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Brief Report

A Quality Improvement Initiative to Improve Antibiotic Stewardship at a Federally Qualified Health Center

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A B S T R A C T

The development of antibiotic resistance is a growing public health concern. Antibiotic stewardship programs (ASPs) employ strategies to improve antibiotic prescribing practices. The purpose of this quality improvement project was to pilot an ASP with a focus on the management of sinusitis and pharyngitis. Antibiotic prescribing practices were evaluated before and after the implementation of the pilot ASP. The primary aim of this project was to improve the concordance of antibiotic prescribing practices with clinical practice guidelines. Although not statistically significant, it was noted that there was an improvement in adherence to clinical practice guidelines after the pilot ASP was implemented.

Indiscriminate use of antibiotics has accelerated the emergence of antibiotic-resistant pathogens. The treatment of resistant pathogens typically requires the use of more powerful antibiotics, which carry a greater risk of adverse drug reactions and higher medical costs. In the United States (US), it is estimated that 2.8 million people acquire antibiotic-resistant infections annually, over 35,000 of which become fatal.[1] The majority of antibiotic expenditures in the US derive from the outpatient setting.[2] However, recent estimates suggest that at least 30% of oral antibiotics prescribed in outpatient settings are unnecessary, with acute respiratory conditions most commonly driving inappropriate antibiotic use.[3-5] In particular, non–guideline-concordant antibiotic prescribing for the management of acute sinusitis and pharyngitis has been well-documented.[3-8]

Improving antibiotic prescribing practices through "antibiotic stewardship" has become the cornerstone of efforts to deter the development of antibiotic-resistant pathogens. Antibiotic stewardship refers to the judicious selection of antibiotic class, dose, route, and duration of therapy for a given diagnosis while avoiding antibiotic prescriptions not indicated by clinical practice guidelines (CPGs). Antibiotic stewardship programs (ASPs) are used to measure and improve how antibiotics are prescribed. Strategies to promote antibiotic stewardship in the outpatient setting include the following: patient and clinician educational interventions, communication skills training, electronic health record (EHR) audit and feedback, peer comparison, clinical decision support tools, use of point-of-care testing, implementation of policies to promote appropriate antibiotic prescribing practices, and delayed antibiotic prescribing.[9-14] The use of these strategies via ASPs has been studied in outpatient settings with promising results.[15-17]

The purpose of this quality improvement project was to pilot an ASP involving clinician education and EHR audit with feedback and to assess the impact of the ASP on antibiotic prescribing practices for acute sinusitis and acute pharyngitis in adult patients.

Methods

Context

This quality improvement project was conducted at a Federally Qualified Health Center (FQHC) in central Massachusetts that serves roughly 29,000 patients across 3 sites. The FQHC is designated a patient-centered medical home with primary care, urgent care, women's health, pharmacy, dental, podiatry, and nutrition services. The pilot ASP focused specifically on antibiotic prescribing practices in the primary care and urgent care clinics in 1 of the 3 FQHC sites, which was collectively staffed by 6 physicians, 9 nurse practitioners, and 1 physician assistant. Five nurse practitioners and 2 physicians volunteered to participate in this quality improvement project. This group was designated the *pilot group*.

Intervention

The interventions used for this pilot ASP included clinician education and audit and feedback. Two 1-hour educational sessions were delivered to the pilot group. Educational sessions included a review of the pilot group's collective chart audit findings, a review of the Infectious Diseases Society of America's 2012 CPGs for acute sinusitis and acute pharyngitis, and communication skills training related to antibiotic prescribing.[18,19] Personalized feedback on

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baseline prescribing practices was provided to all pilot group clinicians via secure email using the model of actionable feedback as a theoretical framework. This model emphasizes timeliness, individualization, lack of punitiveness, and customizability to improve the effectiveness of behavior change through audit and feedback practices.[20] Antibiotic stewardship open-access Centers for Disease Control and Prevention posters were displayed in several clinic rooms. Pilot group clinicians completed 1.75 hours of continuing medical education credit on Stanford University's online module "To Prescribe or Not to Prescribe? Antibiotics and Outpatient Infections", and were subject to monthly antibiotic stewardship reminder emails. These emails highlighted various aspects of the Infectious Diseases Society of America's CPGs for acute sinusitis and pharyngitis. For the audit, a report was generated outlining all adult (age ≥ 18 years) patient encounters with acute sinusitis– and acute pharyngitis–related *International Classification of Diseases, Tenth Revision* codes performed by the pilot group during the prepilot ASP intervention time period (November 1, 2017-March 31, 2018) and the postpilot ASP intervention time period (November 1, 2018-March 31, 2019). Using this report, audits were performed via a manual chart review of the EHR. Data points were systematically collected during the chart audit using specific flow sheets developed by project team members. Figure 1 provides an example of the acute sinusitis chart audit flow sheet.

