Implementation of an Antimicrobial Stewardship Program in a Community Hospital: Results of a Three-Year Analysis

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Abstract

Background: In July 2007, the Pharmacy Department at Suburban Hospital implemented an antimicrobial stewardship program (ASP) using existing clinical pharmacy resources that did not include an on-site infectious diseases (ID) pharmacist. Medical staff personnel were supportive of the ASP, but there were no ID physician resources actively dedicated to the program. Remote access to an ID pharmacist was available.

Objectives: This program evaluated the impact of a pharmacy-driven ASP on cost, antimicrobial utilization, and quality indicators in a community hospital with limited ID professional resources.

Methods: The tenets of the program were adopted from recommendations in the most current Infectious Diseases Society of America/Society for Healthcare Epidemiology of America antimicrobial stewardship guidelines. Antimicrobial utilization, cost, prospective medication use data, and interventions were tracked using customized spreadsheets. Three years of utilization and cost data were captured to provide a baseline and post implementation comparison.

Results: Antimicrobial utilization decreased 5.2% compared to baseline ($P < .001$) as measured by the defined daily dose (DDD) per 1,000 patient days. The associated cost reduction during the period was 24% compared to baseline ($P < .001$), resulting in estimated savings of approximately $290,000. Quality of care indicators improved, and physicians were responsive to daily clinical pharmacist review and pharmacy interventions.

Conclusions: An ASP can be implemented in a community hospital setting with existing clinical pharmacy resources that do not include an ID specialist dedicated full time to the program. Prospective monitoring of antimicrobial usage resulted in decreased antimicrobial cost and utilization and improvements on key quality of care indicators. Based on this evidence of success, the program continues.

Key Words—anti-infective agents, antimicrobial stewardship, therapeutic use


Antimicrobial stewardship is a collective term that receives wide publicity as a new concept, even though the individual components of a stewardship program have been in place at most hospitals for many years. The term “antimicrobial stewardship” is defined as the appropriate selection and dosing of antimicrobials based on indication and patient parameters (such as renal or hepatic function) with the goal of maximizing efficacy and minimizing toxicity, cost, and antimicrobial resistance. Antimicrobial stewardship programs (ASPs) are intended to extend the lifespan of antimicrobials available in the market, because antimicrobial development has not kept pace with the emergence of new drug-resistant pathogens. A well-run ASP promotes the best clinical outcomes while reducing or stabilizing antimicrobial...
resistance, improving patient safety, and promoting cost-effective care.

The concept of antimicrobial stewardship first appeared in the literature in 1973, and the first formal set of guidelines was published in 1997 by the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA). These guidelines highlighted general stewardship concepts but had limited guidance related to the role of a clinical pharmacist. Updated IDSA/SHEA guidelines were published in 2007 and better defined the role of personnel and key components of an ASP that can achieve optimal outcomes: formulary restriction and pre-authorization, prospective audit with intervention and feedback, dose optimization interventions, streamlining, intravenous (IV) to oral (PO) conversion, empiric therapy guidelines and clinical pathways, and clinician education. Interest among pharmacists and their professional associations increased when these new guidelines recommended that an ASP be led by both an infectious diseases (ID) physician and a pharmacist with ID training. To our knowledge, there are no central statistics regarding the official number of practicing ID pharmacists and ID physicians, so it is difficult to estimate the percentage of facilities that could satisfy this recommendation. One small survey of 97 hospitals nationwide conducted in July 2009 revealed that 42% did not have an ID physician available and only 6% (6%) had a full-time, dedicated ID clinical pharmacist. Even if a facility has access to ID physicians, they may be responsible for patients at multiple facilities, making it difficult for them to dedicate attention to a single institution’s stewardship program.

Outcomes associated with successful ASPs have historically been reported in larger hospitals where access to ID physicians and pharmacists may be more prevalent. Success stories in hospitals without a dedicated ID pharmacist, ID physician, or both, such as in many community hospitals, are limited. One of the earliest published case reports detailed efforts at a 120-bed community hospital in Louisiana. Despite early misgivings about prescribing autonomy and the legal ramifications of not accepting ASP recommendations, this hospital documented a 20% cost savings per patient day and ultimately garnered the support of the attending physicians.

