



# Operationalising outpatient antimicrobial stewardship to reduce system-wide antibiotics for acute bronchitis

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## ABSTRACT

**Background** Antibiotics are not recommended for treatment of acute uncomplicated bronchitis (AUB), but are often prescribed (85% of AUB visits within the Veterans Affairs nationally). This quality improvement project aimed to decrease antibiotic prescribing for AUB in community-based outpatient centres from 65% to <32% by April 2020.

**Methods** From January to December 2018, community-based outpatient clinics' 6 months' average of prescribed antibiotics for AUB and upper respiratory infections was 63% (667 of 1054) and 64.6% (314 of 486) when reviewing the last 6 months. Seven plan-do-study-act (PDSA) cycles were implemented by an interprofessional antimicrobial stewardship team between January 2019 and March 2020. Balancing measures were a return patient phone call or visit within 4 weeks for the same complaint. X<sup>2</sup> tests and statistical process control charts using Western Electric rules were used to analyse intervention data.

**Results** The AUB antibiotic prescribing rate decreased from 64.6% (314 of 486) in the 6 months prior to the intervention to 36.8% (154 of 418) in the final 6 months of the intervention. No change was seen in balancing measures. The largest reduction in antibiotic prescribing was seen after implementation of PDSA 6 in which 14 high prescribers were identified and targeted for individualised reviews of encounters of patients with AUB with an antimicrobial steward.

**Conclusions** Operational implementation of successful stewardship interventions is challenging and differs from the traditional implementation study environment. As a nascent outpatient stewardship programme with limited resources and no additional intervention funding, we successfully reduced antibiotic prescribing from 64.6% to 36.8%, a reduction of 43% from baseline. The most success was seen with targeted education of high prescribers.

## BACKGROUND

Inappropriate antibiotic use in the outpatient setting is associated with patient harm due to resistance and antibiotic-related adverse events.<sup>1 2</sup> Acute uncomplicated bronchitis (AUB) treatment guidelines

do not recommend antibiotics for most patients.<sup>3</sup> From 2005 to 2012, antibiotics were prescribed for bronchitis in 85% of Veterans Affairs (VA) primary, emergency and urgent care encounters.<sup>4</sup> The Joint Commission requires outpatient antimicrobial stewardship (AS) to optimise evidence-based practice, and reduce inappropriate antibiotic prescribing and unnecessary costs.<sup>5–7</sup>

With the emergence of drug-resistant bacteria, limited production of novel antibiotics and potential adverse effects of antibiotics, national efforts within the VA healthcare facilities to create stewardship programmes addressing overuse and misuse of antibiotics have remained a priority over the last decade.<sup>8–11</sup> Multiple barriers to stewardship include: data availability to inform interventions; access to technology and technology-based tools; capacity to produce and analyse stewardship-related data; organisational support including financial support, education of providers and patients; and relationships between stewardship personnel and providers.<sup>12–15</sup>

Here we describe the implementation and results of a quality improvement stewardship intervention to reduce antibiotic prescribing for AUB and upper respiratory tract infections (URIs).

## METHODS

### Setting and current state prior to the interventions

The VA Tennessee Valley Healthcare System (TVHS) encompasses 2 academic-affiliated medical centres and 18 community-based outpatient clinics (CBOCs) throughout Tennessee and Kentucky. Eleven CBOCs are VA owned and operated; the other seven are contract clinics, which are clinics contracted to provide service to veterans on behalf of the



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VA. Each clinic is staffed with between 1 and 18 providers. In January 2019, 86 CBOC providers were serving >80 000 veterans. At baseline (July–December 2018), CBOC providers prescribed an antibiotic in 63% of AUB or URI visits.

### Improvement team

The interprofessional antimicrobial stewardship team (AST), a subgroup of our larger AS programme, included a physician lead, a nurse practitioner, an infectious disease fellow and a pharmacist champion who report back to the larger stewardship programme. Two members had advanced training in quality improvement scientific methods including plan–do–study–act (PDSA) methodology.<sup>16</sup> The Behaviour Change Wheel (BCW), used in previous stewardship endeavours, served as the framework.<sup>17–20</sup> The BCW assumes capabilities, opportunities and motivations are sources of behaviour that can be targeted for change interventions.<sup>17 19</sup> Interventions were chosen based on existing evidence-based practice, team discussion and resource availability. VA TVHS primary care leadership was engaged and pledged support for this project.

