Hospital Pharmacy
2019, Vol. 54(4) 250–258

DOI: 10.1177/0018578718781916
journals.sagepub.com/home/hpx
SAGE

Facilitators and Barriers to Antibiotic Stewardship: A Qualitative Study of Pharmacists' Perspectives

Haley J. Appaneal[1,2], Megan K. Luther[1,2], Tristan T. Timbrook[1,2], Kerry L. LaPlante[1,2,3], and David M. Dosa[1,4]

Abstract

Background: The Veterans Affairs (VA) is a leader in the implementation and advancement of antibiotic stewardship programs throughout the nation. The Centers for Disease Control and Prevention (CDC) has also led national antibiotic stewardship efforts and has outlined core elements to improve antibiotic use in hospitals, long-term care, and outpatient settings. Many facilities still face challenges to the implementation and maintenance of successful programs, particularly in nonacute care settings. The objective of this study was to identify barriers and facilitators to antibiotic stewardship within the VA medical centers through qualitative interviews with pharmacists. **Methods:** Eight semi-structured telephone interviews were conducted with pharmacists from 6 VA medical centers within VA New England Healthcare System. Pharmacist respondents were either pharmacy champions (for medical centers with established programs) or pharmacists with responsibilities in making antibiotic recommendations (locations without established programs). All interviews were audio recorded and transcribed verbatim. NVivo 8 was used for data coding and analysis. **Results:** Pharmacists from all 8 medical centers were contacted for interviews and pharmacists from 6 medical centers agreed to interviews (75% VA New England medical center participation). Three main themes regarding antibiotic stewardship were identified from the interviews with pharmacists. Respondents described the importance of (1) a supportive organizational culture, (2) protected time for antibiotic stewardship, and (3) a cohesive organizational structure in the success of antibiotic stewardship programs. **Conclusions:** Our findings support the CDC core elements for antibiotic stewardship, in particular the importance of leadership commitment in the creation of a culture that supports antibiotic stewardship and in ensuring staff are given sufficient time for antibiotic stewardship efforts. Although a strong supportive culture has been built, strategies focused on fostering increased protected time for antibiotic stewardship and a cohesive organizational structure may be helpful in advancing and sustaining successful antibiotic stewardship programs that improve patient outcomes.

Keywords

antibiotic stewardship, antibiotic use, qualitative interviews, pharmacists

Introduction

Antibiotic resistance is a major public health threat.[1-3] Infections due to antibiotic-resistant bacteria and *Clostridium difficile* (*C difficile*) are associated with increased morbidity, mortality, longer hospital stays, and excess health care costs.[4-6] In 2013, the Centers for Disease Control and Prevention (CDC) estimated that at minimum, antibiotic-resistant organisms caused 2 million infections and 23 000 deaths in the United States and that *C difficile* caused at least 250 000 illnesses and 14 000 deaths.[2] In the United States, resistant infections are responsible for $28 to $33 billion in excess health care costs each year.[7]

Antibiotic use is the driving force that selects for antibiotic-resistant bacteria and promotes *C difficile* infection. It is estimated that approximately 50% of antibiotic use in hospitals is inappropriate.[8] Antibiotic stewardship interventions, defined as coordinated strategies that are designed to improve the appropriate use of antibiotics by promoting the optimal drug, dose, duration, and route of administration,

[1]Veterans Affairs Medical Center, Providence, RI, USA
[2]University of Rhode Island, Kingston, RI, USA
[3]Warren Alpert Medical School of Brown University, Providence, RI, USA
[4]Brown University School of Public Health, Providence, RI, USA

Corresponding Author:
Haley J. Appaneal, Research Health Science Specialist, Providence Veterans Affairs Medical Center, 830 Chalkstone Ave, Providence, RI 02908, USA.
Email: haley.appaneal@va.gov

are important to improve antibiotic use in hospitals and to slow the development of resistance.[8] Multidisciplinary antibiotic stewardship programs are pivotal components in ensuring patient safety and providing quality health care. The Veterans Affairs (VA) is a leader in the implementation and advancement of antibiotic stewardship programs throughout the nation. In 2011, the VA developed the National VA Antibiotic Stewardship Task Force to coordinate and guide efforts to improve antibiotic use and patient safety throughout the many VA facilities nationally.[9] Subsequently, in January 2014, the VA approved an Antibiotic Stewardship Directive, which required each VA facility to develop an antibiotic stewardship program and identify a clinical provider and pharmacy champion.[10]

Despite the progressiveness and great strides the VA has made, some medical centers still face barriers, such as limited financial and staff resources, to the implementation and maintenance of successful comprehensive antibiotic stewardship programs, particularly in nonacute care settings.[11,20] The CDC has outlined core elements to improve antibiotic use in hospitals and nursing homes; however, these are largely based off data from non-VA settings.[12,13] It is not well understood which factors assist or hinder the implementation and maintenance of these programs within the VA. The objective of this project was to identify barriers and facilitators to antibiotic stewardship within the medical centers of the VA New England Healthcare System (Veterans Integrated Service Network [VISN] 1) through qualitative interviews with pharmacists identified as champions or pharmacists with responsibilities in making antibiotic recommendations within their medical center.

