



A Path to Better Antibiotic Stewardship in Inpatient Settings

10 case studies map how to improve antibiotic use in acute and long-term care facilities

The Pew Charitable Trusts

Susan K. Urahn, *executive vice president*

Allan Coukell, *senior director*

Elizabeth Jungman, *director*

Antibiotic resistance project

Kathy Talkington, *project director*

David Hyun, *senior officer*

Deepa Raj, *senior associate*

External reviewers

This report benefited from the insights and expertise of external reviewer Arjun Srinivasan, M.D., associate director of health care-associated infection-prevention programs at the Centers for Disease Control and Prevention (CDC), as well as all of the facility stewardship personnel who both shared and reviewed their information. Neither the external reviewers nor their organizations necessarily endorse the findings provided in this report.

Acknowledgments

The authors are grateful to Joe Boero, Andrea Chbeir, Elizabeth Dodds Ashley, Immanuel Ijo, Danielle Kunz, Bridget Olson, Hien Huy Nguyen, Jo Watkins, Debbie Wiechman, and Montgomery Williams, who all participated in multiple interviews sharing information contained in the case studies. We appreciate the assistance of consultant Kavita Trivedi, who conducted these interviews and compiled the information that served as the foundation for this report.

We thank the following Pew colleagues for their contributions to this report: Bernard Ohanian, Demetra Aposporos, Laurie Boeder, Heather Cable, and Katherine Portnoy for their editorial input; Teresa Wilson and Carol Hutchinson for copy editing; and Sara Flood for her work preparing this report for publication.

Cover photo: Getty Images

Contact: Heather Cable, officer, communications

Email: hcable@pewtrusts.org

Phone: 202-552-2059

The Pew Charitable Trusts is driven by the power of knowledge to solve today's most challenging problems. Pew applies a rigorous, analytical approach to improve public policy, inform the public, and invigorate civic life.

Contents

1 Overview

Key findings 2

4 Case studies

A. Vibra Hospital of Northern California 4

B. Park Manor Nursing Home 7

C. Williamson Medical Center 11

D. St. Tammany Parish Hospital 16

E. Blessing Hospital 20

F. Asante Health System 23

G. Sharp Villa Coronado 27

H. University of California, Davis Medical Center 31

I. Strong Memorial Hospital 35

J. University of Alabama at Birmingham Hospital 38

41 Endnotes

Overview

Antibiotics should be used only to treat bacterial infections, and should be prescribed only in doses and for durations appropriate for the patient and infection being treated. Yet the Centers for Disease Control and Prevention (CDC) estimates that up to 50 percent of all antibiotics prescribed in the U.S. are unnecessary or inappropriate, with many of them prescribed in inpatient settings.¹ All antibiotic use contributes to the proliferation of antibiotic-resistant bacteria, and more than 2 million people are infected with antibiotic-resistant organisms each year in the United States, resulting in more than 23,000 deaths.² Furthermore, antibiotic exposure increases the risk of developing a *Clostridium difficile* (*C. difficile*) infection, an illness that usually manifests as diarrhea but can be fatal in extreme cases.³ Antibiotic use also carries the risk of allergic reactions and adverse interactions with other medications.⁴

Antibiotic stewardship programs (ASPs), which are designed to minimize the harmful effects of inappropriate or unnecessary antibiotic use and slow the spread of resistance, promote the responsible use of antibiotics. ASP staff members utilize stewardship actions such as measuring a facility's antibiotic use, providing infectious disease (ID) or pharmacy consultation for prescribers, requiring advance authorization before a physician can prescribe certain antibiotics, and tracking the results of these efforts, to encourage more appropriate antibiotic use.

Many inpatient facilities have recently begun ASPs, driven in part by new mandates. Recent federal policy proposed ASPs for acute care hospitals and long-term care facilities nationwide,⁵ and California state law now requires ASPs in acute care hospitals.⁶ Though widespread implementation of ASPs will take considerable time and effort, these programs provide innumerable benefits: They improve patient safety, minimize unintended consequences associated with all antibiotic use⁷ and can lower total medical costs.⁸

A number of tools exist to guide facilities in the development of ASPs, including the CDC publications "[Core Elements of Hospital Antibiotic Stewardship](#)" and "[Core Elements of Antibiotic Stewardship for Nursing Homes](#),"⁹ and joint recommendations from the [Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America \(IDSA/SHEA\)](#).¹⁰ The CDC's guidelines suggest that ASPs include some or all of the following seven elements:

- **Leadership commitment:** Dedicating the necessary human, financial, and information technology resources to the program.
- **Accountability:** Appointing a leader who is responsible for program outcomes.
- **Drug expertise:** Identifying a pharmacist in charge of working to improve antibiotic use within an institution.
- **Action:** Implementing at least one CDC-recommended action, such as the systemic evaluation of the need for ongoing treatment of a patient with antibiotics after a set period of initial treatment (i.e., an antibiotic timeout, or a reevaluation of the drugs being used, after 48 hours).
- **Education:** Teaching the institution's clinicians and relevant medical staff about antibiotic resistance and optimal prescribing habits.
- **Tracking:** Monitoring patterns of antibiotic prescribing and resistance within the institution.
- **Reporting:** Relaying information on antibiotic use and resistance within the institution on a regular basis to doctors, nurses, and relevant staff.

Less than 40 percent of U.S. hospitals have ASPs that include all seven core elements.¹¹ Many hospitals and inpatient facilities have stewardship programs that apply at least one of these steps, but as federal regulations

take effect and the benefits of stewardship programs become more widely recognized, the number of facilities that implement ASPs with all seven core elements will probably grow.

To illustrate multiple approaches to ASPs, and provide useful examples to health care facilities seeking to establish or improve their antibiotic stewardship efforts, this report provides 10 in-depth case studies of institutions that have implemented ASPs. These facilities were selected to describe how a wide variety of institutions, with diverse financial and staff resources, have been able to implement programs that successfully demonstrated favorable economic and patient outcomes.

Key findings

Though ASPs differ in their details, these case studies reveal themes that are critical to any successful program implementation. One is the presence of an influential stewardship champion: someone within the institution who strongly believes in, and is committed to, antibiotic stewardship. St. Tammany Parish Hospital in Covington, Louisiana, for example, found that the active involvement of the ID physician who championed the cause of responsible antibiotics use was integral to the longevity of the program. This physician initially encountered internal resistance to the idea of an ASP but helped drive momentum and ensure that the program was successfully implemented.



Since implementing our antibiotic stewardship program, we've seen decreased antimicrobial costs and fewer *C. difficile* cases."

Montgomery Williams, *Williamson Medical Center*

Another aspect evident throughout these case studies is a shared responsibility for monitoring the program and implementing new interventions. While a physician champion is critical to a program's success, the champion alone cannot execute the program; this champion must invariably collaborate with multiple colleagues, including pharmacists, infection control staff, nurses, and hospitalists, in order to incorporate ASP elements into daily work routines. At Park Manor Nursing Home in Park Falls, Wisconsin, for example, the front-line nurses are essential to monitoring and improving antibiotic use. They investigate changes in a patient's condition, follow up on microbiology laboratory results, reconcile and adjust antibiotics for any change in condition, and ensure that each patient receives the correct drug in the right dosage and duration. Such a model of shared responsibility, one that trains and engages all staff in ASP policies and procedures, can help employees to embrace and implement stewardship programs.

While the facilities featured in this report were successful by many accounts, some also encountered challenges, such as insufficient funding. Many of these facilities managed to implement robust programs without adding significant numbers of staff; however, each of the programs reported that additional personnel would allow their ASPs to be more effective. Sharp Villa Coronado long-term care facility in California obtained dedicated time for the stewardship pharmacist but lacked immediate resources to fund other full-time positions for either a pharmacist or physician. Instead, the ASP increased the facility's ability to monitor antibiotic use by involving ID pharmacy students in stewardship activities. Staff of other programs also reported that dedicating at least a portion of team salaries to stewardship duties made their ASPs more sustainable and ensured the continued sustainability of a strong program in the event of key personnel loss.

The use of technology varied across programs but emerged as a common theme. For example, at the University of Alabama at Birmingham Hospital, computerized physician order entry and automated dispensing cabinets allowed for easy tracking and dispensing of antibiotics, and bedside bar-coding automatically documented and verified the administration of medication. One ASP that struggled with limited information technology (IT) infrastructure responded with labor-intensive data collection; while this was time-consuming, the program was no less successful than facilities with considerably more IT resources. These case studies demonstrate that, even for a facility with limited IT capacity, robust antibiotic surveillance and the meaningful analysis of data are achievable.

To build or sustain ASPs, many facilities had to demonstrate to administrators the benefits of stewardship programs and justify their costs. Some facilities implemented pilot projects, which were extremely useful for testing an individual intervention, quantifying cost savings, or measuring patient outcomes. In many facilities, ASPs gained support after these pilot projects showed favorable results. At Blessing Hospital in Quincy, Illinois, for example, the pharmacy conducted a three-month pilot study on the use of four antibiotics (aztreonam, tigecycline, daptomycin, and linezolid), monitoring adherence to a set of prespecified criteria for their appropriate use. The study assessed monthly savings, demonstrated opportunities for improvement in prescribing, and weighed potential clinical and economic consequences. As a result of the study, the hospital administration approved the ASP in July 2011.

This report includes, where available, results that show improved patient outcomes and trends in antibiotic use and that demonstrate reductions in adverse events and health care costs. These case studies also discuss issues related to an ASP's development, ongoing sustainability, and future plans for enhancement. Lastly, each case study includes a "lessons learned" section, which provides useful findings for institutions that seek to establish their own ASPs. All of the information presented was provided, and reviewed by, stewardship personnel at each facility.

Case studies



Structure and resources

VHNC is a long-term acute care hospital with 56 licensed beds regulated under acute care hospital requirements. The length of stay averages 25 days per admission. There is also a transitional care unit with 32 beds that is regulated under skilled nursing facility requirements. VHNC is part of a larger hospital corporation, Vibra Healthcare (Vibra), that operates in 18 states.

VHNC serves a patient population that requires acute or rehabilitation care for extended periods of time. Approximately 95 percent of patients are admitted to VHNC with a diagnosed infection and already are receiving antibiotics.

Infectious disease (ID) and pharmacy services: One contracted ID physician spends approximately six hours per week working with the ASP at VHNC. Pharmacy staff includes a director of pharmacy services, four pharmacists, and four pharmacy assistants. Two to three clinical pharmacists are usually present five days a week and a half-day on weekends and are on call at all other times. All of the pharmacy staff members support ASP activities.

Information technology (IT): VHNC uses MedHost Solutions to manage health records, including computerized physician order entry (CPOE) and most laboratory and pharmacy data. There is no clinical decision support system (CDSS) for stewardship interventions.

Laboratory: Dignity Healthcare, an off-site facility, performs laboratory services and reports results within the electronic health record (EHR).

Planning, development, resources, and skills

VHNC's ASP began in 2010 after an increase in *C. difficile* infection rates was observed and the ID doctor was concerned about the number of antibiotics that patients being transferred to the hospital had been prescribed. Some patients developed severe *C. difficile* infections, which led to an excessive number of surgeries and colostomies. ID and infection control staff approached the main hospitalist and the pharmacy director with an initial mission of curbing the spread of *C. difficile* and then began conceptualizing an ASP. Administrators recognized the link between *C. difficile* and antibiotic use and were therefore supportive of the ASP.

To develop the ASP program, the team identified useful tools that included criteria for developing an ASP, such as the 2007 IDSA/SHEA Guidelines, as well as additional policies and recommendations shared by Vibra's corporate management, which the VHNC team adapted. They used an ASP toolkit assembled by the [California Department of Public Health's Healthcare-Associated Infections Advisory Committee](#). The toolkit provides examples of stewardship activities for those newly implementing an ASP and was a particularly useful guide for VHNC staff members as they developed their ASP and defined the scope of activities.



Our antibiotic stewardship program's initial review of 93 patient charts yielded recommended interventions for the majority of those patients."

Debbie Wiechman, *Vibra Hospital of Northern California*

Stewardship overview

The ASP is housed under VHNC's Pharmacy and Therapeutics (P&T) division, which comprises physicians and pharmacists responsible for management of medications in a hospital. The ASP team consists of an ID physician, an infection preventionist, an on-duty hospitalist, and multiple clinical pharmacists. The team has no dedicated staff full-time equivalents (FTE); instead, team members have incorporated their ASP work into existing duties.

