

Next Steps in Ambulatory Stewardship



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KEYWORDS

• Antibiotic stewardship • Outpatient • Ambulatory • Review

KEY POINTS

- Most antibiotic prescribing occurs in outpatient settings and at least 30% to 50% of antibiotics prescribed in outpatient settings are unnecessary.
- The CDC Core Elements of Outpatient Antibiotic Stewardship provide a framework to develop and implement effective stewardship programs.
- Few health systems have implemented ambulatory stewardship programs, despite national recommendations for outpatient stewardship and guidance on best practices for implementation.
- Future directions should include the dissemination and scaling of effective stewardship programs and interventions and increased the engagement of health systems, policy makers, and administrators.

INTRODUCTION

Antibiotics are widely prescribed medications in the United States, with up to 95% of antibiotic volumes prescribed in outpatient settings.¹ However, it is estimated that 30% to 50% of these antibiotics are unnecessary.²⁻⁴ The consequences of unnecessary antibiotic use are numerous, including the promotion of antibiotic resistant organisms. In 2019, there were 2.8 million antibiotic resistant infections resulting in 35,000 deaths in the United States (CDC).⁵ Unfortunately, the development of novel antibiotics has not kept pace with the growing resistance, with only 43 antibiotics in clinical development as of 2020, and fewer than one in five antibiotics that begin Phase 1 clinical trials ultimately approved by the Food and Drug Administration (FDA).^{6,7}

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In addition to resistance, unnecessary antibiotic use also results in patient-reported adverse drug events affecting 26% to 35% of patients prescribed antibiotics in outpatient settings,⁸ and an estimated 145,490 million emergency department visits annually.^{9,10} Furthermore, patients prescribed antibiotics are at increased risk of developing *Clostridioides difficile* infections,^{10–12} and early antibiotic exposure in life has been associated with chronic diseases such as inflammatory bowel disease as patients age.^{13,14} In total, it is estimated that each unnecessary course of antibiotics results in \$21 to 96 dollars in unnecessary health care expenditures.¹⁰

Given the tremendous harms associated with unnecessary antibiotic use, national guidelines from the Centers for Disease Control and Prevention (CDC), Infectious Diseases Society of America, and the American Academy of Pediatrics recommend the implementation of stewardship programs in all outpatient settings.^{15–17} As of 2017, the implementation of outpatient stewardship programs also became a requirement for Joint Commission accreditation for some health systems.¹⁸ However, unlike hospitals, Joint Commission accreditation is not required or sought for many outpatient settings. The CDC published the Core Elements of Outpatient Stewardship in 2016 to assist with the implementation of effective antibiotic stewardship tools (**Table 1**).¹⁵ However, despite these recommendations and resources, the uptake of outpatient antibiotic stewardship has remained low, with only 7% of surveyed organizations having a fully functional outpatient stewardship program in 2020, and only 18% reporting effectiveness in at least one stewardship outcome.¹⁹ In contrast, stewardship in inpatient settings has been broadly implemented, with an estimated 88% of hospitals adopting such programs.

Implementing stewardship programs in outpatient settings poses unique challenges compared to inpatient environments, including diverse and variable governance and regulatory structures for outpatient practices, diverse models for care delivery, variable data structures, variable Joint Commission accreditation requirements, and mixed levels of resources and administrative commitment. Furthermore, while effective stewardship interventions have been implemented in select clinical settings, scaling of interventions, particularly to resource-limited settings, has been a critical gap in reducing unnecessary outpatient antibiotic use.

In this review, we discuss pragmatic strategies for implementing outpatient stewardship programs in the United States and future directions to scale effective interventions. This review primarily focuses on stewardship in outpatient clinics, including retail clinics, urgent cares, and telemedicine, with the aim of promoting responsible antibiotic use and mitigating the consequences of unnecessary antibiotic use.