### Patient and public involvement

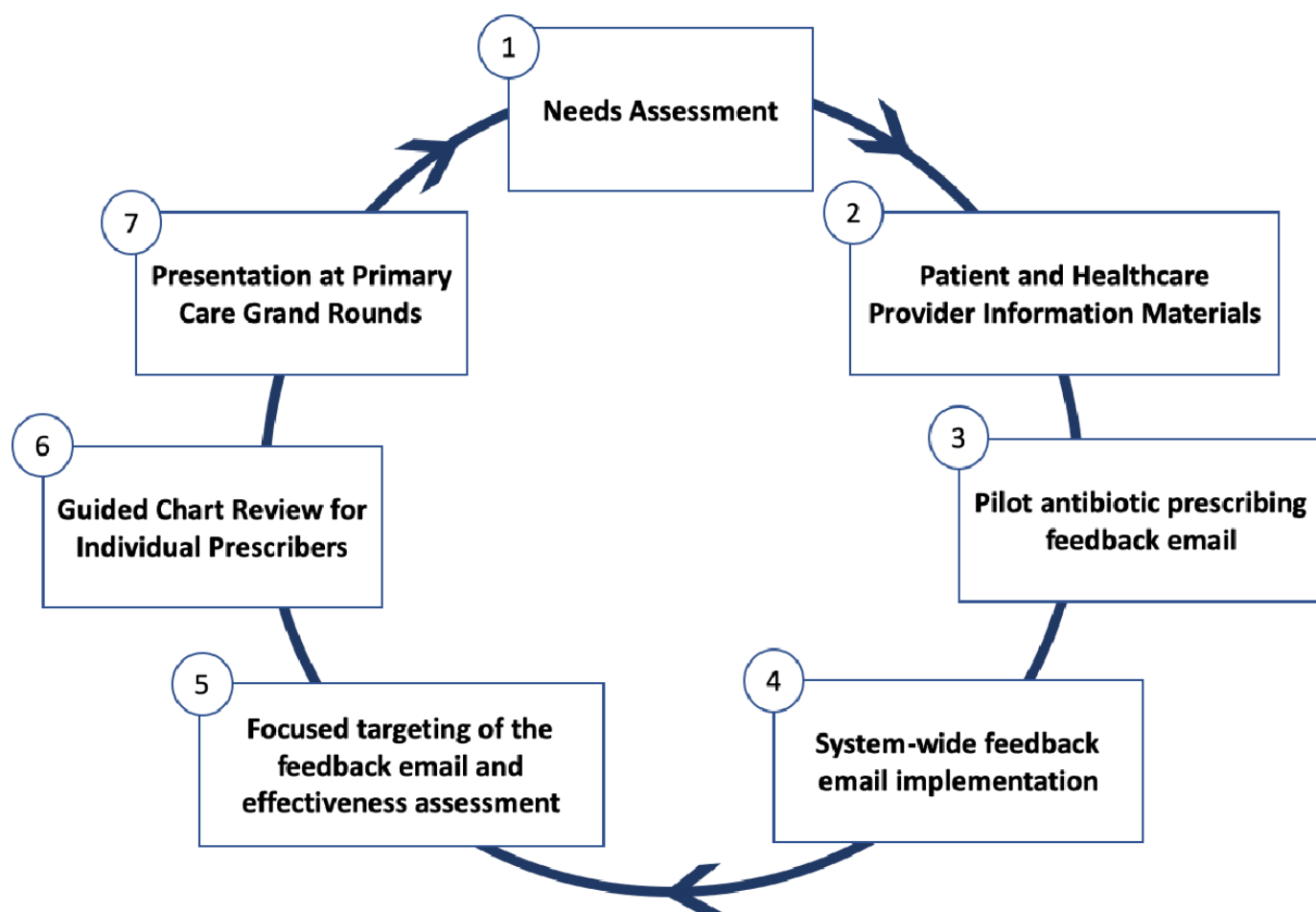
Patient and public involvement was not appropriate for this specific project since it focused on providers' adherence to guidelines for antibiotic prescribing in AUB.

### Interventions

Iterative tests of change were enacted based on stakeholder feedback and the stewardship team's assessment of value, determined by data analysis performed with each PDSA cycle, compared with estimated feasibility and sustainability (figure 1).

