SPECIAL FEATURE

Outpatient antibiotic stewardship: Interventions and opportunities

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ABSTRACT

Improving the use of antibiotics across the continuum of care is a national priority. Data outlining the misuse of antibiotics in the outpatient setting justify the expansion of antibiotic stewardship programs (ASPs) into this health care setting; however, best practices for outpatient antibiotic stewardship (AS) are not yet defined. In a companion article, we focused on recommendations to overcome challenges related to the implementation of an outpatient ASP (e.g., building the AS team and defining program metrics). In this document, we outline AS interventions that have demonstrated success and highlight opportunities to enhance AS in the outpatient arena. This article summarizes examples of point-of-care testing, policies and interventions, and education strategies to improve antibiotic use that can be used in the outpatient setting.

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One of the first hospital antibiotic stewardship programs (ASPs) in the United States was initiated in the late 1970s, when a team of infectious diseases physicians and pharmacists implemented a prospective audit and feedback strategy at Hartford Hospital in Connecticut. Since that time, ASPs have been formally defined and have produced mounting evidence that the use of interventions in acute care results in judicious prescribing and improvement in patient outcomes. Antibiotic overuse and misuse is not unique to the hospital setting, and recent federal policy provides the impetus to implement ASPs across all health care settings. In recognition of the need to expand the fight against drug-resistant pathogens, the White House issued Executive Order 13676: Combating Antibiotic-Resistant Bacteria in September 2014. One facet of the order was the call for defining and establishing antibiotic stewardship (AS) across the continuum of care, including, but not limited to, office-based practices and outpatient settings. In response to the executive order, the National Strategy and National Action Plan for Combating Antibiotic-Resistant Bacteria were published in 2014 and 2015, respectively. These documents were intended to serve as a roadmap for meeting the challenge presented by antibiotic-resistant bacteria. The action plan outlined numerous objectives and milestones aimed at increasing outpatient AS (Table 1).

Presently, there is limited guidance available for AS teams that are forming or expanding into the outpatient practice setting. The factors that drive antibiotic misuse or over-prescribing in the outpatient setting may be different from those in the hospital, including perceived patient and parent or caregiver expectations for antibiotics, diagnostic uncertainty, prescriber time pressures, and patient satisfaction. To address these unique circumstances, stewardship interventions that have been suggested to improve outpatient antibiotic prescribing patterns differ somewhat from those in the inpatient setting. Optimal intervention components are difficult to identify given the paucity of comparable data in this setting; however, experts agree that a multifaceted approach is necessary to improve antibiotic use. The Centers for Disease Control and Prevention (CDC) recently released the Core Elements of Outpatient Antibiotic Stewardship in an attempt to consolidate evidence-based practices and adapt best practices across other clinical settings. When planning a new outpatient AS initiative, the AS team should select

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interventions and education strategies that will be practical and effective for achieving established ASP objectives.

This article describes evidence-based opportunities and interventions for developing and expanding AS initiatives into the outpatient practice setting. For the purposes of this article, the outpatient practice setting will encompass ambulatory care clinics, physician offices, convenient care clinics, urgent care clinics, and community pharmacies. Although emergency departments, nursing homes, and long-term care facilities may be considered outpatient practice sites and some of the concepts discussed herein may be applicable to these settings, these venues also offer unique opportunities and present challenges that may not be addressed.

**Identifying stewardship targets**

Traditionally, AS initiatives have tended to focus on activities under a limited organizational umbrella. However, collaboration among clinics, health systems, laboratories, public health, community pharmacies, and other stakeholders may optimize outpatient AS program and provide new models for achieving outpatient AS objectives. Although outpatient ASPs could certainly have a focus within a particular health system, they have the potential to reach much further. To realize their full potential, outpatient ASPs should strive to engage a broader cohort of partners, including clinics, community pharmacies, and hospitals. Furthermore, outpatient AS initiatives can take on numerous forms; however, at the most basic level, all interventions are designed to affect a process on the patient-infection continuum (Table 2).

When implementing a new AS initiative or expanding an existing ASP, the AS team should perform an evidence-based assessment of antibiotic prescribing for infectious diseases syndromes and identify barriers to optimal management across the patient-infection continuum. This exercise will aid in identifying areas of opportunity for AS initiatives and prioritizing interventions. Once priorities and opportunities have been recognized, AS strategies that have documented success in improving antibiotic overprescribing should be implemented (Table 3). ASP leaders will need to discern the elements of ASPs that are both critical to the success of the AS initiative, but also feasible in the diverse outpatient setting. Most data in the outpatient arena evaluate interventions to curb unnecessary prescribing for acute respiratory tract infections (RTIs), and this infectious syndrome has been an obvious and critical target for intervention given the documented gross overuse of antibiotics to treat acute bronchitis and other RTIs that are primarily viral in nature.