- **Leadership commitment:** VHNC's administration supports the ASP through the implementation of formal institutional policies and procedures for antibiotic stewardship. It has also incorporated stewardship-related duties in the job descriptions of ASP team members.
- **Accountability:** The pharmacy director is responsible for program outcomes and overseeing the ASP's progress in improving antibiotic use.
- **Drug expertise:** The ID physician and clinical pharmacists provide drug expertise. The program also designates one of the clinical pharmacists as the primary ASP pharmacy leader to provide more consistent expertise for their daily stewardship activities.
- **Action:** The ASP team provides prospective audit and feedback, which includes monitoring pharmacy prescriptions and providing recommendations to modify therapy as necessary, for all VHNC patients through chart review. Targets of these services include antibiotic therapies that have continued for more than 72 hours, therapies without a documented discontinuation date in the prescription orders, therapy regimens that include more than one redundant antibiotic with overlapping indications, and therapies that utilize more than three antibiotics. The program also performs reviews for antibiotic dose optimization, and timely transitions from intravenous to oral antibiotic therapy when appropriate.
- **Education:** All staff members undergo training on ASP policy and procedures during new employee orientation and committee meetings.
- **Tracking:** The ASP monitors adherence to pharmacy stewardship recommendations as a process measure. The program assesses its outcomes by measuring antibiotic use, costs, susceptibility data, and rates of infection for *C. difficile* and multidrug-resistant organisms.
- **Reporting:** The ASP reports data to all hospital committees that undertake clinical quality improvement activities. The program compiles a facility-level scorecard that includes process and outcome measures, and a corporate scorecard comparing ASP data across various Vibra facilities. In addition, recommendations based on chart reviews done to assess the appropriateness of antibiotic use are made available to primary providers.

Results

VHNC tracks adherence to stewardship recommendations (process measures), as well as antibiotic use, cost, susceptibility data, and rates of infections for multidrug-resistant organisms (an outcome measure). VHNC also tracks *C. difficile* infection rates as part of a recently implemented policy, but specific data were not available for this report. According to VHNC ASP's most recent review of its stewardship program, the ASP team recommended interventions for 93 patient cases in May and June 2015 based on review of patient charts. Of these patients, all of whom were on antibiotics, 46 required stop dates, which designate when a current course of antibiotics should be discontinued; 42 discontinued antibiotics; 10 received newly prescribed antibiotics or a different drug after a review of cultures; and four doses were changed to better correspond to the patient's weight or renal function. All 93 patients whose charts were reviewed required a change to their antibiotic therapy, and some required multiple interventions.

Sustainability

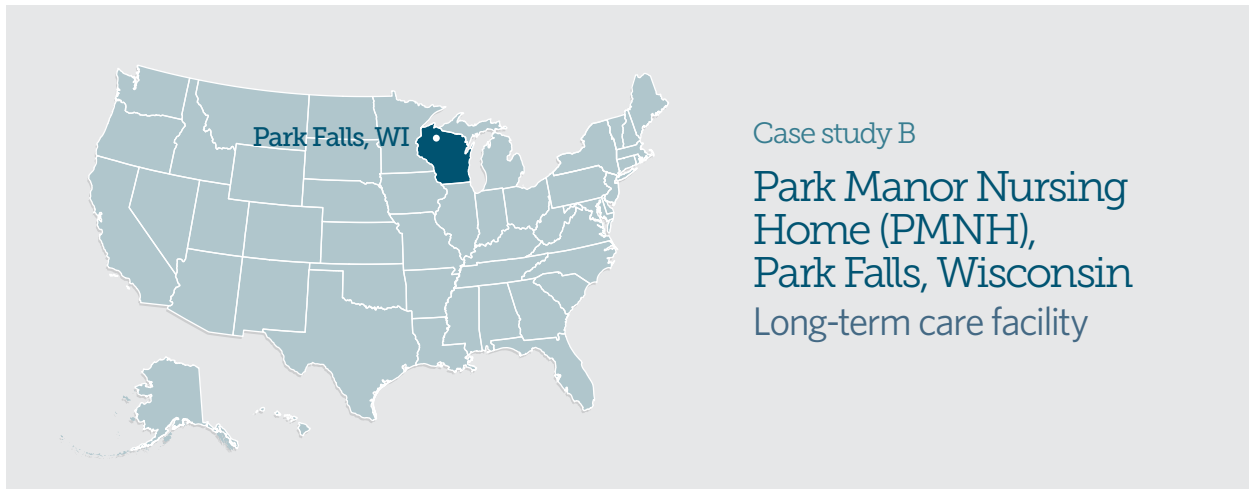
VHNC and its ASP have taken steps to make the program sustainable. In January 2015, the ASP was implemented as a formal policy and procedure, which VHNC ASP members expect will help ensure continuation of the program despite future changes in personnel. In addition, the ASP team believes that the program's institutional achievements, as demonstrated through process and outcome metrics, will help maintain the administration's strong support and commitment. Finally, the program identified a candidate to serve as the primary ASP pharmacist.

Lessons learned

- The ASP team at VHNC found that linking antibiotic use with an increase in *C. difficile* cases or other health care-associated infections can help both administration and staff members understand the need for antibiotic stewardship and build administrative support.
- The team found that training a variety of staff members on ASP policy and procedure can help ingrain stewardship into a facility's culture. Different avenues, such as committee meetings and new employee orientation, can be used to ensure that all staff members are educated.
- Sharing ASP policies and procedures from a corporate entity across various facilities may be useful and can offer an additional support system for nascent programs.

Contact person:

Debbie Wiechman, R.N., C.I.C., infection preventionist
Vibra Hospital of Northern California
Redding, California
dwiechman@vhnorcal.com



Structure and resources

PMNH is a private (employee-owned), for-profit skilled nursing facility with 90 licensed beds, including 11 in the dementia unit, and an average daily census of 70 to 80 residents who are unable to care for themselves at home.

The facility also accepts residents with multiple conditions and those who require intensive skilled care. PMNH does not provide dialysis or ventilator support.

The majority of residents are insured through Medicaid, with a significant number insured through Medicare. Medical staff is composed of primary care providers from the nearby Park Falls office of the Marshfield Clinic, where providers offer family and internal medicine services. A telehealth studio is available to allow nursing home staff to consult with off-site specialty providers.

ID and pharmacy services: No formal ID consultation or on-site pharmacy is available to the ASP at PMNH; the local community pharmacy provides prescription services. Consulting pharmacist services for the PMNH facility are contracted to the local pharmacist.

IT: PMNH uses an electronic medical record system, and there is an internal messaging capability that facilitates electronic communication between staff. Microbiology culture results are manually scanned into medical records. These are used to determine what kind of organism is infecting a patient and which antibiotic orders are needed. No clinical decision support system exists for stewardship interventions.

Laboratory: PMNH has an on-site laboratory that performs simple tests but lacks capacity to perform microbiology tests that identify infection with specific organisms and show what antibiotics might be effective for treatment. Instead, cultures are sent to a reference lab (Dynacare) affiliated with the University of Wisconsin, Milwaukee, with FedEx providing 24-hour delivery. Laboratory and radiology data, as well as physician notes, arrive from Dynacare via fax and are imported into the electronic charting system. The nearby Flambeau Hospital provides backup laboratory services.

Planning, development, resources, and skills

PMNH's ASP was formed in July 2006 after an outbreak of methicillin-resistant *Staphylococcus aureus* (MRSA), a bacterium that can cause mild to severe skin infections, occurred among facility employees and became public

knowledge. Over the last nine years, the ASP has evolved through a process of trial and error. According to the ASP team, the administration has been supportive since the program's inception, because dealing with increasing numbers of staff members and residents with MRSA infections was cost prohibitive. The ASP's initial work during PMNH's MRSA outbreak included creating systems to profile physician antibiotic use and collect data for assembling an annual antibiogram, which helped ensure that appropriate antibiotics were used to treat MRSA infections.

In this institution, education is facilitated via face-to-face interactions between stewardship leaders and prescribers, and this practice of direct feedback has helped dispel common misperceptions among front-line staff. For example, the ASP team found that the belief that antibiotics were required when asymptomatic bacteria are detected in the urinalysis of long-term care patients (a condition known as bacteriuria) was deeply ingrained in the medical staff. In most of these cases, however, antibiotics were not required. The ASP undertook educational efforts to overcome this and other misperceptions and shift the prescribing habits of staff.

Many tools have been useful to PMNH's ASP, such as data collection systems, communication scripts, and professional guidelines. One example is culture and antibiotic use spreadsheets that track the types of bacterial strains identified in samples collected from each resident and the antibiotics used to treat these strains. Another example is nurse communication scripts, which are checklists that nurses can use to ensure that they accurately communicate all relevant clinical information to off-site physicians. These scripts are especially useful when nurses report a patient's change in condition to an off-site physician, because the doctors are subsequently able to adjust antibiotics if necessary. Additionally, PMNH utilized standard long-term care surveillance criteria (known as the [McGeer criteria](#)) for urinary and respiratory tract infections to provide guidelines for appropriate antibiotic usage, as well as the IDSA/SHEA guidelines for developing and expanding stewardship programs.



Determining how to engage physician providers without disenfranchising and alienating them can be difficult.”

Joe Boero, Park Manor Nursing Home

Stewardship overview

PMNH's ASP team consists of three nurses, including an infection control nurse, one data entry clerical assistant, and the medical director, all of whom spend a portion of their time on ASP efforts. The ASP reports to the Quality Assurance Committee.

- **Leadership commitment:** PMNH's administration supports the ASP by ensuring that staff members are allocated sufficient time to contribute to stewardship. The infection control nurse has approval to spend one-quarter of her time on infection control, which includes ASP-related duties; an additional staff nurse assists the ASP for four hours each week; and a data entry clerical assistant spends two hours per month tracking data for the program. The facility also recently committed the director of nursing to five to six hours per week to the program.
- **Accountability:** The medical director leads the ASP and is responsible for the program.
- **Drug expertise:** The medical director, infection control nurse, and director of nurses dispense drug expertise for the ASP. PMNH does not have a pharmacist on staff, and the community pharmacist who provides consulting pharmacy services to the hospital does not consult for the ASP.

- **Action:** The ASP provides feedback to physicians on the appropriateness of their antibiotic prescribing. The program creates antibiotic report cards for each physician; these allow for peer comparison of prescribing habits. The medical director also periodically communicates directly with individual providers in cases of inappropriate antibiotic prescribing. Front-line nurses are a critical resource for improving antibiotic use through PMNH's ASP. These nurses contribute unspecified but important time to the program in their daily work as they utilize nurse communication scripts to investigate changes in a patient's condition, document findings, record physician communication and orders, follow up on microbiology laboratory results, and reconcile antibiotics. They also use these scripts to ensure that the patient is receiving the correct drug in the right dosage for the appropriate duration.
- **Tracking:** The team documents adherence to recommendations as a process measure. To measure outcome, the program monitors institutional antibiotic usage rates and compiles the facility's annual antibiogram, a document summarizing antibiotic resistance rates based on the results of laboratory testing to help providers determine the optimal selection of antibiotics for treating bacterial infections.
- **Reporting:** The ASP annually provides antibiotic report cards to each physician and also provides the annual antibiogram.

Results

PMNH does not have an electronic charting system that collects metrics data for the program as a whole; however, annual antibiotic report cards and physician profiling are distributed to providers. In addition, culture results and antibiotic use are documented on a spreadsheet. Since the inception of the ASP, the facility has noted a reduction in the number of unnecessary antibiotic prescriptions. The following graphic shows the facility's overall antibiotic report card for all providers from 2014.

Figure 1

PMNH Antibiotic Report Card for Treatment of Respiratory Infection, 2014

Provider	Antibiotic starts	Appropriate	Not appropriate*	Percent not appropriate
Provider 1	38	36	2	5.3
Provider 2	24	23	1	4.2
Provider 3	8	6	2	25
Provider 4	2	2	0	0
Provider 5	0	0	0	0
PMNH cumulative	72	67	5	6.9

* Nursing home residents' clinical symptoms met the McGeer Surveillance Criteria for diagnosis of viral respiratory infection.

© 2016 The Pew Charitable Trusts

Sustainability

PMNH's ASP has identified several steps that could help maintain an effective program in the future.

First, the stewardship team would like to adopt an electronic medical record system that links the microbiology reference lab results and pharmacy to the infection control program. This would enable more efficient data

tracking, collection, and collation. The consistent application and interpretation of data with respect to metric definitions are necessary for an effective program. The manual data entry and analysis currently required of the team are time consuming.

Second, the program has identified a need for one or more pharmacists to review the appropriateness of antibiotic prescriptions. The contract pharmacist currently does not directly assist with the ASP and is therefore unable to recommend stewardship interventions in a timely fashion.

PMNH's ASP relies heavily on front-line nurse involvement, and communication between the medical director and physicians. The further development of relations and engagement with physicians will continue to be a focus.

As the program continues to evolve, Park Manor aspires to enroll in CDC's National Healthcare Safety Network Long-Term Care Module and hopes to see residual benefits from its ongoing investment in stewardship efforts. For example, expanded stewardship activities such as surveillance and outbreak identification could cultivate nursing skills that also apply to infection control and resident care.

