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CONFERENCE REPORT

Leading Practices in Antimicrobial Stewardship: Conference Summary

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Background: The Joint Commission's hospital antimicrobial stewardship (AS) standards became effective in January 2017. Surveyors' experience to date suggests that almost all hospitals have established AS leadership commitment and organized structures. Thus, The Joint Commission sought to examine advances in AS interventions and measures that hospitals could implement to strengthen their existing AS programs.

Methods: The Joint Commission and Pew Charitable Trusts sponsored a meeting to bring together experts and key stakeholder organizations from around the country to identify leading practices for AS interventions and measurement. Presenters were asked to summarize the AS activities they thought were most important for the success of their own AS program and leading practices that all hospitals should be able to implement.

Results: The panel highlighted two interventions as leading practices that go beyond current guidelines and established practices (that is, preauthorization and prospective audit and feedback). The first is diagnostic stewardship. This type of intervention addresses errors in diagnostic decision making that lead to inappropriate antibiotic prescribing. The second is handshake stewardship, a method of engaging frontline providers on a regular basis for education and discussions about barriers to AS from the clinician's perspective. The panel identified days of therapy (or defined daily dose, when days of therapy is not possible), *Clostridioides difficile* rates, and adherence to facility-specific guidelines as the preferred measures for assessing stewardship activities.

Conclusion: The practices highlighted should be given greater emphasis by The Joint Commission in their efforts to improve hospital AS, and the Centers for Disease Control and Prevention will be updating the Core Elements of Hospital Antibiotic Stewardship Programs.

Each year in the United States, at least 2 million people become infected with bacteria that are resistant to antibiotics, and approximately 23,000 people die annually as a direct result of infections that cannot be treated effectively with available antibiotics.[1]

To address this public health threat, the National Action Plan for Combating Antibiotic-Resistant Bacteria was released in 2015 as a comprehensive, multifaceted approach.[2] The plan called for ". . . implementation of healthcare policies and antibiotic stewardship programs that improve patient outcomes, and efforts to minimize the development of resistance by ensuring that each patient receives *the right antibiotic at the right time at the right dose for the right duration.*"[2 (p. 6)] The National Action Plan for Combating Antibiotic-Resistant Bacteria recommended that antibiotic stewardship activities should be initiated in hospitals, long term care settings, and outpatient facilities.

Antimicrobial stewardship (AS) is not a new concept. As far back as 1977, experts in infectious disease and infection prevention and control had been calling for structured, multidisciplinary programs to improve antibiotic prescribing.[3] However, there were no requirements for hospitals or other health care organizations to have AS programs. Moreover, it was unclear exactly what such requirements might entail. AS was more of a general concept rather than a specific set of structures and activities, although AS programs typically included clinician education, formulary restrictions, prior approval programs, and monitoring of resistance patterns.[4] This changed in 2007 when the Infectious Diseases Society of America (IDSA) and the Society for Healthcare Epidemiology of America (SHEA) published the first guidelines for AS.[5] This report highlighted the importance of leadership support, a multidisciplinary team, and two core strategies: (1) prospective audit with intervention and feedback, and (2) formulary restriction and preauthorization. A number of other elements were identified that may be beneficial, such as treatment guidelines and clinical pathways.[5] In 2014 the Centers for Disease Control and Prevention (CDC) published the Core Elements of Hospital Antibiotic Stewardship Programs, which provided further guidance for how hospitals should structure their AS activities (Sidebar 1); the CDC called on all hospitals to implement stewardship programs.[6] This publication listed interventions that an AS program might undertake (for example, prospective audit and feedback, prior authorization, disease-specific guidelines,

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Sidebar 1. The Centers for Disease Control and Prevention Core Elements of Hospital Antibiotic Stewardship Programs