EPIDEMIOLOGY OF OUTPATIENT ANTIBIOTIC PRESCRIBING

Wide variation in prescribing rates exist throughout the US between ages, clinician specialty, clinical setting and other variables that is difficult to explain by differences in case mix or illness burden.^{20,21} High rates of inappropriate prescribing have been described both for prescribing when no antibiotic treatment is indicated²² or based on using agents outside of guideline recommendations.²³

Time Trends

The recognition that antibiotic overuse is common is longstanding.²⁴ As part of efforts to promote the value of antibiotic stewardship, the CDC has conducted surveillance of antibiotic prescriptions in the United States using a variety of data sources. During the past decade in the US, there is evidence that the rate of antibiotic prescribing has modestly declined overall, with reductions more pronounced in children as compared

Stewardship Intervention	Description of Intervention	CDC Core Element Category
Antibiotic prescribing audit and feedback	<ul style="list-style-type: none"> • Providing individual clinicians with their antibiotic prescribing data with comparisons to their peers • Data sharing through letters, emails, or virtual dashboards • Transparency how data is analyzed and peer-comparison is performed can amplify impact 	Tracking and Reporting
Display public commitments	<ul style="list-style-type: none"> • Displaying posters or letters in patient care areas that state clinicians' commitment to avoiding inappropriate antibiotic prescribing • Inclusion of photo and signatures of providers 	Commitment
Delayed prescribing	<ul style="list-style-type: none"> • Providing an antibiotic prescription to patients with instructions to fill in the event symptoms worsen or fail to improve after 48–72 h • Included in treatment guidelines for acute otitis media 	Action for Policy and Practice
Communication training for clinicians	<ul style="list-style-type: none"> • Training and education for clinicians on how to navigate conversations with patients and their families when antibiotics are not needed for their acute illnesses • Providing negative and positive treatment recommendations to patients with inclusion of a contingency plan 	
Clinical decision support	<ul style="list-style-type: none"> • Integration of clinical management and treatment guidelines into electronic clinical workflow • Prompts or notices when antibiotic management differs from guidelines 	
Documentation of indication and justification	<ul style="list-style-type: none"> • Requiring documentation in patient medical records explaining the justification for prescribing antibiotics for illnesses where antibiotics are not indicated 	
Follow-up on diagnostic test results	<ul style="list-style-type: none"> • Discontinuation of antibiotics when diagnostic testing confirms a non-bacterial illness • Changing antibiotic selection based on antibiotic susceptibility results of positive bacterial cultures 	

to adult populations. For instance, in 2012, prescribing was 867 per 1000 persons compared to 765 per 1000 persons in 2019, 613 per 1000 persons in 2020 and 636 per 1000 persons in 2021.²⁵ Some of this reduction is likely attributable to greater emphasis on the problems of antibiotic overuse and the growth of stewardship activities. In addition to declines in overall prescribing volume, there is evidence that reductions in unnecessary prescribing has occurred as well.²² Notably, the onset of the

COVID-19 pandemic led to substantial additional changes in antibiotic prescribing with large declines in antibiotic prescribing during the first several months²⁶ due at least in part to decreases in outpatient visits for respiratory viral infections. However, since 2021, antibiotic prescribing rates appear to be restoring to pre-pandemic levels²⁵ likely due to an increase in respiratory infection related outpatient visits.

Variability

Variability in receipt and intensity of health care services is a well established feature of health care delivery,²⁷ and antibiotic prescribing is no exception. Differences in the rates of antibiotic prescribing have been described at the local, regional, national and global level, along with other factors including patient and clinical characteristics.

Geographic differences in antibiotic prescribing rates are profound.²⁸ Antibiotic prescribing rates in North America are among the highest in the developed world, and especially high in the United States when compared to other countries in Europe with rates varying by up to 10-fold between countries.²⁹ Annual data from CDC provides highly granular information about national patterns of antibiotic prescribing based on prescriptions dispensed from retail pharmacies. In 2021, there were 211.1 million antibiotic prescriptions.²⁵ When examined by state, prescribing rates vary by nearly three-fold, with the highest prescribing rates in Mississippi and West Virginia (>1000 prescriptions per 1000 persons) compared to the lowest prescribing states of Alaska, Oregon and Washington (<400 prescriptions per 1000 persons).²⁵ Further variability is evident within smaller regions, for instance higher antibiotic prescribing has been described in rural compared to urban settings.³⁰

Other important features related to clinicians and patients are evident. Antibiotic prescribing rates are higher for persons 20 years or older compared to <20 years, and higher for females compared to males.²⁵ Although the majority of outpatient antibiotics originate in primary care office settings and emergency departments, there has been important growth in prescribing originating from urgent care and retail clinics as well as telemedicine including differences in the rate of inappropriate prescribing between settings.^{31,32} In terms of clinical specialties, advanced practice clinicians, a group that includes physician assistants and nurse practitioners are collectively responsible for the most antibiotic prescriptions, followed by primary care physicians and dentists.²⁵ There is also growing recognition that antibiotic prescribing practices are not equitable, with differential prescribing rates identified for patients with similar diagnoses based on equity markers such as race, ethnicity or preferred language.³³