Lessons learned

- Nurses can be integral to ASPs.
 - This team believes that because most clinical decisions made by the physicians treating nursing home residents are done without the benefit of a face-to-face evaluation between physician and patient, it is imperative that ASPs focus on strong communication between the nurse and the doctor regarding condition reports. The cultivation of stewardship skills and techniques across nursing staff has proved to be a valuable asset that lends itself to overall improvement in nursing care to elderly residents in PMNH.
 - Nurse communication scenario scripts may be particularly useful in optimizing antibiotics use, because they help nurses to ensure that they capture and disseminate all relevant patient information to physicians.
 - Sustainability of the ASP depends on ongoing, periodic feedback to the physician providers and front-line nursing staff.
- PMNH's ASP found that stewardship efforts can often be helped by antibiotic report cards with peer profiling as an instrument of provider feedback in conjunction with distribution of the annual institutional antibiogram.
- The team stressed that events, such as the MRSA outbreak at PMNH, can be used to motivate administrators and staff to implement a program. After implementing an ASP and modifying complementary infection control practices, this facility saw a decrease in MRSA cases, which helped to validate the program and the resources used to sustain it.

Contact person:

Joe Boero, M.D., medical director
Park Manor Nursing Home Ltd.
Park Falls, Wisconsin
dr.boero.pfrmc@gmail.com



Structure and resources

WMC has 185 licensed beds, including 20 intensive care unit beds and a 16-bed pediatric hospital with its own emergency room (ER). Many patients are admitted for orthopedic procedures. Roughly 40 percent of the patient population is insured under Medicare, with a significant minority insured under Medicaid. The facility sees fewer self-paying patients than surrounding hospitals.

ID and pharmacy services: Four physicians manage the ID consult service in rotation. The pharmacy is staffed by 16 clinical staff pharmacists, including a clinical pharmacy manager, a critical care pharmacist, and an internal medicine clinical pharmacist who is contracted for a half-time position through the local college of pharmacy.

IT: The hospital's EHR uses MediTech and a CPOE system. The CDSS flags potential stewardship issues and allows pharmacists to document their recommendations for modifying antibiotic therapies and subsequent acceptance rates of these recommendations by physicians.

Laboratory: The laboratory and microbiology department are located in-house, with microbiology staff members conducting all tests on cultures from the facility. They are able to perform rapid diagnostic lab testing for organism identification using polymerase chain reaction (PCR) testing, which is an effective and cost-efficient method for identifying bacterial organisms. The PCR technology will be used to identify viruses from respiratory samples and bacteria that are isolated from blood cultures. The ASP hopes these tests will help reduce unnecessary prescriptions.

Planning, development, resources, and skills

WMC's ASP began in 2009 under the leadership of an ID physician who recognized the need for stewardship and obtained salary support for the project from the hospital's administration. Original efforts focused on patient care in the critical care units. The ID physician met with the clinical pharmacy manager to review charts and discuss recommendations for 20 critical care patients. Together they made recommendations to the critical care unit attending physicians as part of the initial stewardship efforts at WMC. Six months later, with the hiring of an internal medicine pharmacist, stewardship was expanded to include patient care units outside of the critical care units.

Before the ASP, the formulary at this facility was open and unrestricted. In 2009, the ID physician and pharmacist worked together to develop a list of restricted antibiotics and nonformulary antibiotics (drugs not included in the hospital formulary for reasons of expense, drug safety, or efficacy), and suggested substitutions.

All pharmacy staff members are required to complete internal competency training for transitioning patients from intravenous to oral therapies in a timely manner, and also for pharmacokinetics in order to monitor the metabolism, distribution, and absorption of antibiotics. These ASP initiatives further develop pharmacy staff knowledge on antibiotic therapies, allowing them to incorporate components of stewardship into their daily work. During ASP meetings, student pharmacists are given the opportunity to discuss patients receiving antibiotic therapies and any relevant stewardship recommendations with the group.

The program also uses IDSA/SHEA guidelines on antibiotic stewardship, tools from the Society of Infectious Diseases Pharmacists [Certificate Program in Antimicrobial Stewardship](#) and the [CDC Checklist of Core Elements](#) to inform its work.

Stewardship overview

In September 2012, WMC's ASP was formalized as a subcommittee of the P&T Committee governed by the Medical Executive Committee. In 2014, an ASP Administrative Committee, co-chaired by the ID physician and internal medicine pharmacist, was created; it also includes the chief nursing officer, a nursing information technology specialist, a representative from patient safety and quality control, and the laboratory administrative director.

- **Leadership commitment:** WMC's administration provides salary support for the ID physician (approximately 0.1 FTE) dedicated to administration duties for antibiotic stewardship. No other staff salaries are designated to the ASP. However, all pharmacists at the facility have incorporated stewardship activities into their daily responsibilities, including the internal medicine pharmacist, who spends roughly a quarter of her time performing ASP activities.
- **Accountability:** The internal medicine pharmacist and ID physician co-chair the ASP Administrative Committee and are responsible for program outcomes.
- **Drug expertise:** The internal medicine pharmacist completed the Society of Infectious Diseases Pharmacists Certificate Program in Antimicrobial Stewardship in 2013 and now provides drug expertise for the ASP.
- **Action:** Through either manual chart review or automated surveillance alerts from the CDSS, the pharmacist identifies antibiotic therapies that require modification. ASP members then meet weekly to discuss therapy recommendations with primary providers. Antibiotic therapies that trigger an automated alert include antibiotics ordered for more than three days, those for patients with positive results for *C. difficile* infection, and those for patients who require intravenous-to-oral therapy conversion of antibiotics. Pharmacists provide feedback when indicated and make recommendations to physicians for modifying antibiotic therapies. Providers also have access to the ID physician for consultations via telephone. This ASP also utilizes a clinical decision support pathway for *S. aureus* bloodstream infections: The ASP receives surveillance alerts from CDSS for patients whose blood cultures are positive for this organism, and in response physicians are able to recommend appropriate antibiotic therapy.
- **Education:** The ID physician conducts peer-to-peer educational sessions with hospitalist physicians on the appropriate treatment of asymptomatic bacteriuria. Pocket cards with treatment suggestions were developed for the physicians, and flyers were placed in physician dictation rooms and at nursing stations.
- **Tracking:** As part of its process measures, the ASP team tracks compliance to WMC's guidelines for properly adhering to antibiotic dose adjustments for certain medications, like vancomycin, and also physician

acceptance rates of ASP recommendations. They track antibiotic-associated adverse events (including *C. difficile* rates) and antibiotic resistance rates as process measures. Outcome measures utilized by WMC's ASP include tracking the following: antibiotic-associated adverse events and unintended consequences (including *C. difficile* infections), resistance rates, antibiotic usage, and length of stay for patients with an infectious disease diagnosis.

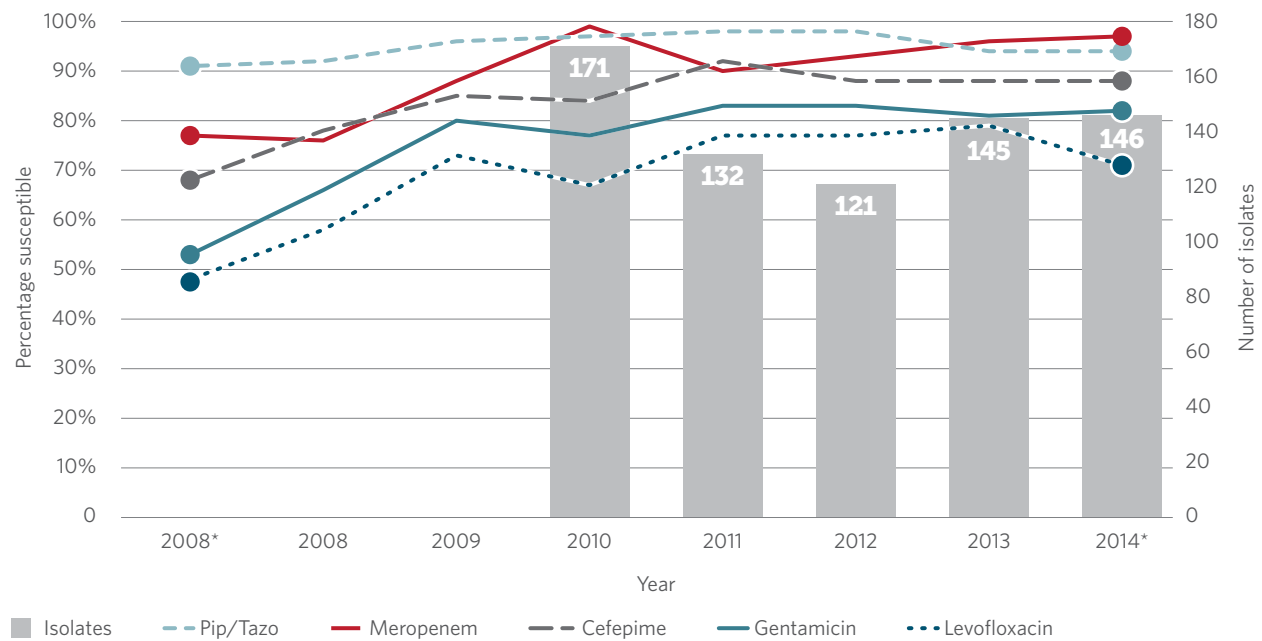
- **Reporting:** Members of the ASP Administrative Committee meet every four to six weeks to discuss ongoing stewardship initiatives. An annual report of ASP activities is presented to the P&T Committee and Medical Executive Committee.

Results

The ASP tracks the number of stewardship interventions made, such as intravenous-to-oral conversions, discontinuing unnecessary antibiotics, and optimizing duration of therapy. It also measures physician acceptance of pharmacist recommendations, which was 85.3 percent in 2013 and increased to 87.6 percent in 2014.

According to WMC's ASP, antibiotic cost per adjusted patient-day, or one single day of hospitalization for a patient, decreased from \$15.64 per patient-day in 2012 and 2013 to \$14.12 per patient-day in 2014. *C. difficile* cases per 10,000 patient-days decreased from 26.3 in 2013 to 21.1 in 2014. *Pseudomonas aeruginosa* susceptibility rates to levofloxacin improved from 58 percent in 2009 to 79 percent in 2014.

Figure 2
Antibiotic Susceptibility for *Pseudomonas aeruginosa*



* Only partial data available for this year

© 2016 The Pew Charitable Trusts

Antibiotic susceptibility rates for *P. aeruginosa* have improved since the stewardship program began.

Sustainability

The stewardship team identified physician buy-in and acceptance of pharmacist recommendations as the primary barriers when its program was launched. As this is a small, nonacademic community hospital, the ASP staff found that many of the physicians were not accustomed to having pharmacists review patient charts and make recommendations based on antibiotic selection and culture results. Occasionally during the nascent phases of the program, pharmacists would call upon the ID physician for a peer-to-peer discussion with the attending physician if a high-risk intervention was not accepted. Over the tenure of the program, as understanding of the ASP grew, physician buy-in improved, and the acceptance of recommendations increased, which has helped ensure more successful interventions. To ensure that the program thrives, WMC has implemented policies, such as the formalization of the Administrative Committee, to continue ASP activities in the face of potential staff turnover or funding reductions.



We took an incremental approach to building our antibiotic stewardship program. Over several years, we went from a small-scale initiative funded by a stipend, to a formal program with an executive-level advisory committee."

Montgomery Williams, *Williamson Medical Center*

Program participants have found it very helpful to discuss projects and initiatives with colleagues conducting ASP programs at other inpatient facilities and to share resources and experiences. WMC staff members believe that a national database of resources and materials to assist in completing projects would be very useful, along with benchmarking metrics for antibiotic use and resistance within CDC's National Healthcare Safety Network (NHSN) Antimicrobial Use and Resistance module. As the hospital is small and has limited capabilities, additional internal and external resources to help develop and implement reporting to NHSN are deemed critical by the program. Additionally, staff members would like to acquire software to track antibiotic usage with methods other than antibiotic expenditures, as neither the institution's CDSS nor its health information management system can calculate antibiotic usage based on days of therapy or defined daily dose.

In the future, the stewardship program plans to add timelines for automatic intravenous-to-oral conversions to their ASP policy and procedures, as well as develop a decision pathway for treating sepsis. The hospital is beginning to discuss expansion of its asymptomatic bacteriuria project, a peer-to-peer educational initiative aimed at optimizing antibiotic treatment for this condition, to surrounding long-term care facilities through a collaborative effort with the Tennessee Department of Health.

Lessons learned

- Since antibiotic stewardship efforts can be directly linked to patient care, WMC's ASP found it helpful for pharmacists to incorporate stewardship activities into their daily responsibilities; additional training may be a useful tool to accomplish this goal.
- The program also learned that creating an administrative committee for an ASP can help facilitate buy-in from many disciplines while developing stewardship strategies. This committee positively influenced the program's structure and provided a forum through which all medical staff could participate in stewardship decisions.

- Finally, the team members highlighted how some of their ASP interventions can be applied to nursing homes or other long-term care facilities that share patients with the hospital. They noted that local or state public health departments may also be interested in this outreach, as the Tennessee Department of Health was in WMC's ASP's effort.



