SHEA WHITE PAPER

Guidance for the Knowledge and Skills Required for Antimicrobial Stewardship Leaders

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Antimicrobial stewardship programs are increasingly recognized as critical in optimizing the use of antimicrobials. Consequently, more physicians, pharmacists, and other healthcare providers are developing and implementing such programs in a variety of healthcare settings. The purpose of this guidance document is to outline the knowledge and skills that are needed to lead an antimicrobial stewardship program. It was developed by antimicrobial stewardship experts from organizations that are engaged in advancing the field of antimicrobial stewardship.

Infect Control Hosp Epidemiol 2014;35(12):1444-1451

Antimicrobial stewardship (AS) refers to coordinated interventions to improve and measure the appropriate use of antimicrobials by promoting the selection of the optimal antimicrobial drug regimen, dose, duration of therapy and route of administration. The objectives of antimicrobial stewardship are to achieve the best clinical outcomes related to antimicrobial use while minimizing emergence of antimicrobial-resistant organisms, *Clostridium difficile* infection, and other adverse events and reducing excessive costs attributable to suboptimal antimicrobial use.[1]

The original model of an antimicrobial stewardship program (ASP) included leadership from a physician and a pharmacist who both had subspecialty training in infectious diseases.[2] Although the in-depth understanding of diagnosis, management, and therapy of infectious diseases afforded by such subspecialty training is advantageous when working with prescribers to improve antimicrobial use, it is not practical in many healthcare settings. Increasingly, physicians and pharmacists without specialized infectious disease training as well as other healthcare providers, such as infection preventionists, are engaged in successful stewardship activities in a variety of settings, including academic and community acute care hospitals and long-term care institutions and outpatient clinics. Furthermore, skills beyond medical infectious diseases and microbiology knowledge are critical in starting and maintaining an ASP, such as understanding how to implement change and how to measure the success of a program.

Recognizing this emerging and changing landscape, the Society for Healthcare Epidemiology of America has partnered with other leaders in advancing the field of antimicrobial stewardship, including the Infectious Diseases Society of America, Making-A-Difference in Infectious Diseases, the National Foundation of Infectious Diseases, the Pediatric Infectious Diseases Society, and the Society of Infectious Disease Pharmacists, to develop a summary description of the core knowledge and skills required for antimicrobial stewardship professionals engaged with building, leading, and evaluating ASPs (Table 1). Those core knowledge and skills include understanding the rationale for antimicrobial stewardship, the types of stewardship interventions and activities that a program may consider, and approaches to measuring process and outcomes associated with an ASP. Sections on antibiotics, microbiology, and infectious diseases syndromes note the required infectious disease and microbiology proficiencies that stewardship team members should obtain. The needed expertise with regard to working with collaborators, such as infection control, microbiology, and information technology, to achieve ASP goals are detailed. Finally, skills focused on leadership and program building knowledge are enumerated.

This guidance document serves several purposes. It can be used by individuals currently involved in antimicrobial stewardship to determine training gaps or by trainees who are contemplating a career in antimicrobial stewardship to assess what training they will require to effectively direct an ASP. It

TABLE 1. Knowledge and Skills for Implementation and Maintenance of an Antimicrobial Stewardship Program (ASP)