Study of the Intervention

The Model for Improvement, developed by the Associates in Process Development, was used to study this pilot ASP. This model provided a framework for quality improvement that involved setting aims, establishing measures, selecting changes, and testing changes via Plan-Do-Study-Act (PSDA) cycles. One PDSA cycle was completed for this pilot program with the intention of handing off the next PDSA cycle to the incoming cohort of Doctor of Nursing Practice students (Figure 2).

Measures

The primary aim of the pilot ASP was to improve CPG-concordant antibiotic prescribing practices in the pilot group. For the purposes of this project, CPG-concordant prescribing practices were defined as 1) indication for an antibiotic prescription concordant with CPG (C-CPG) and 2) antibiotic type, dosage, frequency, and duration C-CPG. The primary aim was measured by comparing audit findings of antibiotic prescribing practices in the pilot group before the pilot ASP was implemented (pre-ASP) and after the pilot ASP was implemented (post-ASP).

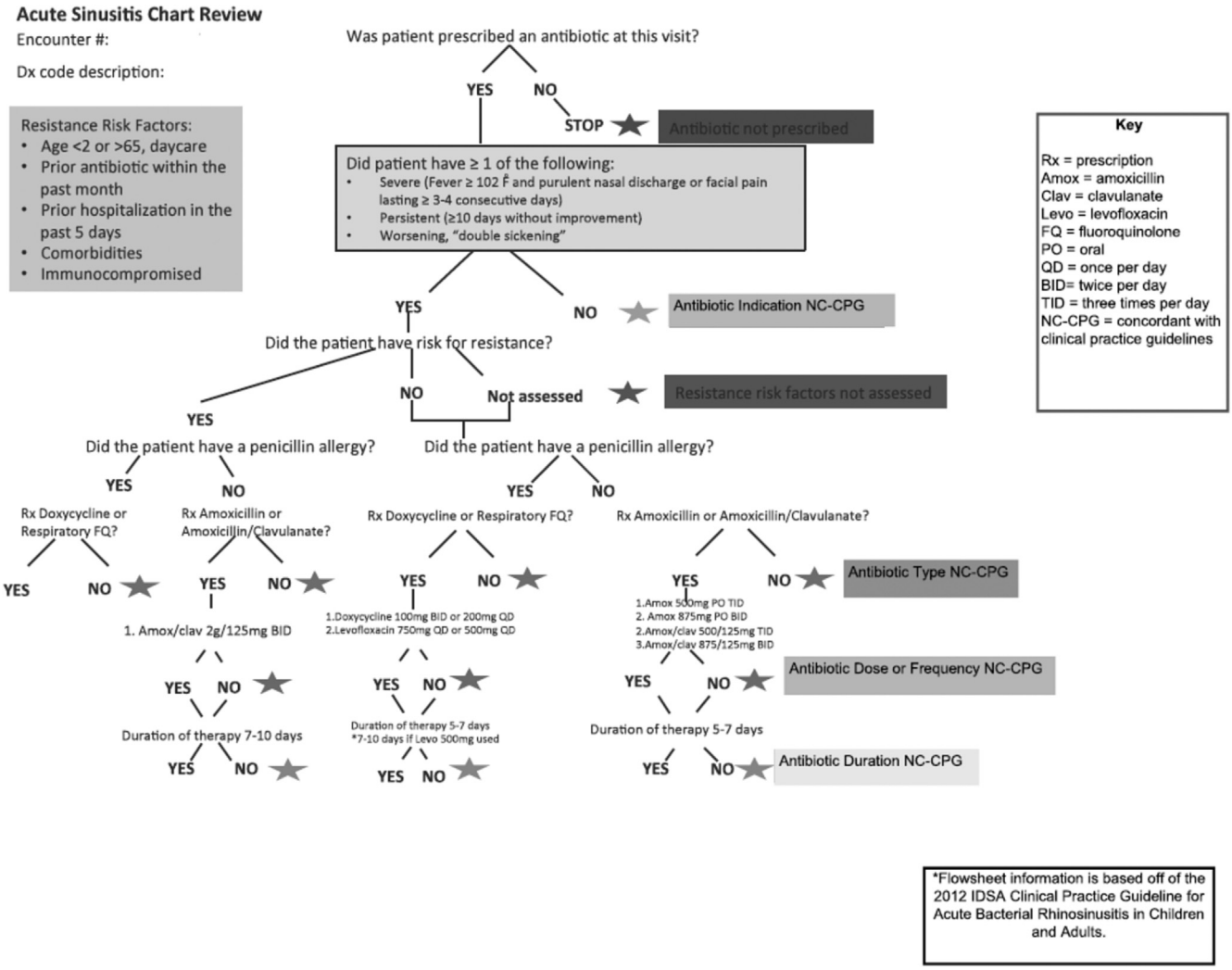

Figure 1. The flow sheet used to guide chart audit data collection for acute sinusitis encounters.

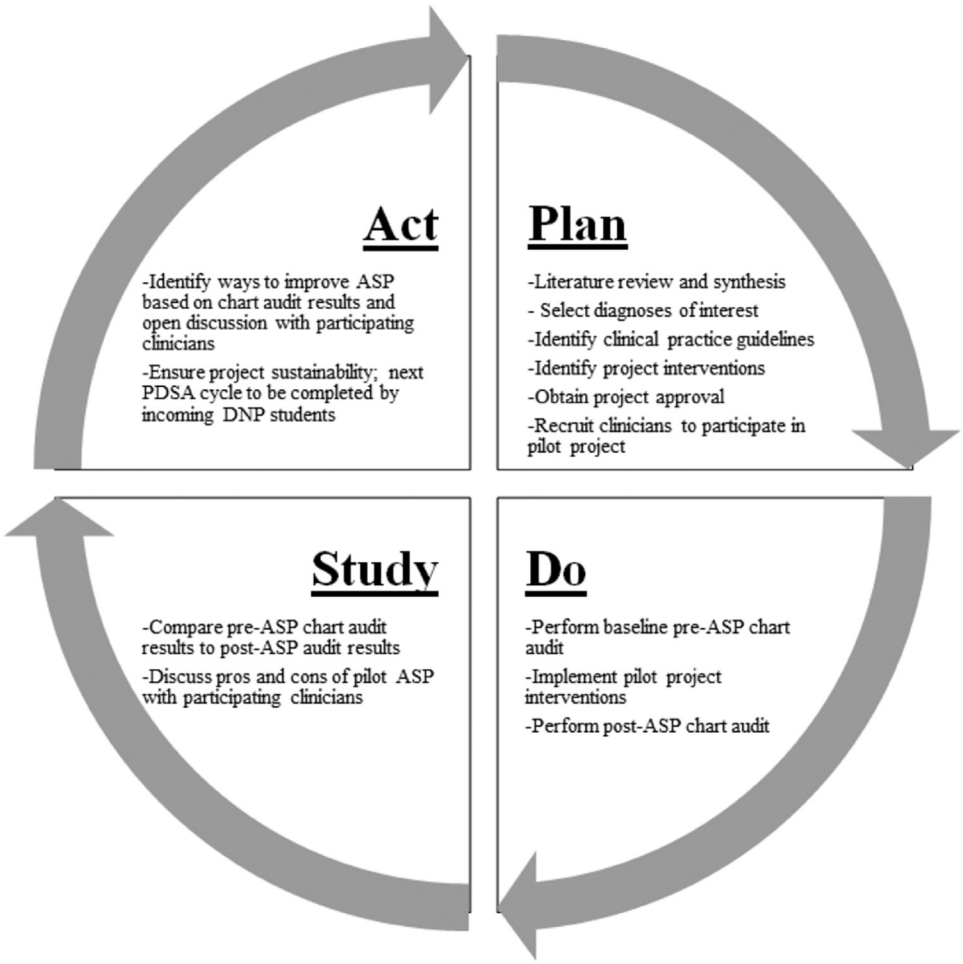

Figure 2. The outline of the PDSA cycle completed for the pilot ASP.