Methods

Approach and Theoretical Framework

Semi-structured telephone interviews were conducted to obtain the in-depth views of pharmacists regarding the culture of antibiotic use at their medical centers and on barriers and facilitators to antibiotic stewardship. Culture of antibiotic use was defined as the values, attitudes, and practices surrounding antibiotic use shared by the medical center staff. Culture represents the way antibiotics are used and the attitudes of staff about how antibiotics are used. The interview questions and the analysis were guided by the framework used by Ploeg et al[14] to explore and understand individual (eg, a clinician's knowledge and attitudes), organizational (eg, leadership support, teamwork, clinical champions), and environmental (eg, support from national VA) factors influencing inappropriate antibiotic use and antibiotic stewardship.

Settings and Participants

This project was conducted with pharmacists of the VA New England Healthcare System, 1 of 21 VISNs within the US Department of Veterans Affairs. At the time this project was conducted, the VA New England Healthcare System consisted of 8 medical centers located throughout 6 states, which provide inpatient and outpatient care to Veterans. In addition, the VA New England Healthcare System had over 35 Community-Based Outpatient Clinics (CBOCs) and 6 long-term care facilities (known as community living centers or CLCs) associated with the medical centers.

Pharmacists were selected for interviews through the use of purposive sampling.[15] The initial goal was to interview at least 1 pharmacist from each medical center (which provide a variety of acute, long-term, and outpatient care). Potential pharmacist participants for interviews were identified through communication with pharmacy directors at each of the medical centers of interest. Pharmacy directors provided e-mail and/or telephone contacts for potential participants, who were either the identified pharmacy champion for medical centers with an established program or a pharmacist with responsibilities in making antibiotic recommendations. Some directors identified more than 1 pharmacist contact. Introductory e-mails were sent to potential participants' work e-mail addresses. Those wishing to participate were instructed to reply and reminders were sent to those who did not respond to the invitation. For those willing to participate, informed consent documents were obtained and a telephone interview was scheduled.

Instrument Development

Although each antibiotic stewardship program is different, there are several core elements of antibiotic stewardship that have been identified by the Infectious Diseases Society of America (IDSA), CDC, and the VA.[8,10,13,16] An interview guide was developed based on these core antibiotic stewardship elements, including questions on leadership support, structure and team members, policies and actions to support optimal antibiotic use, outcomes measures, reporting, and education. Interview questions were designed to be semi-structured, including both specific questions and open-ended questions. The instrument was pilot tested with nonstudy pharmacists and questions were revised based on feedback.

Data Collection and Analysis

All data were obtained through telephone interviews. One of two interviewers conducted all the telephone interviews (ML, TT). All interviews were audio recorded. Questions for the interview were based on the interview guide, with additional probing questions asked based on participant responses. All interviews were transcribed verbatim by one investigator (HA). To review for quality and accuracy, the original audio recordings were compared with transcripts. All transcripts were read through, and then an initial code manual was developed based on previous literature.[11,14] The

initial code manual included facilitator and barrier codes, and codes to organize data into specific individual, organizational, and environmental factors affecting antibiotic stewardship. Transcripts were imported into NVivo 8 (QSR International, Australia) for data coding and analysis. The initial code manual was applied to the transcripts and revised as needed. Data were analyzed for each code and compared with data from other codes. Themes were then identified from this coding procedure. The same study investigators collected, transcribed, coded, and analyzed all study data (HA, ML, TT).

Results

Interviews were conducted with 8 pharmacists from 6 medical centers within the VA New England Healthcare System. Pharmacists from all 8 medical centers were contacted for interviews. Pharmacists from 6 medical centers agreed to interviews (75% VISN-1 medical center participation). Of the 2 medical centers that did not participate, the pharmacists contacted for interviews did not wish to participate and/or could not be reached for a telephone interview after multiple scheduled interviews. Representative medical centers provided a broad range of inpatient (both acute and long-term care) and outpatient services. Five respondents reported that their facility had both acute care and long-term care (known as CLC) beds, 2 respondents reported having only CLC beds, and 1 reported having only acute care beds. Pharmacist respondents reported various levels of previous training regarding infectious diseases (ID) and/or antibiotic stewardship including residency rotations, specialized residency or fellowships, clinical experience, and certificate training.