Category	Knowledge	Skills
General principles of antimicrobial stewardship		
	Understand the mission and goals of antimicrobial stewardship	State the mission and goals of antimicrobial stewardship
	Understand the linkage between antimicrobial use and resistance, selection of pathogenic organisms (eg, *Clostridium difficile*), and other adverse patient outcomes	Describe the relationship between antimicrobial use and resistance, selection of pathogenic organisms, and adverse patient outcomes
	Understand the roles and responsibilities of stakeholders in antimicrobial stewardship, including physician, pharmacist, infection preventionist, microbiologist, hospital administrators	List individuals and disciplines that should be involved in antimicrobial stewardship and explain rationale for inclusion
Approaches to stewardship interventions		
	Describe the common methods for antimicrobial stewardship and approaches for their implementation, including (1) restriction with approval required before the first dose or after a certain time period (eg, 24 hours); (2) postprescription prospective audit and feedback, including discontinuation of antimicrobials when unwarranted, de-escalation of antimicrobial therapy, correction of mismatch between antimicrobial therapy and microbiology results, recommendation regarding duration of therapy; (3) formulary management (4) education; (5) algorithm/order set development; (6) guideline development; (7) IV to PO switch	Determine the best approach for intervention and how to implement that intervention on the basis of different scenarios within a given institution and within different healthcare settings
	Understand the pros and cons of restriction of antimicrobial therapy	Describe appropriate settings for application of antimicrobial restriction strategies and approaches to implementation
	Understand the pros and cons of postprescription prospective audit and feedback regarding antimicrobial therapy including specific interventions such as discontinuation of antimicrobials when unwarranted, de-escalation of antimicrobial therapy, correction of mismatch between antimicrobial therapy and microbiology results, recommendation regarding duration of therapy	Describe appropriate settings for application of postprescription prospective audit and feedback of antimicrobial therapy and approaches to implementation
	Understand how to assess an antimicrobial formulary for redundant agents	Assess a formulary for redundant agents at least annually, make recommendations for streamlining of formulary antibiotics, develop therapeutic interchange policies and procedures
	Understand the role and limitations of education regarding appropriate antimicrobial use	Identify the types of education interventions that may be beneficial for a stewardship program based on the setting and audience
	Understand how to develop institutional algorithms and guidelines for antimicrobial use	Develop and implement algorithms and guidelines for antimicrobial use for the relevant healthcare setting
	Understand approaches for IV to PO conversion, including both switches to the oral form of the same agent and substitution of oral agents that provide the same coverage as an IV regimen for the purpose of earlier discharge and avoidance of IV access	Develop and implement IV to PO conversion protocols and interventions in a healthcare setting

TABLE 1 (*Continued*)

Category	Knowledge	Skills
Antimicrobials	Recognize situations in which an intervention is required	Develop a systematic approach to identify problems with antimicrobial prescribing and design interventions to address problems
	Understand different classes of antimicrobials, including antibiotics, antifungals, and antivirals	State differences in mechanisms of action and spectrum of activity within and among classes of antimicrobials
	Understand common adverse events associated with different antimicrobials, including adverse reactions that mimic infectious syndromes	Proactively monitor for and identify when an antimicrobial may be responsible for a particular adverse event and implement approaches to minimize reactions (eg, slowing vancomycin infusion to prevent red man syndrome)
	Understand the different types of allergic reactions to antimicrobials and how they may be prevented or minimized	Assess whether a patient has a true drug allergy, assess the risk associated with that allergy if certain antimicrobial agents are administered, and implement approaches to minimize reactions
	Understand common drug interactions between antimicrobials, between antimicrobial and other therapeutic agents, and between antimicrobials and food including their clinical significance and strategies to avoid them	Assess a patient's risk for clinically significant drug interactions on the basis of the medication profile and implement strategies to manage or avoid them
	Understand pharmacokinetic and pharmacodynamic properties of different antimicrobial agents and their application to selection of appropriate dosing based on patient, pathogen, and syndrome characteristics	Recommend optimized dosing strategies (eg, amount, frequency, route) on the basis of characteristics of the antimicrobial agent and patient, pathogen, and syndrome characteristics
	Understand approaches to therapeutic monitoring of antimicrobials such as vancomycin and aminoglycosides	Assist pharmacy with development of therapeutic monitoring programs and recommend appropriate initial and follow up doses, dosing intervals, and timing of subsequent levels of antimicrobials on the basis of host factors and interpretation of antibiotic levels
	Assess and respond to antimicrobial shortages	Develop recommendations for alternative therapeutic approaches when antimicrobial shortage exists
	Understand common mechanisms of resistance for different antimicrobial/organism combinations and their impact on resistance to other antimicrobials	Recognize common mechanisms of resistance within an institution for different antimicrobial/organism combinations, understand their impact on resistance to other antimicrobials, and design therapeutic recommendations on the basis of this information
	Understand associations between use of specific antimicrobial agents and development of resistance or *C. difficile*	Monitor for emerging trends of antimicrobial resistance and *C. difficile* infection within an institution and modify therapeutic recommendations on the basis of this information
	Understand antimicrobial therapy options for highly resistant organisms	Implement approaches for treatment of highly resistant organisms
Microbiology and laboratory diagnostics	Understand how to appropriately obtain cultures and other samples for microbiology testing and interpret results	Describe appropriate methods to obtain cultures and other relevant samples (eg, PCR) from different body sites and distinguish between results representing infection, colonization, and contamination