Targeted Conditions and Guideline Adherence

Although there are a broad range of infectious conditions treated with antibiotics in outpatient settings, acute respiratory tract infections are the most commonly diagnosed conditions that receive antibiotic prescriptions.²² These include such conditions as acute sinusitis, pharyngitis, acute otitis media, pneumonia and bronchitis. Other commonly treated infections in outpatient settings include a variety of skin infections and genitourinary conditions including acute cystitis.²² For many of these conditions, evidence-based guidelines exist to recommend the preferred antibiotic choices including the appropriate choice and duration for treatment. Several studies have sought to characterize adherence to guideline recommendations in terms of both antibiotic choices and prescription duration.^{23,34} Although a variety of clinical factors may make selected patients not suitable for standard recommendations, rates of guideline adherence for both antibiotic choice and duration in the United States fall below national goals.^{23,34}

An additional important area pertaining to guideline adherence is appropriate clinical testing and overdiagnosis. Antibiotic overuse occurs when testing is performed without supportive symptoms. This occurs frequently for asymptomatic bacteriuria which is often treated when testing was not indicated in the first place.³⁵ This also applies to respiratory conditions such as pharyngitis where testing for group A Streptococcus in the presence of viral symptoms or in younger children can lead to unnecessary treatment.^{36,37}

STRATEGIES TO REDUCE UNNECESSARY ANTIBIOTIC USE

Stewardship Approaches

Over the past decade, studies have demonstrated the effectiveness of outpatient antibiotic stewardship and identified strategies and interventions for reducing inappropriate prescribing in outpatient settings (see [Table 1](#)). Additionally, CDC published guidance on how to implement stewardship in these settings and defined key elements deemed to be integral to optimizing antibiotic use.¹⁵ The general principles of outpatient stewardship remain similar to those applied to stewardship programs in hospitals. However, inherent differences between the two settings in how care is delivered, and clinical decisions are made necessitated designing stewardship interventions that could be integrated into the structure and workflow of the various outpatient settings. For instance, the two key hospital stewardship interventions of prior authorizations and real-time prospective audit and feedback are not feasible nor practical for most outpatient settings given the high volume of patients with short encounter times for each patient. As a result, antibiotic stewards had to develop different approaches to providing individualized feedback to outpatient clinicians while employing strategies that could effectively impact changes to prescribing patterns in the absence of real-time support.

Providing outpatient clinicians with their prescribing data retrospectively has consistently proven to be one of the most effective interventions in improving antibiotic use especially when their individual prescribing patterns are compared to their peers.^{38–42} Creating easy access to the prescribing data through either periodically generated reports^{38,39} or on-demand digital dashboards that provides transparency on how the data was analyzed^{41,42} can facilitate data sharing with providers. Additionally, leadership or institutional commitment and communications that states the prioritization of outpatient antibiotic stewardship can further incentivize providers to utilize the prescribing data feedback to inform their efforts to change prescribing practices.^{41,43}

There have also been stewardship strategies that address the role and impact patients can have in the clinical decision-making process for antibiotic prescribing, one of the more unique challenges for outpatient settings. Patient expectations for antibiotic treatment and the pressure to prescribe antibiotics perceived by clinicians during an outpatient visit have long been recognized as significant drivers of inappropriate prescribing.^{44–47} Provision of tools and resources that help providers manage patient expectations and alleviate pressure to prescribe can significantly amplify antibiotic stewardship efforts. For example, provider training on how to effectively communicate to parents of children when antibiotics are not needed during a sick visit facilitated the reduction of unnecessary antibiotic use for acute respiratory illnesses.⁴⁸ Mirroring the effective approaches learned from the hospital stewardship experiences, most outpatient stewardship studies involve the implementation of bundled activities such as combining data feedback to clinicians with tailored educational campaigns for both providers and patients.^{41,42,48,49}

