INTRODUCTION

Antimicrobial Stewardship 2012: Science Driving Practice

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This edition of *Infection Control and Hospital Epidemiology* (*ICHE*) is dedicated to articles on antimicrobial stewardship. Though such articles appear regularly in the pages of *ICHE*, this is the first time that an entire issue has been devoted to the topic. By design, this issue comes at a time of tremendous growth in the importance of antimicrobial stewardship. The combination of rising rates of antimicrobial resistance, a rapidly dwindling effective antimicrobial armamentarium, and increasing financial pressures for hospitals has spurred new interest in the one intervention that has been proven to address all these problems simultaneously.

A number of organizations have recognized the importance of implementing stewardship interventions and programs in hospitals, with major efforts being spearheaded by the Centers for Disease Control and Prevention (CDC) and the Society for Healthcare Epidemiology of America (SHEA). The creation of SHEA's Antimicrobial Stewardship Taskforce and the launch of CDC's "Get Smart for Healthcare" campaign (http://www.cdc.gov/getsmart/healthcare) marked the start of a new era of a nationally coordinated effort to promote inpatient antibiotic stewardship in the United States. The growing importance and profile of antibiotic stewardship are reflected in the inclusion of several antibiotic quality measures in the new "inpatient infection control worksheet" currently being piloted by the Center for Medicare and Medicaid Services (available at https://www.cms.gov/Surveycertificationgeninfo/downloads/SCLetter12_01.pdf). The measures are not all encompassing, nor will they independently improve antibiotic use in hospitals. However, it is hoped that they will both raise awareness of the importance of improving antibiotic use in hospitals and help lay a foundation for accomplishing that goal.

This special issue of *ICHE* provides an important "snapshot" of the current state of the science of antimicrobial stewardship and includes several articles that help advance the field. The number of submissions for this special edition came as a pleasant surprise to all of us as more than 80 manuscripts were submitted for consideration. The editors have worked to select articles that both showcase the breadth and depth of current research on stewardship and highlight important lessons learned. When viewed as a group, several important themes emerge throughout the articles.

First, economic analyses of stewardship programs remain critically important and need to become more advanced. Hospitals have certainly not been immune from the current worldwide economic woes. Antimicrobial stewardship interventions are somewhat unique in healthcare in that they can improve both clinical and institutional outcomes. While many quality initiatives increase cost of care, stewardship interventions are economically attractive. Given this, there has perhaps never been a more important time to demonstrate the financial benefit of stewardship. Stevenson and colleagues[1] provide an excellent review on the economics of antimicrobial stewardship and provide a useful business case model that might help others seeking to demonstrate the important economic benefits of these programs. Also on the economic front is an important article from Standiford and colleagues[2] at the University of Maryland. Several studies have shown the important economic benefits of starting a stewardship program, but Standiford et al provide an analysis of the economic consequences of stopping a program. Their program was highly successful from an economic perspective, realizing a 46% decrease in antibiotic expenditures per 1,000 patient-days during its 7-year existence. The program was terminated in 2008, and within 2 years antimicrobial costs had increased by 32%—an increase driven largely by the use of broad-spectrum antibacterial agents often targeted by stewardship programs. The authors estimate that the decision to halt the program cost the medical center about $2 million over a 2-year period. This article should serve as a cautionary tale for any administrator who is contemplating curtailing or eliminating a stewardship program and should provide a useful business case for advocates of stewardship programs. Finally, Beardsley and colleagues[3] present an analysis of the long-term financial impacts of a stewardship program that has been active for more than a decade. This article is especially important as more stewardship programs leave childhood and enter adolescence. It is generally easy to demonstrate financial benefits of stewardship programs in early years due to decreased antimicrobial expenditures following implementation

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of interventions such as formulary restructuring and parenteral to oral conversion programs. It can be harder to show sustained financial impacts in subsequent years. Beardsley et al's submission not only demonstrates that stewardship programs do have sustained economic benefits but also provides a helpful methodology for calculating such benefits.