### PDSA 1 needs assessment

We performed a provider assessment for all general medicine primary care providers to understand capabilities, opportunities, motivations and barriers to reducing antibiotic prescribing as outlined in the BCW; meet providers and listen to their perspective; and get stakeholder buy-in.<sup>21</sup> Team members interviewed providers using a 16-item semistructured interview that assessed provider antibiotic-prescribing confidence, specific factors at the patient, clinic or provider level; available resources to guide antibiotic prescribing; reasons prescribers might order an antibiotic; and provider perspectives on



**Figure 1** PDSA cycles completed throughout the QI project from January 2019 to March 2020. PDSA, plan–do–study–act; QI, quality improvement.

antibiotic prescribing feedback (online supplemental file 1). To improve interinterviewer consistency, team members recorded and reviewed pilot test interviews with two clinicians who were not part of the target group. Interview data were entered and managed using VA-Research Electronic Data Capture, a secure, web-based application designed to support data capture for research studies hosted at Veterans Health Administration.<sup>22</sup>

### PDSA 2 patient interventions

Based on the PDSA 1 needs assessment, PDSA 2 focused on disseminating patient educational materials, increasing the opportunity and capability of providers for change while also targeting the patient. The team distributed Centers for Disease Control and Prevention (CDC) URI educational materials, including waiting room, clinic posters and brochures, and URI supportive care prescription pads were distributed to CBOCs between March 2019 and October 2019.<sup>23</sup>

### PDSA 3–5 audit and feedback

To address the BCW motivation for change, PDSA cycles 3 and 4 implemented individualised prospective feedback emails, which have been shown to be effective in prior studies.<sup>24–27</sup> The proposed email was vetted during PDSA cycle 1 interviews. Providers were shown an example of the proposed feedback email and asked for their opinion on the prototype's aesthetics and content. The email, sent to individual providers, included a graph depicting their AUB/URI antibiotic prescribing rate compared with the VA TVHS CBOC average and informed the provider of which quartile of prescribers he/she fell within, with the first quartile representing the lowest prescribers and the fourth quartile representing the highest prescribers. Piloted at a single site during cycle 3, the intervention received positive feedback (online supplemental file 2). The monthly email was then implemented more broadly at six additional clinics, and finally to providers across the 17 CBOCs in operation at the time during cycle 4. A 'read receipt' tracked whether the email was opened by providers (online supplemental file 3). In cycle 5, the stewardship team evaluated the time and effort to perform the audit and feedback described above against the effect on prescribing and felt that the value for providers who infrequently diagnosed AUB was poor; in other words, this was a high effort–low reward intervention. Therefore, monthly feedback emails going forward were only sent to providers who had an AUB/URI encounter in that month. After 3 months, this intervention was terminated due to ongoing evaluation showing persistent 'high effort–low reward' due to the manual creation of individual graphs and personalised emails, which took approximately 12 hours/month with low 'read' rates.

Analyses were performed at the individual and clinic level to assess for high-prescribing clusters by clinic. We performed a Pareto analysis of individual provider's cumulative antibiotic prescription counts as a percentage of all CBOC prescriptions.<sup>28 29</sup> Additionally, clinic-level

variation in prescribing was assessed by stratifying antimicrobial prescribing by VA versus contract clinics. Based on these analyses and the BCW using education and coercion to identify opportunities and enhance motivation, PDSA 6 focused on individual high prescribers.

For each high prescriber, team members reviewed encounters from January 2019 to November 2019, assessing documentation of history of present illness, physical examination findings, patient comorbidities and medical history (ie, immunocompromised or recently hospitalised). A team member contacted high prescribers up to three times to schedule a focused case review of encounters. Providers' individual barriers and challenges to changing prescribing behaviour were assessed and focused case review feedback was given.

The individual focused case review was conducted via telephone between the team member and the high prescriber. Each individual session, averaging 20–30 min, was started with an open-ended question like 'What are your thoughts after reviewing your patient encounters?'. This allowed providers to express insights, changes they would have made, diagnostic dilemmas they experienced and potential frustrations they encountered. Depending on what was previously discussed, encounters were reviewed in detail including presence of documentation, coding, discussion of whether antibiotics were guideline based, barriers the provider felt during this specific encounter or in AUB/URI encounters in general, and feedback from the provider about what stewardship could do to help providers decrease inappropriate prescribing in the future. Team members continued quarterly assessment of high prescribers and performed quarterly individualised focused case reviews.

In PDSA cycle 7, two team members presented primary care grand rounds. Clinical vignettes, diagnostic and antibiotic prescribing resources, and relevant literature citations were included based on the BCW to model ideal prescribing behaviours and increase provider capability to evaluate antibiotic prescribing decisions for AUB/URI. Results for PDSA 7 were truncated in April 2020 due to the COVID-19 pandemic.

### Outcome measures: antimicrobial prescriptions

AUB/URI was defined by the National VA Academic Detailing Database, accessible via VA intranet for specific providers, and included 28 International Classification of Diseases, 10th Revision codes.<sup>30</sup> The primary outcome was the percentage of AUB/URI encounters in which an antibiotic was prescribed. Data on the outcome were tracked monthly. Chart review and validation of the antibiotic receipt were done through review of the VA computerised patient record system (CPRS). Further chart review revealed many outpatient antibiotic prescriptions were not captured in CPRS. Therefore, monthly chart reviews of all AUB/URI encounters were performed throughout the project to accurately determine the proportion of visits in which an antibiotic was prescribed.