Regardless of institution type or size, collaborative medicine is now being emphasized along with evidence-based practice as the mantra for health care reform because it consistently improves outcomes, reduces cost, and improves patient satisfaction with the health care experience. Programs such as the one described in this report can be readily implemented on a scale appropriate to the institution and serve as a model for coupling quality improvement and cost reduction strategies.

IDENTIFYING THE NEED

In March 2007, monthly cost monitoring reports began to show a continued upward trend in overall antimicrobial (ie, antifungal, antiviral, and antibiotic) costs. Additional analysis indicated that when compared to a subset of 30 hospitals of similar census (average daily census of 200-400 patients), approximately 64% of these peer hospitals had lower mean antimicrobial costs than Suburban Hospital based on cost per adjusted patient day ($/APD). A more detailed retrospective review of drug purchase data found that total costs increased by 11.5% between fiscal years (FY) 2005 and 2007 (Suburban Hospital’s FY ends in June). This was accompanied by an increase in overall utilization, as measured in grams.

In response to these increases, Suburban Hospital’s pharmacy department initiated a retrospective review of antibiotics and antifungals that were high cost, high use, or had the potential for unintended adverse effects. Focus was placed on those drugs that required preservation due to the potential for resistance development. The primary drugs included in the initial analysis were piperacillin/tazobactam, imipenem/cilastatin, cefepime, levofloxacin, daptomycin, linezolid, caspofungin, and tigecycline. Records were reviewed for 118 patients who received one or more of these agents from December 2006 to May 2007 to identify opportunities for improvement. Pharmacy staff engaged in routine discussions with the microbiology and infection control departments and the hospital’s ID physicians to identify opportunities for stewardship. Antimicrobial resistance trends from 2004 to 2007 were also examined.

The data were summarized and presented to the antimicrobial subcommittee and the Pharmacy & Therapeutics (P&T) committee. Based on the data, the P&T committee recommended implementing an ASP. The program was implemented in July 2007. The goal of Suburban Hospital’s program was to improve quality of care by increasing optimal selection of antimicrobials for empiric and definitive therapy based on patient and pathogen factors and to improve patient safety by monitoring for dose appropriateness, organ function, and adverse effects. Program impact was measured by comparing a 1-year baseline period prior to the implementation of the...
ASP to 2 years of follow-up data after the program was initiated.

**DEMOGRAPHICS**
At the time of the initial program implementation, Suburban Hospital was a 236-bed not-for-profit, acute-care community hospital that provided services in cardiothoracic surgery, critical care, orthopedic surgery, oncology, and acute medical/surgical care in Bethesda, Maryland. The Department of Pharmacy had approximately 24 pharmacist full-time equivalents (FTEs). The pharmacy operated according to a decentralized staff model where pharmacists rotated between performing distributive functions and clinical activities under the direction of a lead clinical pharmacist (M.M.) and a clinical pharmacy manager (K.M.) who had primary responsibility for clinical program oversight. No additional pharmacy staff was added to support the ASP, and there were no dedicated ID pharmacists on staff. The day-to-day ASP-related activities were performed using existing pharmacy resources. An external ID pharmacist was accessible on a consultative basis (K.K.). This pharmacist was responsible for assisting with the baseline assessment, providing guidance on program set-up, establishing a work plan, collaborating on process improvement opportunities, preparing materials for the antibiotic subcommittee, and providing data interpretation. In addition, this individual provided clinical ID pharmacy mentorship and assisted with on-site ID-related education for the pharmacy staff. The external ID pharmacist spent approximately 16 hours per month providing support for the program (March 2007 through March 2008), until the program was fully functional and training was completed. Four hours of monthly support were provided for the duration of the measurement period (end of FY09).