Creating an Administrative Committee can help facilitate and streamline buy-in from many disciplines throughout your facility."

Montgomery Williams, *Williamson Medical Center*

Contact person:

Montgomery Williams, Pharm. D., B.C.P.S., Internal Medicine and Antibiotic Stewardship
Pharmacist, Williamson Medical Center
Belmont University College of Pharmacy
Nashville, Tennessee
montgomery.williams@belmont.edu



Structure and resources

STPH is a not-for-profit community hospital with 244 licensed beds, some of which are dedicated to a neonatal intensive care unit. The hospital, located in southeastern Louisiana, serves a large oncology population and a high percentage of dialysis patients.

ID and pharmacy services: There are three ID physicians on staff, one of whom is actively involved in the ASP. The pharmacy employs a department head, a pharmacy operations/IT manager, two clinical pharmacists, and 11 staff pharmacists. No pharmacists received residency training in ID.

IT: The EHR is Epic. CPOE is available, but paper orders are still used.

Laboratory: On-site facilities perform PCR tests to rapidly identify strains of MRSA and *C. difficile* infection but lack the ability to perform rapid identifications of all pathogens.

Planning, development, resources, and skills

This ASP effort originated through the activities of the “Bug Club,” a collaborative that began when an ID physician in the region noticed higher rates of infection after coronary artery bypass grafts at New Orleans-area hospitals that shared the same cardiovascular surgeons, and began a coordinated effort to reduce surgical-site infections. Original core members of the Bug Club included ID physicians, infection preventionists, and clinical pharmacists who represented multiple hospitals in the same region as STPH. After one of the hospitals in the area, Lakeview Regional Medical Center, invested funding in antibiotic stewardship and tracked a subsequent decrease in antibiotic use, these findings were presented to STPH’s administration to make the case for ASP funding. Over time, the collaborative group expanded to address a broader range of stewardship issues and incorporate expertise from additional disciplines such as hospitalists, surgeons, pulmonologists, utilization review specialists, and representatives from the long-term care facilities in the area. Out of these experts, the representatives from the long-term care facilities have since joined the Bug Club.

STPH was able to obtain funding for a CDSS through continued interactions and feedback between providers and administrators. By showing measurable improvements through cost-savings data, and highlighting this technology as a means to increase efficiency of the stewardship program, STPH obtained additional funding for this technology.

When the program was first implemented, the sole clinical pharmacist on staff dedicated the majority of her time to ASP activities. Due to the success of the program, a second clinical pharmacist was hired. Both clinical pharmacists are in the process of completing [antibiotic stewardship certifications](#) through Making a Difference in Infectious Diseases and the Society of Infectious Diseases Pharmacists, and both have attended annual meetings held by the former organization.

The CDC core element guidelines, 2007 IDSA/SHEA guidelines, and [Society of Thoracic Surgeons guidelines](#) have been identified by the stewardship team as instrumental in guiding their program. A presentation to the Gulf States VHA (formerly Volunteer Hospital Association) quarterly meeting of pharmacists and infection preventionists provided additional opportunities to explore the roles of rapid diagnostics in ASP interventions. Additional training opportunities for members of the stewardship team included participating in Web-based antibiotic stewardship training programs provided by various organizations and attending stewardship-focused meetings conducted by the [American Society of Health-System Pharmacists](#).



By showing measurable improvements through cost-savings data and demonstrating the potential for increased efficiency, the hospital was able to get funding for the clinical decisions support system."

Jo W. Watkins, St. Tammany Parish Hospital

Stewardship overview

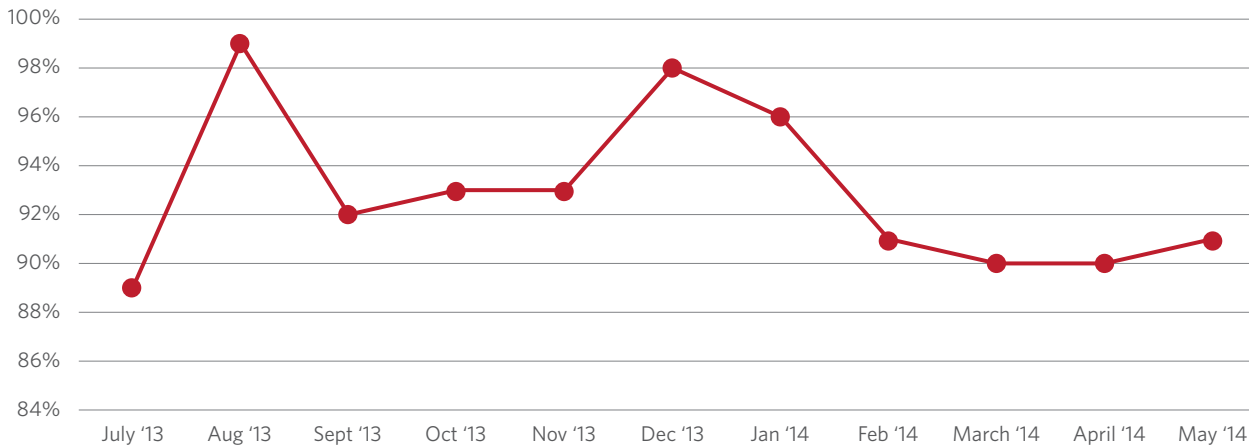
The ASP is a subcommittee of the Medicines Service. The ASP's members include an ID physician, a hospitalist, two clinical pharmacists, the Department of Pharmacy chair, an infection preventionist, a microbiologist, the hospital's medical director, and a data analyst.

- **Leadership commitment:** STPH's administration supports the ASP by dedicating one full-time clinical pharmacist to the program and a second clinical pharmacist who spends 25 percent of workday activities on stewardship duties.
- **Accountability:** The clinical pharmacist and ID physician are responsible for the ASP and its outcomes.
- **Drug expertise:** A clinical pharmacist who completed stewardship training provides drug expertise for the program.
- **Action:** The IT manager in the Department of Pharmacy provides computer-assisted surveillance, including multiple daily reports on patients receiving antibiotics that are targeted for reduction by the stewardship program. The ASP uses prospective audit and feedback: Auditing for antibiotic therapies requiring modification is performed by the clinical pharmacist, and feedback is given to clinicians by the ID physician or pharmacist. Data are reviewed daily.
- **Education:** The ID physician has provided education to the hospitalists on the use of antibiotics for MRSA and regularly discusses stewardship issues with the medical staff during rounds. Additionally, collaborative meetings between stewardship personnel at STPH and other facilities help address current issues concerning appropriate antibiotic selection and dosing.
- **Tracking:** Antibiotic utilization is monitored in defined daily doses (DDDs), a commonly used metric.
- **Reporting:** Monthly statistics on DDDs are sent to the hospital administration and periodically reported to medical staff committees, but the hospital will soon report usage as days of therapy (DOT).

Results

According to STPH's ASP, less than 90 percent of ASP recommendations were accepted initially; today, physicians accept the recommendations of the stewardship program's clinical pharmacist more than 90 percent of the time, with monthly acceptance rates as high as 99 percent.

Figure 3
Acceptance Rates of ASP Recommendations



© 2016 The Pew Charitable Trusts

The ASP's most significant improvement, as demonstrated by an outcome measure, was a decrease in *C. difficile* rates from 9.6 cases per 10,000 patient-days in the third quarter of 2013 to 6.4 cases per 10,000 patient-days at the end of 2014. DDDs for each targeted antimicrobial were calculated for the 12 months prior to initiation and monthly thereafter, with the following estimated results:

- Daptomycin use decreased from an average of 210 DDDs per month to 35 DDDs per month, an 84 percent reduction.
- Linezolid DDDs decreased from 171 to 36 DDDs per month, a 79 percent reduction.
- Tigecycline DDDs decreased from 96 to 13 DDDs per month, an 86 percent decrease.
- Micafungin decreased from 53 to 20 DDDs per month, a 61 percent decrease.



We've seen significant results within just the first couple of years of implementing our antibiotic stewardship program."

Jo W. Watkins, St. Tammany Parish Hospital

Total antimicrobial cost per adjusted patient-day peaked at \$25.93 in October 2012 and was reduced to an average cost of \$8.32 per patient-day after ASP implementation. Since its inception in July 2013, the ASP's review of antimicrobial use has resulted in a total savings of \$1.3 million through December 2014. The cost savings generated by the ASP in the first year alone more than offset the staff time devoted to ASP activities, and justified the addition of a second clinical pharmacist.

Sustainability

Active involvement of the ID physician champion at STPH has been integral to the program's ongoing sustainability and helped minimize resistance by providers. If the pharmacist's initial attempt at providing feedback was unsuccessful, the ID physician discussed individual cases directly with the prescribing physician. Hospitalists and intensive care unit physicians bought into the foundation laid by the ASP, and as a result the medical staff's prescribing patterns have been substantially altered. STPH's ASP members believe that their work has led to an increase in the overall awareness of stewardship, and to more frequent and in-depth discussions with pharmacy staff when physicians prescribe antibiotics the program has targeted for reduction.

As reported by STPH's ASP, the number of recommended ASP interventions has decreased dramatically since the program began, largely due to the change in staff prescribing patterns. However, the program members believe that their hospital administration has shown its ongoing commitment to antimicrobial stewardship by hiring an additional clinical pharmacist for the program. In the future, the ASP hopes to successfully implement an asymptomatic bacteriuria project to assess current prescribing practices and management of patients who meet the criteria, as well as an antibiotic timeout intervention to ensure that providers have opportunities to assess the need for continuing antibiotic therapies on patients. Lastly, the program hopes to use rapid diagnostics and enhanced computer surveillance to improve stewardship outcomes.

Lessons learned

- STPH's ASP members found that clinical pharmacists can achieve the necessary drug expertise with additional training, such as that provided by the Society of Infectious Diseases Pharmacists Certificate Program in Antimicrobial Stewardship.
- The ASP members believe that a pharmacist with IT expertise can be a useful resource for a stewardship program, especially if the pharmacist is familiar with data collection and management of both the EHR and CDSS.
- The program staff believes that a regional approach to stewardship may be the most effective way to address antimicrobial resistance and antimicrobial use across the health care continuum. This program began through a successful collaborative network, and a number of facilities have benefited from it.

Contact person:

Jo W. Watkins, R.Ph., pharmacist
St. Tammany Parish Hospital
Covington, Louisiana
jwatkins@stph.org



Structure and resources

BH is a 342-licensed-bed hospital and the largest medical center within a 100-mile radius. It is a Level II trauma and stroke center with a 16-bed intensive care unit, a transitional care facility, and an inpatient rehabilitation unit. Patients are mostly local or are transferred from nearby critical access hospitals.

ID and pharmacy services: No ID physician is currently available for consultation services. The pharmacy staff includes decentralized clinical pharmacists who provide services from patient care locations outside of the hospital's central pharmacy.

IT: The EHR system is Allscripts, and a CPOE system is also used. The Pharmacy OneSource product Senti 7 is the CDSS, which consolidates data from pharmacy, laboratory, and the admission, discharge, and transfer systems.

Laboratory: The on-site laboratory has the capacity to perform antibiotic susceptibility and resistance testing. It can also perform procalcitonin tests to help determine whether a patient has a bacterial infection, and is in the process of implementing procedures that will provide rapid identification and resistance testing for *S. aureus* strains.

Planning, development, resources, and skills

The ASP began after increased patterns of antibiotic resistance were observed that included increased resistance for *P. aeruginosa* isolates, increased prevalence of vancomycin-intermediate *S. aureus*, and increased overall fluoroquinolone resistance. Bug-drug mismatches, which occur when a patient receives an antibiotic ineffective against the pathogen isolated from cultures, were also frequently seen.

The pharmacy conducted a three-month pilot study on the use of four antibiotics (aztreonam, tigecycline, daptomycin, and linezolid) and monitored adherence to prespecified criteria for their appropriate use. The study quantified monthly savings and demonstrated opportunities for improvement in prescribing, as well as potential consequences from a lack of action. As a result of the study, the hospital administration approved the ASP in July 2011.

The ASP team initially believed it would be difficult to successfully accomplish stewardship activities through a single individual. The program was subsequently designed to incorporate all pharmacists in stewardship activities and initiatives. Program members believe that because the pharmacists continuously worked as a team toward the goal of achieving excellent patient outcomes, stewardship interventions were not met with resistance.



In the program's early stages, a critical component to growth and success was aligning stewardship activities with the organization's strategic and quality improvement plan."

Andrea Chbeir, *Blessing Health System*

This ASP expects pharmacists and residents to be certified in antibiotic stewardship through the Society of Infectious Diseases Pharmacists' Certification Program, with support provided by the Department of Pharmacy. Continuing education activities occur through journal clubs, case-based discussions, and formal continuing education activities. The ASP members found the 2007 IDSA/SHEA guidelines to be a useful tool when designing the program.

