

Implementing Antimicrobial Stewardship Programs in Health Systems



Planned and conducted by ASHP Advantage and supported by educational grants from Astellas Pharma Global Development, Inc., Cubist Pharmaceuticals, Inc., and Pfizer, Inc.



For more information on antimicrobial stewardship, visit www.LeadStewardship.org

Continuing Education Discussion Guide

Executive Summary

Antimicrobial resistance is a major public health problem in the United States. It is attributed largely to excessive and inappropriate use of antimicrobial agents, although inadequate infection prevention and control measures and the transmission of community-acquired infections caused by resistant pathogens may contribute. Hospital-acquired antibiotic-resistant infections are among the leading causes of death in the United States. The research and development pipeline of antimicrobial agents to manage infections caused by resistant pathogens is essentially empty. The emergence of antimicrobial resistance and transmission of antimicrobial-resistant pathogens in health systems may be addressed through antimicrobial stewardship in conjunction with infection prevention and control measures. Antimicrobial stewardship is a coordinated effort to ensure the judicious and effective use of antimicrobial therapy that includes but is not limited to the appropriate selection, dosing, route of administration, and duration of antimicrobial therapy. Optimizing clinical outcomes while minimizing unintended consequences of antimicrobial use is the primary goal of antimicrobial stewardship. A reduction in health care costs without adversely affecting the quality of care is a secondary goal.

Antimicrobial stewardship programs (ASPs) improve antimicrobial use and reduce antimicrobial resistance, mortality, hospital length of stay, and health care costs. Pharmacists should assume a prominent role in antimicrobial stewardship, serving as core members of a multidisciplinary team. There is a shortage of pharmacists with advanced training in infectious diseases (ID), but nontraditional methods may be used to learn about ID and antimicrobial stewardship. Prospective audit with intervention and feedback and formulary restriction and preauthorization are proactive core strategies for antimicrobial stewardship, with supplemental elements often used in conjunction. An increase in the number of ASPs and a decrease in direct compensation for ID physicians have been observed over the past decade in the United States. The approach to implementation of ASPs should be tailored depending on institutional needs and available resources. Various barriers, particularly lack of funding and lack of personnel, can impede ASP implementation. Metrics can be used to evaluate the impact of an ASP, justify its continuation, and make decisions about how best to invest limited resources in ASP activities. Information technology plays an important role in overcoming barriers to implementation. Problems with prescriber lack of cooperation with ASP requirements may be avoided or overcome by involving key staff in ASP development and collaborating with key opinion leaders.

New Educational Initiative

ASHP Advantage is conducting a multidisciplinary educational initiative to improve antimicrobial use in health systems. Using both live and online learning formats, as well as faculty mentoring activities, a multidisciplinary faculty of nationally-recognized experts will assist pharmacists in improving antimicrobial stewardship activities at their practice sites. Activities were developed by an educational steering committee comprising experts in antimicrobial stewardship and infectious diseases. Featured activities include

- On-demand CE activities focusing on the basics of antimicrobial stewardship
- Live webinars and on-demand web-based activities on antimicrobial stewardship challenges and opportunities
- Antimicrobial Stewardship Mentored Initiative featuring onsite visits to selected health systems to evaluate stewardship practices and recommend improvement strategies
- Online resource center with helpful links

For more information and to sign up to become an antimicrobial steward, visit www.LeadStewardship.org

Learning Objectives

After studying this knowledge-based activity, the reader should be able to:

- Describe the goals and components of antimicrobial stewardship programs (ASPs).
- Discuss recent trends in ASPs in U.S. health systems.
- Identify and discuss barriers to the implementation of ASPs in health systems and develop strategies for overcoming these barriers.

Faculty and Disclosures

The assistance of the following faculty and reviewers of this educational activity is gratefully acknowledged. In accordance with the Accreditation Council for Continuing Medical Education's Standards for Commercial Support and the Accreditation Council for Pharmacy Education's Guidelines for Standards for Commercial Support, ASHP Advantage requires that all individuals involved in the development of activity content disclose their relevant financial relationships and that conflicts of interest be identified and resolved prior to delivery of the activity.