- Leadership Commitment: Dedicating necessary human, financial, and information technology resources.
- Accountability: Appointing a single leader responsible for program outcomes. Experience with successful programs show that a physician leader is effective.
- Drug Expertise: Appointing a single pharmacist leader responsible for working to improve antibiotic use.
- Action: Implementing at least one recommended action, such as systemic evaluation of ongoing treatment need after a set period of initial treatment (that is, "antibiotic time-out" after 48 hours).
- Tracking: Monitoring antibiotic prescribing and resistance patterns.
- Reporting: Regular reporting information on antibiotic use and resistance to physicians, nurses, and relevant staff.
- Education: Educating clinicians about resistance and optimal prescribing.

antibiotic time-outs, time-sensitive automatic stop orders, interventions to improve guideline adherence) but did not make specific recommendations.[6]

Shortly after the publication of the CDC Core Elements and the National Action Plan for Combating Antibiotic-Resistant Bacteria, The Joint Commission began developing standards that would require its hospitals and skilled nursing facilities to implement AS programs that followed the CDC Core Elements. The Joint Commission's standards were published in 2016 and became effective in January 2017.[7] From January 2017 to May 2018, 75 of 1,992 (3.8%) hospitals surveyed under the new requirement had deficiencies cited in their AS programs. The most common deficiencies were failure to educate staff adequately (n = 26; 1.3%), inadequate leadership support (n = 19; 1.0%), and inadequate protocols (n = 12; 0.6%). The rate of deficiencies cited in skilled nursing centers was slightly higher, with 26 of 554 (4.7%) having a deficiency cited; the types of deficiencies were similar (unpublished data, Dr. David Baker). Only a small number of hospitals were cited for failure to analyze data to develop improvement activities for AS; however, Joint Commission surveyors said that this was due in part to the absence of clear requirements on what hospitals should be measuring to guide quality improvement efforts.

Joint Commission leaders had a mixed reaction when they reviewed these early survey results. On the one hand, the results provided encouragement that the vast majority of organizations had established formal leadership commitment and organizational structures to support AS. However, the low rate of cited deficiencies raised concerns that the standards might not be rigorous enough or that they lacked enough specificity for surveyors to hold organizations responsible for implementing certain practices. The CDC Core Elements had called only for "implementing at least one recommended action,"[6(p. 4)] and they cautioned AS programs not to attempt too many actions at once. Similarly, the Joint Commission standards did not specify a recommended set or minimum number of actions. Perhaps more was needed. The science and practice of AS may have advanced sufficiently that it was time to set the bar higher. For example, in 2016 the IDSA/SHEA guidelines reviewed the literature on AS and published recommendations for interventions and measures that AS programs should or should not adopt.[8]

In the spring of 2018 The Joint Commission and Pew Charitable Trusts brought together experts and key stakeholder organizations from around the country with the goal of identifying more specific recommendations for what AS programs should do and how they should measure success. Key stakeholders included the CDC, the American Hospital Association, and the National Quality Forum. (Appendix 1, available in online article, provides a full list of the participants and stakeholder organizations.) This article summarizes the key themes that emerged from that conference.

ORGANIZATION OF THE LEADING PRACTICES CONFERENCE

The Leading Practices in Antimicrobial Stewardship meeting was held on May 22, 2018. The meeting included 8 presenters, a 3-person reactor panel, 16 stakeholders (individuals or representatives of invited organizations), and 12 Joint Commission staff members (Appendix 1). The conference organizers selected presenters from among known leaders in the field to get a broad distribution of hospital/health care systems, professional backgrounds, and geographic locations. Each presenter addressed three questions: (1) What three antimicrobial stewardship activities have you done that you think were most important for your success? (2) What activities have you done that you think all hospitals should be doing as foundational elements for their programs? and (3) Have you done anything novel that you think was successful that deserves further research or evaluation? The audience was given a few minutes after each presentation to ask clarifying questions, and the three members of the reactor panel were then given 10 minutes each to discuss similarities and differences in the eight presentations and to suggest emerging themes. After the presenters and the reactor panel were done, the stakeholders privately discussed what they had heard. When the group reconvened, what were thought to be the key recommendations were presented to the group for confirmation. The remainder of the time was spent in a general discussion of the emerging themes, including possible barriers to implementation for some hospitals across the country.