## Balancing measures

Balancing measures were defined as return calls, electronic messages, return clinic visits, and urgent care or emergency department visits within 4 weeks of the initial visit for the same complaint. Balancing measures were tracked monthly throughout the project.

## Statistical analysis

We analysed processes and outcomes using statistical process control charts and  $X^2$  hypothesis testing in accordance with Standards for Quality Improvement Reporting Excellence guidelines.<sup>31</sup> For each measure, we calculated the number of patients who received an antibiotic divided by the number of patients seen that month with an AUB or URI. The proportion of patients who received an antibiotic was compared among the three project periods using two-sided  $X^2$  tests and p-charts. U-charts tracked the number of balancing measure outcomes per group of AUB/UTI over time. The three study time periods were pre-intervention (January 2018–December 2018); intervention PDSA cycles 1–5 (January–July 2019) and intervention PDSA cycles 6–7 (August 2019–March 2020). Data collection ended in March 2020 due to temporal trends likely related to COVID-19. A significance level of 0.05 was used for all  $X^2$  tests. Data were analysed using Microsoft Excel for Office 365 MSO, 2020<sup>32</sup> and Statistical Process Control p-charts and u-charts in QIMacros, V.2019.01 (KnowWare International, Denver, Colorado, USA).<sup>33,34</sup> P-charts (proportion of antibiotics) and u-charts (unintended outcomes) were analysed for evidence of common cause variation, defined as expected, predictable variation, versus special cause variation, defined as specific circumstances that create change in variation using Western Electric Decision rules with 99% CIs.<sup>33,34</sup>

## RESULTS

### Primary outcome: antibiotic prescriptions

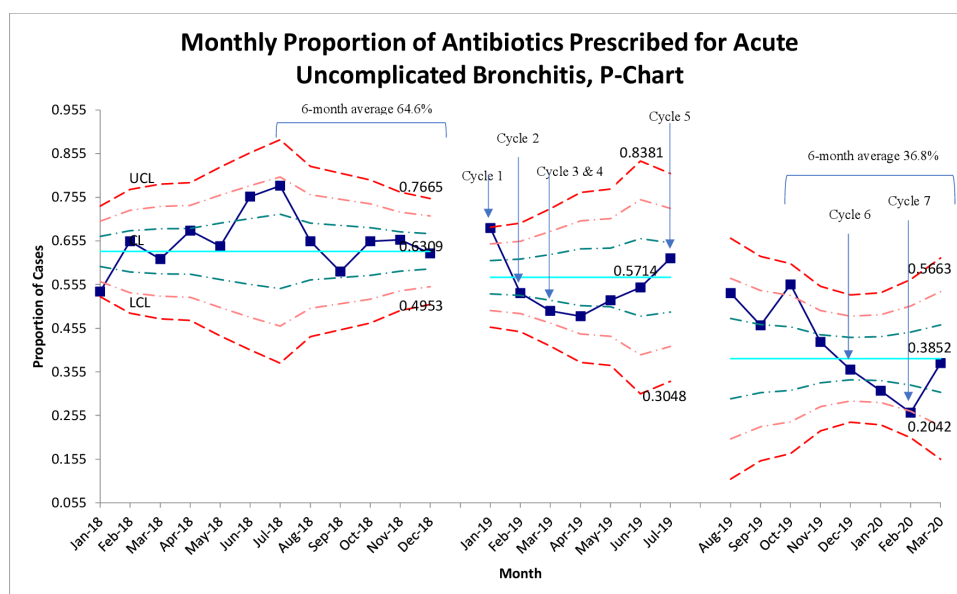
During the baseline period, January–December 2018, antibiotics were prescribed in 63% (667 of 1054) AUB/URI encounters with an average of 64.6% (314 of 486) in the 6 months prior to the intervention. During intervention cycles 1–5, January–July 2019, the average AUB/URI encounters with antibiotic prescriptions decreased to 57%. During and after implementing intervention cycles 6–7, August 2019–March 2020, AUB/URI encounters with antibiotic prescriptions decreased to 38.5%. A clinically and statistically significant reduction in antibiotic prescribing was noted between pre-intervention, intervention cycles 1–5, and intervention cycles 6 and 7 ( $p=0.002$ ) (figure 2).