**Table 1**

Objectives and select milestones outlined in the National Action Plan for Combating Antibiotic-Resistant Bacteria specific to outpatient antibiotic stewardship

<table>
<thead>
<tr>
<th>Sub-Objective 1.1.1A</th>
<th>Strengthen antibiotic stewardship in inpatient, outpatient, and long-term care settings by expanding existing programs, developing new ones, and monitoring progress and efficacy.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within 3 years:</td>
<td>- The Centers for Disease Control and Prevention (CDC), Centers for Medicare and Medicaid Services (CMS), the Agency for Healthcare Research and Quality, and other partners will issue guidance on antibiotic stewardship and best practices for ambulatory surgery centers, dialysis centers, nursing homes, other long-term care facilities, doctors’ offices and other outpatient settings, pharmacies, emergency departments, and medical departments at correctional facilities.</td>
</tr>
<tr>
<td>Sub-Objective 1.1.1B</td>
<td>Strengthen educational programs that inform physicians, veterinarians, members of the agricultural industry, and the public about good antibiotic stewardship.</td>
</tr>
<tr>
<td>Within 3 years:</td>
<td>- CMS will expand the Physician Quality Reporting System (PQRS) to include quality measures that discourage inappropriate antibiotic use to treat non-bacterial infections, such as respiratory tract infections.</td>
</tr>
<tr>
<td>Sub-Objective 1.1.3</td>
<td>Implement annual reporting of antibiotic use in inpatient and outpatient settings and identify geographic variations or variations at the provider or patient level that can help to guide interventions.</td>
</tr>
<tr>
<td>Within 1 year:</td>
<td>- CDC will report outpatient prescribing rates for 2011 and 2012 and use the data to target and prioritize intervention efforts.</td>
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<td>- CDC will establish a benchmark (in terms of prescriptions per population) for reduction in antibiotic use.</td>
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<tr>
<td>Within 3 years:</td>
<td>- Starting in 2016, CDC will issue yearly reports on progress in meeting the national target of 50% reduction in inappropriate use of antibiotics in outpatient settings, as well as on overall trends in antibiotic prescribing.</td>
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<td></td>
<td>- The U.S. Department of Defense (DOD) will establish goals for reducing antibiotic use in DOD facilities that provide outpatient care for military personnel and their families.</td>
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<td>- DOD will centralize reporting of outpatient antibiotic use and issue annual summary reports.</td>
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<tr>
<td>Sub-Objective 2.1.1</td>
<td>Create a regional public health laboratory network that uses standardized testing platforms to expand the availability of reference testing services, characterize emerging resistance patterns and bacterial strains obtained from outbreaks and other sources, and facilitate rapid data analysis and dissemination of information.</td>
</tr>
<tr>
<td>Sub-Objective 2.1.2</td>
<td>Link data generated by the regional public health laboratory network to existing public health surveillance networks so that antibiotic susceptibility testing data are immediately available to local, state, and federal public health authorities as they detect and investigate outbreaks, and to veterinary diagnostic and food safety laboratory databases and surveillance systems, as needed.</td>
</tr>
<tr>
<td>Sub-Objective 2.2.1</td>
<td>Enhance reporting infrastructure and provide incentives for reporting (e.g., require reporting of antibiotic-resistance data to National Healthcare Safety Network as part of the CMS Hospital Inpatient Quality Reporting Program).</td>
</tr>
<tr>
<td>Sub-Objective 2.2.2</td>
<td>Add electronic reporting of antibiotic use and resistance data in a standard file format to the Stage 3 Meaningful Use certification program for electronic health record systems.</td>
</tr>
<tr>
<td>Sub-Objective 2.2.3</td>
<td>Expand the activities and scope of the Emerging Infections Program to include monitoring of additional urgent and serious bacterial threats and evaluating at-risk populations across community and health care settings.</td>
</tr>
<tr>
<td>Objective 3.1</td>
<td>Develop and validate new diagnostics—including tests that rapidly distinguish between viral and bacterial pathogens and tests that detect antibiotic resistance—that can be implemented in a wide range of settings.</td>
</tr>
<tr>
<td>Objective 3.2</td>
<td>Expand the availability and use of diagnostics to improve treatment of antibiotic-resistant bacteria, enhance infection control, and facilitate outbreak detection and response in health care and community settings.</td>
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</tbody>
</table>
Interventions tailored to problems of antibiotic overuse and resistance must include other common outpatient infectious diseases (e.g., otitis media, skin or soft tissue infections, and asymptomatic bacteriuria), specific pathogens, or specific antibiotic agents.