The CDSS was invaluable to the ASP team. It was immediately incorporated into the workflow for the stewardship program. Using the CDSS, pharmacy team members created multiple algorithms to automatically identify bug-drug mismatches and streamline therapy for patients receiving piperacillin-tazobactam, one of the most frequently overused broad-spectrum antibiotics in this hospital. Every pharmacist now uses these algorithms and runs the CDSS, which synthesizes data necessary to identify interventions and opportunities.

Stewardship overview

The ASP team consists of a family practice physician who is considered a champion for antibiotic stewardship, several hospitalists, a pharmacist representative from the local long-term care pharmacy, representatives from area nursing homes, clinical pharmacists, microbiologists, infection control nurses, the chief quality and safety officer, and an epidemiologist.

- **Leadership commitment:** BH's administration has supported the ASP by incorporating stewardship efforts into the job descriptions for all of stewardship team members. The program also purchased a CDSS, which allows pharmacists to more efficiently identify potential opportunities for stewardship interventions.
- **Accountability:** The Pharmacy and Therapeutics Committee and Antimicrobial Stewardship Committee are responsible for the ASP, but there is no single appointed leader.
- **Drug expertise:** All pharmacists complete the Society of Infectious Diseases Pharmacists Certification Program in Antibiotic Stewardship and provide drug expertise for the program.
- **Action:** The pharmacists monitor antibiotic therapies and provide recommendations to modify them when necessary (an action known as prospective audit and feedback). Clinical pharmacists have access to all of the microbiology culture results on a daily basis. There are several procedures for following culture results: For inpatients, unit-based clinical pharmacists review cultures daily and address any opportunities for adjustments in antibiotic therapy; for patients discharged from the emergency room, clinical ER pharmacists ensure appropriate treatment for all positive cultures; and for recently discharged inpatients, unit-based clinical pharmacists ensure appropriate therapy by reviewing discharge medications and communicating recommendations to primary care physicians.
- **Education:** The annual antibiogram is distributed to providers, and any subsequent changes in recommendations for therapies are communicated throughout the health system.
- **Tracking:** Process measures tracked by BH's ASP include adherence to appropriate use guidelines and clinical pathways, as well as how often antibiotic therapy is streamlined. Outcome measures tracked by the program

include rates of *C. difficile* and significant trends in the hospital's antibiogram.

- **Reporting:** ASP process and outcome measures, including percentage of accepted recommendations and rates of hospital-acquired *C. difficile*, are presented to the medical staff.

Results

BH's ASP staff reports that stewardship recommendations are now routinely accepted. The facility estimates that the pilot study, which focused on four antibiotics and implementation of an intravenous-to-oral therapy conversion protocol (which allows a faster transition off of intravenous antibiotics), saved at least \$6,000 per month.

Sustainability

According to BH's ASP staff, a critical component to growth and success during the program's early stages was aligning stewardship activities with the organization's strategic and quality improvement plan. They believe that recent press attention to the need for antibiotic stewardship, and expectations that stewardship activities will likely become a condition of participation for hospitals that are reimbursed by Medicare and Medicaid, have strengthened the administration's ongoing support.

The program staff identified remaining barriers, which include the time needed to write new algorithms in the CDSS or complete data analysis, as well as the ability to justify the costs for and implement rapid diagnostic testing.

In the future, ASP staff members intend to support staff at two local critical access hospitals in the development of their own stewardship efforts.

Lessons learned

- The ASP staff found that well-respected champions are critical, but they should include more than physicians: Pharmacy, laboratory, and administrative champions are all necessary as well. This multidisciplinary stewardship approach can yield successful results for many community hospitals lacking in ID resources or staff.
- ASP members also highlighted the importance of anticipating potential barriers and mitigating any setbacks by incorporating solutions into the design of a new ASP. For example, this facility recognized a lack of consistent baseline knowledge in antibiotic stewardship among the pharmacy staff; in order to avoid potential inconsistencies, all pharmacists were certified in antibiotic stewardship through the same program at the inception of the program.
- The ASP recognized the value of educating staff, particularly the pharmacists, consistently to ensure that stewardship activities are integrated into their daily work.

Contact person:

Andrea Chbeir, Pharm.D., B.C.P.S., clinical specialist, cardiology, PGY-1 residency program;
director, clinical pharmacist supervisor
Blessing Health System, Quincy, Illinois
andrea.chbeir@blessinghealthsystem.org



Structure and resources

Asante is a health system consisting of three hospitals, all located within approximately 75 miles of each other: Asante Rogue Regional Medical Center (ARRMC), a Level III trauma center located in Medford with approximately 370 licensed beds and an active intensive care unit; Asante Three Rivers Medical Center (ATRC), located in Grants Pass with approximately 125 licensed beds; and Asante Ashland Community Hospital (AACH), located in Ashland, with approximately 49 licensed beds. It is the largest health care provider organization in nine counties, providing care to more than 580,000 patients in the southern Oregon/Northern California region.

ID and pharmacy services: ARRMC has one ID physician, one ID pharmacist, and over 30 clinical pharmacists. ATRC and AACH have limited ID services.

IT: The EHR system Epic provides microbiology data for all three facilities but has limited capacity to generate automated surveillance alerts. CPOE is available.

Laboratory: The Asante Health System's laboratory performs services for all three hospitals and includes PCR capabilities for rapidly identifying MRSA and other organisms.

Planning, development, resources, and skills

Asante Health System's ASP began as the project of a pharmacy resident who collaborated with the ID physician to demonstrate the benefits of small stewardship interventions in conjunction with physicians, pharmacists, and other multidisciplinary teams at ARRMC. The ASP gained support from various subspecialties, due in large part to the active role of an ID physician championing antibiotic stewardship.

Implementation of Asante Health System's formal ASP was supported by administrators and founded on a partnership between a physician and a pharmacist. The program officially began in 2009. The collaborative relationship between the ID physician and the vice president of medical affairs provides consistent administrative commitment and support.

With support from the ID physician, the ID pharmacist often works outside the committee structure to garner additional support for the ASP's efforts.

Useful tools for this ASP have included the CDC core elements checklist, the [Institute for Healthcare Improvement driver diagram pilot project](#), and [Oregon-sponsored ASP initiatives](#), conducted jointly by the Oregon Department of Health and the Oregon Patient Safety Collaborative. The annual Making a Difference in Infectious Diseases meeting has also been a useful resource for the ASP's activities.

Stewardship overview

Each of the three hospitals in the Asante Health System has a stewardship program housed within the pharmacy department at each facility. All three programs report to individual P&T Committees at each facility, and AARMC's ID physician helps to oversee all three programs. The ASP teams also consist of pharmacists, microbiology and infection control staff, and administrators from each hospital.

Asante faces a growing need for a CDSS to assist in stewardship interventions and surveillance. The health system is considering software solutions for additional ASP support.

- **Leadership commitment:** Asante Health System supports the ASPs by providing funding for an ID physician and an ID pharmacist at AARMC. Clinical pharmacists across all facilities are also expected to collectively devote 10 hours every two weeks to developing and implementing antibiotic-related initiatives.
- **Accountability:** The ID physician at AARMC is responsible for the programs for all three hospitals.
- **Drug expertise:** The AARMC ID pharmacist and the ATRMC and AACH clinical pharmacists provide drug expertise for the programs.
- **Action:** The EHR facilitates tracking of pharmacy interventions and antibiotic use. The facility uses prospective and retrospective audit with feedback by reviewing past and current antibiotic therapies, and recommends changes when needed. Pharmacy staff members also make changes to antibiotic dosing based on protocols and guidelines, perform a timeout for all broad-spectrum antibiotics after 72 hours of therapy to reassess the need for antibiotics, and monitor for bug-drug mismatches that occur when a patient receives an antibiotic that's ineffective against the pathogen isolated from cultures. As an institution, Asante developed tip sheets for pharmacists, based on the hospital's antibiotic resistance rates, that provide optimal antibiotic therapies for specific infectious diseases.
- **Education:** The ID physician from AARMC supplies newsletters on stewardship efforts to the providers at this facility. AARMC's ID pharmacist presents an ID-related pharmacy continuing education opportunity program once every one to two quarters, with guidance from the ID physician. To enhance stewardship knowledge and training, clinical pharmacists from all three facilities may apply for funding to attend ID conferences or enroll in online ASP certification programs. These staff members also have access to education videos that are posted regularly by the Asante Health System.
- **Tracking:** The programs monitor drug use evaluation for select antibiotics, as well as the number of stewardship interventions.
- **Reporting:** Results from drug use evaluations of antibiotics are presented to the vice president of medical affairs.

Results

Program staff reports that the majority of ASP recommendations the pharmacists made to providers with support from the ID physician have been accepted.

Sustainability

According to the ASP team, the most significant barriers encountered by Asante's facilities have been inadequate pharmacy staffing levels to assist in reviewing antibiotic therapies, limited financial resources to fund additional stewardship efforts, and the lack of an ID physician at the two satellite hospitals. The administrators recognize this and support prioritizing pharmacy personnel to track antibiotic usage, prescribing patterns, and appropriate indications. This has allowed the lead ASP pharmacists at ATRMC and AACH to continue collaborating with the ID physician and pharmacist at ARRCM.

In the future, Asante hopes to employ additional ID physicians to provide more guidance and peer-to-peer feedback on antibiotic prescribing, as well as fund opportunities for ATRMC and AACH's pharmacists to take the Society of Infectious Diseases Pharmacists Certificate Program in Antimicrobial Stewardship and attend stewardship-related conferences. The overall goals are to fund one or two pharmacists each year, record ID-related pharmacy continuing education in videos for enhanced education, and provide the ASP with a CDSS.

Additionally, Asante is in the process of developing an outpatient parenteral antibiotic therapy service for the Infusion Services Department, which will be implemented across the entire health system. This service allows patients to be discharged on intravenous antibiotic therapy, thereby shortening the length of hospitalization and providing significant cost savings. Asante plans to develop a policy that would encourage pharmacists to review the appropriateness of antibiotics ordered for outpatient parenteral antibiotic therapy upon discharge.



Pharmacy student and resident projects can be an easy way to obtain data and support, as well as a means to provide rationale for hospital-based ASPs."

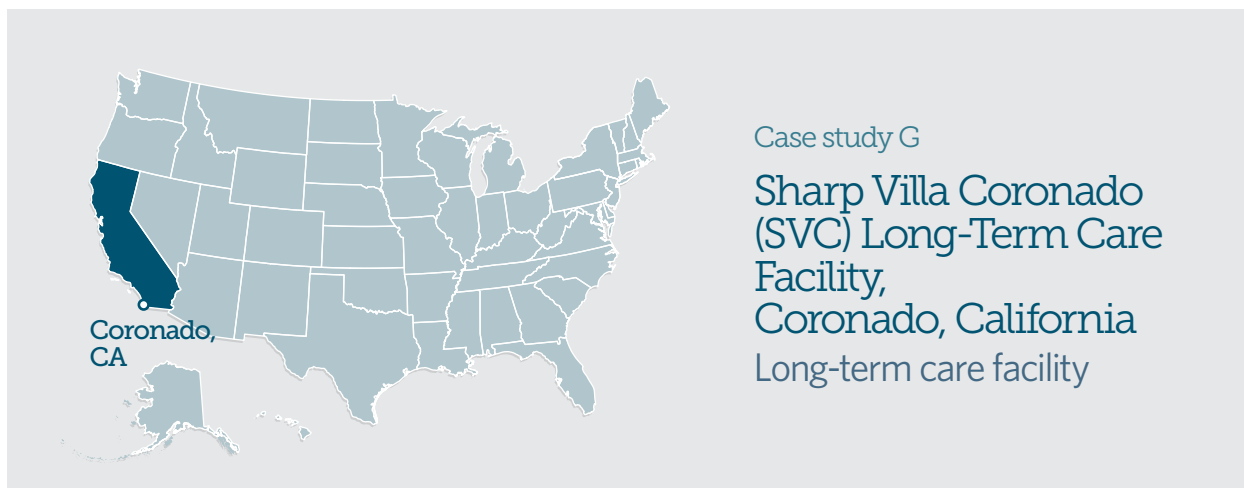
Immanuel Ijo, Asante Health System

Lessons learned

- The stewardship team highlighted critical components to developing a robust ASP, including ID physician championship, support from executive leadership, and multidisciplinary engagement from key stakeholders such as physicians, pharmacists, infection preventionists, and microbiology and information technology experts.
- The program learned that in partnership with an ID physician, clinical pharmacists can be stewards of antibiotics by implementing relatively simple interventions, such as automatic dose adjustments, intravenous-to-oral conversions with timely transitions, and pinpointing bug-drug mismatches.
- Tip sheets that take into account institution-specific guidelines, antibiograms, and formulary guidelines were recognized as useful by this institution's clinical pharmacist stewards.
- ASP staff members identified pharmacy student and resident projects to be an easy way to obtain data and support, as well as a means to demonstrate the need for and benefits of an ASP.

