

# Outpatient Antibiotic Use and the Need for Increased Antibiotic Stewardship Efforts

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Antibiotic-resistant infections pose a growing threat to public health. Antibiotic use, regardless of whether it is warranted, is a primary factor in the development of resistance. In the United States, the majority of antibiotic health care expenditures are due to prescribing in outpatient settings. Much of this prescribing is inappropriate, with research showing that at least 30% of antibiotic use in outpatient settings is unnecessary. In this State of the Art Review article, we provide an overview of the latest research on outpatient antibiotic prescribing practices in the United States. Although many of the researchers in these studies describe antibiotic prescribing across all patient age groups, we highlight prescribing in pediatric populations when data are available. We then describe the various factors that can influence a physician's prescribing decisions and drive inappropriate antibiotic use and the potential role of behavioral science in enhancing stewardship interventions to address these drivers. Finally, we highlight the role that a wide range of health care stakeholders can play in aiding the expansion of outpatient stewardship efforts that are needed to fully address the threat of antibiotic resistance.

Antibiotic-resistant infections pose a real and growing threat to public health, with ~23 000 patients dying as a direct result of these infections each year in the United States alone.<sup>1</sup> Although much of the characterization of antibiotic resistance has revolved around adult patients, more recent studies have revealed that resistance rates for key pathogens have been rising in the pediatric population over the past decade.<sup>2,3</sup>

Meanwhile, the development of new antibiotics has not kept pace with rising resistance. There are currently 48 antibiotics in clinical development, including 2 that were recently approved by the US Food and Drug Administration.<sup>4</sup> However, the historical success rate of clinical drug development is low, with 1 study revealing that only 1 in 5 infectious

disease products that enter phase 1 clinical trials will be approved.<sup>5</sup> Additionally, there remain areas of unmet medical need. For example, less than half of the antibiotics currently in development have the potential to treat infections caused by Gram-negative ESKAPE pathogens (eg, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter* species).<sup>4</sup> Children are especially vulnerable to multidrug-resistant infections because of the lack of pediatric pharmacokinetic and safety data for new antibiotics, which contributes to fewer broad-spectrum antibiotics being approved for pediatric use.<sup>6,7</sup>

All antibiotic use, regardless of whether it is warranted, contributes to the development of antibiotic resistance. Antibiotic stewardship

## abstract

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efforts are aimed at minimizing this risk by ensuring that these drugs are prescribed appropriately and only used when necessary. This means limiting antibiotic use to treating known or suspected bacterial infections and making sure that patients receive the right antibiotic at the most appropriate dose and duration of therapy. In recent years, there has been some indication of decreases in antibiotic prescribing among the pediatric population.<sup>8</sup> However, children continue to account for a large proportion of antibiotic prescribing in the United States. In outpatient settings, patients age  $\leq 19$  years accounted for  $\sim 34.8$  million antibiotic prescriptions from 2010 to 2011.<sup>9</sup> Increased antibiotic stewardship efforts are still needed for this population.

Much of the initial research on the impact of antibiotic stewardship in the United States has been centered on hospital settings. Researchers have shown that inpatient stewardship programs have resulted in a more judicious use of antibiotics, lower rates of antibiotic resistance, fewer adverse events associated with antibiotic therapies, and increased cost savings.<sup>10–14</sup>

More recently, increasing attention has been paid to the need to improve antibiotic prescribing practices in outpatient health care settings. One study revealed that these settings accounted for  $\sim 55\%$  of all the money spent on antibiotics for health care in the United States in 2015.<sup>15</sup> However, many conditions treated in these settings do not require antibiotic use. Expanding antibiotic stewardship efforts into these settings is critical to stemming the threat of antibiotic resistance.

The expansion of outpatient stewardship efforts could also positively impact patient safety. For example, antibiotics are the most common cause of adverse drug event–related emergency department (ED) visits in children.<sup>1</sup> Reducing

unnecessary antibiotic prescribing would decrease patients' exposure to this risk. Additionally, improving outpatient antibiotic use could have an impact on the occurrence of community-associated *Clostridium difficile* infections (CA-CDI). Recent studies have revealed that the majority of patients with CA-CDI were exposed to antibiotics in the weeks leading up to the infection.<sup>16,17</sup> Researchers evaluating CA-CDIs in adult patients predicted that a 10% reduction in antibiotic prescribing could result in a 17% decrease in CA-CDI incidence.<sup>18</sup>

In this review, we provide an overview of the latest research on outpatient antibiotic prescribing practices in the United States. Although many of the researchers describe antibiotic prescribing across all patient age groups, we highlight prescribing in pediatric populations when data are available. We then describe the various factors that can influence a physician's prescribing decisions and drive inappropriate antibiotic use and the potential role of behavioral science in enhancing stewardship interventions to address these drivers. Finally, we also discuss the need for collective action from a wide range of health care stakeholders to aid the expansion of outpatient stewardship efforts.