Recently, CDC in collaboration with a panel of national experts described outpatient prescribing rates for 2010-2011 to understand the breadth of unnecessary antibiotics prescribed to adults and children in the United States. These data can serve as an important starting point for novel outpatient ASPs or as an area for enhancement for existing ones. In this analysis, the investigators estimated that 30% of outpatient antibiotic prescriptions were unnecessary. These data can be used to target and prioritize AS intervention efforts while also providing a benchmark for reduction in antibiotic prescriptions. Collectively, acute RTIs (e.g., sinusitis, otitis media, pharyngitis, bronchitis and bronchiolitis, upper respiratory infections, asthma and allergy, influenza, and pneumonia) accounted for 44% of outpatient antibiotic prescriptions, with half of these prescriptions estimated to be unnecessary. This finding supports an infectious diseases syndrome—specific approach to AS in the outpatient setting, particularly in clinics, emergency departments, and hospital outpatient departments (Table 4) and suggests that acute RTIs can serve as an important starting target disease state for ASPs.

In what follows, we review select examples of outpatient AS interventions for which data exist to support implementation.

### Audit and feedback

Program metrics should be disseminated to stakeholders, team members, and prescribers to identify need or motivation for changes in prescribing patterns. Clinical practices may consider adding antibiotic use metrics (matched to AS initiatives) as a clinical metric to any existing or planned customized measurement dashboards or other methods used to provide feedback to providers. For quality improvement purposes, prescribing metrics can be compared with peer performance in a practice site, network, or region, or with established benchmarks and can be outlined by high-priority condition. Peer comparison and positive reinforcement to top performers is a strategy that has demonstrated the ability to reduce unnecessary antibiotic prescribing for acute RTIs.

Continuously providing prescribers access to real-time antibiotic use metrics allows clinicians and the ASP to track changes in prescribing practices of an individual or group of prescribers. Alternatively, antibiotic prescribing summaries may be provided at specified intervals. When combined with clinician education, quarterly provider feedback demonstrated a nearly 50% relative reduction in broad-spectrum antibiotic prescribing rates for bacterial infections (e.g., sinusitis, streptococcal pharyngitis, and pneumonia) encountered in the outpatient environment. Following cessation of this intervention, broad-spectrum prescribing reverted back toward baseline, suggesting that antibiotic use feedback strategies

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**Table 2**

The patient-infection continuum

<table>
<thead>
<tr>
<th>Patient care segment</th>
<th>Opportunity for action</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need to seek care</td>
<td>• Immunization programs</td>
<td>• If a physician visit for an infection is avoided, then there is not a risk for an antibiotic to be prescribed.</td>
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<tr>
<td></td>
<td>• Patient education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Preventive medicine and wellness initiatives</td>
<td></td>
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<tr>
<td></td>
<td>• Postdischarge bridge calls</td>
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</tr>
<tr>
<td>Decision to prescribe antibiotics and agent selection</td>
<td>• Use of POC diagnostics</td>
<td>• Improve the selection of antibiotics</td>
</tr>
<tr>
<td></td>
<td>• Clinic use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pharmacy use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Prescriber audit and feedback</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Peer comparison</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Prescriber education, behavioral intervention</td>
<td></td>
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<tr>
<td></td>
<td>• Practice updates</td>
<td></td>
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<td></td>
<td>• Development of practice guidelines</td>
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<tr>
<td></td>
<td>• Prescribing tools</td>
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<td></td>
<td>• Suggested alternatives</td>
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<td></td>
<td>• Accountable justification</td>
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<tr>
<td></td>
<td>• Development of regional and local antibiograms of outpatient isolates</td>
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</tr>
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<td></td>
<td>• Development of outpatient or practice formularies</td>
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</tr>
<tr>
<td></td>
<td>• Development of allergy assessment and penicillin skin testing program or referral</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations used: POC, point of care.
Antibiotic stewardship in the outpatient setting