### Interventions

#### Cycle 1 needs assessment: January 2019–March 2019

Team members visited CBOCs and interviewed 69 of 86 (80%) providers from all operational CBOCs ( $n=17$ ). All CBOCs had on-site laboratory services, 4 of 17 (24%) had radiology services, and 2 of 17 (11%) had on-site pharmacies. Seven (41%) CBOCs were operated by contract staff and considered contract clinics.

Fifteen of 69 (22%) providers always felt confident and 53 of 69 (77%) usually felt confident prescribing antibiotics. Confidence increased with use of educational resources like UptoDate (56 of 69, 81%). Providers reported that treating patients with significant comorbidities or advanced age reduced their confidence (51 of 69, 74%). Providers (52 of 69, 75%) cited situations categorised as ‘heightened clinical concern’ due to patient symptoms or comorbidities as encounters when they might prescribe an antibiotic against guideline recommendations (table 1).



**Figure 2** SPC p-chart for monthly AUB/URI-NOS cases.  $X^2$  comparison of the central limits of the three intervention periods had a  $p$  value=0.002. AUB, acute uncomplicated bronchitis; CL, control limit; LCL, lower control limit; NOS, not otherwise specified; SPC, Statistical Process Control; UCL, upper control limit; URI, upper respiratory tract infection.

**Table 1** Cycle 1 semistructured interview results

<b>Prescriber characteristics</b>	<b>N=69 (%)</b>
Physicians	43 (62.3)
Nurse practitioners	24 (34.8)
Physician assistants	3 (4.3)
Non-VA contract provider	28 (40.6)
Antibiotics in practice	
Make up <10% of all clinic visits	52 (75.4)
<b>How would you rate your confidence with prescribing outpatient antibiotics? (N=69)</b>	
Always feel confident	15 (21.7)
Usually feel confident when prescribing outpatient antibiotics	53 (76.8)
<b>What makes you feel more confident in prescribing outpatient antibiotics?* (N=69)</b>	
Resources	56 (81.2)
Certain patients/population	30 (43.5)
Education	31 (44.9)
Specific experiences	32 (46.4)
Other	9 (13.0)
<b>What makes you less confident in prescribing outpatient antibiotics?* (N=69)</b>	
Lack of resources	13 (18.8)
Certain patients/population	51 (73.9)
Work environment	12 (17.4)
Specific experiences	7 (10.1)
Other	16 (23.2)
<b>What resources do you use to help guide antibiotic choice and duration? (N=69)*</b>	
UpToDate	55 (79.7)
Epocrates	23 (33.3)
CDC apps	16 (23.2)
VA educational materials	2 (2.9)
Clinic algorithms	4 (5.8)
Local antibiograms	11 (15.9)
National guidelines	22 (31.9)
None	1 (1.4)
Other	28 (40.6)
<b>Most frequent infections and infectious symptoms seen outpatient (N=69)*</b>	
URI/ URI symptoms	58 (84.1)
UTI/UTI symptoms	35 (50.7)
Cellulitis	31 (44.9)
<b>Providers who had previously received feedback on prescribing (N=69)</b>	16 (23.2)
<b>Number of prescribers who felt feedback would be helpful (N=69)</b>	57 (82.6)
<b>When antibiotics are typically not recommended, what factors may make you more likely to prescribe? (N=69)*</b>	
Heightened clinical concern (acute clinical presentation, persistent symptoms or worrisome symptoms, such as fevers or a productive cough)	52 (75.4)
Comorbidities	17 (24.6)
COPD	28 (40.6)
Diabetes	14 (20.3)
CHF	3 (4.3)

Continued

Table 1 Continued

## Prescriber characteristics

N=69 (%)

\*For these questions, providers could give more than one response.

CDC, Centers for Disease Control and Prevention; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; URI, upper respiratory tract infection; UTI, urinary tract infection; VA, Veterans Affairs.

Most prescribers (53 of 69, 77%) reported never receiving antibiotic prescribing feedback. Of the 16 of 69 (23%) prescribers who recalled receiving feedback, the majority (69%) reported it was helpful (table 1).

### Cycle 2 patient educational material

Educational materials were delivered to 16 of 17 (94%) CBOCs. However, on follow-up, 30% (n=3 of 10) of providers reported not receiving patient educational materials and 50% (n=5 of 10) did not receive clinic room educational signs. The majority of providers (60%, n=6 of 10) reported receiving a CDC URI supportive care prescription pad, and that the resources helped them reduce antibiotic prescribing.

### Cycles 3–5 audit and feedback

All prescribers were receiving monthly feedback emails by June 2019; however, the proportion with a ‘read receipt’ varied over time. During cycle 4, an average of 38% of feedback emails were opened: May 2019 (36%); June 2019 (26%) and July 2019 (52%).