Six respondents (75%) reported they had a formal antibiotic stewardship program. Respondents with formal programs reported these programs had been active ranging from 1 to 4 years. Reported leaders of these programs included ID physician and ID pharmacist teams, ID physician alone, and provider, pharmacy chief, and nurse teams. Respondents themselves reported spending from 0.5 hours to 40 hours on antibiotic stewardship duties weekly. Respondents reported conducting a large variety of antibiotic stewardship duties including retrospective antibiotic reviews, intravenous to oral switches, de-escalation, dosing, prospective audit and feedback, formulary restrictions and approvals, policy development, benchmarking, and coordinating committees. Respondents were often unsure of official full-time equivalent (FTE) allocations for antibiotic stewardship team member; however, 2 respondents reported 1 full FTE for a pharmacist and ½ FTE for a physician, and one respondent reported 1 FTE for a pharmacist.

Three main themes were identified from the interviews with pharmacists and are discussed below. Table 1 provides an overview of the main themes and subthemes identified with representative quotes.

Respondents Described the Importance of an Organizational Culture That Was Supportive of Antibiotic Stewardship

Respondents revealed the belief that having leadership and house-staff who were supportive and committed to antibiotic stewardship was important and was a strength of programs. Interviews revealed the importance of leadership in engaging house-staff and fostering broad "buy-in" and commitment to appropriate antibiotic use throughout the organization. One respondent revealed that "broad acceptance" for antibiotic stewardship started with hospital leadership.

> I do think that the leadership has been very supportive of stewardship over the past few years . . . I feel that overall there's been a broad acceptance . . . I think that starts at the top with leadership acceptance.

Four respondents also revealed the belief that the culture of appropriate antibiotic use did vary by provider and service. Services that were noted to be more conscious or accepting of antibiotic stewardship included ID and primary care, while specialties including urology, urgent care, and surgery tended to be less accepting.

> I would say overall [the culture of antibiotic use is] generally positive . . . There are some resistant physicians that . . . may not be as lenient towards changing or maybe holding antibiotics . . . but I would say overall . . . physicians are more than welcoming towards advice that we give them.

Respondents Described Lack of Time for Antibiotic Stewardship at the Organization and Individual Levels as a Weakness

Respondents described a general lack of time for antibiotic stewardship activities as a weakness. The belief that time for antibiotic stewardship was limited and a desire for more dedicated time specifically for antibiotic stewardship duties, obligations, and/or responsibilities was common among all respondents.

> I think the limitation is always time and effort that we can put in because of our other obligations.

> . . . Everyone wants to be involved . . . the weakness is not everyone has the time necessary to be fully involved.

With regard to specific team members and time limitations, respondents consistently identified themselves or other pharmacists and physician core team members as not having enough time for antibiotic stewardship. Respondents revealed that part-time allocation for antibiotic stewardship core team members was common, especially with physicians, and difficulties "carving out time" for stewardship. Not having FTE allocations for core members was

Table 1. Major Themes and Subthemes With Examples and Representative Quotes.