Approximately 9 private practice ID physicians had prescribing privileges at the facility. One of these physicians was the co-chairperson of the antimicrobial subcommittee, and there were others who participated as members at various times. There were no dedicated ID physician hours allocated to support the day-to-day stewardship activities. Overall, the relationship between the ID physicians and pharmacy was collaborative.

**METHODS**

**ASP overview**

[Note: The term “antimicrobial” in this section is used to describe the activities in the stewardship program pertaining to antibiotics and antifungals; antivirals were not included.]

The ASP began in July 2007. The antimicrobial subcommittee provided indirect oversight of the program. This committee was co-chaired by a clinical pharmacist and an ID physician and convened bi-monthly. The ID physician chair helped to facilitate discussions on clinical topics during the meetings and added credibility to the initiatives proposed by pharmacy. The committee members included several specialty physicians (eg, intensivists, ID, and emergency room) and representatives from infection control, nursing, microbiology, and medication safety. The diverse representation of specialty physicians was helpful. They were able to help facilitate communication among their respective medical groups about the practice changes that were recommended by the committee. The recommendations from the committee were forwarded to the hospital’s P&T committee for final approval.

The primary components of the ASP were adopted from the main tenets of the IDSA/SHEA guidelines. One of the key foci of the program was formulary restriction and pre-authorization, which is also known as a “front-end approach.” Antibacterials and antifungals that were high cost, high use, or required preservation due to the potential for resistance issues to develop were included. Three agents met the criteria for inclusion: daptomycin (Cubicin; Cubist Pharmaceuticals, Lexington, MA), linezolid (Zyvox; Pfizer Pharmaceuticals, New York, NY), and caspofungin (Cancidas; Merck and Co. Inc, Whitehouse Station, NJ). These are collectively referred to as “restricted drugs.” A policy approved by the antimicrobial subcommittee and the P&T committee limited ordering privileges to select prescribers and specified the duration of treatment before requiring an ID consult. Intensivists were allowed to order the drugs for the first 72 hours of therapy and then an ID physician consult was required; ID was the only discipline allowed to prescribe these anti-infectives on an unrestricted basis. If an order was received for a restricted drug after hours (ie, overnight), then the pharmacist would contact the physician, inform him or her of the policy, and offer a therapeutically equivalent recommendation until the patient could be seen by an ID physician or intensivist the following day.

In addition to restricting selected agents, the hospital’s antimicrobial formulary was reviewed and additional automatic substitutions were approved for anti-pseudomonal cephalosporins (cefepime for
ceftazidime) and lipid amphotericin products (liposomal amphotericin B for amphotericin B lipid complex and amphotericin B cholesteryl sulfate complex). Although not automatic, patients were prospectively identified for potential conversion from levofloxacin to ciprofloxacin when appropriate. Empiric therapy guidelines for community-acquired pneumonia, aspiration pneumonia, sepsis, urosepsis, intra-abdominal infections, bacterial meningitis, and Clostridium difficile–associated disease were approved by the P&T committee and disseminated to the medical staff.

Prospective audit with intervention and feedback was conducted daily. The hospital computer system (Meditech, version 5.61, Westwood, MA) was utilized to generate a list each morning of patients who were on the targeted antimicrobials. The clinical pharmacist and the clinical pharmacy manager reviewed all patients who were receiving the restricted drugs (linezolid, daptomycin, and caspofungin) and intervened if necessary based on patients’ clinical status and culture and sensitivity results. Patients receiving broad spectrum antimicrobials (eg, piperacillin/tazobactam, imipenem/cilastatin, ertapenem, cefepime, levofloxacin, and tigecycline) were also concomitantly evaluated for appropriate use and streamlining opportunities. The primary intervention method was via direct conversation with the prescriber, and the outcome (eg, acceptance or denial) was documented. For the restricted drugs, expanded clinical and demographic information was collected. Additional details on the process are provided in the next section. This information was aggregated and reported quarterly to the antimicrobial subcommittee and provided to the Chief Medical Officer. This stage, which is also referred to as the “back end approach,” allowed for targeted education of the prescriber, another key component of an ASP.12,13