When outcomes were stratified by clinic type (VA vs contract), we found greater reduction in prescribing for VA clinics from 61.6% pre-intervention to 51.8% (absolute reduction of 9.8%) post-PDSA 1–5 compared with contract clinics which increased from 65.9% to 71% (figure 3). These results suggested likely differences in clinic-associated prescribing culture; however, addressing culture is no small task. Due to limited resources, the AST members determined addressing individual high prescribers would be low-hanging fruit for future interventions.

### Cycles 6 and 7: general and focused provider educational interventions

The improvement team determined that 14 of the 106 CBOC providers (13.2%) accounted for 55% of all AUB/URI antibiotic prescribing. Three of these providers were no longer employed by the VA. The primary care chief invited the 11 providers to participate in individualised focused case reviews with stewardship members in December 2019. Seven responded and participated. After individualised focused case reviews, 6 of 7 (85.7%) providers reduced antibiotic prescribing and were not identified as high prescribers for AUB/URI during the next quarter. Of the four who did not participate in feedback, one (25%) continued to be identified as a high prescriber. These providers demonstrated a sustained reduction in subsequent quarterly reviews.

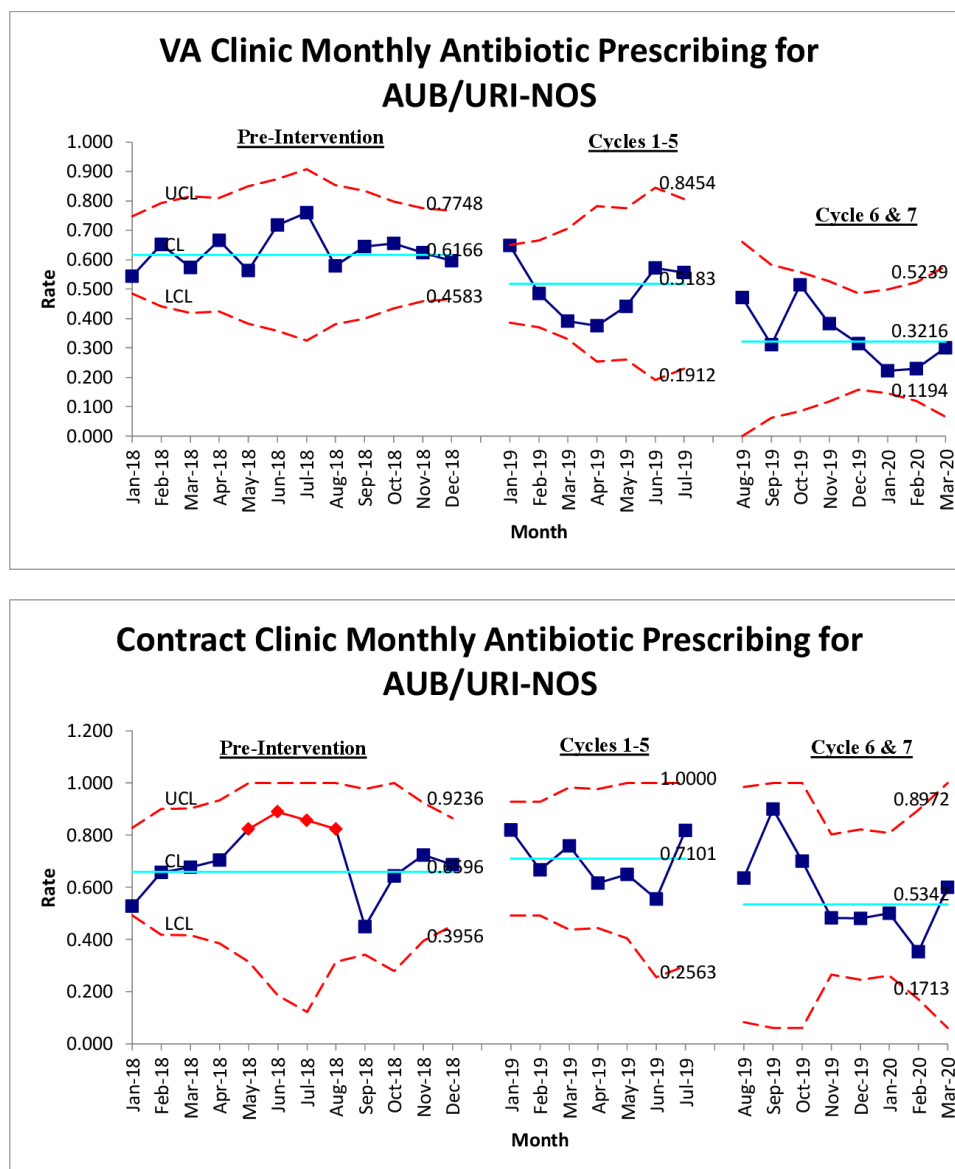
### Balancing measures

Throughout the improvement period, there was no increase or special cause variation in return calls, secure messages, return clinic visits, emergency department or urgent care visits (figure 4).