Table 3  Antibiotic stewardship interventions with demonstrated success in the outpatient setting

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Additional testing to aid in diagnostic certainty (e.g., point-of-care tests for group A streptococcus or influenza, viral polymerase chain reaction, procalcitonin, C-reactive protein)</td>
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</tr>
<tr>
<td>Audit and feedback</td>
<td></td>
</tr>
<tr>
<td>Clinical decision support tools</td>
<td></td>
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<tr>
<td>Communication training for prescribers</td>
<td></td>
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<tr>
<td>Delayed prescribing strategies</td>
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<tr>
<td>Evidence-based guidelines</td>
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<tr>
<td>Patient education</td>
<td></td>
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<tr>
<td>Provider education</td>
<td></td>
</tr>
<tr>
<td>Provider pledge to practice antibiotic stewardship</td>
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</tbody>
</table>

need to be sustained to maintain optimal prescribing habits. In addition, once targets of use have been met, the effectiveness of these strategies may become stagnant.

Education

A comprehensive education plan is imperative to the success of any planned AS activity and is necessary for adoption of changes in practice. Education in the outpatient setting will need to be directed at prescribers, pharmacists, and other health professionals, as well as patients and other members of the community. Given that the audience is likely to be scattered across different clinics, pharmacies, or other venues, educational methods (e.g., formal or informal didactic presentations, webinars, workshops, case review, posters, newsletters, brochures, electronic health record (EHRs) alerts, or direct person-to-person communication) selected for use will need to be varied. The AS team must develop the education plan in tandem with targeted AS initiatives and have a plan for who to educate, how to educate, when to educate, and appropriate intervals for re-education as needed. ASPs should be visible to the end users, and educational materials should be easily accessible. Education alone is an insufficient stewardship strategy and should be combined with a corresponding AS intervention (e.g., audit and feedback, clinical decision support, delayed prescribing, public display of provider pledge to practice antibiotic stewardship). Without a plan for continual educational efforts, the beneficial effects of education on antibiotic prescribing are likely to diminish over time.

Educational resources

Educational programs target health care providers and the general community. They should encompass a number of topics ranging from treatment guideline updates to the benefits of vaccination and wellness programs on antibiotic avoidance. It is important that the educational objectives of the AS team be consistent with the targeted AS initiative. To facilitate the development of educational content, there are several reputable Web-based resources available; some provide shortened summaries of national evidence-based guidelines, Web-based learning modules, or health care consumer education materials that can be downloaded for use with little or no alteration.

In the United States, the “CDC Get Smart: Know When Antibiotics Work” national campaign (http://www.cdc.gov/getsmart/community/index.html) provides evidence-based resources for common infectious diseases and educational courses designed by experts in the field. In addition, the website contains brochures, posters, fact sheets, and letters that can be distributed to patients and placed in clinics or pharmacies. State and local health departments have implemented community-based AS educational campaigns and resources; these tools typically focus on the lack of efficacy of antibiotics in treating common viral illnesses or prevention of Clostridium difficile infections (CDIs). In the United Kingdom, the TARGET Antibiotics Toolkit (http://www.rcgp.org.uk/clinical-and-research/toolkits/target-antibiotics-toolkit.aspx) was designed as a resource by the Antimicrobial Stewardship in Primary Care (ASPIC) collaboration to optimize antibiotic prescribing in the primary care setting. E-learning modules, patient education leaflets, auditing toolkits, self-assessment checklists, and additional resources are provided on the ASPIC webpage, which is publically accessible.

Clinician education

Efforts to improve antibiotic use and selection for specific infections must include those responsible for prescribing and dispensing antibiotics. Many studies have used passive educational techniques, such as lecturing, continuing education, and seminars, as the principle intervention or as a supplement to other interventions. While education is often delivered only once, several studies delivered education multiple times, including 1 study that held bimonthly sessions. The academic detailing model has demonstrated effectiveness in reducing the number of antibiotic prescriptions and in improving antibiotic selection. The academic detailing model involves one-on-one education by clinical specialists (including pharmacists, nurses, or physicians) to help clinicians provide evidence-based care to their patients. This method primarily involves educational outreach, generally in a frontline clinician’s office, where information is provided interactively. This allows the educator to understand where the clinician is coming from in terms of knowledge, attitudes, and behavior. The educator will then modify the presentation to address the personal learning opportunities to keep the practitioner engaged. The one-on-one
visit ends with specific practice-changing recommendations. Pharmacists or other health care providers can participate in the academic detailing training series developed by the National Resource Center for Academic Detailing (http://www.narcad.org/training-series.html).