Analysis

Statistical analysis of the pilot group chart audit results pre-ASP and post-ASP included group absolute change, standard error, *P* values, and 95% confidence intervals. This type of analysis was selected as a way to compare within-group changes from pre-ASP with post-ASP and to determine statistical significance.

Ethical Considerations

This quality improvement project was determined to be "not human subjects research" and was formally waived by the University of Massachusetts Medical School Institutional Review Board. The project was reviewed and accepted by the FQHC's Quality Care Committee.

Results

Acute Sinusitis

For the pilot group, from pre-ASP to post-ASP, the following absolute changes were noted: there was a 10% increase in antibiotic indication C-CPG ($P = .3051$), there was a 0.9% increase in antibiotic type C-CPG ($P = .9443$), there was a 13.3% increase in antibiotic dosage or frequency C-CPG ($P = .5175$), and there was a 12.2% increase in antibiotic duration C-CPG ($P = .4767$). All within-group

Table 1
Pilot Group Absolute Change, Standard Error, *P* Values, and 95% Confidence Interval (CI) for the Acute Sinusitis Pre–Antibiotic Stewardship Program (ASP) and Post-ASP Chart Audit

Audit Finding	Pre-ASP, n/N (%)	Post-ASP, n/N (%)	Absolute Change (Standard Error)/*P* Value	95% CI for Absolute Change
Antibiotic indication C-CPG				
Pilot group	9/10 (90.0)	11/11 (100.0)	10.0 (9.5)/.3051	29.9% to −9.9%
Antibiotic type C-CPG				
Pilot group	9/10 (90.0)	10/11 (90.9)	0.9 (12.9)/.9443	27.8% to −26.0%
Antibiotic dosage or frequency C-CPG				
Pilot group	6/9 (66.7)	8/10 (80.0)	13.3 (20.2)/.5175	55.9% to −29.2%
Antibiotic duration C-CPG				
Pilot group	7/9 (77.8)	9/10 (90.0)	12.2 (16.8)/.4767	47.7% to −23.2%

C-CPG = concordant with clinical practice guideline.

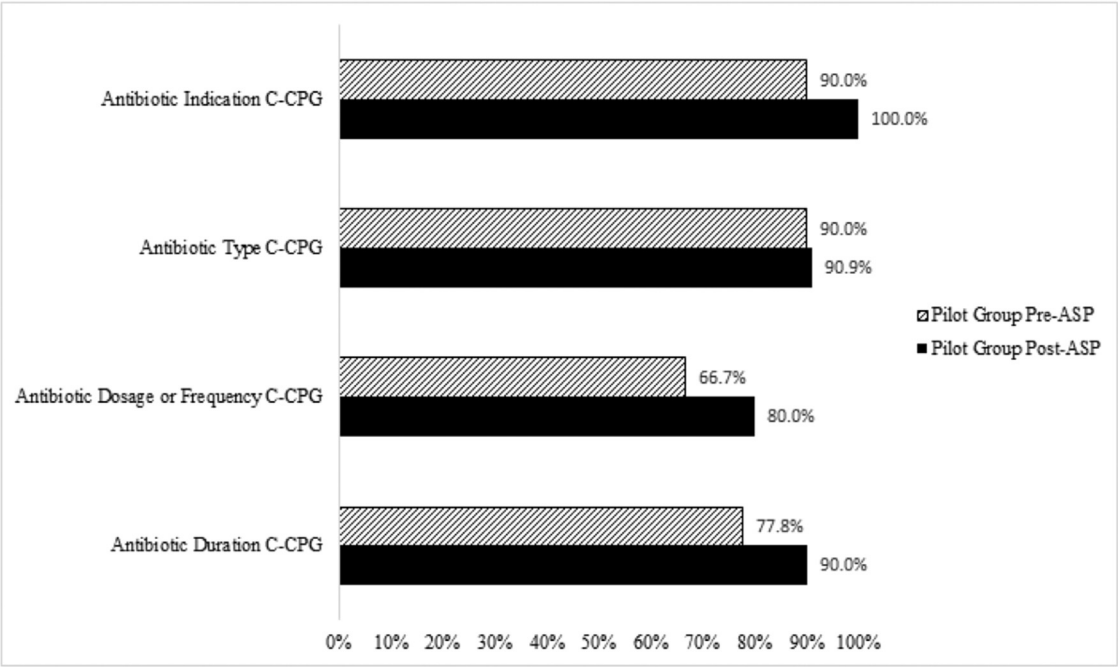

Figure 3. A comparison of the pilot group pre-ASP to post-ASP acute sinusitis chart review results.