Selecting the Right Targets and Metrics

Outpatient stewardship efforts have targeted various diagnoses that frequently lead to inappropriate antibiotic prescribing, with acute respiratory illnesses receiving the most attention to date. Effective stewardship programs have often selected goals and targets for improvement by conducting a baseline analysis of antibiotic prescribing for a given cohort of providers and identifying where the largest room for improvements are.^{50,51} In addition to taking into consideration the common diagnoses that are associated with inappropriate antibiotic use, stewardship leaders have further defined their targets based on whether (a) antibiotics were prescribed unnecessarily,^{49,52} (b) inappropriate types of antibiotics were selected,^{39,53} or (c) incorrect duration of therapies were prescribed.^{54,55}

Several stewardship studies have generated metrics that can be utilized to assess appropriate antibiotic use as they relate to the above-mentioned stewardship targets for individual clinicians and to incorporate into the provider data feedback programs as well as to measure the impact and performance of the stewardship activities. In addition, there are several quality measures that have been developed and utilized by health plans that can also be adopted by stewardship teams. **Table 2** summarizes these metrics.

Stewardship leads need to take into consideration the feasibility of performing the data collection and analysis necessary for integrating antibiotic prescribing metrics into their ambulatory stewardship activities. This will largely depend on available staff time and technical data management expertise. Equally important is considering whether the data analysis for the selected metrics can be conducted through databases accessible to the stewardship team and how much effort from staff will be needed to extract the necessary data elements. For instance, metrics that can be calculated using standardized documentation coding such as diagnosis or prescription codes in claims or administrative databases are likely to be easier to utilize than those that require data acquired through medical chart reviews.

Stewardship Targets	Specific Examples of Metrics
Prescription rates for diagnoses where antibiotics are not indicated	<ul style="list-style-type: none"> • Antibiotic rates for bronchitis and bronchiolitis (HEDIS QM) • Antibiotic rates for viral upper respiratory infections (HEDIS QM) • Antibiotic rates for acute viral sinusitis (CMS QM) • Antibiotic rates for all diagnoses for which antibiotics are not indicated
Prescription rates for all acute respiratory illness diagnoses	<ul style="list-style-type: none"> • Antibiotic utilization for respiratory conditions (HEDIS QM)
Rates of selection of antibiotics concordant with clinical guidelines	<ul style="list-style-type: none"> • Rates of antibiotic selection concordant with first-line agents recommended by clinical guidelines for sinusitis, pharyngitis, or acute otitis media • Rates of selection of amoxicillin with or without clavulanate for acute bacterial sinusitis (CMS QM)
Prescription rates for specific classes or types of antibiotics	<ul style="list-style-type: none"> • Prescription rates for cefdinir • Prescription rates for azithromycin • Prescription rates for fluoroquinolones
Duration of antibiotic therapy	<ul style="list-style-type: none"> • Rates of antibiotic prescriptions with guideline concordant duration of therapy for acute otitis media

Operational Considerations for Sustainable Antibiotic Stewardship

Implementation of antibiotic stewardship interventions typically requires significant amounts of staff time and effort along with information technology resources, especially when prescribing data and metrics are utilized. Additionally, quality improvement implementation expertise and experience are also frequently needed. The high level of resources necessary for antibiotic stewardship is a significant barrier for outpatient practices when considering implementation, and most practices or programs are likely to need external resources and technical assistance.^{56,57} As a result, the most effective and sustainable approaches to antibiotic stewardship in outpatient facilities will require an operational framework in which stewardship experts and data analysts external to the outpatient practices provide guidance, education, and technical support in implementing stewardship interventions. Health systems, health plans and public payer organizations, and public health agencies are best positioned provide such support to outpatient clinicians and lead outpatient stewardship programs or initiatives.

Most of the outpatient antibiotic stewardship studies mentioned above have demonstrated success in reducing inappropriate prescribing by employing operational structures in which a central stewardship team with dedicated staff and funding for outpatient facilities within a health system managed the data, conducted the analysis, and provided feedback and education to the individual providers and practices. As we have learned from experiences from hospital stewardship programs, the centralized approach affords certain advantages such as the alignment of stewardship goals and benchmarks across practices and the ability to provide peer-comparison data feedback from a larger cohort of providers.⁵⁸ It also provides opportunity to apply a standardized approach and workflow for collecting and analyzing prescribing data, ideally through an automated system that is compatible across different types of clinical and administrative databases and electronic health records products.⁵⁹ Such an approach will minimize repetitive or duplicative efforts to create data analytical processes at each practice setting as well as minimize stewardship staff time in maintaining the stewardship feedback activities.