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Describe microbiologic characteristics of bacteria that cause clinical disease in humans, including appearance on Gram stain and other stains (eg, acid fast, modified acid fast) and state expected antibiotic susceptibilities	Correctly interpret microbiologic data regarding bacteria that cause clinical disease in humans and recommend appropriate empirical and susceptibility-directed therapy when indicated
Describe microbiologic characteristics of fungi that cause clinical disease in humans including appearance on relevant stains and state expected antifungal susceptibilities	Correctly interpret microbiological data regarding fungi that cause clinical disease in humans and recommend appropriate empirical and susceptibility-directed therapy when indicated
Describe laboratory approaches to testing for common viral pathogens in humans and interpret results	Correctly interpret microbiological data regarding viruses that cause clinical disease in humans and recommend appropriate therapy when indicated
Describe laboratory approaches to testing for C. difficile disease and interpret results	Correctly interpret C. difficile test results on the basis of the testing approach used at the institutions and recommend appropriate therapy
Understand CLSI recommendations for constructing institutional antibiograms	Work with the microbiology laboratory to develop and interpret antibiograms at least annually, including unit-specific (eg, ICU), condition-specific (eg, UTI), and population-specific antibiograms (eg, pediatrics) where appropriate
Understand the strengths and weaknesses of using an antibiogram to assist with decisions on recommendations for empirical therapy	Use information derived from an antibiogram to identify and track resistance problems, make formulary decisions, and prepare optimal clinical pathways at an institution
Understand approaches to detecting and reporting antimicrobial susceptibilities	Work with the microbiology laboratory to select appropriate panels for automated systems and adopt selective and cascade reporting when necessary
Understand MIC and breakpoints including both their role in determining appropriate antimicrobial therapy and the impact of CLSI breakpoint changes on microbiology reporting	Use MIC and breakpoint data to select appropriate antimicrobial agents and dosing and evaluate resistance trends appropriately
Understand when MIC data should be requested at institutions that do not routinely provide such data	Appropriately request MIC determination for certain pathogens and syndromes (eg, viridians group streptococcal endocarditis)
Understand the basic principles of testing antibiotic combinations for synergy and antagonism	Identify situations in which synergy testing may enhance antimicrobial treatment recommendations
Understand options for rapid diagnostic testing in the microbiology laboratory	Assist the laboratory in decisions regarding implementation of rapid diagnostic testing and appropriately incorporate results into stewardship interventions
Understand the uses of inflammatory biomarkers (eg, procalcitonin) in antimicrobial stewardship	Assist the laboratory in decisions regarding implementation of inflammatory biomarker testing and appropriately incorporate results into stewardship interventions
Understand the strengths, weaknesses, and diagnostic accuracy of testing performed in the microbiology laboratory	Identify which tests are preferred in a given situation on the basis of the strengths, weaknesses, and diagnostic accuracy of testing available in your microbiology laboratory
Common infectious syndromes	
Critically read national guidelines for infectious diseases relevant to antimicrobial stewardship	Assess the level of evidence used to generate guidelines and understand the applicability of guidelines to one's own healthcare environment

