the 9-month intervention period. The Mann-Kendall test was utilized for antibiotic prescribing overall, and also by primary diagnosis. Statistical process control (SPC) charts were developed to assess how antibiotic prescribing changed over the 9-month intervention period and shared with the sites on a monthly basis.

An interrupted time series model using a binomial generalized estimating equation was used to evaluate the association between the antibiotic stewardship intervention and inappropriate prescribing for both diagnoses, with clustering by each UCC. Odds ratios (ORs) were calculated to assess the difference in antibiotic prescribing during the intervention period when compared to the baseline period, adjusted for age and race/ethnicity. For secondary analyses, the model was stratified by primary diagnosis and then by clinician participation status, and both models were run using an exchangeable correlation structure.

RESULTS

Forty-nine UCCs from 18 different states participated in the study. These sites represented 27 different urgent care networks. A total of 138 clinicians participated in the study, with each site providing up to four clinicians. Among the 15,588 patient encounters reviewed during the study, 2,470 resulted in one or more antibiotic prescriptions (15.8%). The mean age of the patients included in the collected encounters was 26.3 years (23.0 SD). Demographic information of these encounters is presented in Table 1.

In the baseline period, there were 3,851 viral illness encounters, among which 490 had an antibiotic prescribed (12.7%), and 559 bronchitis encounters, among which 293 had an antibiotic prescribed (52.4%). Out of all the encounters, 49.2% were entered by a clinician directly participating in the study, and 50.6% were entered by clinicians not involved. During the intervention period, there was a decrease in the proportion of reviewed charts that were from

clinicians directly participating in the study, with the proportion of clinicians not actively participating rising from 47.6% to 52.5% between the first 3 and final 3 months ($p < 0.001$).

During the 9-month intervention period, antibiotic prescribing for bronchitis and viral illness decreased. For bronchitis, inappropriate prescribing was 53.1% during baseline and decreased during the intervention period (Mann-Kendall $p = 0.002$) to 38.7% by the final two months of the intervention (14.5% absolute reduction, 27.2% relative reduction). During the baseline period, prescribing rates for clinicians directly participating in the study were lower compared with non-participants for bronchitis (40% vs 61%, $p = 0.012$). For viral illness, inappropriate prescribing was 12.7% during baseline and decreased during the intervention period (Mann-Kendall $p = 0.002$) to 9.9% by the final two months of the intervention (2.7% absolute reduction, 21.7% relative reduction). For both diagnoses combined, inappropriate prescribing was 18.0% during baseline and decreased during the intervention period (Mann-Kendall $p < 0.001$) to 13.5% by the final two months of the intervention (4.5% absolute reduction, 25% relative reduction) (Figure 1).

During the baseline period, the rate of inappropriate prescribing was highest for White patients (20.2%) compared with Black (11.4%) and Hispanic (14.5%) patients ($p < 0.001$). Inappropriate prescribing rates remained higher among White patients (15.9%) compared with Black (13.1%) and Hispanic (9.9%) ($p = 0.011$) in the intervention period.

The interrupted time series analysis demonstrated significant decreases in inappropriate antibiotic prescribing among clinicians directly participating in the study, but not among clinicians who did not directly participate (p -value for interaction by study participation = 0.002) (Table 2, Figure 1). For bronchitis, antibiotic prescribing significantly decreased by 48% (aOR 0.52, 95%CI 0.33-0.83) for clinicians who directly participated in the quality improvement study. Among clinicians not directly participating in the study, there was a marginally significant

decrease in prescribing of 34% (aOR 0.66, 95%CI 0.42-1.01). For viral illness, antibiotic prescribing decreased by 33% (aOR 0.67, 95%CI 0.55-0.82) for clinicians directly participating in the quality improvement stewardship intervention. Among clinicians not directly participating in the study, there was no significant change in inappropriate prescribing for viral illness. For the two diagnoses combined, inappropriate prescribing decreased by 39% (aOR 0.61, 95%CI 0.48-0.77) in the intervention period compared to baseline for clinicians directly participating in the quality improvement stewardship intervention.