The diverse and continuously evolving landscape of outpatient health care settings where antibiotics are frequently prescribed present another challenge for reducing inappropriate prescribing and requires stewardship leads to tailor the implementation of stewardship interventions to each subset of outpatient setting. For example, potential target areas for stewardship in urgent care clinics where antibiotics are most frequently prescribed for patients who are seeking care for acute respiratory infections⁵⁰ will be expected to be different than stewardship targets in dental clinics where a significant proportion of antibiotic prescriptions are for prophylaxis for dental procedures and acute oral cavity infections.⁶⁰ Certain types of outpatient practices may already have formalized policies and procedures for routinely providing feedback to clinicians on their quality of care through which antibiotic stewardship could be implemented.

FUTURE DIRECTIONS

Dissemination and Scalability of Interventions

Numerous studies have shown the effectiveness of stewardship interventions in specific health systems, populations, care settings, or for particular metrics. We now have a clear understanding of some of the types of stewardship interventions and bundles of interventions that are likely to be successful in ambulatory settings. However, despite this knowledge, effective interventions have not been adequately disseminated

or scaled. The Agency for Healthcare Research and Quality and others have identified key components to effective dissemination and scaling^{61–63} including: (1) reaching the intended audience with the information, (2) motivating them to use and apply evidence, and (3) providing them with the ability to do so. **Table 3** presents examples of potential mechanisms to increase the reach, motivation, and ability of systems to implement outpatient stewardship programs and interventions.

Reach: Survey data indicate that knowledge about the importance of not prescribing antibiotics when not needed and the threat of growing antimicrobial resistance has been effectively disseminated among clinicians,⁵⁶ health systems, payers, and public health agencies. Outpatient antibiotic stewardship has been recommended by most professional societies,^{17,64} public health agencies including the CDC,¹⁵ payers such as the Centers for Medicare and Medicaid Services, and accreditation agencies such as the Joint Commission.⁶⁵ Unfortunately, clinicians continue to prescribe antibiotics unnecessarily, though they are aware of the harms associated with unnecessary antibiotic use. In contrast, many patients continue to hold misconceptions about the need for antibiotics and the associated risks.⁶⁶ To date, few interventions to reduce antibiotic use have focused on patients. Patients are likely important partners in curtailing unnecessary antibiotic use, particularly because clinicians often cite patient preferences as a key driver of antibiotic prescribing.⁴⁵

Motivation: In inpatient settings, key motivators for antibiotic stewardship have included regulatory requirements, including those from the Joint Commission⁶⁵ and Centers for Medicare and Medicaid Services, public reporting of stewardship metrics for benchmarking such as through the National Healthcare Safety Network, and clearly delineated cost savings⁶⁷ associated with supporting inpatient programs. In contrast, many outpatient clinics are not accredited by the Joint Commission, and though costs associated with outpatient antibiotic use have been recently quantitated at the societal level,¹⁰ it has been more challenging to quantify cost savings for ambulatory stewardship at the clinic or health system level. Additionally, clinicians in outpatient settings often face time constraints, competing priorities, and concerns about lower patient satisfaction if they do not prescribe antibiotics.^{46,56,68,69} Some clinicians also worry that patients may simply seek antibiotics from another clinician if they do not prescribe them. Like inpatient clinicians, diagnostic uncertainty and fear of complications from not treating with antibiotics are also drivers of prescribing. Lack of awareness of their own prescribing habits can also diminish motivation to change, as clinicians tend to assume they are excellent prescribers.⁵⁶ Moreover, qualitative studies have suggested that the threat of antimicrobial resistance may be too abstract to motivate clinicians, and more tangible outcomes such as adverse drug events might be more persuasive.⁷⁰ Pragmatically, many of the barriers to motivation at the clinician level can be systematically addressed with specific interventions.