Table 1. Suggested Antimicrobial Stewardship Interventions from the Leading Practices in Antimicrobial Stewardship Conference*

Key Suggested Interventions	Other Suggested Interventions
Implement disease state guidelines.	Ensure strong leadership and adequate financial support.
Engage frontline clinicians.	Engage local medical communities and academic partners.
Address inappropriate diagnostic testing.	Determine whether patients labeled as having a beta-lactam allergy are truly allergic.
	Establish standard processes and procedures to evaluate antimicrobials at transitions of care.

* These suggestions should be viewed as interventions that complement, strengthen, or go beyond the traditional interventions conducted by antimicrobial stewardship programs, such as the Centers for Disease Control and Prevention's Core Elements for the structure of antimicrobial stewardship programs and interventions such as preauthorization and prospective audit and feedback.

KEY RECOMMENDATIONS FOR STEWARDSHIP INTERVENTIONS

The leading practices discussed by experts fell into two broad categories. Some were more established practices that are supported by considerable evidence and recommended strongly in society guidelines. Others can be viewed as emerging practices (Table 1). These are practices that have been successfully implemented in the experts' hospitals and which they believe most other hospitals can implement successfully, but for which there is not yet enough published experience for them to be strongly recommended in guidelines.

Established Practices

Preauthorization and Prospective Audit and Feedback. All the stewardship programs at the meeting had implemented either preauthorization, prospective audit and feedback, or both. The effectiveness and utilization of these stewardship interventions are well established in the medical literature and were given strong recommendation (moderate-quality evidence) in the 2016 IDSA/SHEA guidelines.[8] *Preauthorization* refers to the practice of requiring providers to seek approval before certain antibiotics can be used, and *prospective audit and feedback* is the practice of having an independent provider, not on the clinical team, review a patient's antibiotics to give input to the treating team. These interventions require some degree of expertise in antibiotic use but not necessarily infectious disease physicians or pharmacists, who are sometimes not available in smaller hospitals. All the experts emphasized that implementation should be flexible and based on available expertise. For example, prospective audit and feedback could include simply reviewing certain courses of therapy for concurrence with hospital guidelines. Richard Wunderink, MD, an intensivist, cautioned that preauthorization must be implemented thoughtfully to ensure that there are no delays in administering antibiotics in critical situations, such as sepsis, and stewardship experts agreed with him. In the only prospective trial comparing these interventions, prospective audit and feedback had a larger impact than preauthorization.[9] Preauthorization and prospective audit and feedback appear to be fundamental to the success of hospital stewardship programs; therefore, it may be appropriate to address these more directly in the Joint Commission standards and survey methods.

Emerging Practices

Implement Disease State Guidelines. AS programs have often focused their oversight on use of specific antibiotics. In contrast, multiple presenters said a key component of their success was developing and implementing guidelines for specific "disease states" and "infectious disease syndromes," such as empiric antibiotic selection guidelines for pneumonia, urinary tract infection (UTI), and skin and soft tissue infection. Although national guidelines are available, some stressed the importance of developing guidelines de novo or adapting national guidelines based on local conditions, such as antibiotic resistance patterns, to ensure that recommendations are appropriate and supported by key stakeholders to speed adoption. However, the value of this approach is fully achieved only if guidelines are linked to a coordinated set of activities that measure adherence rates, identify prescribers with low adherence, and provide academic detailing on recommended prescribing practices. Ideally, these guidelines are also supported through advanced clinical decision support tools in electronic health records (EHRs). The 2016 IDSA/SHEA guidelines makes similar recommendations, although they judged the supporting evidence as low quality.[8] All speakers emphasized the value of EHR clinical decision support tools to help implement and monitor success of disease state guidelines, although they warned of the difficulty and expense required to develop and implement tools in the EHR.

Engage Frontline Clinicians: Handshake Stewardship. Several panelists said a key component of their success was aggressive, active engagement with frontline providers, which some referred to as "handshake stewardship." Handshake stewardship was first described by Hurst and colleagues, who distinguished it from previous methods by (1) lack of restriction and preauthorization, (2) review of all prescribed antimicrobials, and (3) a rounding-based, in-person approach to feedback by a pharmacist-physician team.[10] Panelists stated that active engagement allowed providers to ask questions that the AS team would not have thought to address, get feedback on internal practice guidelines, and create a more collaborative working relationship. Most meeting participants supported this approach, but some expressed

concern that not all hospitals would have the resources to do it. Programs can take steps in this direction by attending meetings to increase face time with providers.