Contact person:

Immanuel Ijo, Pharm.D., B.C.P.S., ID pharmacist
Asante Health System, Rogue Regional Medical Center
Medford, Oregon
immanuel.ijo@asante.org



Structure and resources

SVC is a 120-bed long-term care facility with 60 skilled beds and 60 subacute beds. SVC accommodates ventilator-dependent residents and residents requiring transitional care for rehabilitation, wound care, intravenous antibiotics or infusions, parenteral nutrition, and custodial care. Approximately 10 physicians, including internists, family medicine physicians, and pulmonologists, provide clinical services at SVC.

SVC is part of a health care system, Sharp Healthcare, that includes one other long-term care facility and four inpatient facilities. One of the inpatient facilities, Sharp Coronado Hospital (SCH), is a 59-bed hospital located across the street from SVC.

ID and pharmacy services: ID physicians from SCH are available for consultation at SVC, particularly when multidrug-resistant organisms are identified. Three clinical pharmacists provide coverage for all pharmacy needs at both facilities. A clinical coordinator oversees the clinical pharmacy services, and a rotating pharmacy student from a regional pharmacy school provides support for tracking all SVC residents on antibiotics.

IT: The EHR system is Cerner, which includes CPOE and the capacity to develop customized protocols, also known as Powerplans. There is no CDSS for stewardship interventions.

Laboratory: The laboratory at SCH performs services for all patients at SVC. Gram stains are performed on-site, but cultures are sent to a larger sister facility for further microbiological testing.

Planning, development, resources, and skills

Sharp Healthcare's motivation for an ASP across its facilities began in 2009 with the recognition of increasing antibiotic usage and *C. difficile* rates. This led to the establishment of an ASP at SCH with the hiring of the ASP pharmacist in 2009 and the further expansion of the ASP to SVC in 2011.

The ASP pharmacist initially evaluated the appropriateness of antibiotic therapies and provided stewardship interventions for 30 percent of residents and patients. The program was able to demonstrate cost savings and continued to fine-tune its interventions. Because it was extremely difficult for a single pharmacist to evaluate all patients receiving antibiotics, the hospital administration suggested developing a procedure for ID pharmacy students to assist with daily antibiotic monitoring. Administrative champions for the ASP were the director of pharmacy and the chief nursing officer.

A Sharp Healthcare IT specialist provides trends and benchmarks for DOT for all inpatient locations through the Cerner system. The ASP also utilizes the modified McGeer criteria (which provide surveillance definitions for long-term care facilities), the 2007 IDSA/SHEA guidelines, individual [IDSA treatment guidelines](#), and [Infectious Disease Association of California](#) educational symposiums to guide ASP activities and interventions.

Stewardship overview

The Sharp Healthcare System Antibiotic Review Committee, which broadly oversees all ASP work at the four hospitals, includes eight ID physicians, four ASP pharmacists, the lead system microbiologist, an IT specialist, and the lead clinical coordinator. This committee develops many of the protocols and Powerplans that are shared systemwide, in addition to antibiotic formulary decisions. If something works well at one site, it is promoted at all of them.

A subcommittee of the health care system's Antibiotic Review Committee oversees stewardship activities specifically for both SVC and SCH. It consists of the ASP pharmacist, the ID physician, two hospitalists who function as physician champions, and the infection preventionist. They report quarterly to the hospital P&T Committee and to the Subacute Physicians Committee every three to six months.



Administration suggested developing a pharmacy ID student program to assist with daily antimicrobial use monitoring.”

Bridget Olson, Sharp Villa Coronado

- **Leadership commitment:** Most of the ASP's work has been formalized into policies and procedures for SVC and SCH. The ASP pharmacist's time is protected to work on ASP-related issues two days a month and one hour every staffing day or when meetings are occurring. The ID physician receives funding to chair the P&T Committee.
- **Accountability:** The ASP pharmacist at SVC is responsible for ASP activities and outcomes in the facility. This pharmacist reports to the pharmacy clinical coordinator, the director of pharmacy, and ultimately the chief nursing officer, all of whom work within SVC. The ASP Committee reports to Sharp Healthcare System's P&T Committee.
- **Drug expertise:** The ASP pharmacist provides drug expertise and trains the other clinical pharmacists to be competent in providing ASP consultations.
- **Action:** The ASP has an automatic renal dosing protocol for all SVC patients, so that all antibiotic doses are automatically adjusted for patients' kidney functions to avoid toxicity. The ASP also reassesses the duration of antibiotic therapies for all urinary, respiratory, and skin and soft tissue infections on the sixth or seventh day of treatment. Additionally, SVC has a fever and suspected infection protocol, or Powerplan, that incorporates recommended antibiotic therapy regimens. ASP consults are initiated by nursing; the ID physician or ASP pharmacist must recommend and discuss treatment with the primary physician prior to placing a pharmacy order.
- **Education:** The ASP pharmacist conducts annual training sessions to educate nurses on ASP goals and interventions and to provide them with opportunities to review and discuss procedures. Each pharmacist receives one-on-one education before joining the ASP. Clinical pharmacists are taught to conduct pharmacy ASP consults by the ASP pharmacist. The ASP pharmacist sends out monthly email updates including any

changes in policy and practices, formulary additions, and observations on ways to improve stewardship efforts. An electronic ASP folder that contains related ASP information, reports, and references is maintained. The health system held a staff training conference on ASPs in November 2014 that was attended by many pharmacists and physicians.

- **Tracking:** The program tracks the acceptance rates of stewardship interventions as a process measure. DOT per antibiotic and antibiotic class are also tracked for SVC.
- **Reporting:** Sharp Healthcare produces quarterly reports that evaluate days of therapy per antibiotic and antibiotic class for all of its facilities; these data are used for benchmarking. The SVC ASP team reports its progress to Sharp Healthcare System’s P&T and Subacute Physicians committees every six months.



Much of the antibiotic stewardship program’s work has now been formalized into policies and procedures.”

Bridget Olson, Sharp Villa Coronado

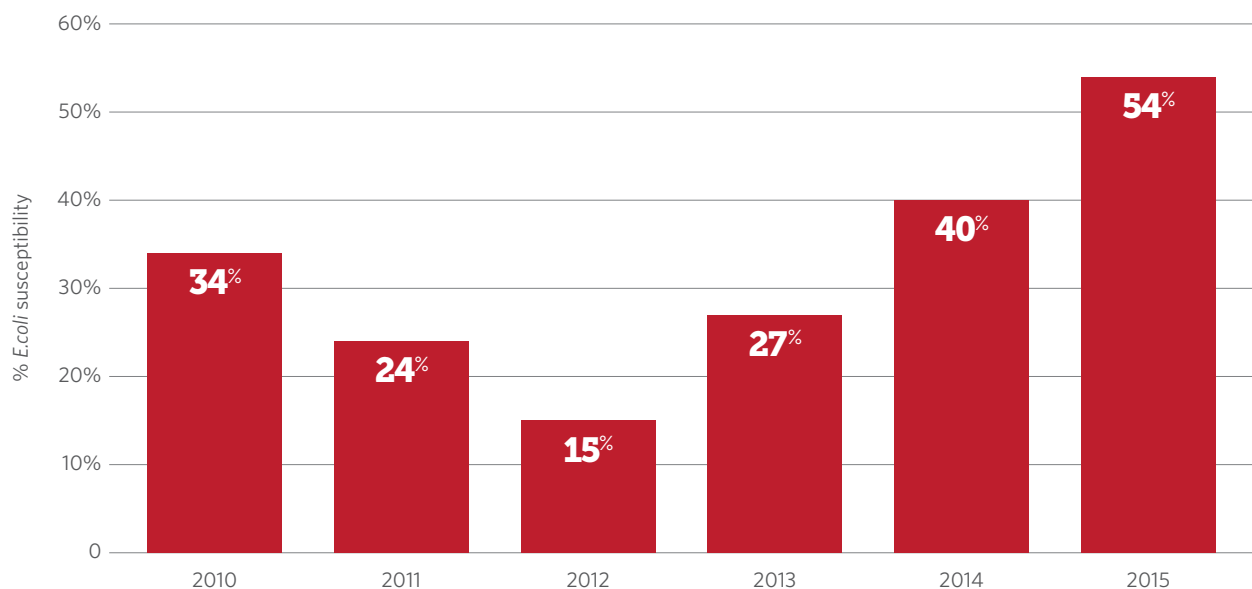
Results

Process metrics for this ASP include monitoring the percentage of interventions accepted. Overall, physician acceptance of ASP recommendations increased from 79 percent in 2011 to 94 percent in 2015.

Outcome metrics measured include antibiotic utilization measured as DOT, changes in susceptibilities, and *C. difficile* rates. Antibiotic use at SVC decreased overall by 59 percent since the ASP’s initiation in 2011, with significant decreases in broad-spectrum antibiotics, vancomycin, antifungals, and therapy for treatment of *C. difficile*.

Figure 4

Escherichia coli Susceptibility to Levofloxacin



Sustainability

Much of the ASP work at SVC has been formalized into policies and procedures, and program staff members have little concern that it will be eliminated. ASP members report that the physicians and nurses truly value the pharmacy ASP consult service, but there remains a need for the ASP pharmacist to have FTE staff positions dedicated to stewardship activities.

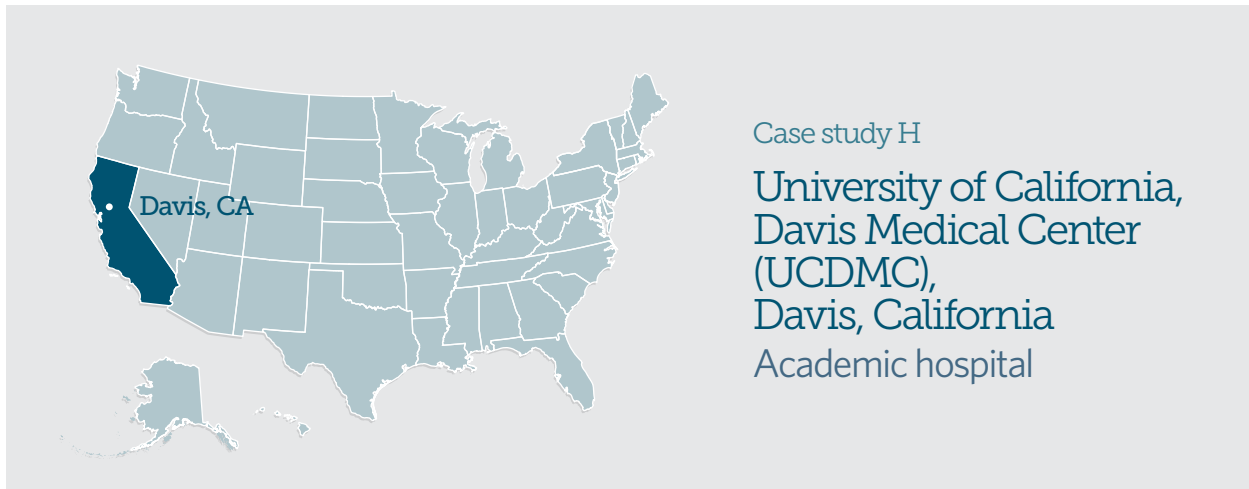
Future needs identified by this ASP include obtaining more dedicated time for the ASP pharmacist, as well as improved documentation for patients transferred to SVC with respect to antibiotic use history and physician's notes.

Lessons learned

- With training, clinical pharmacists are able to successfully carry out prospective audit and feedback interventions with little input from ID physicians.
- In any long-term care setting, ASP personnel must work closely with nurses. SVC's staff members rely on nurses to assist them in assessing residents, communicate symptoms, and make recommendations to physicians on call. Their assessment plays an important role in informing the primary provider's antibiotic prescribing decisions.
- The team found that pharmacy ASP consults and tools, such as fever and suspected infection protocols, can be particularly successful in long-term care settings when pharmacists discuss cases with both the bedside nurses and the primary providers.

Contact person:

Bridget Olson, R.Ph., ID/ASP pharmacist
Sharp Coronado Hospital and Villa Coronado Long-Term Care Facility
Coronado, California
bridget.olson@sharp.com



Structure and resources

UCDMC is a tertiary care, academic health system with 619 licensed beds that includes a Level I trauma center, an intensive care unit, stem cell and solid organ transplant services, and specialty pediatric care services.

ID and pharmacy services: Inpatient consultative ID services are available for all hospitalized patients seven days a week. Four ID pharmacists participate in rounds for the inpatient ID service, managing both adult and pediatric patients.

IT: The EHR system is Epic, and the CDSS is Theradoc.

Laboratory: UCDMC's laboratory has the capability known as MALDI-TOF mass spectroscopy to rapidly and accurately detect pathogens from patient samples. It employs enzyme-linked immunosorbent assay and PCR tests for *C. difficile* infection and has procalcitonin testing capabilities. The laboratory sends all suspected carbapenem-resistant *Enterobacteriaceae* to an off-site reference laboratory for confirmation.