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Introduction

Each year nearly 100,000 Americans die from hospital-acquired antibiotic-resistant infections at an estimated cost to the U.S. health care system of \$21 billion to \$34 billion.¹ Many of these infections are the result of excessive or inappropriate antibiotic use and the emergence and transmission of antimicrobial-resistant pathogens. Up to 50% of antimicrobial use in hospitals is unnecessary or inappropriate.² Inadequate infection prevention and control measures and the transmission of community-acquired infections caused by resistant pathogens contribute to the problem of antibiotic-resistant infections in hospitals.^{3,4} Antimicrobial resistance is associated with increased mortality, prolonged hospital lengths of stay, and increased health care costs.⁵

In a 2004 report, the Infectious Diseases Society of America (IDSA) described the growing problem of antimicrobial resistance and the lack of new antimicrobial agents to combat infections caused by these pathogens in the research and development pipeline.⁶ Policy makers were urged to take prompt legislative action to address the problem by creating financial incentives for pharmaceutical manufacturers to invest time and resources in research.

Recent reports demonstrate that the problem of antimicrobial resistance and lack of new antibiotics in the pipeline is a global one that has worsened, with increases in the incidence of multidrug-resistant infections for which currently available antimicrobial agents are ineffective.^{7,8} The Strategies to Address Antimicrobial Resistance Act (known as STAAR or H.R. 2400) was introduced in 2009 to encourage the development of new antimicrobial agents as well as strengthen federal antimicrobial resistance surveillance, prevention and control, and research efforts.⁹ No timeline is available for when action might be taken to pass the legislation.

A campaign to improve antibiotic use in inpatient health care facilities, *Get Smart for Healthcare*, is underway by the Centers for Disease Control and Prevention (CDC).² The "10 x '20 initiative," a call to action to develop 10 new systemic antimicrobial drugs by the year 2020, recently was launched by IDSA.¹⁰ The organization has called on global political, scientific, industry, economic, intellectual property, policy, medical,

TABLE 1.
ESCAPE Pathogens¹²

E*nterococcus faecium*
S*taphylococcus aureus*
C*lostridium difficile*
A*cinetobacter baumannii*
P*seudomonas aeruginosa*
E*nterobacteriaceae*
 (includes *Enterobacter* species, *Klebsiella pneumoniae*, *Escherichia coli*)

and philanthropic leaders to create incentives that stimulate new antimicrobial research and development.

The majority of hospital-acquired infections in the United States are caused by a small group of bacteria with increasing resistance to currently available antimicrobial agents.^{10,11} The acronym ESKAPE has been used for these pathogens—*Enterococcus faecium*, *Staphylococcus aureus* (*S. aureus*), *Klebsiella pneumoniae* (*K. pneumoniae*), *Acinetobacter baumannii*, *Pseudomonas aeruginosa* (*P. aeruginosa*), and *Enterobacter* species—because of the high likelihood of their escape from the effects of antimicrobial therapy. These agents are now referred to as ESCAPE pathogens (Table 1) with C for *Clostridium difficile* replacing K for *K. pneumoniae* and E for Enterobacteriaceae (which include *Enterobacter* species, *K. pneumoniae*, *Escherichia coli*, and other pathogens) instead of *Enterobacter* species, to reflect recent increases in antimicrobial resistance in and the impact of hospital-acquired infections caused by these organisms.¹²

Antimicrobial Stewardship

The absence of new antimicrobial agents in the research and development pipeline makes it imperative that currently available agents are used wisely to stem the emergence of resistance to and loss of effectiveness of these agents. Antimicrobial stewardship, a coordinated effort to promote the judicious and effective use of antimicrobial agents that includes but is not limited to the appropriate selection, dosing, route of administration, and duration of antimicrobial therapy, is an

important strategy for achieving this goal.¹³ When used in conjunction with infection prevention and control, antimicrobial stewardship also prevents the transmission of antimicrobial-resistant pathogens in health systems.

The primary goal of antimicrobial stewardship is to optimize clinical outcomes while minimizing unintended consequences of antimicrobial use (e.g., toxicity, the selection of pathogenic organisms, the emergence of resistance).¹³ Reducing health care costs without adversely affecting the quality of care is a secondary goal of antimicrobial stewardship.