Ability to Implement Interventions: A recent expert convening identified a lack of concrete guidance on the quantity of resources needed for outpatient stewardship as a key limitation to implementation. Clear guidance on the structure of stewardship leadership (eg, physician and pharmacist) and appropriate staffing levels in full-time equivalents per number of hospital beds has been published for inpatient stewardship, and compliance with these guidelines has been shown to directly correlate with stewardship outcomes.⁷¹ However, no such information exists for outpatient stewardship, which limits the ability of stewards to request appropriate resources to support outpatient programs. Given the significant resource limitations faced by outpatient systems, particular attention should be given to ensuring that interventions are pragmatic and sustainable, and that efforts are not duplicated unnecessarily. Providing concrete

Table 3
Mechanisms to promote scalability and uptake of stewardship interventions

Strategies for Stewards and Clinicians	
Report interventions in sufficient detail that other health systems could replicate the program.	<ul style="list-style-type: none"> • Include all intervention components in a supplement (patient education, provider education, commitment posters, clinical care pathways, example audit and feedback reports, and so forth). • Include exact criteria used to define metric numerators and denominators (eg, International Classification of Diseases codes, medication lists, and so forth) • Include non-proprietary statistical code or detailed methods for the generation of audit and feedback reports if applicable. • Include statistical code used for the analysis
Report at least basic implementation information necessary for another system to use the program	<ul style="list-style-type: none"> • What are the characteristics of your system and population? • About how much did it cost to implement the program and/or maintain the program? • What level of personnel time (full time equivalents), and level of expertise (pharmacist, nurse, physician, infectious disease knowledge, and so forth) was needed to implement the program? • Were there any major barriers or facilitators to implementation? How did you overcome these barriers? • Has the program been sustained? If not, why not? What happened to outcomes after it was discontinued? • How much did it cost to implement the program? Did the program result in any cost savings?
Share Resources	<ul style="list-style-type: none"> • Share clinical care pathways, patient education, and provider education materials for other systems to modify and use. • Share methods, templates, and code used to generate audit and feedback reports, create dashboards, or collect data for benchmarking
Dissemination	<ul style="list-style-type: none"> • Leverage social media to share non-PHI outcomes of interventions. • Present and publish findings using peer-reviewed mechanisms. • Directly share successful interventions with colleagues regionally and within your professional network.
Patients	<ul style="list-style-type: none"> • Engage patients in the development of stewardship interventions. • Create patient-facing materials to be used outside of the point-of-care, and disseminate materials using methods preferred by patients.
Policies and Reporting	<ul style="list-style-type: none"> • Share how the implementation of specific stewardship interventions fulfills relevant regulatory requirements such as those set by The Joint Commission or the Centers for Medicare and Medicaid Services. • Describe the impact and outcomes of stewardship interventions on improving performances in relevant quality measures reported to payers as part of value-based reimbursement programs.

(continued on next page)

Table 3 (continued)	
Strategies for Stewards and Clinicians	
	<ul style="list-style-type: none"> • Share if the implementation of stewardship contributed to the facility receiving recognition by professional societies, public health agencies, or patient safety organizations.
Resources	<ul style="list-style-type: none"> • Provide concrete guidance on best practices for outpatient stewardship program leadership and personnel (pharmacists, physicians, local champions, and information technologists, and so forth) including full time equivalents per patient population or number of clinics that should be allocated to outpatient stewardship [for example, full-time equivalent (FTE)/ clinic or encounters] for each role.
Metrics	<ul style="list-style-type: none"> • Recommend unified concrete metrics with clear criteria for inclusion and exclusion criteria for the numerator and denominator • Provide a free resource for systems to benchmark outpatient prescribing for all age groups and payer types.
Interventions	<ul style="list-style-type: none"> • Provide an open access repository to compile successful interventions and intervention components for practices to leverage • Provide concrete guidance on how to implement each Core Element (eg, Excel template and 1- page handout on how to use a point prevalent approach for tracking and reporting) • Partner with electronic health record manufacturers to: <ol style="list-style-type: none"> 1. Standardize default settings for common antibiotics and infectious disease diagnostics 2. Create integrated ambulatory stewardship dashboards 3. Create default settings for antibiotics to require association with an indication or diagnostic code. 4. Store antibiotic prescribing data, diagnoses, and laboratory orders and results in standardized data tables for all electronic health record users. 5. Develop collaborative agreements to share de-identified data for reporting and benchmarking
Dissemination	<ul style="list-style-type: none"> • Leverage payers to help with dissemination as they may have greater access to outpatient clinics than professional societies. • Leverage state health departments for local dissemination.

guidance on criteria for metrics, materials to use, mechanisms to implement interventions, and estimated costs and resources needed for implementation and sustainability could significantly reduce the burden associated with the implementation of outpatient stewardship interventions. Furthermore, it would reduce the level of expertise needed to be effective in outpatient stewardship. To this end, effective interventions should be reported in sufficient detail to allow others to replicate them. Additionally, stewardship interventions should be designed such that they can be adapted for local context and culture.

