


## Concise Communication

# Patterns of use and perceptions of an institution-specific antibiotic stewardship application among emergency department and urgent care clinicians

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## Abstract

We surveyed emergency department and urgent care clinicians to assess patterns of use and perceived usefulness of a local antibiotic stewardship application to deliver institution-specific prescribing guidance. Among 114 eligible respondents, the application was widely utilized, and it was perceived to be a useful clinical resource that improved prescribing.

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A limitation of most commercially available clinical decision support resources is that local antibiotic utilization strategies, formularies, and antibiotic resistance patterns are not reflected in the antibiotic prescribing guidance. In addition, most guidance is not designed specifically with a focus on minimizing unnecessary antibiotic use. In contrast, local clinical decision support resources can be customized to provide institution-specific, antibiotic stewardship-focused prescribing guidance. At Denver Health, the antibiotic stewardship program developed an institutional application with first-line and alternative treatment recommendations for common inpatient and outpatient infections (ie, antibiotic, dose, and duration of therapy), diagnostic testing guidance, antibiotic dose adjustments for renal dysfunction, antibiotic resistance rates (ie, the annual antibiogram), and perioperative antibiotic prophylaxis recommendations (see Supplementary Document 1 online).<sup>1</sup> The content is accessible by mobile device or computer. In this study, we aimed to characterize utilization patterns and perceptions of the application among antibiotic prescribers in the emergency department and urgent care setting. We hypothesized that the application was widely utilized, was perceived to be a useful clinical resource, and was perceived to improve antibiotic prescribing.

## Methods

### Study design and setting

The study instrument was a self-administered online survey. Denver Health is an urban, academic, integrated healthcare system. The sample frame was all clinicians who prescribe antibiotics in the Denver Health Emergency Department and its 2 urgent care centers: 63 attending physicians, 26 advanced practice providers (APPs), and 67 emergency medicine residents (156 total). To be eligible for the survey, providers must have worked at least 1 emergency department or urgent care shift within the previous 90 days and either personally prescribe antibiotics or oversee the prescription of antibiotics.

### Survey development and administration

Survey questions addressed the following constructs: (1) proportion of clinicians who use the application; (2) frequency of use; (3) perceived usefulness of the application; (4) perceived impact on prescribing; (5) factors associated with use or nonuse of the application; and (6) beliefs and attitudes about antibiotic use and antibiotic resistance. Validated questions from previously published surveys were used to assess beliefs and attitudes toward antibiotic use and resistance.<sup>2–5</sup> Otherwise, new survey questions were developed.

Draft survey questions were reviewed and revised by 6 experts, including a survey methodologist (N.A.). The survey was built in REDCap and was pretested in a small group of physicians and APPs. After revisions, the survey was pilot tested in a larger group of hospitalists (n = 53) and emergency medicine interns (n = 17).

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**Table 1.** Characteristics of Respondents and Reported Use of the Application

Characteristic	All Respondents (N = 114)		Attending Physicians and Advanced Practice Providers (N = 68)		Emergency Medicine Residents (N = 46)	
	No. of Respondents	n (%)	No. of Respondents	n (%)	No. of Respondents	n (%)
Primary area of work, no. (%)	113		67		46	
Emergency department		87 (77)		41 (61)		46 (100)
Urgent care		26 (23)		26 (39)		...
Years in practice, mean (SD)	109	9.4 (8.4)	64	14.0 (8.2)	45	2.9 (1.1)
Female, no. (%)	110	59 (54)	65	42 (65)	45	17 (38)
Clinician type, no. (%)	114		68		46	
Attending physician		44 (39)		44 (65)		...
Advanced practice provider		24 (21)		24 (35)		...
Emergency medicine resident		46 (40)		...		46 (100)
Ever used the Denver Health antibiotic application	114	111 (97)	68	66 (97)	46	45 (98)
Regular user	109	103 (95)	65	59 (91)	44	44 (100)
Used in previous 30 d	111	106 (95)	66	64 (97)	45	42 (93)
Device primarily used to access the application	110		66		44	
Smartphone		93 (85)		60 (91)		33 (75)
Computer		17 (15)		6 (9)		11 (25)
Tablet		0		0		0
No. of application uses per shift, mean (SD)	108	3.0 (2.2)	66	2.7 (2.1)	42	3.4 (2.3)
<b>Clinical purposes for which the application is used</b>						
Whether antibiotic indicated	109	51 (47)	65	35 (54)	44	16 (37)
Antibiotic choice	110	109 (99)	66	65 (98)	44	44 (100)
Antibiotic dose	109	103 (95)	65	59 (91)	44	44 (100)
Renal dose adjustments	110	41 (37)	66	25 (38)	44	16 (36)
Duration of therapy	109	103 (95)	65	62 (95)	44	41 (93)
Antibiotic resistance rates (antibiogram)	110	46 (42)	66	30 (45)	44	16 (36)
Diagnostic testing	110	14 (13)	66	9 (14)	44	5 (11)

Pilot data were inspected for level of item nonresponse and variability in the distribution of responses. Personalized invitations with a link to the final REDCap survey instrument (Supplementary Document 2 online) were sent by electronic mail to the 156 clinicians in the sample frame. Up to 6 personalized reminder invitations were sent to nonresponders. In total, the survey was open in the field for 6 weeks. Responses could not be linked to individual respondents. Data were analyzed for all respondents combined and stratified by attending physicians and APPs versus emergency medicine residents. The Colorado Multiple Institutional Review Board approved this study.