Guidelines for developing an institutional program to enhance antimicrobial stewardship were published in 2007 by IDSA and the Society for Healthcare Epidemiology of America (SHEA).¹³ These guidelines call for a clinical pharmacist with infectious diseases (ID) training and an ID physician to serve as core members of a multidisciplinary antimicrobial stewardship team, with compensation provided for their time.¹³ According to the American Society of Health-System Pharmacists (ASHP) statement on the pharmacist's role in antimicrobial stewardship and infection prevention and control, pharmacists should assume a prominent role in antimicrobial stewardship because of their knowledge of and influence over antimicrobial use and membership on multidisciplinary committees in the institution.¹⁴ A clinical microbiologist, infection control professional, information system specialist, and hospital epidemiologist should be included in the antimicrobial stewardship program (ASP) core team, according to IDSA/SHEA guidelines.¹³

Antimicrobial stewardship programs have been shown to improve antimicrobial use and reduce antimicrobial resistance.^{15–20} The programs also reduce mortality, hospital length of stay, and health care costs.^{20–22} The cost-effectiveness of pharmacist-managed ASPs is well documented.^{23–27}

Interventions

The IDSA/SHEA guidelines call for two proactive core strategies as the foundation of the ASP: (1) prospective audit with intervention and feedback and (2) formulary restriction and preauthorization.¹³ Supplemental elements may be used in conjunction with these core strategies depending on local practice patterns and available resources. Table 2 lists the various types of

interventions used in ASPs, barriers that can impede ASP implementation, and possible strategies for overcoming the barriers.

Prospective audit with intervention and feedback

to the prescriber (i.e., evaluating the appropriateness of orders for antimicrobial agents, contacting the prescriber if the order is inappropriate, and recommending alternative therapy) can reduce inappropriate antimicrobial use and serve an educational purpose to modify future prescribing.^{13,28} This strategy allows prescribers to maintain autonomy, which is a concern with some other interventions.²⁸ Difficulty identifying patients with inappropriate therapy and communicating recommendations to prescribers are potential problems. Computerized systems can be used to screen for and identify patients with inappropriate therapy based on microbiology and pharmacy data. Legal concerns about failure to follow written recommendations may arise; developing policies and procedures for oral communication without permanent documentation may help alleviate these concerns.²⁹

Formulary restriction and preauthorization

involves limiting the use of an antimicrobial agent to certain indications, prescribers, physician services, or patient populations, often depending on local antimicrobial resistance patterns and patient safety issues.^{28,30} Immediate and substantial reductions in antimicrobial use and costs can be achieved through these strategies, although increases in the use of and resistance to an alternative antimicrobial agent may result.¹³

Barriers to the use of preauthorization requirements include increased staffing requirements, a perceived loss of prescriber autonomy, and delays in initiation of therapy.^{28,29} To avoid delays in therapy, which can adversely affect clinical outcomes, policies and procedures that facilitate immediate dispensing of a first dose and applying formulary restrictions and preauthorization requirements only to subsequent doses have been suggested.^{31,33} This approach is designed to strike a balance between preventing the excessive antimicrobial use that promotes resistance and incurring the delays in therapy that adversely affect clinical outcomes. Initial antimicrobial therapy that is later determined to be inappropriate or redundant based on the results of culture and antimicrobial susceptibility tests is discontinued as soon as possible.

TABLE 2.

Antimicrobial Stewardship Interventions, Barriers to ASP Implementation, and Strategies for Overcoming the Barriers^{13,28–32}

Intervention	Barriers to ASP Implementation	Strategies for Overcoming Barriers
Prospective audit with intervention and feedback	Difficulty identifying patients with inappropriate therapy and communicating with prescribers Legal concerns about failure to follow written recommendations	Use computerized systems to screen for and identify patients based on microbiology and pharmacy data Develop policies and procedures for oral communication without documentation
Formulary restriction and preauthorization	Delays initiating therapy Increased staffing requirements Perceived loss of prescriber autonomy	Develop policies and procedures for immediate dispensing of first doses with restriction and preauthorization for subsequent doses Develop and implement CPOE systems
Education	Lack of acceptance of ASP Marginal efficacy in modifying prescribing behavior when education is passive Need for repeated education for reinforcement	Provide frequent education in conjunction with active intervention
Guidelines and clinical pathways	Nonadherence to guidelines and pathways	Obtain multidisciplinary input in development of and provide education about evidence-based guidelines and pathways Incorporate guidelines and pathways into CPOE
Antimicrobial order forms	Inappropriate interruption in therapy from automatic stop orders Time required to complete paper order forms	Educate prescribers about order renewal requirements Incorporate antimicrobial order form into CPOE system
Combination therapy	Lack of proven benefit in improving clinical outcomes and reducing resistance	Develop guidelines for use of combination therapy and discontinuing redundant or unnecessary therapy
Streamlining/de-escalation of therapy	Reluctance to de-escalate therapy when cultures are negative and clinical improvement has been observed Lack of availability of assays for biomarkers used to monitor and shorten therapy	Educate prescribers about safety of de-escalation in absence of resistant pathogens Educate clinical laboratory managers about usefulness of biomarkers in shortening therapy
Dose optimization	Concerns about drug administration	Develop antimicrobial use guidelines to address concerns
Parenteral-to-oral conversion	Difficulty identifying eligible patients	Develop guidelines with clinical criteria for conversion