Theme/subtheme	Example facilitators or barriers identified	Representative quotes
1. Importance of a culture supportive of antibiotic stewardship throughout the organization.		
Importance of leadership in fostering broad acceptance or "buy-in" for antibiotic stewardship principles	• Facilitators of "buy-in" described: - Having a member of leadership part of the antibiotic stewardship team or trained in infectious diseases (n = 3) - Importance of antibiotic resistance and antibiotic stewardship nationally (n = 2)	*I can tell you that the support from leadership is definitely a strength because we do have the chief of staff on our [antibiotic stewardship] service . . . [Staff] are very supportive . . . in general when it comes down to antimicrobial use . . . and having a chief of staff who is trained in infectious diseases, being part of your committee, does help out quite a bit.* *I think a lot of people do recognize that antimicrobial stewardship is an important . . . focus of the VA at the moment, as well as nationally.* *. . . I turn on the news any day of the week and . . . hear about new antibiotic resistant bacteria becoming a major health concern. So . . . from all perspectives [of] a healthcare team [appropriate antibiotic use] should be one of . . . the number one priorities.*
Importance of a strong relationship between the house-staff and the antibiotic stewardship team for "buy-in"	• Facilitators to a strong relationship described: - Dedicated team - Consistent members - Established and ongoing relationship - Numerous interactions (n = 4)	*Having . . . worked here for many years . . . with the internal medicine service, having an already . . . ongoing relationship with many of the physicians does help. Now transitioning to this role [as a stewardship pharmacist] . . . to be able to approach them, and kind of explain . . . what we are doing and where things are headed helps a little more with buy-in.* *. . . Having a smaller group . . . instead of having 15 different people, kind of trying to tell [physicians] the same thing or intervene. I think is a good thing and is helpful . . .* *The other thing would probably be just physician buy-in . . . I feel that . . . having more opportunities . . . to be involved and working with the physicians . . . just building those relationships . . . would be very beneficial. As far as stewardship acceptance rate . . . it varies according to just how well the pharmacist is trusted and how valuable the physician team at the facility sees the pharmacist.*
	• Barriers to a strong relationship described: Staff turnover	*. . . I think everybody should be involved. [laughs] All the physicians . . . nurses . . . I think we could always be doing a better job . . . A lot of our house-staff . . . is rotating so by the time they get used to . . . the way we do things here . . . then they change or they leave and go somewhere else.*
2. Lack of time for antibiotic stewardship at the organization and individual levels regarded as a program as a weakness.		
Insufficient time from core team members for clinical antibiotic stewardship duties (n = 8)		*Another [weakness] is just manpower. We don't have the hours to spare right now for me . . . or for [another pharmacist] to sit down and do purely stewardship activities.* *We have a physician . . . [but is] pulled in many different directions [and] . . . doesn't always have the time . . . for this [antibiotic stewardship] program. So I mean . . . that's a weakness in that no one seems to have much time [laughs].*
Insufficient time for other activities related to antibiotic stewardship beyond clinical care	• Barriers described: - Lack of time for IT duties (n = 4) - Lack of time for other duties (ie, administrative and education) (n = 2)	*I think probably the top [wish-list item] would be . . . for sure more IT support. I don't think there is any doubt about that because there's lots of things that I would like to do, lots of ideas, there's just no way that I can make them happen without someone else helping me.* *When it comes down to things to improve, I think we're really working harder on the benchmarking and trying to collect that information, which is very hard . . . we did it the old fashioned way by daily reports . . . which is way too labor intensive and it takes away from the . . . patient care focus of it so . . . that's something that we are definitely working on . . . the benchmarking areas.* *Basically, we don't really have much tracking at all yet . . . I tracked patients . . . and then went in manually to read and see notes to see whether they got antibiotics or not . . . That's kind of a back door way, but we had to do [it that way] with being down an IT person, that's the only way we could really think of doing it.* *. . . And really having enough time to balance not only doing the clinical aspect but . . . doing more of the policy work and other things like that is definitely a downside at the moment . . . Right now it's hard to get as many interventions done as we might like, knowing there has to be time devoted for the kind of the admin parts of the process as well.* *We haven't done very much education. So education to providers hasn't really happened to this point . . . a weakness is just not being able to . . . do any of our education up to this point.*

(continued)

Table 1. (continued)

Theme/subtheme	Example facilitators or barriers identified	Representative quotes
3. Respondents described a lack of connection within an organization as a weakness.		
Support and guidance for antibiotic stewardship split across multiple campuses	• Barriers described: - Lack of consistent on-site access to support at all locations. (n = 3)	*One area . . . that we want to expand on is . . . outpatient antimicrobial use. But . . . [our organization] is very . . . dispersed . . . so the [outpatient facilities] don't always have the support or the know-how or somebody to follow-up on. Our outpatient providers probably would want more help and support and I think we definitely want to move in that route . . .* *I don't know if we need [our] own [antibiotic stewardship program] here, but we definitely . . . could use more support, more overlap [from the acute care location]. I think that would definitely be helpful . . . or if there was some guidance about what we could do on a regular basis locally to make sure [antibiotic use is] appropriate . . . Versus just our own efforts, making it kind of standard across campuses.*
Reliance on "less-optimal" non face-to-face communication methods (n = 3)	• Barriers described: - Difficulties in performing patient evaluations remotely	*Its hard with the CLC because we're up here and they're down there to find out if the patient is really sick. So . . . where here . . . you can go to go see the patient to find out more [of] what's going on by talking to the patient or talking to . . . the people taking care of [the patient] directly. [At the] CLC . . . you're talking to someone on the phone . . . Cuz sometimes the patient will have a . . . say positive culture . . . but the patient is not sick . . . It's hard [to know that] when you talk to someone on the phone versus talking to someone in person.*
	- Push back from house-staff	*I think the stewardship team is a little bit distant from the rest of the medical facility. One, in that they're in a different building than where . . . the patients are actually being treated. And two, just because the medical residents never really see us. And so . . . because of that when we call them . . . I think we get some push back and some hesitancy as far as accepting our recommendations. Just because they're not familiar with us . . . they can't put a name to a face with us . . . And I think that's a weakness.*
	- Difficulties in meeting as a group to discuss antibiotic stewardship goals	*. . . Having periodic meetings as a group . . . a whole group . . . where we are all able to dedicate time and talk about what our goals are as a program . . . and how do we carry out those goals. It makes it hard . . . that I am in [the main acute care location] and some people are in [the CLC location]. One of our providers is now off-site at times at another clinic, so everyone's schedules are just all over the place, and not having that face-to-face, meeting, or connection, it just makes it much more difficult.*
Lack of regular interaction with the antibiotic stewardship team at locations other than the main acute care facility (n = 3)	• Barriers described: - Lack of visits - Lack of regular education/updates	*I'm a consultant when they call me, so I don't physically go [to the CLC location]. I don't [spend any time on antibiotic stewardship at the CLC] . . . unless they call me . . . Other than that, I don't go to the CLC at all.* *. . . There is no formal education for antibiotics . . . that happens down at the [CLC location] campus.* *I don't really feel like we get . . . too many updates on that sort of thing . . . I think it would be helpful to have just . . . some more communication kind of from the specialty services about . . . how we can help guide the physicians here and make sure the patients are . . . treated . . . as best they can be . . .* *I mean from my perspective . . . we don't get a whole lot of information or updates about . . . antibiotic usage . . . I mean maybe we get communication . . . a couple times a year . . . But . . . it's not regular at all.*
	- Lack of communication	*So . . . for us [appropriate antibiotic use around the CLC] doesn't [come up in conversation] . . . It's a little bit tougher with the CLC because our departments are kind of separated and we don't have a pharmacist that goes down there and sits down with them. So any time they need to get in contact with us they call us. And usually it's more of a one-way communication channel, with us calling them . . .*