Perfectionism Versus Pragmatism

Ideally clinicians would diagnose infections correctly, only prescribe antibiotics when they are necessary, and use the narrowest spectrum agent possible for the shortest duration needed to treat the infection. However, in real-world settings, the effectiveness, acceptability, and sustainability of interventions varies considerably. For example, the effectiveness of interventions that aim to reduce immediate antibiotic use for acute otitis media ranges from 0% to 27%^{49,72,73}; whereas those that aim to reduce the duration of antibiotics are 60% to 76% effective.^{54,74,75} The difference in effectiveness is triangulated by looking at the acceptability of these interventions among parents and clinicians. One example pertains to prescription duration. Nearly all surveyed parents wanted the shortest duration of antibiotics needed to treat the infection and most clinicians were very likely to prescribe the shortest duration. In contrast, clinicians were far less likely to use observation without an antibiotic prescription.⁷⁶ Thus, while ideally clinicians would simply not prescribe antibiotics when not needed, focusing on duration may result in substantially less overall antibiotic exposure for some diagnoses.

Similarly, though delayed prescribing (ie, giving a wait-and-see antibiotic prescription to be used only if the patient worsens or does not improve within 72 hours) results in higher antibiotic use than observation without an antibiotic prescription, antibiotic use is substantially less among patients who receive a delayed compared to an immediate prescription.⁷⁷ Delayed prescriptions may have higher acceptability and uptake by clinicians and patients than observation. A mindset that focuses on risk reduction using strategies that can be realistically implemented and have high acceptability and effectiveness should be considered rather than exclusively focusing on eliminating unnecessary antibiotic use.

Precision Stewardship

Precision stewardship has been used to successfully guide antimicrobial stewardship in some health systems by identifying which patients are at highest risk of developing *C.difficile* infection or are at greatest risk for developing antimicrobial resistant organisms.⁷⁸ At the time of this article only a few health systems have leveraged precision stewardship to target stewardship interventions and to our knowledge the use of precision stewardship has not been employed in outpatient settings. This may be an undeveloped opportunity to improve patient outcomes, reduce unnecessary and reduce resources needed for stewardship in outpatient settings. For example, algorithms could be created to automatically identify outpatients who are at high risk for the development of antimicrobial resistant organisms or *C.difficile* infections based on antibiotics prescribed, prior culture results, and their medical history. These patients could be flagged for review by pharmacists who could make recommendations on modifications to antibiotic regimens as needed. As a second example, precision stewardship could potentially be used to automatically identify patients that are more likely to have asymptomatic bacteriuria than a urinary tract infection based on patient characteristics and laboratory results to direct appropriate completion of cultures and antibiotic management.

Role of Payers

As previously described, outpatient practices need significant levels of resource support and technical assistance to adopt antibiotic stewardship activities effectively and sustainably. Health care payers are well positioned to provide this support and can play an important role in facilitating outpatient antibiotic stewardship especially for outpatient

practices that are physician-owned and are not part of a health system. These organizations can analyze data from administrative and clinical databases which can help inform strategies to improve access to care for patients, provide technical assistance to outpatient practices on how to implement quality improvement activities, and utilize value-based reimbursement programs to incentivize and provide financial resources for outpatient providers to adopt practices that can improve individual and population health outcomes. There have been many examples of payers leveraging these capacities to support improvements in a wide-range of public health issues such as preventing asthma exacerbations in children,⁷⁹ increasing COVID-19 vaccination rates,⁸⁰ and improving naloxone access to reduce deaths from opioid overdose.⁸¹

There are also a smaller number of examples of payers applying their resources toward improving antibiotic use in outpatient settings. Several studies have demonstrated the feasibility and effectiveness of using state Medicaid claims data to assess antibiotic prescribing patterns to identify outpatient practices or geographic regions that had higher levels of antibiotic prescribing.^{82,83} One initiative in Kentucky involved a partnership between the state Medicaid agency and antibiotic stewardship experts from an academic medical center that identified specific geographic areas in the state with high antibiotic use.³⁰ There have also been payer initiatives that have provided financial resources to outpatient practices for improving antibiotic use through reimbursement programs designed to incentivize quality improvement.⁸⁴ Translating these examples into broader and consistent payer support for outpatient antibiotic stewardship will be essential to achieving significant reductions in inappropriate antibiotic prescribing.