### DISCUSSION

The iterative outpatient interventions described here reduced antibiotic prescribing for AUB/URI from 64.6% to 36.8%, across a large, primary care clinic system. By sharing our ‘lessons learnt’, we aim to aid other organisations in implementing effective, outpatient stewardship interventions while avoiding processes that may be more resource intensive and less effective. We believe that there are two primary lessons learnt that can inform other outpatient stewardship programmes. First, reviewing and providing individual patient encounter feedback for the highest prescribers was the most effective and time-efficient intervention for sustained reduction in inappropriate antibiotic prescribing. Second, we found that VA CBOCs were more responsive to improvement interventions than contract clinics to implement evidence-based practice guidelines.

Individualised, focused case review and education for high-prescribing individuals was more time-efficient and more effective in reducing antibiotic prescribing for AUB/URI in both VA and contract clinics as compared with generating individual prospective audit and feedback emails for all providers. Notably, this intervention occurred after the improvement team visited CBOCs, meeting and interviewing providers to learn about processes and barriers at each site, which built rapport and made individualised reviews easier. Comparison feedback emails have been shown to be both ineffective<sup>35</sup> and effective<sup>24 25 36–39</sup> in increasing provider guideline adherence. Although there was some reduction in prescribing with implementation of feedback emails, the reduction was not sustained once the intervention was removed.<sup>26 27</sup> In cycle 6, as opposed to the prior cycles, we securely emailed a list of all AUB/URI-not otherwise specified cases in the preceding 3 months for each high prescriber and included detailed notes on cases that were not guideline concordant. These cases were then reviewed by phone with a team member. This detailed, encounter-specific feedback was more consistent with studies reporting positive results from audit and feedback.<sup>38</sup> As opposed to an aggregated, comparative audit and feedback used in cycles 3–5, encounter-level, patient-specific feedback used in cycle 6 may be an important