## OUTPATIENT ANTIBIOTIC USE

Understanding how antibiotics are prescribed in outpatient settings is a key first step to improving the use of these critical therapies. Recent analyses reveal that there is significant room for improvement in prescribing practices in these health care settings.

### Quantity of Antibiotic Prescribing

Researchers in a number of studies have explored the volume of antibiotic prescribing in outpatient settings in the United States. Although volume analysis alone

cannot indicate how much of outpatient prescribing is unnecessary or inappropriate, it can help highlight areas in which targeted stewardship efforts may prove useful, such as high-prescribing regions or provider types.

Analysis by the Centers for Disease Control and Prevention (CDC) of IMS Health Xponent (a database that captures information on oral outpatient antibiotic prescriptions in nonfederal community and mail-order pharmacies) data revealed that for patients of all ages, health care providers prescribed 269.4 million antibiotics in outpatient settings (the equivalent of 838 antibiotic prescriptions per 1000 persons) in 2015.<sup>19</sup> Findings from the CDC's analysis of 2011–2014 data revealed a nearly consistent, but slow, downward trend in outpatient prescribing rates over time, with 877 prescriptions per 1000 persons in 2011, 867 prescriptions per 1000 persons in 2012, 849 prescriptions per 1000 persons in 2013, and 835 prescriptions per 1000 persons in 2014.<sup>20–23</sup> Similarly, a recent report by the Blue Cross Blue Shield Association revealed a 9% decline in outpatient antibiotic prescriptions filled by commercially insured members, largely driven by decreases in prescribing for infants and children.<sup>8</sup> Despite these recent improvements, US prescribing rates continue to be high compared with those of other countries, such as Sweden, which dispensed 328 antibiotic prescriptions per 1000 persons in 2014.<sup>24</sup>

Analysis of 2010–2011 data from the National Ambulatory Medical Care Survey and the National Hospital Ambulatory Medical Care Survey revealed that for patients of all ages, 12.6% of outpatient visits to physician offices, EDs, and hospital-based specialty clinics resulted in an antibiotic prescription.<sup>25</sup> Many of these prescriptions were written for patients with acute respiratory

conditions, including sinusitis, suppurative and nonsuppurative otitis media (OM), pharyngitis, viral upper respiratory tract infection, bronchitis and bronchiolitis, asthma and allergy, influenza, and viral and nonviral pneumonia. Children <2 years of age had the highest prescribing rate among different patient age groups.

Primary care providers account for the largest proportion of those prescribing antibiotics and are key targets for outpatient antibiotic stewardship efforts. IMS data from 2015 revealed that 41% of all outpatient antibiotic prescriptions were written by family practice doctors, pediatricians, and internal medicine physicians.<sup>19</sup> Nurse practitioners (NPs) and physician assistants (PAs) accounted for 23% of those writing outpatient prescriptions. The prescribing rate of NPs and PAs rose by 64% since 2011.<sup>19,20</sup> Although these data cannot reveal the cause of this increase, NPs and PAs are playing an increasingly important role in providing outpatient health care services and should be involved in outpatient stewardship efforts moving forward.<sup>26</sup> Other specialties that regularly prescribed antibiotics included dentists (9%), providers with surgical specialties (7%), emergency medicine physicians (6%), and dermatologists (3%).<sup>19</sup>

Geographic analysis also reveals a clear need for improved stewardship efforts in Southern states. States in this region have consistently higher outpatient antibiotic prescribing rates than those in other regions.<sup>19–22,27</sup> In 2015, Southern states averaged 920 prescriptions per 1000 persons. This is compared with the Western region, the region with the lowest prescribing rate in the United States, where residents received on average 632 antibiotic prescriptions per 1000 persons.