ASP = antimicrobial stewardship program; CPOE = computerized physician order entry

Education is needed to promote acceptance of ASP strategies and influence prescribing behavior.¹³ Education should be provided in conjunction with active intervention (e.g., prospective audit and intervention) because passive education alone (e.g., distribution of written guidelines) is only marginally effective for modifying prescribing behavior.¹³

Guidelines and clinical pathways that are evidence based and take into consideration local microbiology and antimicrobial resistance patterns may improve antimicrobial use.¹³ These guidelines and clinical pathways should be developed with multidisciplinary input to improve the likelihood of adherence.

Antimicrobial order forms with requirements for the prescriber to justify antibiotic use and automatic stop features to prevent excessively long therapy can reduce inappropriate antimicrobial use.¹³ Inappropriate interruption in therapy from the use of automatic stop orders is a potential problem that can be avoided by educating prescribers about order renewal requirements.¹³ Completion of paper antimicrobial order forms can be time consuming. Incorporating antimicrobial order forms into computerized physician order entry (CPOE) systems minimizes the time required to complete forms.²⁸

Combination therapy involves the use of more than one antimicrobial agent instead of monotherapy to provide a more broad spectrum of coverage in certain types of patients and situations. This approach ostensibly improves clinical outcomes and prevents antimicrobial resistance, although the data are insufficient. Combination therapy often is redundant and unnecessary. Therefore, it is not routinely recommended in the IDSA/SHEA guidelines.¹³

Streamlining or de-escalation of therapy is an intervention designed to decrease the selection pressure that leads to resistance. The most common approach to streamlining involves discontinuing inappropriate or redundant antimicrobial therapy based on culture and antimicrobial susceptibility data (e.g., discontinuing broad-spectrum therapy and initiating targeted therapy with a more narrow spectrum of activity suited to the isolated pathogen). This intervention reduces antimicrobial exposure, the selection of resistant pathogens, and health care costs by targeting the causative pathogen more effectively.¹³ However, cultures are negative in many infected patients, and streamlining of therapy based on antimicrobial susceptibility data is not possible in these patients. Clinicians often are reluctant to de-escalate therapy when cultures are negative and clinical improvement has been observed.²⁹

Patients with hospital-acquired, ventilator-associated, or healthcare-associated pneumonia and cultures typically receive a three-drug regimen empirically to minimize mortality from multidrug-resistant pathogens. A possible approach to reducing selection pressure in such patients entails switching to a single antibiotic if cultures are negative for methicillin-resistant *S. aureus* and *P. aeruginosa*.³⁴

Reducing the duration of antimicrobial therapy is another approach to de-escalation of antimicrobial therapy. The duration of antimicrobial therapy in many clinical practice guidelines is based on expert opinion, not the results of randomized clinical trials. The use of a shorter-than-recommended duration of therapy in patients with ventilator-associated pneumonia (VAP), for example, has been shown to not compromise clinical outcomes.^{35,36} Colonization with resistant bacteria and VAP recurrence are associated with a longer duration of therapy.³⁷

Biomarkers for bacterial infection and sepsis, such as procalcitonin, have been used to shorten antimicrobial therapy without adversely affecting clinical outcomes.³² However, the availability of such assays in clinical laboratories currently is limited.

Dose optimization is an intervention to improve drug dosing and administration taking into consideration the patient characteristics (e.g., age, weight), causative pathogen, site of infection, and pharmacokinetic and pharmacodynamic characteristics of the antimicrobial agent.¹³ Barriers to use of this intervention include nursing staff concerns about drug administration, which can be addressed through antimicrobial use guidelines (e.g., use of extended dosing intervals for aminoglycosides and prolonged infusions of β -lactam antibiotics).

Parenteral-to-oral conversion for antimicrobial agents when the patient's condition permits can reduce the risk of complications from intravenous (i.v.) access and decrease the hospital length of stay and health care costs.¹³ Guidelines with clinical criteria for conversion should be developed to facilitate use of this intervention.