Second, as the practice of medicine increasingly shifts to non–acute care settings, we need to expand our knowledge of stewardship into these important new locations. Historically, stewardship efforts have been limited to acute care hospitals and even limited in their application in those facilities, with most published experience coming from academic medical centers. Several articles in this issue do help chart new territories for stewardship efforts. Shrestha and colleagues[4] summarize their experience with a stewardship intervention focused on the transitions of care to outpatient parenteral therapy. In nearly a third of all cases, their program was able to avoid postdischarge parenteral antibiotics—not only saving resources but also improving the quality of life of the patients. This type of intervention will likely become increasingly important as the quickening pace of health care leads to more and more referrals for outpatient parenteral antibiotics and scrutiny of transitions of care intensifies at the national level. Pate et al[5] demonstrate that stewardship interventions can be successfully implemented in a long-term acute care facility—a setting where stewardship has been historically problematic. What is especially important about their article is the fact that the interventions were accomplished within the resource constraints of the facility. There is also little information on antibiotic use and potential stewardship targets in pediatric hospital settings. To address this gap, Levy et al[6] provide a nice longitudinal 3-year assessment of the appropriateness of antimicrobial use in a children's hospital. The good news is that the authors found that rates of appropriate use were better in their facility than in many publications examining use in adult acute care settings. At the same time, they found some key opportunities for improvement on critical care and surgical services. Surgical units are another area where stewardship has traditionally been a challenge. However, the article by Dubrovskaya et al[7] shows how one facility used the 2010 publication of guidelines on management of intra-abdominal infections to improve the use of antibiotics by their surgical services. Finally, many antimicrobial stewardship programs have avoided interventions in intensive care settings. Elligsen and colleagues[8] counter this practice with a study that showed that a postprescription review program in their intensive care unit reduced *Clostridium difficile* cases and was associated with an improvement in the overall susceptibility to meropenem.

Third, this stewardship special issue also highlights the fact that considerable room for improvement and further study remains. Despite numerous publications demonstrating the benefits of parenteral to oral conversion programs and several articles detailing methodologies for implementation, the article by Jones and colleagues[9] suggests that this remains a prime area for interventions. The authors reviewed fluoroquinolone use at 128 Veterans Affairs hospitals and found that nearly half of all days of intravenous fluoroquinolone therapy were avoidable. This could represent an easy target for many stewardship programs, including those with significant resource constraints and even in facilities that might have thought this issue had been addressed.

Last, but certainly not least, this issue features an article from the CDC Prevention Epicenter facilities that is, to our knowledge, the first multicenter trial of an antimicrobial stewardship intervention.[10] The results of the intervention were mixed: use was significantly reduced in 2 facilities, increased in 2 facilities, and unchanged in another. The authors delve into a few potential explanations for why this might have occurred and suggest that the key predictor of success of the new intervention might have been the presence of an established stewardship program. Perhaps even more important than the results of this study is its very existence as a grant-supported, multicenter stewardship interventional trial, using standard methodologies for assessing interventions and outcomes across 5 very different facilities. This study brings an apparent paradox of stewardship research into sharp focus. Large studies like this need to be supported and repeated in other settings and with other types of interventions. But even while we call for larger and more complicated studies of stewardship interventions, the gaps in our knowledge of stewardship demonstrate the simultaneous need for smaller and simpler trials. Although this study represents a significant advance in the science of antimicrobial stewardship, one should not underestimate the importance of smaller-scale investigations that can be conducted at single centers or through research collaboratives such as the SHEA Research Network.

Studies examining the implementation of "simple" interventions remain important as we work toward expanding the scope of antimicrobial stewardship. What will be critical to these future studies is that they continue to advance the assessment of outcomes. We must move beyond an exclusive focus on process measures and toward evidence-based appraisals of validated outcome measures. The review article by Dr John McGowan[11] provides a very nice summary of where we are currently with respect to assessment of stewardship programs and, more importantly, some thoughts on how we can move forward.

There has perhaps never been a more critical juncture for antimicrobial stewardship. There is growing interest from key stakeholders—clinicians, healthcare administrators, and policy makers—and a growing body evidence demonstrating the benefits of stewardship. We now need to harness the interest and the science to move toward making stewardship programs an integral part of all healthcare facilities. Education and messaging will play an important role. For too long, our message on the benefits of stewardship has been too narrowly focused on reducing costs and potentially reducing antibiotic resistance. The former is not compelling to most clinicians, and the latter, while generally accepted, has been difficult to

demonstrate clearly since the emergence and spread of resistance is so complicated and multifactorial. Moving forward, we need to emphasize that antibiotic stewardship is, fundamentally, a critical patient safety and public health issue for all healthcare settings that can improve the quality of care.

To this end, this issue also includes a joint policy statement from SHEA, the Infectious Diseases Society of America, and the Pediatric Infectious Diseases Society[12] that outlines a national approach to antimicrobial stewardship and another position paper from SHEA and the Association of Professionals in Infection Control and Epidemiology[13] that describes a role for infection preventionists in antimicrobial stewardship. When implemented properly, stewardship imparts important benefits simultaneously to individual patients, with improved cure rates and reduced risks of *Clostridium difficile* infections and other antibiotic-associated adverse events, to healthcare settings, with reduced rates of antibiotic resistance, and to society overall with reduced healthcare costs. Our communications goal must now be to help others recognize these realities, and it is our hope that this special issue of *ICHE* is a step in that direction.

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