Finally, an analysis of total outpatient antibiotic prescribing by antibiotic

class reveals a need for stewardship efforts to be targeted at the prescribing of macrolide antibiotics. The 3 most prescribed antibiotic classes in outpatient settings in 2015 were penicillins (61.6 million prescriptions), macrolides (49.4 million prescriptions), and cephalosporins (36.3 million prescriptions).<sup>19</sup> Although there has been a decrease in the number of macrolides prescribed in the United States (from 59.2 million in 2011 to 49.4 million in 2015), this antibiotic class should be a continued priority for stewardship interventions.<sup>20</sup> Macrolides, such as azithromycin, are not a recommended first-line therapy for many common bacterial infections that are treated in outpatient settings, such as OM, sinusitis, and group A streptococcal pharyngitis. Guidelines for these 3 conditions recommend other first-line agents in part because of the higher proportions of resistance to macrolides found in the primary causative pathogens for these infections when compared with other available antibiotics.<sup>28–32</sup> The epidemiology of these infections can evolve, as evidenced by the change in proportions of pathogens causing acute OM since the introduction of the pneumococcal conjugate vaccines.<sup>33</sup> It will be important to monitor such changes to ensure that appropriate antibiotics are selected for treating these infections.

### **Appropriateness of Antibiotic Prescribing**

Recently, researchers have also delved into how much of outpatient prescribing is inappropriate. In 2016, The Pew Charitable Trusts and the CDC convened a panel of medical and public health experts to assess 2010–2011 antibiotic prescribing data from the National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey and identify inappropriate prescribing practices.

Initial analysis from this work was focused on identifying the amount of unnecessary antibiotic prescribing by outpatient providers. Taking into account prescribing guidelines and variation in prescribing by geographic region, researchers found that for patients of all ages, at least 30% of outpatient antibiotic prescriptions are unnecessary, with the majority of unnecessary prescriptions being written to treat patients with acute respiratory conditions.<sup>25</sup> Among age groups, estimates for the proportion of unnecessary prescribing ranged from a low of 18% in patients aged  $\geq 65$  years to 29% in patients 0 to 19 years old, with a high of 35% in patients ages 20 to 64 years.

A second objective in this analysis was to identify the amount of inappropriate antibiotic selection for 3 common conditions in outpatient settings in the United States: suppurative OM, sinusitis, and pharyngitis. We found that only 52% of patients (including both pediatric and adult patients) with these 3 infections who were treated with antibiotics received recommended first-line treatments based on practice guidelines.<sup>34</sup> Taking into account patient allergies and treatment failures, both of which might necessitate the use of second-line agents, we estimated that at least 80% of patients should be receiving first-line antibiotics.

We also found that antibiotic selection for treating pediatric patients with these 3 conditions adhered closer to practice guidelines than selection for treating adult patients.<sup>34</sup> For example, whereas 60% of patients age  $\leq 19$  years who were diagnosed with pharyngitis were treated with recommended first-line antibiotics, only 37% of adult patients with the same diagnosis were treated with these therapies.

The national prescribing patterns identified in these analyses are consistent with what has been observed at local levels in other studies, in which significant variation and deviation from guideline recommendations were identified for pediatric antibiotic use in upper respiratory infections, community-acquired pneumonia, and skin and soft tissue infections.<sup>35–38</sup>

### **WHAT IS DRIVING INAPPROPRIATE ANTIBIOTIC PRESCRIBING?**

There is a clear need to improve antibiotic prescribing by physicians practicing in outpatient settings. However, to reduce inappropriate prescribing, it is important to better understand the barriers to physicians adhering closer to practice guidelines. Since the 1990s, there has been a significant amount of research related to drivers of antibiotic prescribing in outpatient settings. These studies have revealed that the decision to prescribe antibiotics is a complex process in which physicians are influenced not only by medical information but also by nonclinical factors. Outlined below are key factors that have been shown to influence doctors' antibiotic prescribing decisions.

#### **Patient Satisfaction and Pressure**

Studies have consistently revealed that doctors consider patient demand to be a driving factor in antibiotic prescribing decisions.<sup>39–46</sup> The general consensus from these studies is that physicians feel that patients and their families expect tangible actions to address their illnesses or concerns. One interview-based study among pediatric primary care providers revealed that the majority of respondents (22 of 24) argued that there was a “culture of expectation” among parents for antibiotics.<sup>39</sup> Twenty of these respondents admitted to giving in to this pressure from parents even when antibiotics are not clinically indicated. Another

study of pediatric practices revealed that physicians were significantly more likely to prescribe antibiotics when they believed a parent expected a prescription, regardless of the diagnosis or the parents' actual expectations.<sup>47</sup>