Role of Electronic Health Record Companies

Electronic health record (EHR) systems can play a vital role in reducing unnecessary antibiotic use. EHRs can provide clinical decision support, require accountable justification for prescriptions, provide quick access to stewardship resources and pathways and education materials for patients, and acquisition, storage, and reporting of prescribing data. Unfortunately, a major limitation of EHRs has been that most tools are not EHR agnostic and are proprietary. Therefore, effective tools cannot be easily disseminated between different health systems and health systems incur significant costs to implement stewardship tools. Potential approaches to assist with dissemination include: (1) collaboration with major EHR companies to assure effect stewardship tools are incorporated in standard builds for all health systems; (2) promote collaboration between EHR companies to effectively design and standardize stewardship tools and default settings; or to (3) adopt universal standards and systems, such as Fast Health Care Interoperability Resources (FHIR),⁸⁵ to promote interoperability across different EHRs.

Role of Policy Makers

The U.S. national action plans to comprehensively address antibiotic resistance have been integral to elevating antibiotic stewardship as a national public health priority and effective in mobilizing federal government agencies and resources. However, much of the actions outlined for the implementation of health care antibiotic stewardship have focused to date on hospital settings⁸⁶ and there have been insufficient recommendations directing federal efforts and resources toward the facilitation of outpatient stewardship. Future action plans should delineate actions that federal agencies can take, especially for the Centers for Medicare and Medicaid Services, that can help define the roles of payers in incentivizing the prioritization of outpatient antibiotic stewardship and dedicate the necessary resources for outpatient practices to adopt stewardship activities.

To facilitate the elevation of antibiotic stewardship among other competing public health priorities for outpatient providers, antibiotic use measures need to be consistently considered for inclusion in key core sets of quality measures. These core measure sets are intended to standardize how quality of care is assessed across specific provider networks, payer organizations, health care facilities and systems. They also signal to these health care providers and stakeholders which clinical and public health issues need to be urgently addressed through quality improvement efforts. In the past couple of years, a quality measure that assesses whether antibiotics are inappropriately prescribed for patients diagnosed with acute bronchitis was added to the core measure sets for Medicaid.⁸⁷ This inclusion will help stakeholders such as state Medicaid agencies and their managed care organizations to prioritize outpatient antibiotic stewardship efforts and mobilize their resources to support outpatient providers in improving their antibiotic prescribing. Further inclusion of antibiotic use measures in other core measure sets as well as considerations for including antibiotic quality measures that assesses overall utilization levels will be needed to support stewardship across broader groups of providers.

Health Equity

Inequities in antibiotic prescribing by race, ethnicity, language preference, insurance type, and socioeconomic status remain pervasive.⁸⁸ Data on the direction of the inequity (who is more likely to receive unnecessary antibiotics) and scale of the inequity have been mixed. In some studies, minorities and those from disadvantaged backgrounds are less likely to receive antibiotics, broad-spectrum antibiotics, or long durations of antibiotics than their peers.^{89–91} It is possible that in some cases this indicates that these populations are less likely to be exposed to unnecessary care. However, the extent to which these differences are associated with clinical outcomes, reflect inequities in access to care, and how well these differences align with patient preferences is largely unknown. Stewards should carefully monitor prescribing and patient outcomes based on race, ethnicity, language preference, and insurance status to identify and address inequities in care. Future work is needed to clearly understand the underlying etiology of these inequities so they can be systematically addressed, and these insights incorporated into stewardship interventions.

SUMMARY

Unnecessary outpatient antibiotic use remains a substantial threat. Considerable progress has been made in identifying effective interventions and making recommendations for stewardship programs. However, innovative, pragmatic strategies are needed to scale effective interventions to ultimately reduce outpatient antibiotic use. Outpatient stewardship continues to lag behind inpatient stewardship programs despite the fact that more antibiotics are prescribing in outpatient than inpatient settings. A national change in approach that includes broader collaborative involvement of health systems, public health, payers, policy makers, electronic health record companies, and patients is needed to advance the field.

CLINICS CARE POINTS

- Prescribe antibiotics only when necessary to reduce harm to patients.
- The CDC Core Elements of Outpatient Antibiotic Stewardship can serve as a guide for implementing effective stewardship programs in clinics.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

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