Marc Meyer, RPh, BPharm, CIC, FAPIC, described how Southwest Health System in Colorado was able to implement daily rounding within critical access hospitals and how this was facilitated by their smaller size. Although regular engagement of frontline providers appears to be a leading practice, the manner in which this is done will likely need to vary depending on hospitals' unique circumstances and resources. Sara Cosgrove, MD, MS, from Johns Hopkins University pointed out that if active engagement with frontline providers and others across an organization is critical for success, AS programs may need to rethink how they select personnel and prioritize hiring people who have strong interpersonal skills and not just clinical expertise. It is important to consider existing clinical work flow when designating personnel responsible for clinician engagement and feedback. Certain pharmacists or other clinical staff who already have daily interactions with prescribers may be preferable because they have established trust with the rounding team.

Address Inappropriate Diagnostic Testing: Diagnostic Stewardship. Several presenters emphasized that AS programs should address inappropriate test ordering that often leads to incorrect diagnoses and unnecessary antibiotic use. Some labeled this "diagnostic stewardship" or "testing stewardship." This type of activity is closely related to the topic of implementing disease state guidelines, but it is distinct because it extends to routine testing that was not for a disease state or clinical syndrome. For example, providers sometimes order urine cultures for patients without clear signs or symptoms of UTI, and this testing can cascade to inappropriate diagnosis of UTI and inappropriate use of antibiotics in patients with asymptomatic bacteriuria. Participants also discussed the problem of ordering polymerase chain reaction (PCR) testing to detect the presence of *Clostridioides difficile* for all patients with diarrhea, regardless of frequency of stools or the clinical circumstances.[11] With *C. difficile* colonization rates of 10%–20% and rates of nosocomial diarrhea from causes other than *C. difficile* running at 10%–15%,[12] inappropriate testing leads to frequent overdiagnosis and overtreatment of *C. difficile*. This issue is also important because overdiagnosis of *C. difficile* infection prevents AS programs from accurately tracking true rates, an important marker of success of AS programs. Several national organizations have published recommendations on proper testing and test interpretation for inpatients with diarrhea.[13]

OTHER RECOMMENDATIONS FOR STEWARDSHIP INTERVENTIONS

In addition to these key themes, participants mentioned several other interventions they thought were particularly valuable. Although our goal was to identify AS practices that went beyond current requirements, many participants stressed the importance of strong leadership and adequate financial support for the AS program. Many perceived that the current Joint Commission survey process was not able to assess the adequacy of leadership and financial support. Matthew Goetz, MD, mentioned that the Veterans Health Administration has issued staffing guidelines (minimum full-time equivalents) for key personnel in AS programs that may be useful for assessments.

Several speakers discussed the importance of community engagement, including both the medical community around a hospital (for example, long term care facilities, dentists) and the academic community for collaboration. Collaboration was thought critical for small, rural, and critical access hospitals to leverage individual expertise and to curate resources. An example of academic collaboration involving children's hospitals is the Sharing Antimicrobial Reports for Pediatric Stewardship (SHARPS) quality improvement collaborative, which provides benchmarking reports, webinars, and other support.[14]

Rita Olans, DNP, CPNP-PC, APRN-BC, from the Massachusetts General Hospital Institute of Health Professions discussed the need for AS programs to incorporate interventions to determine whether patients labeled as having a beta-lactam allergy were truly allergic and to provide those who were not truly allergic with documentation of this so they would not be "relabeled." However, she also identified multiple obstacles to success, including the limited availability and cost of inpatient allergy consultation and skin testing and the low priority placed on it. This intervention is also recommended by the IDSA/SHEA guidelines,[8] although it was given a "weak recommendation" at the time the guidelines were written.