DISCUSSIONS

Over the course of nine months, the quality improvement project resulted in a substantial reduction of inappropriate prescribing for both bronchitis and viral illness diagnoses across nearly 50 geographically diverse US urgent care centers. When stratifying encounters by whether the clinician was a direct participant in the quality improvement study, reductions in inappropriate antibiotic prescribing were seen for participating clinicians but not for clinicians who did not directly participate. For participating clinicians, inappropriate prescribing for bronchitis diagnoses decreased by 48% in the intervention period and decreased by 33% for viral illness diagnoses.

These results add to the growing evidence on the effectiveness of antibiotic stewardship interventions in urgent care settings, including studies with inappropriate prescribing reductions of similar magnitude to those observed in this study.⁹⁻¹⁵ Notably, the baseline rates of inappropriate antibiotic prescribing were relatively low at baseline compared with previously published estimates, particularly for viral illness (12.7%); Palms et al. observed urgent care inappropriate prescribing at 75.8% for bronchitis and 41.6% for viral upper respiratory tract infections.⁵ Nonetheless there was a large and significant reduction (33%) among clinicians directly participating in the study. The antibiotic stewardship intervention was coordinated through a national trade association of UCCs (UCA) and represented a diverse set of UCCs

across 18 states and 27 different networks, suggesting broad generalizability of findings. The primary diagnoses of bronchitis and viral illness are commonly occurring diagnoses in people of all ages, making the findings generalizable to people of all age groups. Additionally, the stewardship interventions were in line with the CDC's Core Elements of Outpatient Antibiotic Stewardship²¹ and similar to multifaceted antibiotic stewardship approaches implemented in other studies.^{9,13,16}

Prior studies have suggested that racial differences exist in rates of antibiotic prescribing, with White patients more likely to receive an antibiotic prescription.^{22,23} In this study, White patients were nearly twice as likely to receive an inappropriate antibiotic prescription during the baseline period compared with Black patients. Prescribing differences between races were reduced but persisted during the intervention period. Although this represents a minoritized group receiving more appropriate care, these differences in care by patient race may be driven by implicit bias. Further studies are needed to determine the role of other factors, including socioeconomic status on receiving inappropriate antibiotic prescriptions.

Reductions in inappropriate antibiotic prescribing were largely seen among clinicians directly participating in the study, but not among non-participating clinicians. Although some of the interventions were intended to be disseminated from directly participating clinicians to all clinicians at the center, it is possible that some of the more individual clinician-focused interventions (e.g., webinar participation) have a larger impact on reductions in inappropriate prescribing. Alternatively, clinicians who were not direct participants may be joining the UCC during the course of the study, as evidenced by the increasing proportion of non-participating clinicians over time; new clinicians may have less opportunity for interaction with the stewardship intervention content. Clinician turnover at UCCs may be higher compared with many other clinical settings, highlighting the importance of regular engagement in stewardship interventions.

Limitations

Since data was measured per encounter, not per patient, it is not known if repeat visits are present in the dataset. Race and ethnicity were collected as one variable; therefore, interpretation of this variable may be less valid. Although this was not a main aim of the study, conclusions regarding race and ethnicity should be explored in future studies. This study did not include a sustainability period to measure if the observed association was sustainable past the intervention period, so we cannot make conclusions regarding long-term effectiveness. It is noteworthy that baseline prescribing rates for participants differed from non-participants for bronchitis. This observation suggests the potential influence of selection bias, as clinicians who opted to participate in the quality improvement (QI) intervention might have been more inclined towards appropriate antibiotic prescribing practices; however, this difference in baseline prescribing rates was not seen for viral illness diagnoses ($p=0.93$). Additionally, we did not capture specifics on which interventions were applied at each UCC. UCCs included in the study could choose from a set of validated interventions best suited to their environment. Although this precludes evaluations of specific interventions, we can conclude that having UCCs implement interventions from a set of validated options is effective in reducing inappropriate prescribing overall. This is an intentionally generalizable approach that may be broadly applicable across environments. There were also issues of clinician turnover at participating UCCs which resulted in some loss of continuity for monthly chart extraction at some sites. Despite this, most participating UCCs met the data collection targets.

Conclusion

Overall, the antibiotic stewardship intervention was associated with reduced rates of inappropriate prescribing for both bronchitis and viral illness diagnoses in this large, geographically diverse collection of urgent care centers. This study highlights the importance of

direct clinician engagement with stewardship efforts and provides a broadly applicable approach to antibiotic stewardship implementation in UCCs.

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Author Contributions

Dr Liu had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Roberts and Park contributed equally.