Communication training for prescribers has also been shown to decrease unnecessary antibiotic prescribing. This strategy can be used to address factors that drive antibiotic misuse, specifically perceived patient or parent or caregiver expectations for antibiotics and patient satisfaction. Contrary to the belief of many clinicians, patient satisfaction is less associated with the receipt of an antibiotic and more dependent on the quality of communication provided during an encounter. The message should focus on why an antibiotic is or is not needed, nonantibiotic treatment options, and contingency planning. Incorporating positive (offer symptomatic treatment options) and negative (explain why antibiotics are not needed) treatment recommendations during the patient encounter has demonstrated an 85% reduction in the risk of antibiotic prescribing for viral RTIs, while improving patient satisfaction scores. Shared decision making is another example of a communication approach that has demonstrated reductions in antibiotic use for acute RTIs, without reducing patient satisfaction. In this process, the patient and prescriber make health care decisions together after reviewing patient expectations, options for management, and the benefits and risks. In a recent analysis, this approach led to a 38% reduction in antibiotic prescribing compared to usual care without reducing patient satisfaction.

Patient education

Traditionally the main objective of patient education in the outpatient setting has been to decrease patient perception of the need for an antibiotic in viral illnesses when they are not indicated, such as in acute RTIs. This continues to be an important objective for patient education in this setting, although with the continued development of AS interventions focused on a particular infection or syndrome, more specific educational messages are necessary. There are multiple patient education delivery methods that can be considered: mailing or distributing brochures and informational pamphlets, displaying pamphlets and posters in clinics and pharmacies, providing hyperlinks in the EHRs for printing and distributing at the point of care, or public presentations to community groups. These types of patient education are intended to supplement key AS interventions, and are unlikely to affect antibiotic use outcomes alone. Educational efforts to improve antibiotic use in outpatient settings should be coordinated to target health professionals and consumers across a variety of venues.

Additional patient education efforts should target the patients’ need and decision to seek care (Table 2). Programs to promote wellness, vaccinations, and community pharmacy-based disease management can help to reduce unnecessary office visits and therefore reduce the risk of receipt of an antibiotic prescription. Community pharmacies should incorporate patient education on optimal antibiotic use into direct-to-consumer advertising and onsite direct-to-patient educational initiatives.

Computerized decision support and electronic health records

EHRs and computerized order entry have become critical instruments in the rapidly changing health care environment. The availability of clinical decision support (CDS) can be invaluable to the busy outpatient prescriber who is limited by the nature of the encounter, often lacks real-time access to specialists, and may not have the opportunity to change a prescription once it is written. CDS tools developed from EHRs offer an opportunity to assist with AS at the point of prescribing to include electronic alerts, antibiotic order sets, and cascading questions to guide antibiotic selection, dose, and duration for a particular infection or patient. Having CDS tools available at the point of prescribing, such as accountable justification for nonrecommended antibiotic prescribing, is a useful strategy to ensure guideline-concordant antibiotic prescribing. EHRs also provide data that can be aggregated to conduct electronic surveillance of antibiotic prescribing practices and to assess the impact of the ASP. The AS team should place emphasis on the design and use of CDS tools that will prompt the prescriber to optimize antibiotic use, selection, dose, and duration (or no antibiotic) based on clinically relevant factors such as prescribing indication, available microbiology culture results and susceptibilities, antibiotic allergies, drug-drug interactions, renal function, medical history, and cost or insurance coverage. Other examples of CDS tools include embedding clinical guidelines into the health record (or easy Web-based access, laminated cards, posters, etc.), real-time community or facility antibiograms, or the use of branching logic to guide decisions. Regardless of the CDS mechanism, prescribers need to be educated before and during the implementation to optimize its uptake and utility. Studies evaluating the impact of CDS tools on antibiotic use in the outpatient setting have primarily focused on acute RTIs and have generally demonstrated a favorable reduction in antibiotic prescribing. In one instance, implementation of a clinical pathway-based intervention in combination with a peer champion and patient education resulted in a significant decrease in overall antibiotic (14.4% relative reduction; P <0.001) prescribing for acute RTIs that are not pneumonia.