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TABLE 1 (*Continued*)

Category	Knowledge	Skills
	Critically read recent literature on infectious disease issues relevant to antimicrobial stewardship	Recognize important findings and incorporate them into practice when appropriate
	Describe the recommended durations of antimicrobial therapy for common infectious diseases, including those based on sound evidence versus those based on tradition	Incorporate recommendations regarding antimicrobial duration of therapy based on guidelines, clinical response, and source control as part of stewardship recommendations and interventions
	Recognize clinical syndromes and infections where combination therapy is recommended	Recommend combination therapy when clinically indicated and monotherapy in all other settings
	Understand presentation, diagnosis, management, and appropriate antimicrobial use, including appropriate duration of therapy associated with common infectious syndromes, including (1) upper and lower respiratory tract infection; (2) urinary tract infection; (3) intra-abdominal/pelvic infection; (4) Skin, soft-tissue, bone and joint, diabetic foot infection; (5) central nervous system infection; (6) bloodstream, catheter, and endovascular infection; (7) infections involving prosthetic materials and devices other than catheters; (8) gastrointestinal infection, including *C. difficile* infection; (9) methicillin-resistant *Staphylococcus aureus* infection; (10) sepsis; (11) febrile neutropenia; (12) fungal infection; (13) viral infection	Accurately classify and treat (dose, duration of therapy) common infections
	Understand the infectious and noninfectious differential for certain common conditions (eg, infiltrates on chest radiograph)	Recognize common noninfectious conditions that may be misdiagnosed as infections and recommend alternative strategies to evaluation and treatment
Measurement and analysis		
	Understand methods, data needs, and interpretation of data on antimicrobial use	Assess sources at an institution for data on antimicrobial use
	Understand and compare standard methods of measuring antimicrobial use, including metrics such as DDD, DOT, and LOT	Determine when to use various metrics (eg, DDD, DOT, and LOT) to measure antimicrobial use in a particular healthcare setting on the basis of the patient population and available data
	Understand approaches to benchmarking antimicrobial use within and across institutions	Identify appropriate benchmarks within an institution or from similar institutions for antimicrobial use
	Understand processes and definitions associated with the NHSN AUR module	Report to and analyze data from the NHSN AUR module whenever possible
	Discuss approaches to measure the impact of a stewardship program or stewardship intervention, including (1) reductions in antimicrobial use; (2) reductions in inappropriate antimicrobial use; (3) improved patient outcomes (eg, decreased length of hospitalization, mortality, and readmissions); (4) changes in rates or proportions of resistant organisms; (5) decreases in rates of *C. difficile*; (6) decrease in adverse events (eg, renal dysfunction); (7) adherence to institutional pathways and protocols; (8) decrease in time to appropriate therapy; (9) decrease in antimicrobial costs and costs of care	Document results of a stewardship intervention and assess and evaluate its effect