Lisa Davidson, MD, from the Atrium Health system emphasized the need for standard processes and procedures to evaluate antimicrobials at transitions of care. When patients are transferred from hospitals to skilled nursing facilities, it is crucial to document the indication for antibiotics, culture results and whether cultures are still pending, and the recommended duration of antibiotics. Valerie Vaughn, MD, provided information from the Michigan Hospital Medicine Safety Consortium suggesting that most of the total antibiotic course received by hospitalized patients occurs after discharge. The duration of outpatient therapy is often inappropriately long and provides an excellent opportunity for AS programs to reduce unnecessary antibiotic use. Others commented that prospective or real-time interventions at discharge are challenging because of the difficulty identifying when patients will be discharged and the short time period between when the discharge decision is made and when the patient actually leaves the hospital.

KEY RECOMMENDATIONS FOR MEASUREMENT

Panelists and participants identified three key measurement targets for AS programs (Table 2).

Table 2. Suggested Measures for Antimicrobial Stewardship Programs from the Leading Practices in Antimicrobial Stewardship Conference

Key Suggested Measures	Other Suggested Measures
Days of therapy per 1,000 days present or patient-days	Prescribing patterns of individual clinicians
Hospital-onset *C. difficile* rates	Total duration of antibiotic therapy
Appropriate use and concordance of care with clinical practice guidelines	

Total Antibiotic Use

There was widespread agreement that AS programs should routinely measure days of therapy per 1,000 days present or patient-days, and five presenters highlighted this measure to demonstrate the success of their AS programs. One advantage of this measure is that it is sensitive for detecting improvements in both unnecessary use and inappropriate duration of use of antibiotics and can be used in adult and pediatric settings. This is consistent with the IDSA/SHEA guidelines, which say that defined daily dose (DDD) is an alternative for hospitals that cannot measure days of therapy, but DDD cannot be used in pediatrics.[8]

A few of the presenters highlighted the benefits of reporting antibiotic use data into the National Healthcare Safety Network (NHSN) Antimicrobial Use (AU) Option. The AU Option allows hospitals to have access to their antimicrobial prescribing rates and to assess their performance using risk-adjusted benchmarks of antibiotic use through the Standardized Antimicrobial Administration Ratio. Several experts commented on the benefits of benchmark data, saying that being able to show providers that their use was higher than average was useful in garnering support for stewardship interventions. The presenters also pointed out that the AU Option and the various Standardized Antimicrobial Administration Ratio categories allow stewardship programs to focus measurement efforts specifically on classes of drugs or specific agents being targeted for interventions.

Hospital-Acquired *C. difficile* Infection Rate

Multiple studies have shown that AS programs can lower the rate of hospital-acquired *C. difficile*.[15,16] Thus, this measure serves as a useful marker of a program's success (that is, an outcome measure). In addition, a high rate of hospital-acquired *C. difficile* may indicate a variety of other problems of relevance to an AS program, such as excessive and inappropriate testing for *C. difficile* (as described above).

Appropriate Use and Concordance of Care with Clinical Practice Guidelines

Implementing disease state and infectious disease state guidelines was identified as a key intervention, as described above. Participants emphasized the importance of concomitantly measuring adherence to guidelines, although it is often challenging to identify patients' diagnoses in real time rather than after discharge when final diagnoses are assigned. For example, a patient might be admitted with shortness of breath and diagnosed with pneumonia only at discharge. Although this would not prevent retrospective audit and feedback, it sometimes limits the ability to intervene prospectively. Others pointed out the benefits of requiring a written indication for each antibiotic prescription for more accurately determining the denominator when measuring appropriateness.

OTHER RECOMMENDATIONS FOR MEASUREMENT

Prescribing Patterns of Individual Clinicians

Many participants stressed that it is ideal to measure the prescribing patterns of individual clinicians, including local benchmarking and feedback. To exemplify the importance of this practice, one presentation showed that the high use of micafungin at a hospital was due predominantly to the prescribing pattern of a single individual. However, others pointed out that many hospitals do not have the data-analytic resources to perform this level of analysis. Ideally, EHR vendors and other health information technology companies will develop software to automate much of this task.