It is important to anticipate challenges and barriers associated with CDS tools when considering implementation. Providers are unlikely to use a CDS tool if it will interrupt workflow, its function is inflexible, or it introduces time pressure in the context of the medical encounter. New CDS tools should be designed or implemented with the assistance of information technology (IT), infectious diseases specialists, and frontline providers with the opportunity for testing and refinement before and after its introduction into clinical practice. The development and maintenance of CDS tools within the EHR is labor intensive and requires ongoing dedicated resources.

Outpatient clinic practices should develop policies requiring providers to specify the indication and duration of antibiotic therapy on prescriptions. The EHR can be used to support this policy by mandating these entry fields during electronic prescribing, and the data can be collected for process measures as metrics for AS. The AS team should identify and work with IT to extract meaningful outcome and
Delayed prescribing

Delayed prescribing, also referred to as watchful waiting, is an effective strategy that can be implemented for mild acute otitis media\(^2\) and acute RTIs.\(^6\) This strategy reduces antibiotic use by requesting that patients delay filling their prescription by 24-48 hours, postdating the prescription or contacting the patient after the encounter to determine whether an antibiotic is necessary considering lack of symptom improvement. For practices that use electronic prescribing, postdating the prescription is often not feasible; rather, the provider can add a note to the prescription such as “fill in 2 days if not better” in the signature field.\(^4\) Delayed prescribing is one approach that can be used to address overprescribing related to patient pressure for antibiotics and concerns often relayed by providers that patient satisfaction scores may suffer if antibiotics are not prescribed.\(^5\) When using this approach, it should be noted that patients may feel uncomfortable deciding on their own when the prescription should be filled. Therefore, to improve the effectiveness of this approach, a member of the AS team should contact the patient or their caregiver at a specified time to assess the need to fill the prescription for the antibiotic.

Guideline implementation

Clinical experts on the AS team should review, implement, and maintain community-wide or health system-specific antibiotic use guidelines for common outpatient infectious diseases. These guidelines should take into account local prescribing trends, resistance patterns, and antibiotic cost. In a systematic review, Drekonja et al.\(^10\) identified that the use of prescribing guidelines are associated with improved antibiotic outcomes (e.g., reduced overall use or improved agent selection) in the outpatient setting. Guidance on when and how to use antibiotics needs to be accessible, short, easy-to-read, and widely promoted.

In response to a significant increase in the incidence of CDI in the province of Québec, Canada, an educational program targeted to physicians and pharmacists was launched to reduce outpatient antibiotic prescriptions for common outpatient infections.\(^6\) The guidelines were available on the Internet and were heavily promoted in a widespread educational campaign. One year following the dissemination and promotion of the guidelines, the number of antibiotic prescriptions in Québec per 1000 residents was reduced with an associated decrease in prescription costs. Combining the dissemination of user-friendly guidelines with an active promotion and educational campaign demonstrated sustained reductions in antibiotic prescribing out to 36 months.

One of the advantages to the implementation of treatment guidelines is the opportunity to provide a community-wide best practice document designed by disease state experts. The goal is to drive optimal antibiotic use by disseminating this information to the frontline provider, such as a primary care provider or community pharmacist. The dissemination of guidelines on a large scale has proved difficult to implement in the outpatient setting.\(^25\) This can be overcome with attentiveness to factors that are deemed critical to success,\(^21,61\) such as interdisciplinary guideline development, engagement of peer champions, incorporating recommendations into CDS, and facilitating implementation through audit and feedback strategies similar to the inpatient setting.\(^2,21\)

Point-of-care testing

Improved use of point-of-care (POC) diagnostics in outpatient practice has been identified as a means to promote AS in this setting.\(^52,63\) POC testing for infectious diseases in community pharmacies and ambulatory care settings represents an ideal opportunity to enhance AS by influencing the decision to use and select an antibiotic. POC tests paired with a physician–pharmacist collaborative practice agreement (CPA) can benefit patients by offering access to care and initiation of therapy in a timely manner while concurrently reducing disease transmission within the population.\(^68\)

There are approximately 60,000 community pharmacies in the United States, and 95% of all Americans live within 5 miles of a pharmacy.\(^57,58\) In addition, pharmacies are open nights and weekends, when many other care settings are closed. Thus, community pharmacists are a highly accessible health professional in most communities. A recent analysis revealed that 10,838 community pharmacies possessed a Clinical Laboratories Improvement Act (CLIA) certificate of waiver enabling them to perform POC tests.\(^69\) Although this varies by state, community pharmacies are an opportunity to expand access to POC testing for infectious diseases.