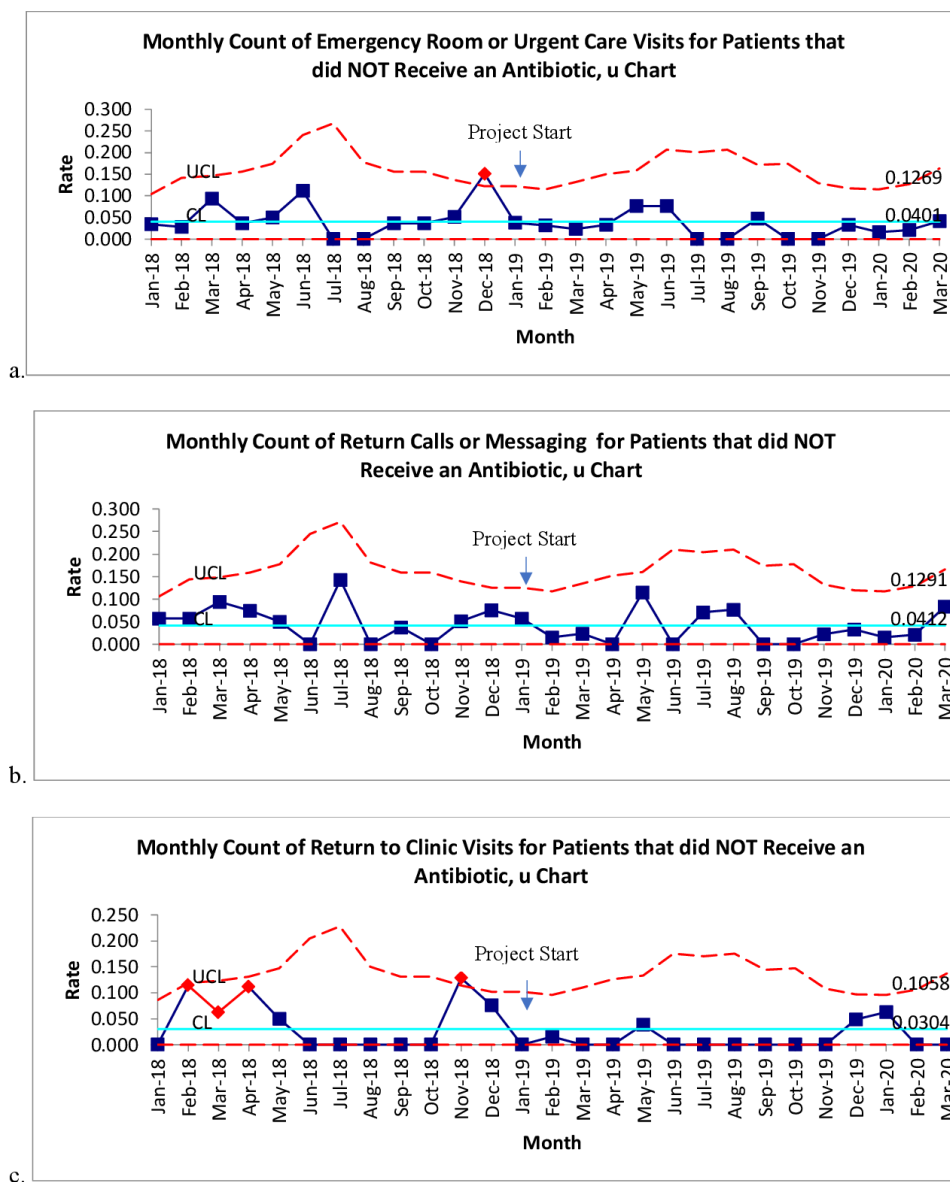


**Figure 3** Proportion of encounters for acute bronchitis or respiratory tract infection, not otherwise specified (NOS) with antibiotic prescription, by clinic type. AUB, acute uncomplicated bronchitis; CL, control limit; LCL, lower control limit; UCL, upper control limit; URI, upper respiratory tract infection; VA, Veterans Affairs.

component driving this intervention's success because providers can self-reflect on prescribing practices and identify tangible opportunities to improve. Although clinically busy primary care providers may demonstrate passive resistance or indifference to interventions due to differing priorities and demands,<sup>40</sup> in cycle 1, clinicians identified heightened clinical concern for the individual patient often outweighs the concern for antibiotic overuse. This concern for patients explains why patient-level feedback may be more compelling to providers. Despite these concerns, this project did not identify special cause variation or negative impacts on return to clinic visits, emergency rooms or urgent care visits, or return calls or messaging while reducing antibiotic usage, consistent with prior studies.<sup>41</sup> AUB/URI complications are rarely avoided by prescribing antibiotics and often have greater risks than benefits<sup>1,42</sup>; however, providers

are often influenced to prescribe antibiotics based on individual patient-specific factors.<sup>43</sup> Ultimately, patient-specific feedback paired with focused case reviews with the stewardship team could have been implemented earlier, ideally after CBOC visits, and resulted in the same dramatic antibiotic-prescribing reduction with significant decrease in implementation time and resources.

Prior VA studies have shown improvements in antibiotic prescribing, but reductions were not sustained or did not show significant improvement in URI-specific prescribing.<sup>35,36</sup> Consistent with prior studies, peer comparison emails and provider and patient education reduced antibiotic prescribing<sup>25,39</sup>; however, we saw that these interventions were more impactful in VA-operated clinics, and less impactful in contract clinics. Previous research evaluating patient satisfaction among CBOCs showed VA CBOCs had higher patient satisfaction, emotional



**Figure 4** Balancing measures for (a) emergency room/urgent care visits, (b) return calls/messaging and (c) return to clinic visits. CL, control limit; UC, upper control limit.

support, education and information, and overall coordination scores than contract clinics.<sup>44</sup> Contract clinics may be more reflective of private sector outpatient antibiotic-prescribing practices and may be less familiar with VA-specific quality metric monitoring and oversight, leading to less buy-in to interventions.

This study has several limitations. The audit-and-feedback email intervention was not delivered by a clinical or administrative leader known to each clinic. This may have impacted whether a provider read the email.<sup>45</sup> Second, three high prescribers were no longer employed by the VA between cycles 5 and 6, which likely impacted overall prescribing. Detailed data on time invested in the development and implementation of each intervention were not collected and were estimated retrospectively which could bias evaluation of effort versus reward. Finally, this work was conducted in a VA community-based setting which has unique contextual factors, and would

likely need to be adapted for implementation in other care settings.

## CONCLUSION

We implemented a series of successful and unsuccessful interventions, adjusting interventions based on process analysis, outcome and balancing measure data during the course of an outpatient antibiotic stewardship intervention and achieved a significant reduction in outpatient AUB/URI antibiotic prescribing. Providing patient-level, individualised case reviews for the highest prescribers was found to be the most resource-efficient and effective intervention. Development of interpersonal relationships with providers, key to any successful intervention, preceded improvement implementation. Further study is needed to evaluate the feasibility and reproducibility of targeting



high prescribers with individualised, patient-level case review feedback in other VA and non-VA settings.

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