Note. VA = veterans affairs; IT = information technology; CLC = community living center.

commonly regarded as "unfortunate" or a program weakness. Three respondents revealed a desire for more FTE allocations specific for stewardship.

One respondent consistently revealed the belief that time constraints and staffing issues were major barriers to having "a successful program" and the "impact" of the program was limited by not being able to carry out certain tasks, such as prospective audit of antibiotic use in both the CLC and outpatient settings. Another respondent mentioned not having "enough resources to do as in depth a job as we want to do sometimes" as a major weakness of their antibiotic stewardship program.

Two respondents also revealed that although leadership was supportive of having an antibiotic stewardship program, they desired more active support in terms of the financial resources needed to purchase additional antibiotic stewardship staff time.

> They [leadership] are certainly . . . on board with having a program, but . . . the time allowed to be able to do it, [just] isn't there. And I don't know if that's necessarily . . . something that would fall to leadership, having to make time . . . for myself . . . We're just down . . . bodies . . . everyone's kind of stretched thin right now. And I wouldn't necessarily say that's their fault.

Another respondent spoke about the lack of dedicated financial support:

> I mean they [leadership] support us . . . and they respect us, but there is no money involved . . . There's no extra funding for extra people . . .

Respondents Described the Dispersion of Organizations Across Multiple Campuses or Physical Locations as a Weakness

Respondents described difficulties due to medical centers being distributed across multiple campuses in different locations, different buildings on the same campus, and/or even among different wards in the same building. This dispersion of care resulted in a lack of connection among all facilities in the organization, related to reliance on non face-to-face communication and limited interaction. Respondents revealed that their organizations were "very dispersed" and antibiotic stewardship activities were primarily focused within the main facility locations (usually the acute care facility). However, stewardship activities in other locations or campuses, which tended to offer more outpatient or long-term care services, were often not as developed or were completely absent. One respondent described specific barriers to antibiotic stewardship that occurred due to separation of the CLC campus from the acute care campus:

> We haven't done [antibiotic stewardship] down at the other [CLC] campus yet, because we have issues with the lab and turnaround time for drug levels and plus they're not 24-7 like we are.

Multiple separated campuses also led to antibiotic stewardship team members', namely ID physicians, time being split between campuses, and difficulties in contacting off-site personnel.

> Our ID physician . . . is only here [at this campus] once a week. So if we need to get in contact [with them] we have to page [them], email [them], or send smoke signals to try and find [them] . . . [laughs] . . . hunt [them] down.

Separation of facilities across multiple campuses or buildings on the same campus was a barrier to face-to-face communication and difficulties in having to rely on less optimal communication methods, such as telephone, email, or pagers and also lead to a lack of regular interaction between the antibiotic stewardship team at the main acute care location and other locations, such as the CLC.

In addition to increased interaction and communication within organizations, one respondent desired more shared support among organizations throughout the VISN. This respondent felt it would be helpful to determine what each site within the VISN "had and didn't have" for antibiotic stewardship resources and then share needed resources, such as clinical decision support software or information technology (IT) personnel, among sites at the VISN level.

Discussion

The main themes for this study were focused around facilitators and barriers to antibiotic stewardship as perceived by pharmacists. These findings revealed 3 major individual and organizational factors that respondents felt influenced the success of antibiotic stewardship at their medical centers.

Previous findings have demonstrated that cultural support and resources for antibiotic stewardship are among the most common barriers faced by hospitals.[11,17-19] Our interviews revealed a strong supportive culture of stewardship among medical centers. In addition, they revealed the belief that a culture of broad acceptance for antibiotic stewardship throughout the medical center starts with clear support from leadership and that leadership and house-staff support were generally strengths. Similar results have been reported from VA medical centers nationwide.[20] A 2015 survey of 140 VA medical centers found that 92% of respondents had a written policy for stewardship, a significant improvement from just 17% of 126 respondent facilities in 2011.[20] Not surprisingly, facilities reporting challenges related to provider buy-in also significantly decreased from 59% in 2012 to 35% in 2015.