Concept and design: Liu, Dolan, Hamdy.

Acquisition, analysis, or interpretation of data: Liu, Hamdy, Roberts, Park, Balthrop.

Drafting of the manuscript: Roberts, Park.

Critical review of the manuscript for important intellectual content: All authors.

Statistical analysis: Roberts, Park.

Obtained funding: Liu.

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Supervision: Liu, Dolan, Hamdy.

Conflict of Interest Disclosures: None reported.

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Figure 1. Inappropriate antibiotic prescribing by provider participation in the quality improvement project and by diagnosis

Percent of urgent care encounters with an inappropriate antibiotic prescription by month, diagnosis, and whether the clinician for the chart was a direct participant in the quality improvement project (blue line) or was not directly participating in the QI project (red line). Faded lines represent the 95% confidence intervals for the inappropriate antibiotic prescribing rate. Inappropriate prescribing changes were different between participating clinicians and non-participating clinicians for both bronchitis ($p < 0.001$ for interaction term) and viral illness ($p = 0.036$). Prescribing patterns were also different by study participation among bronchitis diagnoses ($p = 0.012$) but not viral illness ($p = 0.093$).

Table 1. Urgent care center encounter patient characteristics.

Characteristic	Baseline Period	Intervention Period	Overall
Total visits	3,477	12,111	15,588
Race/Ethnicity			
Black	330 (9.5%)	1,274 (10.5%)	1,604 (10.3%)
White	2246 (64.6%)	7,697 (63.6%)	9,943 (63.8%)
Hispanic	308 (8.9%)	1,004 (8.3%)	1,312 (8.4%)
Other	593 (17.1%)	2,136 (17.6%)	2,729 (17.5%)
Insurance			
Commercial	2,168 (62.4%)	7,458 (61.6%)	9,626 (61.8%)
Military	53 (1.5%)	169 (1.4%)	222 (1.4%)
Public	1,028 (29.6%)	3,503 (28.9%)	4,531 (29.1%)
None	101 (2.9%)	419 (3.5%)	520 (3.3%)
Unsure	127 (3.7%)	561 (4.6%)	688 (4.4%)
Missing	0	1	1
Age			
0-11m	112 (3.2%)	295 (2.4%)	407 (2.6%)
1-20y	1,592 (45.8%)	5,653 (46.8%)	7,245 (46.5%)
21-40y	885 (25.5%)	2,939 (24.3%)	3,824 (24.5%)
41-60y	511 (14.7%)	1,848 (15.3%)	2,359 (15.1%)
61-80y	344 (9.9%)	1,230 (10.2%)	1,574 (10.1%)
81 and over	30 (0.9%)	124 (1.0%)	154 (1%)
Missing	3	22	25

Table 2. Antibiotic prescribing by diagnosis during the baseline and intervention periods, stratified by whether the clinician was participating in the quality improvement project.

	Inappropriate antibiotic prescribed / number of encounters (%)		Odds of inappropriate prescribing, intervention vs. baseline	
	Baseline	Intervention	aOR ^a	p-value
Bronchitis Diagnoses Overall	293/559 (52.4)	632/1338 (47.2)	0.63 (0.46-0.87)	0.005
Participating clinician	92/230 (40.0)	129/448 (28.8)	0.52 (0.33-0.83)	0.006
Non-participating clinician	201/329 (61.1)	503/890 (56.5)	0.66 (0.42-1.01)	0.057
Viral Illness Diagnoses Overall	490/3851 (12.7)	1055/8560 (12.3)	0.92 (0.77-1.10)	0.369
Participating clinician	241/1870 (12.9)	390/5024 (7.8)	0.67 (0.55-0.82)	<0.001
Non-participating clinician	249/1981 (12.6)	665/4591 (14.5)	1.17 (0.86-1.58)	0.317
Bronchitis and Viral Illness	783/4410 (17.8)	1687/10953 (15.4)	0.86 (0.72-1.03)	0.099
Participating clinician	333/2100 (15.9)	519/5472 (9.5)	0.61 (0.48-0.77)	<0.001
Non-participating clinician	450/2310 (19.5)	1168/5481 (21.3)	1.08 (0.85-1.38)	0.540

a. Generalized estimating equation, adjusted for age and race/ethnicity, accounting for clustering by clinic.