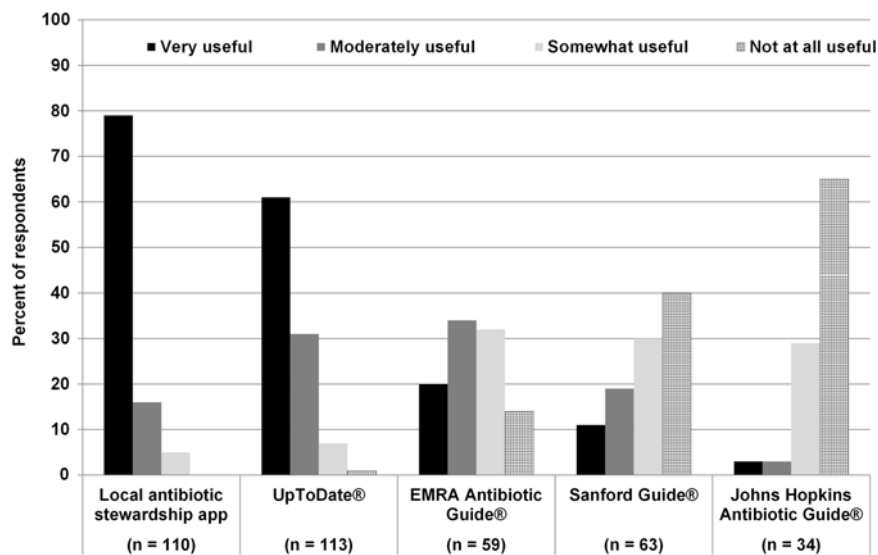
## Results

Of 156 survey invitations sent, 125 responses were received, for an overall response rate of 80%. Overall, 114 respondents met eligibility criteria and completed the survey: 44 attending physicians, 24 APPs, and 46 emergency medicine residents (Table 1). Most respondents worked in the emergency department.

Overall, 111 respondents (97%) reported ever having used the antibiotic stewardship application (Table 1). Of those, 95%

considered themselves to be regular users. Most (85%) reported primarily using the application by smartphone. On average, respondents accessed the application 3 times (standard deviation, 2.2) per shift. Of the potential clinical uses for the application, >90% of respondents reported using it for infection-specific recommendations for antibiotic choice, antibiotic dosing, and duration of therapy. Utilization patterns of the application were similar between the attending physician and APP group and the emergency medicine resident group (Table 1).

Among 110 users of the application, 95 (86%) reported it to be a “very useful” clinical resource. Residents were more likely than attending physicians or APPs to report the application as “very useful” (95% vs 80%;  $P = .02$ ). In the context of commercially available clinical decision support resources, the antibiotic stewardship application was more frequently reported as “very useful” (Fig. 1). Clinicians perceived the application to have a strong effect on their accuracy of antibiotic choice and dosing and on their consistency of prescribing (Supplementary Table 1 online). To a lesser degree, the application was perceived to reduce the time required to prescribe antibiotics, to decrease durations of therapy prescribed, and to decrease the frequency of fluoroquinolone prescriptions.



**Fig. 1.** Perceived usefulness of the Denver Health antibiotic stewardship application and commercially available clinical decision support resources. The analysis excluded responses from those who were not familiar with a given resource: local application (n = 2), EMRA Antibiotic Guide (n = 48); Sanford Guide (n = 50); and Johns Hopkins Antibiotic Guide (n = 78).

Most respondents agreed that antibiotics are overused and antibiotic resistance is a problem (Supplementary Table 2 online). However, fewer agreed that they personally overprescribe antibiotics. Most respondents reported that they would like more feedback on their antibiotic prescribing, education on optimal prescribing, and training on improving communication when antibiotics are not indicated.

## Discussion

Reports of smartphone applications to promote antibiotic stewardship are increasing.<sup>1,6–10</sup> Consistent with several prior studies,<sup>8–10</sup> our local application was rapidly adopted; >90% of respondents considered themselves to be regular users of the application. To our knowledge, this is the first study to evaluate clinicians' perceptions of an institution-specific application in comparison with commercially available clinical decision support resources. Although we did not perform a statistical comparison because this was not a prespecified analysis, the perceived usefulness of the local application was higher than for other resources. The greatest perceived effects on prescribing were increased accuracy of antibiotic choice and dosing and increased consistency of prescribing. In aggregate, these findings suggest that clinicians find value in an easily accessible resource with prescribing guidance tailored to their institution.

Based on Google Analytics data, we previously reported that 80% of uses of the application occurred via smartphone.<sup>1</sup> The results of the present survey corroborate these data because 85% of respondents reported that smartphones were the primary device used to access the application. Notably, however, nearly half of clinicians reported having accessed the application by computer. This finding suggests that the mobile website platform, which facilitates use of the application by mobile device or computer, may be preferable to platforms specific to one type of device. Allowing providers to choose the most convenient method of access at a given time may be a factor that contributed to the high utilization of this application.

This study has several limitations. First, users of the application could have been more likely to complete the survey than nonusers. This potential nonresponse bias was mitigated by the excellent response rate of 80%. Second, social desirability bias may have

led providers to avoid negative feedback about the application. Because the survey was anonymous and the favorable responses tended to cluster at the extreme of the scale (eg, very useful), this factor was unlikely to have impacted the results. Third, the generalizability was limited given that this survey included a limited scope of providers at a single institution. Finally, whether implementation of the application actually changed antibiotic prescribing could not be assessed through this study design.

In summary, a local antibiotic stewardship application was widely utilized by emergency department and urgent care clinicians and was perceived to be a useful clinical resource that improves antibiotic use. Institution-specific applications may be valuable tools to disseminate point-of-care, antibiotic stewardship-focused prescribing guidance.

**Supplementary material.** To view supplementary material for this article, please visit <https://doi.org/10.1017/ice.2019.331>

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