The VA Central Office has been a leader in garnering local leadership support for antibiotic stewardship in VA medical centers nationally and demonstrated their commitment through the publication of the Antibiotic Stewardship Directive in January 2014.[1,20] Among the requirements of this initiative was that all VA medical centers needed a formal written antibiotic stewardship policy. The CDC core elements for antibiotic stewardship in hospitals and nursing homes also document the importance of leadership commitment.[12,13] These documents note that support from leadership is critical to the success of any antibiotic stewardship, and as such recommend leadership commitment as the first core element of stewardship.[12,13] It is recommended that leaders demonstrate their support in the form of formal written statements and by creating a culture which promotes appropriate antibiotic use through education and celebration

of improvements.[12,13] Despite these recommendations, a 2016 survey of 207 non-VA, not-for-profit academic medical centers, and community hospitals demonstrated that only 55% had a formal written statement of leadership support for antibiotic stewardship.[17]

In addition to leadership committing to creating a culture of antibiotic stewardship, the CDC core elements also recommend that leadership demonstrates their commitment through ensuring staff are given sufficient time to contribute to antibiotic stewardship activites.[13] Our interviews indicated that despite leadership committing to the value and practices of antibiotic stewardship, providing protected time for stewardship is still a challenge. This challenge is not unique to the VA; recent commentary noted that sustained protected time for stewardship is often lacking globally.[21] It has been recommended that 2 FTE ID physicians and 1 FTE ID-trained clinical pharmacist are needed for every 1000 acute care beds for stewardship.[22] A staffing calculator to account for time needed to implement and manage a robust antibiotic stewardship program was recently validated among the VA system and it was recommended that 1 FTE clinical pharmacist was needed per 100 occupied beds.[23] Therefore, it is not surprising that pharmacist respondents indicated that programs still struggle with not having sufficient time and resources for antibiotic stewardship activities, particularity from physician and pharmacist champions. Similar results have been demonstrated in VA facilities nationwide, with almost half of respondent facilities reporting limited ID support (46%) and limited pharmacy support (44%) as challenges to antibiotic stewardship in the 2015 survey.[20] Limited resources was one of the major themes identified in a previous qualitative study of physician and pharmacist antibiotic stewardship team members at 21 unique non-VA hospitals.[11] This qualitative work found that antibiotic stewardship programs were hampered by lack of consistent antibiotic stewardship personnel and not having adequate percent effort for team members dedicated to antibiotic stewardship.[11]

The IDSA 2007 and updated 2016 guidelines for hospital antibiotic stewardship recommend that programs be led by ID physician and a clinical pharmacist with ID training, and the CDC core elements recommend that stewardship duties be specifically listed in job descriptions and annual performance reviews.[8,13,16] This is often not possible, especially in smaller community hospitals and nonacute care settings, given resource restraints such as finances, availability of ID expertise, and interest.[16] Without protected time for antibiotic stewardship, routine duties may take priority over antibiotic stewardship activities and compromise the success of the stewardship program, as was described by our respondents.[24] Time constraints may leave limited time for the diverse clinical and administrative requirements needed for a successful program.[18] Our pharmacist respondents commonly revealed the desire for additional IT support and/or data tools to improve their efficiency with "hard" or "labor-intensive" tasks. In the 2015 national survey, 64% of VA facilities also noted challenges with limited IT/data tools.[20] Increasing access to external software and clinical decision support systems or IT personnel through shared resources among VA medical centers may ease the time burden placed on busy antibiotic stewardship pharmacists and providers.

Our respondents commonly described how their medical centers were dispersed across many physical locations or campuses and that most of the antibiotic stewardship efforts tended to be focused in the main acute care locations. In other locations, lack of communication and interaction with the antibiotic stewardship team were barriers that were described. Lack of ID-trained staff and on-site resources, such as on-site laboratories and many diagnostic tools, are commonly described barriers to antibiotic stewardship in nonacute care locations, namely, outpatient and long-term care settings.[12] It may not be feasible and/or necessary for all facilities within an organization to have their own resources, and a closer connection between all facilities may be all that is needed. This connection could be potentially fostered through increased face-to-face communication and regularly scheduled in-person meetings. Previous qualitative interviews of antibiotic stewardship pharmacist and physician members demonstrated the importance of face-to-face communication and interprofessional networks and collaborations, such as committee work and guideline composition, for antibiotic stewardship program success.[11] A potential strategy may be to include antibiotic stewardship team member representatives from all facilities in all organization-wide in-person committee meetings and discussions. Telehealth may be another helpful option when in-person meeting is not feasible. Intermountain Healthcare, a network of 22 hospitals, uses a telehealth team to provide data, mentorship, and ID consultation remotely to its smaller hospitals.[18] Increased participation and utilization of resources provided nationally by the National VA Antibiotic Stewardship Taskforce may also be helpful. The National VA Antibiotic Stewardship Taskforce provides a number of useful tools for VA antibiotic stewardship programs, such as a shared intranet web site for communication and educational tools, such as guidelines, policies, and interventions.[25]