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Category		
	Understand how to display and report data regarding process and outcome measures in internal and external presentations and reports and manuscripts	Effectively disseminate results of an ASP internally and externally
	Understand appropriate types of study design (eg, before-after and cluster randomized) and analysis (eg, time-series analysis) for stewardship interventions	Design, execute, analyze, and disseminate studies and critically review projects and manuscripts detailing antimicrobial stewardship interventions
Informatics/IT	Assess IT resources available at an institution for performing antimicrobial stewardship activities	Leverage IT resources to obtain needed information regarding antimicrobial use and to develop alerts or flags for stewardship interventions (eg, bug-drug mismatch, antimicrobial starts, and antimicrobials continued after 48–72 hours)
	Assess external proprietary antimicrobial stewardship IT software programs	Work with IT to develop a business case for purchase and to implement the use of such programs within an institution or health system
	Determine order sets that may be useful for an institution	Develop and implement electronic order sets in line with institutional guidelines
Program building and leadership	Understand the complex interpersonal and interprofessional needs to best develop and sustain an ASP	Develop and maintain communication and conflict resolution skills to assist in communication with a variety of stakeholders
	Understand how your ASP intersects with the institution's strategic plan	Adapt stewardship efforts to current and evolving strategic initiatives within the institution and develop goals and reports to reflect how the ASP helped in meeting local goals
	Understand how to write and present a strategic plan and business case to institutional leadership for stewardship programs for initial establishment of a program	Develop and present a report detailing the rationale for stewardship and proposed benefits, including financial and improvement in patient safety and justification, for funding of proposed team members
	Understand how to write and present a business case to institutional leadership for stewardship programs for maintenance of a program	Develop and present annual reports detailing interventions, cost-savings and maintenance, and improved patient safety
	Understand how to obtain physician and prescriber buy in for a program or intervention	Develop and present educational material regarding the benefits of antimicrobial stewardship and prescriber roles and responsibilities and develop approaches to manage outlier prescribers
	Understand how to obtain pharmacy/pharmacist buy in for a program or intervention	Develop and present educational material regarding the benefits of antimicrobial stewardship and pharmacist/pharmacy department roles and responsibilities
	Understand basic theories regarding patient safety, quality science, implementation science, and organizational change	Effectively communicate the goals and approaches of antimicrobial stewardship with patient safety and quality improvement groups and use approaches of implementation science and change theory to develop effective interventions and relationships with prescribers
	Understand the medical-legal implications of a stewardship program at your institution	Work with the risk management and legal departments to reach consensus upon the medical-legal ramifications of institutional stewardship activities

TABLE 1 (*Continued*)

Category	Knowledge	Skills
	Understand reporting requirements and regulatory mandates related to antimicrobial use (eg, Surgical Care Improvement Project), core measures, US News and World Report rankings for pediatric hospitals)	Provide guidance to quality improvement departments regarding implementation and measurement of initiatives to improve compliance with requirements
	Understand unique challenges and strategies for implementing and managing antimicrobial stewardship across multiple institutions or within a health system	Assess use and needs of each separate institution and identify common strategies for implementation
Special populations and non-acute hospital settings		
	Understand how to apply and modify stewardship approaches for special populations (eg, immunocompromised, oncologic, neonatal and other ICU, transplant, and geriatric)	Develop and implement an effective stewardship intervention for special populations
	Understand how to apply and modify stewardship approaches in non-acute hospital settings (eg, long-term acute care and ambulatory surgery center), the emergency department, and the operating room	Develop and implement an effective stewardship intervention in non-acute hospital settings, the emergency department, and the operating room
	Understand the approaches to implementing stewardship activity when resources are limited	Develop and implement an effective stewardship intervention in resource-limited institutions
Infection control		
	Discuss basic infection prevention principles and processes and the interrelationship with ASP	Identify and apply appropriate infection control practices to support and enhance antimicrobial stewardship and recognize clinical situations in which infection control involvement is needed
	Understand current recommendations for use of antibiotics for surgical prophylaxis	Correctly apply evidence-based recommendations for surgical prophylaxis
	Understand the differences between surveillance definitions and clinical definitions for HAI	Distinguish between surveillance and clinical definitions for HAI when interacting with prescribers

NOTE.   AUR, Antimicrobial Use and Resistance; CLSI, Clinical Laboratory and Standards Institute; DDD, defined daily doses; DOT, days of therapy; HAI, healthcare-associated infection; ICU, intensive care unit; IT, information technology; IV, intravenous; LOT, length of therapy; MIC, minimum inhibitory concentration; NHSN, National Healthcare Safety Network; PCR, polymerase chain reaction; PO, oral; UTI, urinary tract infection.

also serves as a tool to assess educational needs when developing courses and curricula related to antimicrobial stewardship and as a framework for administrators to determine what knowledge and skills are needed for developing an ASP. Finally, it identifies parameters for consideration for certification programs in antimicrobial stewardship.

ACKNOWLEDGMENTS

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