Antimicrobial cycling is the scheduled substitution of a specific antimicrobial agent or class for another agent or class to prevent or reverse antimicrobial resistance.¹³ In theory, cycling may minimize the selection pressure that leads to resistance by providing diversity (i.e., heterogeneity) in antimicrobial use.^{13,38} This selection pressure decreases when use of an agent or class is reduced.³⁰ However, the long-term effectiveness of antimicrobial cycling for preventing or reversing antimicrobial resistance is unclear, so this intervention is not routinely recommended in the IDSA/SHEA guidelines.¹³ Potential barriers to the use of antimicrobial cycling include nonadherence to policies and procedures for

antimicrobial cycling because of a lack of awareness of the currently scheduled antimicrobial agent.²⁸ The need to exclude patients from receiving the scheduled antimicrobial agent because of drug allergies, toxicity, or other concerns also may be a problem.^{13,30}

Recent Trends

Results of a 2009 survey of ID physician members of IDSA about the extent to which ASPs have been implemented in U.S. hospitals and key barriers to implementation recently were reported.³⁹ Of 471 respondents, 61% reported that an ASP had been established at their institutions and another 12% reported plans to establish an ASP. By contrast, 50% of respondents to a similar survey conducted in 1999 indicated that their hospital pharmacy would not dispense certain antimicrobial agents without the approval of ID consultants, a response that was interpreted as evidence of an ASP.⁴⁰ These findings reflect an increase in ASPs over the past decade.

In 2009, plans for or an established ASP were significantly less likely among respondents at small community hospitals with less than 200 beds than among respondents in larger university hospitals.³⁹ A combination of primary strategies, including post-prescription review with feedback, formulary restriction, and preauthorization, was used in most (73%) established ASPs. The survey findings reflect a shift over the past decade from the use of formulary restriction alone to the use of tailored interventions that provide feedback to prescribers. In 2009, the most commonly used supplemental interventions in both established and planned ASPs were education and guidelines or clinical pathways. Antimicrobial cycling was the least common supplemental intervention in both established and planned ASPs. The most common barriers to implementing an ASP were lack of funding and lack of personnel. One in four established ASPs had no paid physician or pharmacist. Roughly half (52%) of respondents with ASPs reported that ID physicians involved in the ASP received no direct compensation. By contrast, 18% of respondents to the 1999 survey did not receive compensation for their involvement in antimicrobial stewardship.⁴⁰

In 2009, the level of support for the ASP from administrators was higher at university hospitals than

community hospitals.³⁹ Most respondents with established ASPs indicated that new data were needed to convince administrators to continue to support the ASP and influence clinicians to adhere to ASP recommendations. Data demonstrating a cost savings from the ASP was considered most useful to administrators. Clinicians sought data demonstrating a reduction in antimicrobial resistance. The most common reason for selecting specific antimicrobial agents for an ASP was high cost.

Justification

Implementing ASPs can present a challenge because of a lack of funding and personnel, the reluctance of physicians to accept the ASP, and other barriers listed in Table 2. The challenges in small community hospitals and non-teaching institutions differ from those faced at larger academic facilities, so the approach to implementation must be tailored to address the needs of the institution.⁴¹

Obtaining support and authority from administration for initiating an ASP requires preparation of a strong business case based on the potential consequences of inappropriate antimicrobial use and antimicrobial resistance, especially increased mortality and health care costs. The many published reports demonstrating the cost-effectiveness of ASPs in improving antimicrobial use and reducing antimicrobial resistance, mortality, and health care costs should be used to strengthen the business case for an ASP. The resources listed in the Resource Center of this initiative's Web site www.LeadStewardship.org are helpful for preparing proposals to justify devoting resources to the ASP.

Current reimbursement policies of the Centers for Medicare & Medicaid Services (CMS) whereby payment is not provided for certain hospital-acquired infections that the agency considers avoidable "never events" can be used to strengthen the financial argument for implementing an ASP.^{42,43} The agency discontinued payment for these and other preventable medical errors that result in serious consequences for the patient beginning in 2008.

General acute care hospitals in the state of California have been required to develop a process for evaluating the use of antibiotics as part of quality improvement activities since 2008.⁴⁴ A statewide ASP

initiative to strengthen and promote optimal use of antibiotics in health care facilities has been developed by the California Department of Public Health in response to the legislation.⁴⁵ Similar legislation could be adopted by CMS in the future, providing a mandate and justification for ASP implementation nationwide.

Recommendations and requirements of influential groups, such as IDSA, SHEA, the Joint Commission, National Quality Forum, and CDC, provide support for ASP implementation. The Joint Commission's National Patient Safety Goal (NPSG) 7 to reduce the risk of health-care-associated infection requires the implementation of evidence-based practices to prevent infections due to multidrug-resistant organisms.⁴⁶ Failure to meet this NPSG could affect Joint Commission accreditation decisions.