In its first year, the antibiotic resistance program achieved a 23 percent reduction in *C. difficile* rates."

Hien Huy Nguyen, *University of California, Davis*

Planning, development, resources, and skills

Though UCDMC has had several iterations of an ASP since 1986, the facility was first able to measure improved outcomes as a result of stewardship interventions within the hospital population through a pilot program in 2011. Most recently, the hospital funded the program's expansion to include more formal pharmacy and ID involvement, with prospective audit and feedback to monitor and give recommendations as needed for prescriptions. Spurred by the state of California's legislation mandating stewardship programs in hospitals, and the ASP physician champion's efforts, this expansion began through a discussion with hospital leadership to evaluate state regulations for stewardship. An emphasis was placed on ASP's impact on antibiotic resistance rates, *C. difficile* rates, antibiotic cost data, and patient outcomes data.

Because a basic antibiotic approval process was already in place when the formal ASP began, the stewardship team considered expansion to be relatively simple. Primary barriers included funding, IT tools, generating reports, and creating buy-in of clinical services. Each of these barriers was addressed while expanding the ASP.

The ASP determined that Theradoc should be the EHR resource for evaluating antibiotic therapies for potential stewardship intervention, as it includes intervention alerts and tracking results that can be easily shared among team members. However, many antibiotic medications were not initially incorporated correctly into the system. The ASP worked with the IT department to refine the information being transferred from Epic to Theradoc, then developed additional Epic tools to collect more detailed antibiotic questions and information from pharmacists. They also developed EHR reports to track utilization. Ultimately, the ASP utilized multiple IT systems and developed additional IT tools, thereby maximizing the strengths of each IT system. Useful tools identified by this ASP include the 2007 IDSA/SHEA guidelines as well as other peer-reviewed publications and CDC resources.

Stewardship overview

The ASP is a joint venture of the ID and pharmacy divisions, with the latter providing primary funding. The ASP team is staffed by both an ID physician and a pharmacist five days a week, and an ID fellow often joins weekday rounds. Staff members from infection control and the microbiology lab are part of the ASP. Pharmacy residents and students commonly attend ASP meetings.

- **Leadership commitment:** The pharmacy staff is funded for 1.5 FTEs dedicated to stewardship, and an additional 1.0 FTE is devoted for an ID physician to function as a member of the ASP. ASP activities have also been formalized into hospital-wide policies and procedures.
- **Accountability:** The ID physicians and one ID pharmacist lead ASP efforts. The hospital's chief operating officer is ultimately responsible for the program and its outcomes.
- **Drug expertise:** The ID pharmacists provide drug expertise for the program.
- **Action:** The ASP implemented formulary restriction and preauthorization, an approval process for high-cost, high-risk antibiotics that requires clinicians to obtain approval prior to ordering. Additionally, some drugs require ID consultation for use. The program members also instituted a prospective audit and feedback system, which automatically sends an alert to the ID pharmacists through the EHR and CDSS for a variety of antibiotic use-related issues and conditions that may require intervention by the stewardship team. Intervention alerts are triggered for situations such as certain antibiotic levels being out of normal range, bug-drug mismatches, yeast in sterile sites, and positive vancomycin-resistance enterococci cultures.
- **Education:** The ASP staff performs face-to-face discussions with physicians when it identifies inappropriate antibiotic prescribing patterns. For example, the ASP determined there was a significant variation from treatment guidelines in perioperative antibiotic use. The ASP compiled the relevant infection and antibiotic use data and met with each group of surgeons to standardize antibiotic choice and duration for perioperative use, sharing that information with service line leaders.
- **Tracking:** The ASP staff members track DOT per 1,000 patient-days, *C. difficile* rates, and antibiotic susceptibility rates. The team also tracks ASP interventions and acceptance rates by providers.
- **Reporting:** During monthly team meetings, adult and pediatric providers meet to share and discuss the antibiotic resistance and other relevant microbiology data for their patient populations.

Results

During the first year of the pilot program's expansion in 2013, the ASP recorded 2,068 interventions with a 92 percent acceptance rate. The majority of these focused on de-escalating or stopping antibiotics. A combined 18 percent of interventions were related to antibiotic escalation or optimizing the clinical efficacy of the antibiotic regimen.

A primary goal that UCDMC's ASP achieved was a 23 percent reduction in *C. difficile* rates, which represented a total estimated savings of \$23,540. Costs for the top 11 ASP-targeted antibiotics (high-cost and broad-spectrum agents that represent roughly 30 percent of the hospital's total antibiotic expenditures) fell by 7.8 percent, or \$119,000, which was another primary goal. The ASP also decreased DOT per 1,000 patient-days by 3.7 percent and length of therapy (LOT; the total number of days that the patient continues to receive any antibiotic therapy) per 1,000 patient-days by 3.3 percent. Reductions in DOT and LOT were two of the program's secondary goals.

Sustainability

The ASP policies and procedures are included in the job descriptions and performance reviews of all staff members at the institution, thereby ensuring the program's sustainability. The ASP staff believes that to further expand the program, it will be important to revise existing policies to include funding for clinician time, derive timely data to track the ASP's success, and maintain buy-in and good relationships with clinical services. If these barriers can be tackled, the team members believe expanding the ASP will be a successful effort.

At this time, the hospital does not benchmark antibiotic utilization, and there are no current plans to report these data into CDC's National Healthcare Safety Network Antimicrobial Use module. There are, however, ongoing discussions on expanding the ASP's footprint and impact, which may include rounding with various medical and surgical teams.

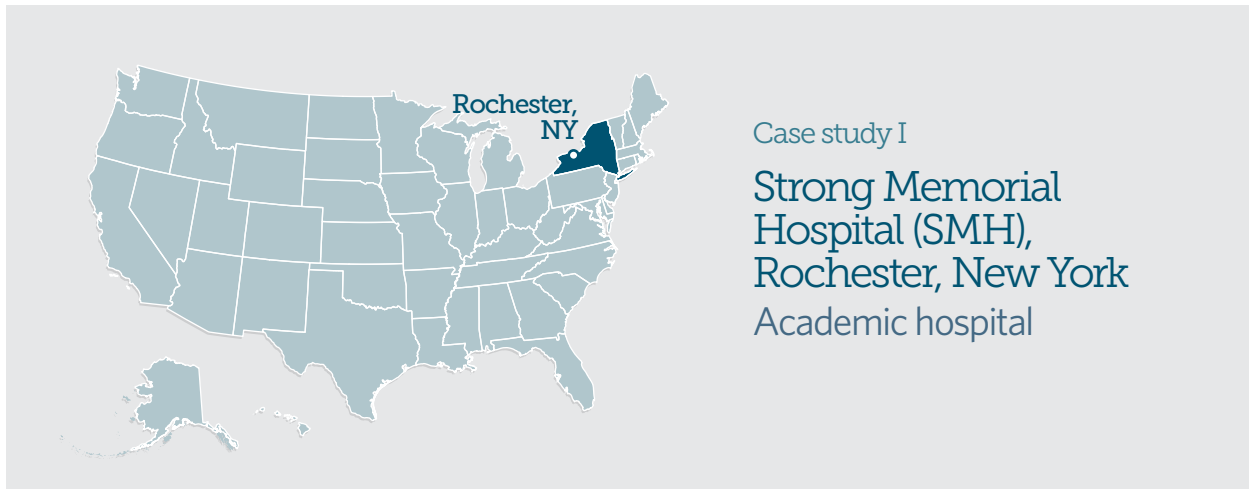
The ASP currently works with individual services to refine guidelines around antibiotic use and continually evaluate the evidence to optimize prescribing habits. Information gathered includes local data on infections and outcomes as well as reviews of published literature. Additionally, there are plans for the ASP to be the primary conduit for acting upon data provided by new rapid diagnostics (e.g., MALDI-TOF). The program is also considering expansion to the outpatient arena. ID pharmacists currently monitor outpatient parenteral antibiotic therapies to facilitate patients getting discharged on intravenous antibiotic therapies.

Lessons learned

- The team demonstrated that a successful pilot program can assist with securing funding for an ASP.
- UCDMC found that utilizing alerts from the EHR, as well as intervention alerts from the clinical decision support system, can help overall stewardship efforts.
- The expanded pilot project demonstrated that pediatric and adult ASPs can work together in a single program to help emphasize the multidisciplinary nature of stewardship and change an entire facility's prescribing habits.

Contact person:

Hien Huy Nguyen, M.D., professor of medicine
University of California, Davis
Davis, California
h.nguyen@ucdavis.edu



Structure and resources

SMH has more than 700 licensed beds and is the academic medical center for the University of Rochester School of Medicine and Dentistry. It includes a Level I trauma center, a newly opened freestanding children's hospital, and a regional cancer institute. Specialized care provided by the center includes both a stem cell and solid organ transplant program, trauma and burn care, and complex cardiology services, including an artificial heart program. The hospital offers services to patients throughout the western New York region.

ID and pharmacy services: ID clinical care for adults and pediatric patients is provided by the university's ID division, which includes more than 15 adult ID physicians and seven pediatric ID doctors. Two adult ID teams and one pediatric ID team provide daily consults for an average of more than 40 inpatients. One ID physician, one ID pharmacist, and one resident pharmacist provide services for the ASP.

IT: The EHR system is Epic with CPOE, and order sets as well as data capture and reporting are performed through Epic. There is no separate CDSS, although this functionality has been developed within the Epic system for select initiatives such as the appropriate management of antibiotic allergies.

Laboratory: There is an on-site microbiology laboratory with 24/7 services to perform real-time culture and antibiotic susceptibility testing. PCR technology is available to detect pathogens from blood isolates.



Over time, the antibiotic stewardship program has become embedded into the culture of the hospital."

Elizabeth Dodds Ashley, Strong Memorial Hospital

Planning, development, resources, and skills

The ASP began nearly 20 years ago as an antibiotic management program. It initially focused on cost savings through drug restrictions. Since then, the ASP has had a physician champion who has worked closely with the pharmacy. The ASP physician champion also serves as the hospital epidemiologist and clinical director of the ID division.

The ASP has expanded into the outpatient sector with activities such as monitoring outpatient parenteral antibiotic therapy. An emergency room-based ASP operates in tandem with the inpatient ASP and follows up on microbiology culture results for all patients seen in the ER. Useful tools for the facility's ASP have included the 2007 IDSA/SHEA guidelines on antibiotic stewardship and the CDC core elements for hospital ASPs.

Stewardship overview

The ID Division and the Department of Pharmacy share oversight of the ASP. Program meetings are attended by three adult ID physicians, two pediatric ID physicians, pediatric and adult pharmacists, and microbiologists.

- **Leadership commitment:** The hospital administration supports 1.0 FTE for the Department of Pharmacy dedicated to stewardship activities. Pharmacy has provided training support for the pediatric pharmacist to complete the Society of Infectious Diseases Pharmacists Certificate Program in Antimicrobial Stewardship. There is also a pharmacy resident who dedicates time and effort to stewardship projects.
- **Accountability:** An ID physician and the ID pharmacist who serves as the ASP pharmacist are both responsible for the ASP success.
- **Drug expertise:** The ASP pharmacist, along with other pharmacists, provides drug expertise for the program.
- **Action:** The ASP provides the antibiotic rounding program, which includes weekly rounds between an ASP member and six clinical services. Before the meeting, the ASP pharmacist reviews all patients receiving antibiotics and identifies any opportunities for intervention. Antibiotic indications, or medical issues that necessitate antibiotic treatment, are captured for all antibiotic orders; these data are used for real-time interventions by front-line pharmacy staff when therapy clearly deviates from existing treatment guidelines. The EHR also triggers an alert for cases such as restricted agent use that require ASP approval. Data are regularly mined to identify opportunities for further investigation, intervention, and communication. SMH's ASP uses prior authorization, which requires the approval of designated ASP staff, either the ASP pharmacist or an ID fellow, for 12 antibiotics before starting a patient on therapy, as well as post-prescriptive review and feedback for all patients who receive vancomycin for longer than 72 hours.
- **Education:** ASP team members have many opportunities to educate various providers about preferred prescribing methods. They provide information at events such as monthly internal medicine noon conferences, annual surgery grand round lectures for medical staff, numerous medicine grand rounds related to stewardship topics, medical student lectures, and weekly conferences with trainees on critical care services.
- **Tracking:** The program tracks process measures such as adherence to ASP guidelines, appropriateness of antibiotic use, and treatment of *C. difficile* infections. It also tracks outcome measures including DOT per 1,000 patient-days and antibiotic costs.
- **Reporting:** This facility participates in a citywide hospital ASP collaborative, which provides the opportunity to benchmark and compare antibiotic use in facilities across the city. The ASP also reports quarterly to SMH's Infection Prevention Committee meetings.

Results

SMH's ASP reported that antibiotic use in DOT per 1,000 patient-days and antibiotic cost per patient-day has remained consistently low, and below available benchmarks, since the program was implemented.