If allowed by state regulations, implementation of pharmacy-based, collaborative disease management programs that incorporate CLIA-waived POC testing should be explored.\(^62,70\) These programs can target various diseases such as influenza, group A streptococcus (GAS) pharyngitis, human immunodeficiency virus,\(^86\) and hepatitis C virus. Programs could focus on either identifying infected patients and linking them to care or providing care under CPAs or via telemedicine. Either way, the focus should be to identify patients with a disease of interest, provide timely treatment with recommended antimicrobial agents, provide supportive care when antibiotics are not indicated, and share information among practitioners. Successful collaborative disease state management models for influenza and acute pharyngitis have been described.\(^63-65,71\) Pharmacists, physicians, and public health officials should seek opportunities to replicate and expand CPAs for AS where permissible. Although CLIA-waived POC tests are simple to perform, their integration into successful disease management programs is not always straightforward. Therefore, we recommend that individuals seeking to develop and implement collaborative disease management programs that incorporate CLIA-waived POC tests receive appropriate training through a certificate program (e.g., National Association of Chain Drug Stores; http://nacds.learnercommunity.com).

Although numerous CLIA-waived POC tests for infectious agents have been approved for use in the United States, relatively few examples have described how their use can enhance...
AS activities. Some of these experiences are summarized as follows.

Influenza management model

Seasonal influenza is responsible for the hospitalization of more than 200,000 people in the United States annually with an associated mortality of 3000–49,000.2,73 Although the influenza vaccine can reduce the probability of acquiring influenza, prompt treatment with antivirals can help to lessen symptoms and prevent serious complications. To be optimally effective, antiviral treatment should be initiated within 2 days of the onset of symptoms.74 Community pharmacists represent an early opportunity to intervene in the course of disease. POCT testing for influenza in a community pharmacy could provide early diagnosis to facilitate the prescribing of antivirals, potentially eliminating the need for empiric antibacterial prescriptions when positive.

Klepser et al.65 described their experience implementing a collaborative disease management model for patients with influenza-like illness. This model was studied in 55 community pharmacies in 3 states. According to the algorithm, patients with influenza-like illness were screened to determine whether the use of a CLIA-waived rapid influenza diagnostic test was appropriate. Eleven percent of patients had a positive influenza test result and offered a prescription for oseltamivir under a CPA. No individuals received an antibiotic. These findings indicated improved rates of antiviral use when indicated and a significant reduction in unnecessary antibiotic use compared with published data.25,26

Pharyngitis management model

Acute pharyngitis accounts for more than 18 million office visits annually throughout the world and more than 7 million visits to pediatricians each year in the United States.77 GAS is the most common bacterial cause of pharyngitis, accounting for 5%–18% and 20%–37% of cases of pharyngitis among adults and children, respectively.78-83 Most cases of pharyngitis are of viral origin.39 Therefore, it is disturbing that despite the relatively low frequency with which GAS is identified as the causative pathogen in cases of adult pharyngitis, data continue to show that antibiotics are prescribed for 60%–72% of cases of viral origin.39,78,85 Among adults, neither U.S. or European guidelines support the use of a rapid antigen detection test (RADT) to direct treatment decisions.39 Similar reductions in antibiotic prescription rates were also identified with the use of GAS RADT in pediatric patients being seen in the emergency department.86 The use of GAS RADT and modification of prescriber behavior in response to results to reduce unnecessary prescribing of antibiotics for pharyngitis not caused by GAS can be a possible strategy as part of outpatient AS.8,39,78

Recommendations

The National Action Plan for Combating Antibiotic-Resistant Bacteria includes actions that will advance AS and intensify educational programs directed at optimal antibiotic use practices in all health care settings, including outpatient settings. U.S. governmental agencies (e.g., CDC, Agency for Healthcare Research and Quality, Centers for Medicare and Medicaid) have recently provided guidance on core elements for outpatient AS,1 and implemented reporting of antibiotic prescribing rates at the population level,59 and they will continue to expand quality measures for optimal antibiotic use. We have provided recommendations for implementing and assessing outcomes for outpatient ASP in Table 5.