Metrics

Metrics should be developed to measure the prevalence of hospital-acquired infections caused by resistant organisms, antimicrobial susceptibilities of common pathogens obtained from antibiograms, antimicrobial use patterns, health care costs, and other variables related to hospital-acquired antibiotic-resistant infections in the institution. The data collected using these metrics can illustrate problems and provide support for implementing and continuing ASPs. Comparison of data collected before and at appropriate intervals after implementing an ASP can be used to demonstrate the impact of the ASP and detect trends.

Antibiograms are reports of the susceptibility of various pathogens to different antibiotics during a specific period (usually 1 year). Susceptibilities often vary among different regions in the country, different hospitals in a city, and even different areas in a hospital (e.g., intensive care units). Antibiograms are compiled by the clinical microbiology department for the overall institution and various hospital locations. The information provided in antibiograms is useful in conjunction with data on antimicrobial use and costs for common hospital-acquired infections because antibiograms reflect local microbiology and resistance patterns. The insight obtained from these data can be used to establish guidelines and clinical pathways for empiric antimicrobial therapy that optimize clinical outcomes and minimize health care costs.

Antibiograms typically provide susceptibility data for an isolate to various individual antimicrobial agents, but antibiograms are not useful for identifying the most effective combination antimicrobial therapy for the isolate. Combination antibiograms provide information about the susceptibility of isolates to various combinations of antimicrobial agents.⁴⁷ In critically-ill patients, combination antibiograms have been found useful for selecting the dual empiric antimicrobial therapy that is most effective against multidrug-resistant pathogens while minimizing unnecessary antibiotic exposure.⁴⁸

Information gleaned from the use of process and outcome metrics can be used to evaluate ASP success and make decisions about how best to invest limited resources in ASP activities. For example, the number of recommendations for antibiotic use implemented is a process metric that reflects ASP acceptance, and a low rate of implementation suggests a need for education. The percentage of isolates of a pathogen with antimicrobial resistance and the number of resistant hospital-acquired infections per 1000 patient-days are outcome metrics that reflect ASP success.⁴¹ A longer period often is required before improvement is observed in these and other outcome metrics than improvement in process metrics.⁴¹ Other process metrics include the number of full-time equivalents dedicated to ASP activities and amount of time invested in ASP activities.

Data from antibiograms may be useful as outcome metrics of the success of ASP activities, but antimicrobial resistance rates should not be relied on solely to judge the success of the ASP.⁴⁹ Resistance rates may also reflect the impact of infection prevention and control measures and the transfer from nursing homes of patients with antimicrobial-resistant infections.^{30,50}

Reports of data gathered using metrics should be prepared and shared with hospital administrators and other stakeholders.⁴¹ Comparisons of data gathered using metrics may be made with benchmarks established at other hospitals in a region or throughout the nation.⁴¹ Reports should be tailored to the audience, with an emphasis on cost data for administrators and safety data for clinicians.

Information Technology

Computerized physician order entry and electronic clinical decision support systems can facilitate the implementation of many of the ASP interventions and overcome many of the barriers to ASP implementation listed in Table 2. Systems with the capability for managing data on a real-time basis are particularly valuable. Ideally, interfaces between the clinical laboratory and the CPOE system are established to facilitate the use of evidence-based guidelines and clinical pathways with antibiotic selection based on culture and antimicrobial susceptibility data.

Information technology can be used to efficiently collect and analyze data related to metrics to yield meaningful insight into the impact of ASP activities. Antimicrobial drug use data that illustrate problems with antimicrobial prescribing that involve specific physician services, types of patients, hospital units, or antimicrobial agents can be generated using information technology.

The use of information technology can minimize the staff time needed for labor-intensive ASP interventions, especially formulary restriction, preauthorization, and antimicrobial order forms. Incorporating guidelines and clinical pathways into CPOE systems has the potential to improve adherence.⁵

Information technology also can be used to educate physicians, other health care professionals, students, and patients about ID and the need for antimicrobial stewardship. Hospital-specific applications posted on the Internet for downloading and use on smart phones, tablets, and other mobile communications devices have been developed to promote antimicrobial stewardship.⁵¹

The availability of information technology and information systems specialists often is limited in small community hospitals in rural areas.⁴¹ These limitations must be considered in selecting metrics and planning ASP interventions. However, sophisticated information systems are not necessarily required for a successful ASP. The scope of the ASP should take into consideration the available information technology, personnel, and other resources.