This perception of pressure from patients and parents is exacerbated by other factors, such as economic concerns or patient satisfaction scores. Interviews with physicians reveal that some do not see the point of denying patients an antibiotic prescription when they can simply visit another doctor.<sup>39,40,43</sup> Physicians in private practice may be particularly sensitive to losing patients to competitors if patients are dissatisfied with not receiving a prescription.<sup>44</sup> The use of patient satisfaction scores as a way to measure physician performance also contributes to concern about failing to meet patient expectations for an antibiotic prescription.<sup>44</sup> However, providing an antibiotic prescription to a patient who expects one may not be essential to ensuring patient satisfaction with an office visit. A small study of 2 pediatric practices in the United States revealed that meeting parent expectations for communication at a visit was the only important predictor of patient satisfaction.<sup>47</sup> A parent not receiving an expected prescription did not decrease the parent's satisfaction with the office visit.

Finally, it is important to note that although patient demand continues to be cited as a primary factor in antibiotic prescribing decisions, more recent interviews with physicians have shown that some doctors are perceiving a decrease in this demand.<sup>39,42,48</sup> Clinicians attribute this in part to increased media attention around the issue of antibiotic resistance.

#### **Time Constraints**

Another key factor in driving antibiotic prescribing decisions is the time

constraints that are inherent in outpatient practice. In outpatient offices, doctors have limited time in which to diagnose a patient and determine the most appropriate treatment plan. Studies have revealed that physicians see the combined pressures of workload and time constraints as factors that contribute to overprescribing.<sup>39,40,43,45,48</sup> One study of Norwegian general practitioners revealed that physicians with higher annual consultation rates (a proxy for physician workload) also had significantly higher rates of antibiotic prescribing.<sup>49</sup> Concerns about time limitations are potentially compounded by perceived patient pressure. Physicians report that it often takes less time to prescribe an antibiotic than to provide a lengthy explanation to a patient as to why an antibiotic is not needed.<sup>42,43</sup>

Decision fatigue resulting from physician workload may also contribute to inappropriate antibiotic prescribing. A 2014 study of primary care practices revealed that as physicians' workdays wore on, they were significantly more likely to prescribe antibiotics for acute respiratory infections.<sup>50</sup> The authors posited that decision fatigue, or a decline in decision-making abilities after having to make repeated decisions, could be an explanation for this increase.

#### **Diagnostic Uncertainty**

Physicians often identify diagnostic uncertainty as another driver of inappropriate antibiotic prescribing practices.<sup>42,48,51,52</sup> Bacterial and viral infections often present with similar symptoms in patients. Interviews with physicians have revealed that this uncertainty can lead to antibiotic prescribing as the perceived safe choice.<sup>42,45,48,53</sup> A recent study revealed that clinicians who perceived minimal risk associated with antibiotic use were significantly more likely to prescribe antibiotics

**TABLE 1** The CDC's Core Elements of Outpatient Antibiotic Stewardship

Core Elements of Outpatient Antibiotic Stewardship	Example Activities <sup>a</sup>
Commitment	Write and display public commitments for antibiotic stewardship Include antibiotic stewardship–related duties in job descriptions
Action for policy and practice	Provide communication skills training for clinicians Require a written justification for nonrecommended antibiotic prescribing
Tracking and reporting	Self-evaluate antibiotic prescribing practices Implement at least 1 antibiotic prescribing tracking and reporting system
Education and expertise	Provide patient education materials Providing continuing education activities for clinicians

Adapted from Centers for Disease Control and Prevention. The core elements of outpatient antibiotic stewardship. Available at: [https://www.cdc.gov/antibiotic-use/community/pdfs/16\\_268900-A\\_CoreElementsOutpatient\\_508.pdf](https://www.cdc.gov/antibiotic-use/community/pdfs/16_268900-A_CoreElementsOutpatient_508.pdf). Published 2016. Accessed November 30, 2017.

<sup>a</sup> This table provides only a few examples of the wide range of activities that can be implemented by physicians and outpatient health care facilities to address each of the 4 core elements of outpatient antibiotic stewardship. A more complete list of potential activities, along with a checklist for physicians and outpatient facilities, can be found in the full CDC report.

for conditions for which antibiotic use is not indicated than clinicians who viewed antibiotics as potentially harmful.<sup>54</sup>

Diagnostic tests, particularly those that assist physicians in differentiating between bacterial and viral infections, can play a role in minimizing this uncertainty. For example, 1 study revealed that physicians who used C-reactive protein testing prescribed significantly fewer antibiotics for lower respiratory tract infections than physicians who did not use the test.<sup>55</sup> However, a follow-up study revealed that this effect was not sustained over a 3.5-year period.<sup>56</sup> Although diagnostics have a clear role in aiding physicians' prescribing decisions, it will be important to incorporate these tools into broader stewardship strategies to address the full range of factors that impact physicians' decision-making.