changes from pre-ASP to post-ASP were not statistically significant (Table 1, Figure 3).

Acute Pharyngitis

For the pilot group, from pre-ASP to post-ASP, the following absolute changes were observed: there was a 16.2% increase in antibiotic indication C-CPG ($P = .3623$), there was a 21.4% increase in antibiotic type C-CPG ($P = .0611$), there was a 13.3% decrease in antibiotic dosage or frequency C-CPG ($P = .1404$), and there was a 1.4% increase in antibiotic duration C-CPG ($P = .9252$). All within-group changes from pre-ASP to post-ASP were not statistically significant (Table 2, Figure 4).

Discussion

Acute Sinusitis

After the implementation of the pilot ASP, there was an improvement in antibiotic prescribing practices for the management of acute sinusitis. Post-ASP, there were 0 instances in which antibiotics were prescribed when not indicated by CPGs. The data reflect improvements in both aspects of the primary aim, which include 1) indication for antibiotic prescription C-CPG and 2) antibiotic type, dosage, frequency, and duration C-CPG.

Acute Pharyngitis

After the implementation of the pilot ASP, there was again an overall improvement in prescribing practices with regard to both aspects of the primary aim. The only exception to this was an observed decrease in antibiotic prescriptions with a dosage or frequency C-CPG.

Interpretation

Although these improvements were not found to be statistically significant, the percent change data from pre-ASP to post-ASP supports the potential usefulness of these interventions in improving antibiotic stewardship. The lack of statistical significance may be at least partially explained by the small sample size; however, the association between the intervention and the outcomes cannot be inferred given the results. From open discussion with the pilot group clinicians, the most widely accepted parts of the intervention included the 2 scheduled meetings during which Infectious Diseases Society of America's guidelines, communication skills training, and audit and feedback results were reviewed. Similar interventions have also proven beneficial in other

Table 2
Pilot Group Absolute Change, Standard Error, *P* Values, and 95% Confidence Interval (CI) for the Acute Pharyngitis Pre–Antibiotic Stewardship Program (ASP) and Post-ASP Chart Audit

Audit Finding	Pre-ASP, n/N (%)	Post-ASP, n/N (%)	Absolute Change (Standard Error)/*P* Value	95% CI for Absolute Change
Antibiotic indication C-CPG				
Pilot group	8/14 (57.1)	11/15 (73.3)	16.2 (17.5)/.3623	52.0% to −19.7%
Antibiotic type C-CPG				
Pilot group	11/14 (78.6)	15/15 (100)	21.4 (11.0)/.0611	43.9% to −1.1%
Antibiotic dosage or frequency C-CPG				
Pilot group	14/14 (100)	13/15 (86.7)	−13.3 (8.8)/.1404	4.7% to −31.3%
Antibiotic duration C-CPG				
Pilot group	11/14 (78.6)	12/15 (80)	1.4 (15.1)/.9252	32.3% to −29.5%

C-CPG = concordant with clinical practice guideline.