Personnel

A lack of pharmacy personnel with advanced training in ID is often viewed as a barrier to ASP implementation, although it need not be. Completion of a postgraduate year (PGY) 1 residency and a PGY2 residency in ID and board certification as a pharmacotherapy specialist are recommended by the Society of Infectious Diseases Pharmacists (SIDP) and the Infectious Diseases Practice and Research Network of the American College of Clinical Pharmacy.⁵² An online listing of ID residency training programs and fellowships is maintained by SIDP. Some PGY2 residency training programs in ID are accredited by ASHP.

The number of advanced training opportunities in ID is limited, and these programs are time consuming.¹⁴ Therefore, the availability of pharmacists with advanced ID training is limited, resulting in competition among employers for qualified candidates. Recruiting pharmacists with advanced ID training is difficult, especially at small or rural hospitals with limited financial resources.

In many institutions, the responsibility for antimicrobial stewardship falls to pharmacists without advanced ID training. These individuals can contribute to antimicrobial stewardship in substantial ways. For example, staff pharmacists can identify patients receiving i.v. therapy that could be converted to oral therapy, detect therapy that has exceeded the recommended duration, and screen orders for restricted antimicrobial agents that require authorization or are not consistent with guidelines or clinical pathways.³⁰

Pharmacists without advanced ID training can augment their knowledge of the subject through various educational programs that are more readily available and less time consuming than ID residencies. An antibiotic stewardship certificate program for pharmacists recently was developed by SIDP. An antimicrobial stewardship training program for pharmacists is available from MAD-ID Making a Difference in Infectious Diseases Pharmacotherapy. The SIDP and MAD-ID programs use a variety of formats, including live webinars, to deliver didactic information and teach practical skills.

A variety of less formal methods may be used by pharmacists to learn about ID and antimicrobial stewardship, including attending rounds with ID physicians.

Identifying a pharmacist or physician mentor with ID expertise and discussing patient cases with this mentor is another method. Participating in ID-related continuing education programs also can be helpful.

Although the IDSA/SHEA guidelines call for a pharmacist with ID training and an ID physician to serve as core members of the antimicrobial stewardship team, the lack of these personnel should not impede ASP implementation.⁴¹ A clinical pharmacist or pharmacy resident with an interest in ID but no advanced training or the director of pharmacy could serve as a core team member. Similarly, a staff physician, resident, or fellow with a strong interest in ID could serve on the team in institutions that lack an ID physician. Physician and pharmacist members of the pharmacy and therapeutics committee might serve on the ASP core team because this committee is the ideal forum for coordinating ASP activities due to its authority for managing antibiotic use in the institution.

If an infection control professional is not available to serve on the core team at an institution, a member of the infection prevention and control committee might suffice. A patient safety representative is an alternative because patient safety is a focus of ASP activities.⁴¹

Physician Resistance

Implementation of an ASP may be hindered by a lack of cooperation from the medical staff for various reasons, including resistance to change. A diplomatic approach is needed in addressing such situations. Many physicians at small community hospitals are private practitioners who consult on a part-time basis, and they may be unaware of ASP goals and requirements.⁴¹ Medical residents and house staff at teaching hospitals often are receptive to feedback about antimicrobial prescribing but reluctant to implement ASP recommendations without consulting the attending physician.⁴¹

Involving key staff in ASP development and obtaining their buy-in before initiating an ASP can facilitate the implementation process. The benefits and requirements of the ASP should be explained to all staff who will be involved in the ASP to promote adherence. A variety of formats may be used for education (e.g., in-service programs, grand rounds, electronic newslet-

ters). Patient safety should be emphasized to dispel the common misperception of ASP as a cost-driven bureaucratic effort that undermines physician autonomy. The educational message should be tailored to the audience, with different content for emergency department physicians who administer first doses of antibiotics and ID physicians who manage subsequent therapy.⁵ The design of ASP processes should be user friendly to facilitate adherence.⁵

The assistance of an ID physician champion (i.e., key opinion leader) can be obtained to address problems with uncooperative colleagues, but this remedy may not be feasible in small hospitals without ID physicians. The authority and support of hospital administration may be needed to address problems with uncooperative prescribers.⁴¹

Starting Small

Implementing an ASP where none exists can be daunting, especially when resources are limited. Establishing realistic goals for the ASP and focusing initially on activities that are readily implemented (e.g., addressing problems with the prescribing of only a few antibiotics or the treatment of a few types of infections) are recommended, especially if these “low-hanging fruit” have proven benefits. Because the ESCAPE pathogens in Table 1 are responsible for most hospital-acquired infections in the United States, the ASP should focus on these organisms.^{5,12} Subsequent efforts can be more ambitious, especially if results of initial efforts are sufficient to obtain additional resources for ASP activities.