There are several limitations to the findings of this study. First, case series are limited by definition. However, only themes mentioned by at least 50% of respondents were used. Second, the generalizability of these findings to other VA and non-VA medical centers in other regions may be limited given the regional sampling employed in this study. The small sample size representing just 6 medical centers limits generalizability. Finally, interviews were only conducted with pharmacists identified as champions and/or pharmacists with responsibilities in improving antibiotic use by their facility and there is the potential that other antibiotic stewardship team members, such as ID physicians, infection control personnel or microbiologists, and house-staff, such as attendees, hospitalists, residents, and nurses, may have different experiences and opinions than the respondents of this study.

Conclusions

In conclusion, this study identified several facilitators and barriers to antibiotic stewardship as perceived by antibiotic stewardship pharmacists in the VA New England Healthcare System. Interviews revealed the importance of a supportive organizational culture, protected time for antibiotic stewardship, and a cohesive organizational structure. Our findings support the CDC core elements, in particular the importance of leadership commitment in the creation of a culture that not just supports antibiotic stewardship but also ensures staff are given sufficient time for antibiotic stewardship efforts. Strategies focused on continuing to build a supportive culture, and on fostering increased protected time for antibiotic stewardship and a cohesive organizational structure may be helpful in advancing and sustaining successful antibiotic stewardship programs that improve health care outcomes.

Authors' Note

The study protocol and informed consent document were approved by the Institutional Review Board and the Research and Development Committee of the Providence Veterans Affairs Medical Center (approval number 2015-030). All participants provided informed consent before they participated in interviews. Interview transcripts are not publically available or on request from the corresponding author to protect the identity of the interview respondents and their facilities. The views expressed are those of the authors and do not necessarily reflect the position or policy of the United States Department of Veterans Affairs. This material is based upon work supported, in part, by the Office of Research and Development, Department of Veterans Affairs.

Author Contributions

HA, KL, and DD developed the study design. HA recruited the participants. ML and TT conducted interviews. HA transcribed the interviews. HA, ML, and TT performed the analyses. All authors contributed to paper writing and have read and approved the final manuscript.

Acknowledgments

We would like to acknowledge Jennifer M. DeAngelis, BA, the Program Coordinator of the Rhode Island Infectious Diseases Research Program (RIID), College of Pharmacy, University of Rhode Island, Kingston, Rhode Island, for her assistance contacting potential participants, collecting informed consent, and scheduling interviews. We also would like to thank all of the pharmacists who participated in the telephone interviews.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Haley Appaneal is supported in part by a Career Development Award, Department of Veterans Affairs, and has received research funding from Merck. Megan Luther is supported by a fellowship with the Department of Veterans Affairs, Office of Academic Affiliations, and has received research funding from Merck and Pfizer. Tristan Timbrook has received honorarium for speaking and/or consulting for BioFire Diagnostics and GenMark Diagnostics. David Dosa is a Veterans Affairs government employee. He has received research funding through the VA, The West Foundation, and National Institutes of Aging. Kerry LaPlante has received research funding or acted as a scientific advisor for Allergan, Bard, Merck, Ocean Spray, Pfizer, and The Medicines Company. The funding source did not have any involvement in the collection, analysis, or interpretation of data; in the writing of the report; or in the decision to submit the article for publication.