### Externalized Responsibility

Finally, some studies have revealed that although physicians acknowledge that inappropriate antibiotic prescribing is a problem, many perceive the problem as being one driven by physicians other than themselves, particularly physicians from other specialties.<sup>39,42</sup>

### DEVELOPING STEWARDSHIP INTERVENTIONS TO ADDRESS DRIVERS OF ANTIBIOTIC USE

Recognizing the clear need to enhance stewardship efforts in outpatient facilities, the CDC released a report in 2016 outlining the core elements of outpatient antibiotic stewardship.<sup>57</sup> These elements include demonstrated commitment to antibiotic stewardship principles, the implementation of at least 1 policy or practice aimed at improving antibiotic prescribing, tracking and reporting antibiotic use, and the provision of educational resources to clinicians and patients. In Table 1, we highlight a few types of activities that can be implemented to address each of these elements. Through the implementation of these core elements, physicians and other health care stakeholders can help address nonclinical drivers of inappropriate antibiotic prescribing.

For example, commitment to antibiotic stewardship can be demonstrated through the use of public commitment letters. One study revealed that physicians displaying poster-sized commitment letters in examination rooms prescribed significantly fewer inappropriate antibiotics than their peers, representing an ~20% absolute reduction in inappropriate

prescribing. The authors posited that this was due to physicians' desire to adhere to their public commitments.<sup>58</sup>

Additionally, there are a number of options for potential policies or practices that could be implemented in outpatient facilities to address drivers of antibiotic prescribing. For example, communications training around talking to patients about when an antibiotic is and is not needed can help minimize the impact of perceived patient pressure. Studies have revealed that certain communication practices or training can decrease unnecessary antibiotic prescribing and, in some instances, improve patient satisfaction with the office visit.<sup>56,59–63</sup> Another potential practice that could ensure that physicians are aware of their own prescribing practices is requiring that physicians provide a justification for why an antibiotic is needed. One study revealed that requiring a justification and including a physician's written justification note in a patient's medical record significantly reduced inappropriate prescribing.<sup>64</sup>

Physicians can also set their own practice policies using evidence-based diagnostic criteria and treatment recommendations that adhere to national guidelines. This can apply not only to adhering to guidelines on when to prescribe an antibiotic but also on how to best use diagnostic tests. For example, the current guideline for group A streptococcal pharyngitis does not recommend testing for group A *Streptococcus* in patients with symptoms that strongly suggest a viral infection and in children <3 years old.<sup>32</sup> Overuse of this test could lead to unnecessary prescribing for patients who are group A *Streptococcus* carriers without an active infection.<sup>65,66</sup> Another example is ensuring appropriate responses to urine culture results in patients with

suspected urinary tract infections (UTIs). A study of patients diagnosed with UTI and treated with antibiotics in a single ED revealed that only 51% of those patients met the criteria for a confirmed UTI.<sup>67</sup> Another study revealed that an intervention aimed at ensuring adequate follow-up for patients with negative urine culture results lead to the avoidance of ~3500 unnecessary antibiotic days over a period of 30 months.<sup>68</sup>

Finally, tracking and reporting antibiotic use can also ensure that physicians are aware of their own inappropriate prescribing practices. One study revealed that an audit and feedback intervention in which primary care physicians were provided with their own prescribing data significantly improved prescribing habits for common acute respiratory tract infections.<sup>69</sup> However, a follow-up study revealed that the impact of this intervention was limited, with prescribing returning to above-baseline levels after the termination of the audit and feedback intervention.<sup>70</sup> Another study was built on the traditional audit and feedback intervention by classifying participating physicians according to whether they were “top performers.”<sup>64</sup> This intervention also resulted in significantly reduced inappropriate prescribing.

Although research on effective outpatient antibiotic stewardship interventions has been expanded in recent years, additional studies are needed to determine how to effectively scale up antibiotic stewardship interventions. To date, many studies have been conducted in outpatient practices associated with large medical centers and have been supported with resources that might not be available at an average outpatient office. Some interventions, such as the commitment poster highlighted above, require minimal resources. However, others, such as the provision of regular audit and

feedback reports, might be difficult to implement at a smaller practice. Research into antibiotic stewardship in outpatient settings with varying levels of resources is needed to enhance current stewardship efforts. Additionally, research into what resources are currently available at outpatient clinics and potential policies or incentives to support antibiotic stewardship implementation are needed to expand stewardship practices nationwide.