Pharmacy staff education was conducted via printed and in-person instruction, including in-services provided to all staff clinical pharmacists on selected anti-infective related topics. Clinical ID updates were included in the pharmacy’s monthly newsletter and were distributed hospital-wide. At program initiation, staff pharmacists were required to complete an antimicrobial stewardship training course that included a 2-hour self-study workshop and a 2-hour case-based interactive course. The ID physicians provided a 1-hour continuing medical education program (referred to as the Antimicrobial Consensus Conference) to hospital staff starting in 2006; this is repeated annually.

Responsibility for antimicrobial dose optimization was given to clinical staff pharmacists during each shift. These pharmacists reviewed the patients who were receiving antimicrobials to determine whether they were receiving the appropriate daily dose based on renal/hepatic function. Drugs commonly targeted for dose reduction due to renal insufficiency included penicillins, cephalosporins, carbapenems, tetracyclines, azole antifungals, and fluoroquinolones. The pharmacists were allowed to adjust doses automatically per a protocol that was approved by the P&T committee. Patients who were receiving aminoglycosides and vancomycin were monitored, and doses were adjusted per protocol as part of the pharmacokinetics program.

Patients were also assessed to determine eligibility for conversion to bioequivalent PO therapy based on hospital criteria and were automatically converted if they met the criteria per the P&T–approved protocol. Medications included in the IV to PO program included azithromycin, fluoroquinolones, metronidazole, linezolid, and fluconazole.

Data Collection and Analysis

The study periods in this evaluation were organized by fiscal year to coordinate with the start of the ASP in July 2007 (the beginning of Suburban Hospital’s fiscal year). As such, the antimicrobial cost and utilization analyses are reported for 3 full fiscal years: 1 year baseline (July 2006 to June 2007 [FY07]), and 2 years following implementation (July 2007 to June 2008 [FY08], and July 2008 to June 2009 [FY09]). Medication administration and process measures (such as physician acceptance and IV to PO conversion) were documented for the 2 years following program implementation (July 2007 through June 2009).

Data were collected in 2 separate customized Excel spreadsheets (version 2003; Microsoft Corp, Redmond, WA). The first spreadsheet tracked cumulative pharmacists’ interventions by month, including IV to PO conversions, renal dose adjustments, and antimicrobial streamlining for all anti-infectives other than the restricted drugs. No patient demographics or quality measures were recorded in this data set. For the 3 restricted drugs, medication use data were entered prospectively in a second spreadsheet on a daily basis. Data recorded included basic demographics (eg, height, weight, renal/hepatic function), length of stay, and length of therapy. Indications for use were documented at the start of therapy, and then a final diagnosis was recorded based on culture and sensitivity reports. Prior therapies were also tracked in addition to physician acceptance rates. Specific quality
of care and process indicators were recorded for each of the 3 drugs: for linezolid, platelet count, discontinuation secondary to a decrease in platelets, concomitant selective serotonin reuptake inhibitor (SSRI); for daptomycin, frequency of creatinine phosphokinase levels; and for caspofungin, degree of hepatic impairment. Automatic calculations programmed into the spreadsheet summarized the data and populated a preformatted medication use evaluation (MUE) scorecard that reported aggregate data by quarter. Patients were included in the data set based on their admission date.

Antimicrobial cost data included purchases made through the hospital’s pharmaceutical wholesaler and direct purchases from the manufacturer and were retrieved in aggregate using proprietary software (Cardinal Health Pharmacy Solutions, Houston, TX). This information was reported quarterly throughout the study period until the close of fiscal year 2009 and was entered into an Excel spreadsheet. Costs were tracked and represented per adjusted patient day ($/APD) to account for the proportion of antimicrobials purchased for use in the outpatient setting. The APD was calculated by the following equation: inpatient hospital days x (total pharmacy revenue/inpatient pharmacy revenue). Antimicrobial utilization was calculated based on the defined daily dose per 1,000 acute patient days (DDD/1,000 patient days). The DDD per 1,000 patient days is defined by the World Health Organization (WHO) for most drugs used on a maintenance basis to standardize comparisons of drug utilization. The DDD per 1,000 patient days was calculated by dividing the aggregate use of a specific antimicrobial (in grams) by a defined daily standard dose for that drug and then expressing it per every 1,000 acute patient days.