References

1. Department of Veterans Affairs. Antimicrobial Stewardship Programs (ASP) (VHA Directive 1031). http://www.va.gov/vhapublications/ViewPublication.asp?pub_ID=2964. Published January 2014. Accessed May 2014.
2. Centers for Disease Control and Prevention. Antibiotic resistance threats in the United States, 2013. http://www.cdc.gov/drugresistance/threat-report-2013/pdf/ar-threats-2013-508.pdf .Published 2013. Accessed January 2014.
3. World Health Organization. Antimicrobial resistance: global report on surveillance 2014. http://www.who.int/iris/bitstream/10665/112642/1/9789241564748_eng.pdf?ua=1. Published 2014. Accessed May 2018.
4. Lautenbach E, Weiner MG, Nachamkin I, Bilker WB, Sheridan A, Fishman NO. Imipenem resistance among pseudomonas aeruginosa isolates: risk factors for infection and impact of resistance on clinical and economic outcomes. *Infect Control Hosp Epidemiol*. 2006;27(9):893-900.
5. Roberts RR, Hota B, Ahmad I, et al. Hospital and societal costs of antimicrobial-resistant infections in a Chicago teaching hospital: implications for antibiotic stewardship. *Clin Infect Dis*. 2009;49(8):1175-1184.
6. Patel G, Huprikar S, Factor SH, Jenkins SG, Calfee DP. Outcomes of carbapenem-resistant Klebsiella pneumoniae infection and the impact of antimicrobial and adjunctive therapies. *Infect Control Hosp Epidemiol*. 2008;29(12):1099-1106.
7. Scott R. The direct medical costs of healthcare-associated infections in U.S. hospitals and the benefits of prevention. https://www.cdc.gov/hai/pdfs/hai/scott_costpaper.pdf. Published 2009. Accessed August 2013.
8. Dellit TH, Owens RC, McGowan JE, Jr, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis*. 2007;44(2):159-177.
9. Chou AF, Graber CJ, Jones M, et al. Characteristics of antimicrobial stewardship programs at Veterans Affairs hospitals: results of a nationwide survey. *Infect Control Hosp Epidemiol*. 2016;37(6):647-654.
10. Department of Veterans Affairs. Antimicrobial Stewardship Programs (ASP) (VHA Directive 1031). http://www.va.gov/vhapublications/ViewPublication.asp?pub_ID=2964. Published January 2014. Accessed May 2014.
11. Pakyz AL, Moczygemba LR, VanderWielen LM, Edmond MB, Stevens MP, Kuzel AJ. Facilitators and barriers to

implementing antimicrobial stewardship strategies: results from a qualitative study. *Am J Infect Control*. 2014;42(10)(suppl): S257-263.
12. Centers for Disease Control and Prevention. *The Core Elements of Antibiotic Stewardship for Nursing Homes*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2015. http://www.cdc.gov/longtermcare/index.html. Accessed 20 September 2015.
13. Centers for Diease Control and Prevention. *Core Elements of Hospital Antibiotic Stewardship Programs*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2014. http://www.cdc.gov/getsmart/healthcare/implementation/core-elements.html .Accessed 30 May 2018.
14. Ploeg J, Davies B, Edwards N, Gifford W, Miller PE. Factors influencing best-practice guideline implementation: lessons learned from administrators, nursing staff, and project leaders. *Worldviews Evid Based Nurs*. 2007;4(4):210-219.
15. Palinkas LA, Horwitz SM, Green CA, Wisdom JP, Duan N, Hoagwood K. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Adm Policy Ment Health*. 2015;42(5):533-544.
16. Barlam TF, Cosgrove SE, Abbo LM, et al. Implementing an antibiotic stewardship program: guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Clin Infect Dis*. 2016;62(10):e51-e77.
17. Bernard S, Pakyz AL, Kuper K, Nguyen N, Stevens MP. How ready are hospitals to meet the centers for Medicare and Medicaid antibiotic stewardship requirements? *Open Forum Infect Dis*. 2016;3(suppl 1):968.
18. Stenehjem E, Hyun DY, Septimus E, et al. Antibiotic stewardship in small hospitals: barriers and potential solutions. *Clin Infect Dis*. 2017;65(4):691-696.
19. Doron S, Nadkarni L, Lyn Price L, et al. A nationwide survey of antimicrobial stewardship practices. *Clin Ther*. 2013;35(6):758-765.e720.
20. Kelly AA, Jones MM, Echevarria KL, et al. A report of the efforts of the Veterans Health Administration National Antimicrobial Stewardship Initiative. *Infect Control Hosp Epidemiol*. 2017;38(5):513-520.
21. Pulcini C, Morel CM, Tacconelli E, et al. Human resources estimates and funding for antibiotic stewardship teams are urgently needed. *Clin Microbiol Infect*. 2017.
22. Spellberg B, Bartlett JG, Gilbert DN. How to pitch an antibiotic stewardship program to the hospital C-suite. *Open Forum Infect Dis*. 2016;3(4):ofw210.
23. Echevarria K, Groppi J, Kelly AA, Morreale AP, Neuhauser MM, Roselle GA. Development and application of an objective staffing calculator for antimicrobial stewardship programs in the Veterans Health Administration. *Am J Health Syst Pharm*. 2017;74(21):1785-1790.
24. Rapp RP, Kaye KS, Cano SB, Hermsen ED, DePestel DD. A hospital pharmacist's guide to antimicrobial stewardship programs. http://www.ashpadvantage.com/docs/stewardship-white-paper.pdf. Accessed November 26, 2014.
25. Graber CJ, Madaras-Kelly K, Jones MM, Neuhauser MM, Goetz MB. Unnecessary antimicrobial use in the context of Clostridium difficile infection: a call to arms for the Veterans Affairs Antimicrobial Stewardship Task Force. *Infect Control Hosp Epidemiol*. 2013;34(6):651-653.