Total Duration of Antibiotic Therapy

Elizabeth S. Dodds Ashley, PharmD, MHS, described how the Duke Antimicrobial Stewardship Outreach Network tracks total antibiotic therapy duration. In one hospital, 64.2% of the total length of therapy occurred after discharge, compared to 42.6% and 40.0% at two comparison hospitals. The Veterans Health Administration has also done analyses of total duration of therapy. However, measures like these require outpatient prescriptions to have discrete data fields in the EHR to allow calculation of duration of therapy.

DISCUSSION

Several of the recommendations from this panel are consistent with those from the recent guidelines from IDSA/SHEA.[8] Preauthorization and prospective audit and feedback are foundational AS interventions (that is, leading practices) that all hospitals should be expected to include in their programs to improve antibiotic prescribing. Similarly, panelists supported the IDSA/SHEA recommendation for organizations to develop facility-specific clinical practice guidelines. However, to maximize effectiveness, hospitals should measure adherence to their guidelines and provide group-level

and, when possible, individual clinician-level feedback. This may be challenging for hospitals without adequate information technology support for both designing clinical decision support tools and measuring adherence using EHR data to obviate the need for chart abstraction.

The panel highlighted two interventions as emerging leading practices that go beyond current guidelines. The first is diagnostic stewardship. This type of intervention goes upstream and looks at errors in diagnostic decision making that lead to inappropriate antibiotic prescribing. Diagnostic stewardship can be considered a type of clinical practice that focuses more on what should not be done rather than what should be done. Thus, it can complement the traditional work done by AS programs. A high-priority target for diagnostic stewardship is testing for *C. difficile*, which is important to (1) prevent unnecessary treatment for patients who are only colonized with *C. difficile* without true infection, and (2) ensure accurate measurement of *C. difficile* infection rates**.** Another high-priority target for diagnostic stewardship is not testing for or treating asymptomatic bacteriuria.

The second emerging leading practice is handshake stewardship. Although the panel felt that this model of engaging frontline providers was superior to traditional methods, all recognized that the value of handshake stewardship and the ability to implement it successfully are dependent on the resources available, particularly the interpersonal skills of the member of the AS team. A key advantage of this approach is that the interactions with the clinical teams foster a collaborative rather than adversarial approach to improving antibiotic use.

The panel recommended to The Joint Commission that all hospital AS programs should measure (1) days of therapy (or DDD when days of therapy is not possible) and (2) hospital-onset *C. difficile* rates. Joint Commission Medication Management (MM) Standard MM.09.01.01 requires that a hospital "collects, analyzes, and reports data on its antimicrobial stewardship program,"[17] but it does not say which measures must be used and analyzed. Although AS programs should analyze other measures to assess the success of hospital-specific programs (for example, compliance with customized clinical practice guidelines), these two measures should be fundamental elements of AS.

The Joint Commission will examine the practices discussed at this meeting to determine if some are appropriate for revised standards or for specific examples that surveyors should evaluate to assess compliance with existing standards. The CDC will update the Core Elements of Hospital Antibiotic Stewardship Programs to reflect best practices and updated literature since it was originally released in 2014.

It is not known what proportion of hospitals' AS programs already follow these recommendations. Future research should evaluate this and assess possible barriers to implementation, particularly limitations to developing clinical decision support tools in EHRs and the use of EHR data for measurement. Although some EHR vendors support these tasks, the vendor community should be broadly engaged to address feasibility issues. Reporting data into the NHSN AU Option allows hospitals to not only measure antibiotic use but also compare their use to other hospitals. It is likewise important to evaluate how well accreditation surveyors are able to assess existing standards and any proposed standards.

CONCLUSION

AS is advancing quickly as more hospitals implement and expand programs and more research is conducted. This discussion of AS has identified best and emerging practices that will support improvements in antibiotic use in hospitals. The Joint Commission accreditation standards can play an important role in driving quality and can spur the implementation of these practices. The Joint Commission standards must be dynamic and evolve with new data and implementation experience.

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SUPPLEMENTARY MATERIALS

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