Total hospital admissions, average length of stay, emergency room visits, and outpatient visits were measured to identify any trends in patient census that might impact the overall use of antimicrobials during the study period. Antimicrobial resistance was tracked annually via the hospital’s antibiogram. Overall trends were reviewed at the antimicrobial subcommittee and as needed, but extensive analyses were not performed.

Descriptive statistics (rates and proportions) were computed; significance testing for changes in cost and utilization data was accomplished via the chi-square test for comparing the difference between rates. The chi-square test for comparing proportions was used to test for significant differences in quality of care and process measures.

RESULTS

There was little variation during the study period with respect to the number of hospital admissions (14,787 in 2008 and 14,610 in 2009), average length of stay (4.26 and 4.22, respectively), and emergency room (43,160 and 43,826) and outpatient visits (87,770 and 92,132), reflecting a relatively stable inpatient hospital population during the time period evaluated.

Cost and Utilization

Overall cost and utilization declined during the study period compared to baseline (FY07) (Figure 1). Total antimicrobial costs (antibiotics and antifungals combined) decreased 24% from $13.83/APD in FY07 to $10.47/APD in FY09 (difference between rates, $3.36; 95% CI, 3.33–3.39; P < .001) (Figure 1). The extended sum of these total savings approached $290,000, largely due to reductions in antibiotic expenditures which accounted for more than 90% of the total for the drugs monitored. Overall antimicrobial utilization decreased 5.2% from 821.33 DDD/1,000 patient days in FY07 to 778.77 DDD/1,000 patient days in FY09 (difference between rates, 42.56 DDD/1,000; 95% CI, 42.55–42.57; P < .001) (Figure 1). The class-specific (antimicrobial and antifungal) changes in cost and utilization are provided in Table 1. The standard deviation around each metric also declined during the study period (Table 1).

Quality and Process Measures

Quality of care and process measures tracked for the restricted drugs improved during the course of the 2-year study period (FY08 and FY09); however, due to small sample sizes, most computations did not reach statistical significance. For example, fewer than 100 patients were administered daptomycin in either study year (n = 40 in FY08; n = 51 in FY09). Among patients administered linezolid (n = 113 and n = 73 in FY08 and FY09, respectively), the average length of therapy declined from 5.26 days in FY08 to 3.75 days in FY09 (P = .005). The clinical relevance is that patients were either switched earlier to another therapy based on culture and susceptibility results or therapy was discontinued altogether. Patient monitoring for adverse drug effects improved as well, although the measures did not reach statistical significance. The proportion of patients on linezolid who experienced a 25% platelet drop declined from 22.1% to 15.1% (P = .234). Compared to the baseline period, fewer patients were required to

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discontinue therapy due to a platelet drop (12.4% and 9.6%; \( P = .556 \)) during the study period. For those administered daptomycin, the average length of therapy also decreased, albeit not significantly (6.59 to 5.95 days; \( P = .341 \)), and monitoring improved slightly (as measured by dosage appropriateness and CPKs drawn during treatment; data not shown).

**Interventions**

Over the course of the 2-year intervention period, 4,515 interventions related to antimicrobials were recorded by pharmacy staff. Renal dose adjustments were the most frequent intervention (44% of total), followed by antimicrobial streamlining (37%) and IV to PO conversion (19%). For the restricted drugs, physician denial rates of pharmacists’ interventions decreased from 42% to 15% between FY08 and FY09. In addition, in FY08, only 2% of therapy was stopped by the physicians following microbiology cultures and/or changes in patients’ clinical status; in FY09, this number increased to 21%.