### **FUTURE DIRECTIONS**

In addition to continued research into effective antibiotic stewardship strategies, action and policies from various health care stakeholders will be needed to ensure widespread implementation in outpatient settings.

As the frontline for patient care in the United States, clinicians can be leaders in implementing outpatient stewardship efforts. Unnecessary antibiotic prescribing remains high, particularly for patients with acute respiratory conditions. Pediatricians can evaluate their own prescribing habits, identify areas in their own practices that are in need of improvement, and implement targeted stewardship interventions. Not all stewardship activities require large amounts of time and resources. Physicians can begin with simple yet effective interventions, such as posting a commitment poster in their waiting rooms.

Other stakeholders will also need to engage in stewardship efforts. For example, health systems can provide outpatient facilities in their systems with access to additional expertise, such as infectious disease specialists, which can aid in stewardship implementation. These organizations can also leverage shared electronic health records to build the data systems needed to implement an audit and feedback intervention.

Additionally, health systems can help minimize time constraints faced by physicians by implementing systems to reduce office visits by patients who have mild viral infections. For example, Kaiser Permanente Northern California provides an Appointment and Advice Call Center service for its patients. A study published in 2015 revealed that providing self-care advice to patients with upper respiratory infection symptoms calling into the Appointment and Advice Call Center was appropriate for the vast majority of patients.<sup>71</sup> By triaging these visits that often result in unnecessary antibiotic use, health systems can minimize the burden on physicians and ensure that patients still receive advice on how best to manage their symptoms.

Public and private health insurers are another type of health care stakeholder with an important role in supporting outpatient stewardship efforts. For example, health plans can leverage prescribing data for their health care providers to help provide a clearer picture of how antibiotics are being prescribed. For example, the Blue Cross Blue Shield Association recently released a report using medical and pharmacy claims from its members to assess antibiotic use nationally.<sup>8</sup> Health plans can also use these data to identify high prescribers within their networks and use this information to conduct targeted outreach to reduce inappropriate prescribing.

Public health agencies at the local, state, and national levels all play a critical role in supporting outpatient stewardship implementation. These organizations can provide outpatient clinics with information and resources for effectively implementing antibiotic stewardship interventions. For example, a few state health departments have developed modified versions of the antibiotic commitment poster to be used by practitioners in their

states.<sup>72,73</sup> Additionally, local and state health departments can form collaborative networks among inpatient and outpatient facilities in their regions to leverage shared resources and learning to aid implementation. These public health agencies also have a key role in providing the data needed to track antibiotic prescribing habits and identify potential areas in need of continued improvement. For example, the Oregon Health Authority used data from within the state to identify prescribing trends since 2008.<sup>74</sup> Through this analysis, it identified bronchitis, sinusitis, and OM as key conditions still in need of improvement in Oregon.

Finally, policy initiatives used to promote stewardship have largely been focused on inpatient settings. For example, The Joint Commission's new medication management standard requires antibiotic stewardship programs in acute care hospitals.<sup>75</sup> Additionally, the Centers for Medicare and Medicaid Services currently require antibiotic stewardship programs in long-term care facilities as a condition of participation in Medicare and Medicaid.<sup>76</sup> Furthermore, state governments in California and Missouri enacted legislation requiring stewardship programs in hospitals.<sup>77,78</sup> It is possible that future initiatives may be developed to promote stewardship in outpatient practices. If so, it will be important that any outpatient-focused policy be designed with an understanding of the drivers of inappropriate antibiotic prescribing and use evidence-based strategies to address these barriers.

## CONCLUSIONS

Analysis of antibiotic prescribing trends reveals a continued need to improve prescribing practices in outpatient settings in the United States. Research into effective

stewardship interventions in these settings has been expanded over the past decade. Although additional research is needed to optimize stewardship interventions and identify appropriate incentives to spur stewardship implementation, health care stakeholders can act now to aid individual physicians with antibiotic stewardship activities in their clinics. Through this collective action, stakeholders can leverage shared resources to reduce inappropriate prescribing and minimize the threat of antibiotic resistance.

### ABBREVIATIONS

CA-CDI: community-associated *Clostridium difficile* infection  
 CDC: Centers for Disease Control and Prevention  
 ED: emergency department  
 NP: nurse practitioner  
 OM: otitis media  
 PA: physician assistant  
 UTI: urinary tract infection

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