Data from the first year, when only two clinical services participated in antibiotic rounds, showed that out of approximately 1,000 patient reviews, stewardship interventions were recommended for a quarter of these patients.

Sustainability

The staff believes that as a long-standing program, the ASP has contributed practices that have become embedded in the culture at SMH. Generally, however, SMH providers do not think of existing stewardship activities as part of a formal ASP. While practitioners are supportive of stewardship actions and interventions, they worry that a formal ASP would impose additional restrictions on provider practices. To address this, the team is focusing on branding the ASP within the facility. By demonstrating the ASP's ability to reach so many patients with just a simple weekly review, program members believe they were able to justify the program's expansion to additional services throughout the facility. In the future, the ASP hopes to gain support and expand by receiving at least a 0.5 FTE funding support for a physician dedicated to stewardship. This new clinician could provide a strong stewardship presence in the intensive care unit, in addition to the oversight of hospital-wide stewardship activities. For further support, the ASP will request additional time from a dedicated pharmacist.

Lessons learned

- SMH's ASP found that the electronic health record system can be used to develop alerts for providers, and that the CPOE system can guide therapy without the use of a clinical decision support system by utilizing existing IT systems tailored to suit the needs of the program.
- Stewardship staff also learned that antibiotic indications can be required for prescriptions to ensure opportunities for ASP intervention.
- Front-line pharmacy staff can be educated about stewardship principles that could be implemented across the institution.

Contacts:

Elizabeth Dodds Ashley, Pharm.D., M.H.S., F.C.C.P., ID pharmacist

Duke Antimicrobial Stewardship Outreach Network

Duke University, Durham, North Carolina (formerly of Strong Memorial Hospital)

libby.dodds@duke.edu

Christopher Evans, Pharm.D., ID pharmacist

University of Rochester Medical Center

Rochester, New York

christopher_evans@urmc.rochester.edu

Paul Graman, M.D., professor of medicine

University of Rochester Medical Center

Rochester, New York

paul_graman@urmc.rochester.edu



Structure and resources

UABH is a large academic medical center with 1,157 licensed beds and 11 intensive care units. It serves as the only Level I trauma center in the state and as a major Southeast referral center for solid organ transplantation.

ID and pharmacy services: The ID Department supports three inpatient consult services with one solely dedicated to the immunocompromised patient population. Collectively, the ID consult services evaluate more than 200 new patients monthly, including 40 to 50 new transplant-associated infections. The Department of Pharmacy devotes 120 pharmacist FTEs to 24-hour clinical pharmacy services. In addition to the centralized pharmacy compounding and distribution services, decentralized pharmacy specialists are located throughout the hospital.

IT: The hospital utilizes CPOE and automated dispensing cabinets to allow easy tracking of antibiotic storage and dispensing, as well as bedside bar-coding to provide automated verifications and documentations of medication administration. Cerner is the EHR and CPOE system for the institution. The CDSS is Medmined.

Laboratory: The on-site microbiology laboratory has the capability to perform mass spectroscopy allowing for the rapid and accurate identification of pathogens detected in patient samples. Additionally, the laboratory uses PCR testing for rapid detection of *C. difficile* infections, and T2 Biosystems to identify both *Candida* species and yeast pathogens commonly isolated from patient samples.



Following implementation of our antibiotic stewardship program, we observed a significant reduction in overall fluoroquinolone use."

Danielle F. Kunz, *University of Alabama Hospital, Birmingham*

Planning, development, resources, and skills

Historically, the Department of Pharmacy maintained an active relationship with the ID Department to develop antibiotic use policies. This relationship was facilitated through the P&T Committee. One of the key initiatives that preceded the formal ASP was fluoroquinolone restrictions after a 2005 hospital analysis revealed an increasing rate of overall use of this category of antibiotics. A restriction program was implemented, and formulary agents were restricted to ciprofloxacin and moxifloxacin. The hospital created guidelines for antibiotic

use, with any deviations requiring approval from ID faculty. After an institution-wide educational effort, the restriction initiative was implemented in October 2006. Following implementation of the formulary restriction, the facility observed a significant reduction in overall fluoroquinolone use, including a 77 percent relative reduction in ciprofloxacin use. In addition, several nosocomial, or hospital-acquired, Gram-negative pathogens, including *P. aeruginosa* and *Acinetobacter* species, showed increased sensitivity to ciprofloxacin. This intervention led to the creation of the UABH's formal ASP in 2008.

A veteran pharmacist who specializes in ID within the Department of Pharmacy accepted responsibility for the stewardship initiatives. ASP champions received support from the chief pharmacy officer, hospital and quality leadership, P&T committee, and Departments of Medicine and ID faculty.

The ASP reviews protocols and records involving the use of antibiotics for the emergency room and outpatient clinics. As a general rule, any agents that are restricted for inpatient use are also restricted in outpatient areas.

Stewardship overview

The ASP falls under the P&T Committee. All ASP-proposed initiatives and guidelines must be presented to and approved by the P&T Committee. Once approved, ASP members present the initiatives through educational activities to staff and pharmacists.

An ID physician chairs the ASP. There are six additional physician members (three ID specialists, one trauma, one pulmonary, and one critical care) and an ASP pharmacist. Other staff members consult as necessary.

- **Leadership commitment:** The hospital administration provides funding to the Division of Infectious Diseases for 1.0 FTE to support an ASP physician, and to the Department of Pharmacy for one FTE ASP pharmacist.
- **Accountability:** The ID physician, who chairs the program, and the ASP pharmacist lead the program and are responsible for its success. All ASP team members and inpatient pharmacists are responsible for implementing program activities and interventions.
- **Drug expertise:** The ASP pharmacist and other inpatient pharmacists provide drug expertise.
- **Action:** The ASP requires preauthorization of antibiotic agents before starting therapies, performs antibiotic timeouts by placing a 72-hour limit on all antibiotic use followed by reassessment to determine whether therapies should be continued, and provides prospective audit and feedback, which allows ASP staff to interact directly with prescribers and modify therapy as needed. The ASP pharmacist uses Medmined to conduct prospective and retrospective monitoring of antibiotic agent prescribing and monitor compliance with stewardship initiatives. The ASP uses Cerner to notify providers of new implementation initiatives, management of antibiotic shortages, required documentation of approval for restricted agents, and hard stop dates for empiric antibiotic therapy.
- **Education:** The ASP provides in-service education and conducts meetings to disseminate new stewardship information prior to the implementation of new activities.
- **Tracking:** The ASP tracks monthly antibiotic use data, expressed as DOT per 1,000 patient-days. The pharmacy department provides antibiotic expenditure data monthly to the ASP. Medmined is used for prospective monitoring of ASP initiatives.
- **Reporting:** The team presents a semiannual progress report to the P&T Committee, which includes the results of ongoing initiatives, antibiogram data, and antibiotic expense data.

Results

At monthly ASP meetings the team reviews all antibiotic utilization data (DOT per 1,000 patient-days), the usage of eight restricted drugs, and antibiotic expenditures.

Sustainability

Because antibiotic use protocols and guidelines already existed at UABH, ASP members feel that the program has been welcomed. They believe the administration was forward-thinking about the program's original proposal, and it was successfully approved with little resistance. However, the health system's administrative structure has presented some challenges in terms of funding. Negotiations are underway to expand ASP services to four affiliate hospitals on a contractual basis, and representatives from these facilities will be included in future UABH ASP committee meetings. Once services are expanded, ASP team members will also attend stewardship meetings at the four affiliate hospitals on a bimonthly basis.

The ASP team believes that active participation of ID physicians, ID fellows, and decentralized pharmacists is critical to the continued success of stewardship initiatives, and that administrative support of the Department of Medicine and the university health system has ensured the program's long-term success.



Plans are underway to expand the antibiotic stewardship program to four affiliate hospitals."

Danielle F. Kunz, University of Alabama Hospital, Birmingham

Lessons learned

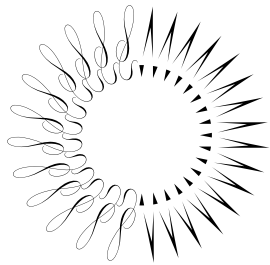
- The ASP physician chair and pharmacist determined that in order to be successful in their roles, and change the prescribing culture of an institution, they must develop relationships with clinicians.
- The team found that the ASP's relationships with clinical pharmacists are crucial to success. The ASP pharmacist educates clinical pharmacists, who implement ASP initiatives within this institution.
- Rapid identification of pathogens was critical to the success of the UABH program.
- Finally, the program members observed that even without a dedicated data analyst, the ASP was able to obtain outcomes data by collaborating with other hospital staff members, including information technology support staff.

Contact person:

Danielle F. Kunz, R.Ph., B.C.P.S., AQ-ID, infectious disease/antimicrobial stewardship
University of Alabama Hospital, Birmingham
Birmingham, Alabama
dkunz@uabmc.edu

Endnotes

- 1 U.S. Centers for Disease Control and Prevention, "Antibiotic Resistance Threats in the United States," 2013, accessed Nov. 12, 2014, <http://www.cdc.gov/drugresistance/pdf/ar-threats-2013-508.pdf>.
- 2 U.S. Centers for Disease Control and Prevention, "Antibiotic Resistance Threats."
- 3 Jennie H. Kwon, Margaret A. Olsen, and Erik R. Dubberke, "The Morbidity, Mortality, and Costs Associated with *Clostridium difficile* Infection," *Infectious Disease Clinics of North America* 29, no. 1 (2015): 123-134, doi: 10.1016/j.idc.2014.11.003; Stuart H. Cohen et al., "Clinical Practice Guidelines for *Clostridium difficile* Infection in Adults: 2010 Update by the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA)," *Infection Control and Hospital Epidemiology* 31, no. 5 (2010): 431-455, doi 10.1086/651706.
- 4 Pranita D. Tamma, Alison Holmes, and Elizabeth Dodds Ashley, "Antimicrobial Stewardship: Another Focus for Patient Safety?" *Current Opinion in Infectious Diseases* 27, no. 4 (2014): 348-355, doi: 10.1097/QCO.000000000000077.
- 5 The White House, "National Action Plan for Combating Antibiotic-Resistant Bacteria," March 2015, accessed Nov. 12, 2015, https://www.whitehouse.gov/sites/default/files/docs/national_action_plan_for_combating_antibiotic-resistant_bacteria.pdf.
- 6 Kate Traynor, "California Strengthens Antimicrobial Stewardship Mandate for Hospitals," *American Journal of Health-System Pharmacy* 72, no. 5 (2015): 338-340, doi: 10.2146/news150016.
- 7 Brittin Wagner et al., "Antimicrobial Stewardship Programs in Inpatient Hospital Settings: A Systematic Review," *Infection Control and Hospital Epidemiology* 35, no. 10 (2014): 1209-1228, doi: 10.1086/678057; Tamma, Holmes, and Ashley, "Antimicrobial Stewardship," 348-355; David Y. Hyun et al., "Antimicrobial Stewardship in Pediatrics: How Every Pediatrician Can Be a Steward," *Journal of the American Medical Association Pediatrics* 167, no. 9 (2013): 859-866, doi: 10.1001/jamapediatrics.2013.2241.
- 8 Sigmund Ruttimann et al., "Long-Term Antibiotic Cost Savings from a Comprehensive Intervention Program in a Medical Department of a University-Affiliated Teaching Hospital," *Clinical Infectious Diseases* 38, no. 3 (2004): 348-356, doi: 10.1086/380964; Philip Carling et al., "Favorable Impact of a Multidisciplinary Antibiotic Management Program Conducted During 7 Years," *Infection Control and Hospital Epidemiology* 24, no. 9 (2003): 699-706, doi: 10.1086/502278; Harold C. Standiford et al., "Antimicrobial Stewardship at a Large Tertiary Care Academic Medical Center: Cost Analysis Before, During, and After a 7-Year Program," *Infection Control and Hospital Epidemiology* 33, no. 4 (2012): 338-345, doi: 10.1086/664909.
- 9 U.S. Centers for Disease Control and Prevention, "Core Elements of Hospital Antibiotic Stewardship Programs," 2014, accessed Sept. 16, 2015, <http://www.cdc.gov/getsmart/healthcare/pdfs/core-elements.pdf>; U.S. Centers for Disease Control and Prevention, "Core Elements of Antibiotic Stewardship for Nursing Homes," 2015, accessed Nov. 17, 2015, <http://www.cdc.gov/longtermcare/pdfs/core-elements-antibiotic-stewardship.pdf>.
- 10 Timothy H. Dellit et al., "Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship," *Clinical Infectious Diseases* 44, no. 2 (2007): 159-177.
- 11 U.S. Centers for Disease Control and Prevention, "Percent of Hospitals with Antibiotic Stewardship Programs by State," 2014, accessed Dec. 1, 2015, <http://www.cdc.gov/media/images/dpk/2015/dpk-antibiotics-week/img3.pdf>.



THE
PEW
CHARITABLE TRUSTS