Conclusion

Pharmacists can play an important role in reducing the threat to public health and costs of hospital-acquired antibiotic-resistant infections through antimicrobial stewardship. Implementing an ASP can present a challenge because of limited resources and other barriers. Institutional needs and available resources should be taken into consideration in planning a strategy for ASP implementation that optimizes the use of limited resources, overcomes barriers to implementation, and improves clinical outcomes.

Target Audience

This continuing pharmacy education (CPE) activity is beneficial for pharmacists, including clinicians, managers, and educators who are interested in learning more about implementing antimicrobial stewardship programs in health-systems.

Continuing Pharmacy Education



The American Society of Health-System Pharmacists is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education. This activity provides 0.5 hours (0.05 CEUs) of continuing pharmacy education credit (ACPE activity #204-000-11-422-H01P).

To receive CPE credit, participants must read the discussion guide, review the self-assessment questions, and [click on this link](#) to attest to completion of the activity and complete the activity evaluation. Participants may print their official statements of CPE credit immediately. The estimated time to complete this activity is 30 minutes. This activity is provided free of charge and is available from May 31, 2011 through May 31, 2013.

Self-Assessment Questions

1. **Which of the following is the primary goal of antimicrobial stewardship programs?**
 - a. To minimize antimicrobial use and unintended consequences from antimicrobial use.
 - b. To optimize clinical outcomes while minimizing unintended consequences of antimicrobial use.
 - c. To restrict antimicrobial prescribing and reduce health care costs.
 - d. To reduce health care costs without adversely affecting the quality of care.
2. **Which of the following ASP interventions is not routinely recommended by IDSA and SHEA?**
 - a. Combination therapy.
 - b. Streamlining or de-escalation of therapy.
 - c. Dose optimization.
 - d. Guidelines and clinical pathways.
3. **Discontinuation of broad-spectrum therapy and initiation of targeted therapy with a more narrow spectrum of activity based on the results of culture and antimicrobial susceptibility tests is an example of:**
 - a. Antimicrobial cycling.
 - b. Dose optimization.
 - c. Prospective auditing.
 - d. Streamlining therapy.
4. **The scheduled substitution of a specific antimicrobial agent or class for another to prevent or reduce antimicrobial resistance is known as:**
 - a. Antimicrobial cycling.
 - b. Dose optimization.
 - c. Prospective auditing.
 - d. Streamlining therapy.
5. **Which of the following trends in ASPs was observed over the past decade in U.S. hospitals?**
 - a. An increase in the number of ASPs, especially in small community hospitals, but no substantial change in direct compensation for ID physicians.
 - b. Increases in the number of ASPs and direct compensation for ID physicians.
 - c. An increase in the number of ASPs and a decrease in direct compensation for ID physicians.
 - d. No substantial changes in the number of ASPs or direct compensation for ID physicians.
6. **Which of the following is the most common barrier to ASP implementation in U.S. hospitals, according to the results of a 2009 survey of ID physician members of IDSA?**
 - a. Insufficient knowledge.
 - b. Lack of acceptance by physicians.
 - c. Lack of funding.
 - d. Nonadherence to guidelines.

7. Which of the following is an outcome metric for ASPs?

- a. Number of recommendations for antibiotic use implemented.
- b. Number of pharmacists assigned to ASP activities.
- c. Number of hours invested in ASP activities.
- d. Number of resistant hospital-acquired infections.

8. Which of the following is best used to overcome barriers to ASP implementation related to increased staffing requirements for labor-intensive ASP interventions and a lack of personnel?

- a. Antibigrams.
- b. CPOE.
- c. Education.
- d. Metrics.

9. Which of the following strategies is best used to prevent a lack of physician cooperation with ASP requirements?

- a. Distribute written policies, procedures, and guidelines for the ASP.
- b. Obtain support and authority for the ASP from administrators.
- c. Provide an analysis of the cost-effectiveness of the ASP.
- d. Involve physician champions in ASP development.

Answers: 1. b, 2. a, 3. d, 4. a, 5. c, 6. c, 7. d, 8. b, 9. d

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