The National Action Plan set a goal of reducing inappropriate antibiotic prescribing by 50% in the outpatient setting by the year 2020.5 Although accomplishing a 50% reduction in antibiotic prescribing seems daunting, data on outpatient AS initiatives and community pharmacy-based disease management programs have shown that this goal is safely achievable. We support the goal of minimally reducing antibiotic prescribing by 50% by 2020. This said, it may be reasonable to establish disease state-specific targets for reducing antibiotic use (Table 4). We endorse the use of the CDC Core Elements for Outpatient Antibiotic Stewardship (commitment, action for policy and practice, tracking and reporting, and education and expertise) as a framework for clinicians and facilities to begin work toward this goal.11

Presently, data regarding comprehensive ASPs are lacking in the outpatient setting. If widespread engagements in AS efforts in the outpatient sector are accomplished and antibiotic use patterns optimized, it will result in improved public health and patient safety. Detection of antibiotic prescribing rates is a sensitive and reasonable parameter to use to measure the results of AS efforts. Systematic reviews evaluating the impact of outpatient AS interventions on prescribing have consistently shown improvement in antibiotic prescribing practices,10,86-92 with one review demonstrating a 9.7% reduction in the
Antibiotic stewardship in the outpatient setting

Table 5
Recommendations for implementing and measuring the impact of outpatient antibiotic stewardship programs

<table>
<thead>
<tr>
<th>Implementation</th>
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<tbody>
<tr>
<td>• Use Centers for Disease Control and Prevention Core Elements as a road map.</td>
</tr>
<tr>
<td>• Develop a comprehensive community strategy to realize maximal benefits.</td>
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<tr>
<td>• Use a multifaceted approach targeting all 4 phases of the patient-infection continuum.</td>
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<table>
<thead>
<tr>
<th>Outcomes</th>
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<tr>
<td>• Use an assessment of quantity and appropriateness of antibiotic prescribing as the primary outcome.</td>
</tr>
<tr>
<td>• Short-term—Global and disease-specific targets of antibiotic prescription reductions to measure effectiveness of interventions.</td>
</tr>
<tr>
<td>• Long-term—Improvement in inpatient antibiotic use for community-acquired infections, declining incidence of outpatient and inpatient drug-resistant pathogens, and decreased antibiotic-associated complications (e.g., adverse drug reactions, community-associated C. difficile).</td>
</tr>
</tbody>
</table>

Proportion of patients receiving antibiotics at 6 months.90 Pharmacy-based management models of acute pharyngitis have demonstrated more than a 50% reduction in inappropriate antibiotic prescriptions.65 Owing to the intertwined relationship between outpatient and inpatient antibiotic use, susceptibility profiles, and adverse events, it is likely that all these parameters will be influenced by reducing outpatient antibiotic use. However, the impact that outpatient AS has on these patient and microbial outcomes is not well characterized. A reduction in the rate of outpatient antibiotic prescribing by 10% may reduce community-associated C. difficile infections (CA-CDI) by 17%.93 Experience with a multifaceted intervention that combined the use of guidelines, education, and feedback to reduce prescribing rates for specific antibiotics associated with a high CA-CDI risk demonstrated a 55.5% reduction in prescribing of these agents 24 months following intervention.94

A need for AS in the outpatient setting has been recognized for decades, but its implementation has proved difficult. Unlike the inpatient setting, financial incentives for the development of AS are not realized and the infrastructure to develop an AS team is often lacking in this diverse setting. The overall success of outpatient AS will largely depend on partnerships with inpatient AS teams, local or state health departments, and other external stakeholders with common objectives. This support will help to leverage AS policies, provide education or training across the state or region, and support the AS collaborative to target specific antibiotic overuse and misuse issues. Unique strategies to overcome some of the challenges in the outpatient setting require further research; some examples include the use of electronic consultation or telemedicine to extend expertise in managing infectious diseases95 and a coordinated approach to AS in the outpatient setting.96

Conclusion
Antibiotic resistance is a complex public health crisis. No single intervention will prevent the spread of antibiotic resistance or improve the use and safety of today’s antibiotics. Progress requires a comprehensive plan tailored to the needs in the community, individual practices, or health system with a commitment from prescribers to use antibiotics judiciously in clinical practice. With the federal mandate to decrease antibiotic resistance, many of the historical barriers to implementation of AS across the continuum of care will disentangle through strategies outlined in the National Action Plan. In the meantime, AS activities in the outpatient setting should continue to progress, with an emphasis on expansion of strategies that have demonstrated effectiveness, piloting of innovative models that can be researched and implemented on a broader scale, and the development of coordinated efforts among teams of health professionals and stakeholders to establish widespread AS practices.

References
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