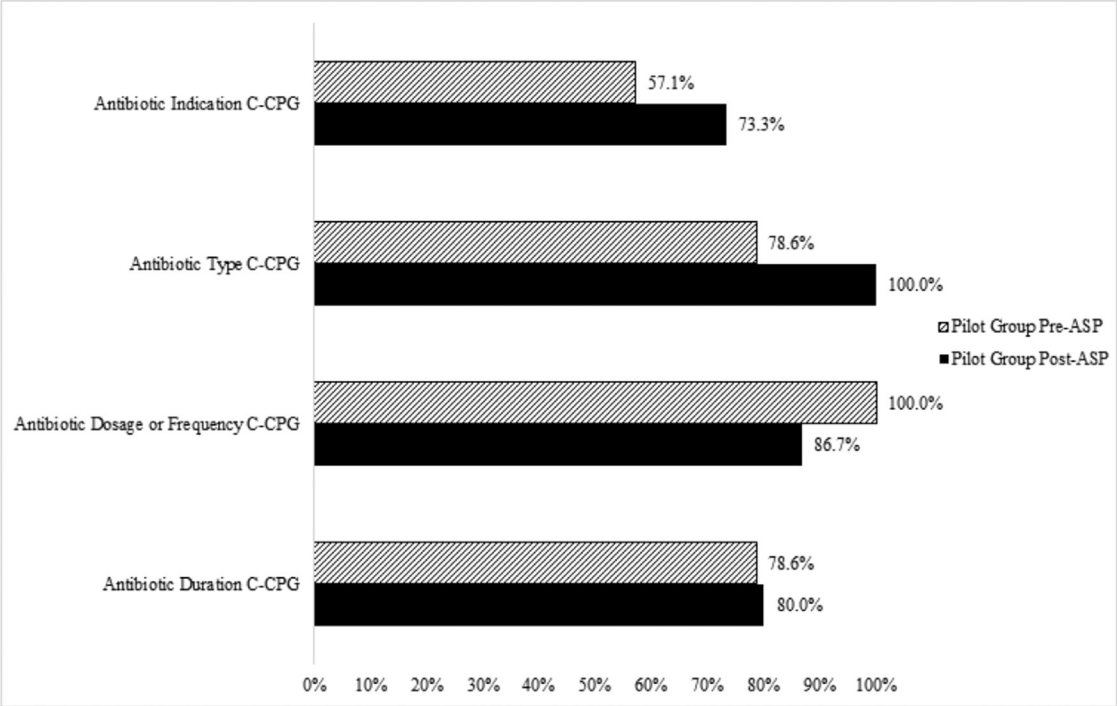

Figure 4. A comparison of the pilot group pre-ASP to post-ASP acute pharyngitis chart review results.

studies.[12-14] Based on the literature, the successful implementation of ASPs requires a thoughtful, dynamic, and consistent effort to achieve the desired outcome.[9,10] It is important to remember that the intention of this initiative was not to study the effectiveness of ASP strategies on improving antibiotic prescribing behavior, as that has been well understood in the literature, but rather to pilot their implementation in a specific clinical setting. When successfully implemented, extrapolating from the literature, improving antibiotic prescribing practices would be expected to improve patient outcomes and reduce overall health care costs in this FQHC. The results of this pilot ASP highlight the importance of proceeding with additional PDSA cycles, increasing the sample size, and refining the interventions in future work. The pilot ASP provides an initial framework from which modifications can be made and further PDSA cycles can be performed.

Limitations

There were several limitations associated with the implementation of this pilot ASP. The clinicians enrolled in this project may have modified their prescribing behavior because of the awareness of being observed, a phenomenon known as the Hawthorne effect. Additionally, self-selection bias may have been present because all enrolled clinicians volunteered to participate. The small sample size of the audited patient encounters yielded low statistical power, therefore increasing the likelihood of inflated effect size estimation and limiting the generalizability of the results. Finally, the relatively short 5-month time frame in which data were collected may have restricted the ability to measure long-term prescribing behaviors of the clinicians.

Conclusions and Future Steps

Moving forward, in accordance with the Model for Improvement, this pilot ASP can be modified and maintained considering the limitations discussed. Future PDSA cycles should include a larger sample size and be perpetuated over a longer period of time in order to better analyze the longitudinal efficacy and measure sustainability. Additional ASP interventions that were not previously used can be incorporated, such as the implementation of organizational policies to promote appropriate antibiotic prescribing practices, which would be expected to aid sustainability as well.

Additionally, these interventions can be applied to a broader range of clinical scenarios, such as previously excluded diagnoses or patient populations. If proven successful, this pilot ASP could be used as a model in other outpatient health care settings, such as other FQHCs. In conclusion, ASPs are a promising approach to the improvement of antibiotic prescribing practices which, in turn, can improve patient outcomes and combat the threat of antibiotic resistance.

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