**DISCUSSION**

This report demonstrates how a community hospital was able to successfully implement an ASP without a full-time ID pharmacist or ID physician dedicated to the program. The report also presents preliminary utilization, cost, and quality benchmarks pre and post implementation. The ability to access ID pharmacy expertise remotely and ID physician expertise in the hospital setting provided enough support such that a program could be implemented under the leadership of clinical pharmacists who did not have formal ID training. Routine communication and direct reporting of the information to the Chief Medical Officer helped improve physician compliance with policies, and hospital administrative support was perceived as a key factor in program sustainability. Feedback from the members of the antimicrobial subcommittee and a collaborative working relationship with the ID physicians were also helpful. The committee provided suggestions for policy changes and protocol development and assisted in identifying areas for additional improvement.
opportunities. In addition, standardizing the data collection through the use of electronic documentation assisted greatly in helping to measure program outcomes.

Total savings from the ASP for FY07 to FY09 was almost $290,000 based on the variance in cost per APD from pre- and postimplementation data. Because overall cost is influenced by changes in both utilization and price, we note that a portion of the savings realized could have been attributed to a reduction in the contract acquisition costs. However, the decline in DDD/1,000 patient days validated that a portion of the savings was due to a decline in antimicrobial utilization. Significant changes in the outpatient census during the measurement period could potentially influence cost per APD; this did not appear to be a factor, because outpatient visits only increased by 5% during the evaluation period and very few antimicrobials are administered in the outpatient setting. Further validating our findings, when Suburban Hospital was benchmarked at the end of FY09 against the same 30-hospital group previously mentioned, only 29% had lower antimicrobial costs (vs 64% in FY07).9

The reduction in antimicrobial utilization was attributed to the routine monitoring of patients, more than 4,500 interventions made by the clinical pharmacists, and the decentralized pharmacy staff. The 5% reduction in utilization does not take into account any increases that might have occurred in the absence of an ASP. Although hospital-specific antimicrobial utilization data were not available prior to FY07, other reports have shown that utilization generally increases on an annual basis. One evaluation of systemic antibacterial use for 22 university teaching hospitals showed that the mean (±SD) total antibacterial use increased from 798 (±113) days of therapy per 1,000 patient days in 2002 to 855 (±133) in 2006 (P < .001), reflecting a 7.1% increase.16 Therefore, Suburban Hospital’s observed reduction in utilization would be even greater if this avoided increase in utilization were added to the overall reduction in volume.

We anticipated that a reduction in utilization for one restricted drug might trigger changes in another drug – a “squeezing the balloon” effect. This was partially observed with linezolid and daptomycin. A 40% decrease in the number of linezolid treatment days was noted for FY08 to FY09 (500 to 327.5) with a concomitant 35% decrease in the number of patients on linezolid (113 vs 73) during the same period. Approximately half of this decrease in linezolid utilization may be explained by a shift to daptomycin (40 patients in FY08 compared to 51 in FY09). Among those patients continuing on linezolid, the observed decrease in length of therapy reflects an earlier conversion to vancomycin, discontinuation of treatment following pharmacist and physician review, and decreased use for urinary tract infections.

During the initial implementation, there were rapid returns on the program’s investments with respect to cost reductions and improvements in patient monitoring and dose appropriateness. Close oversight of the antimicrobial use data in conjunction with quality and process measures provided an opportunity to re-examine roles and responsibilities to best meet the clinical priorities. For instance, in April 2009 the P&T committee voted to allow pharmacists to order creatinine phosphokinase levels for patients receiving daptomycin based on manufacturer recommendations.17 For the restricted drugs, the decrease in physician denials of pharmacists’ interventions suggested that there was increasing acceptance of the program

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<th>Table 1. Mean cost and utilization of selected anti-infectives by drug class 1 and 2 years after implementation of antibiotic stewardship program</th>
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Note: APD = adjusted patient days; DDD = defined daily dose; FY = fiscal year; pt = patient.

9Significance testing for FY09 compared to baseline data (FY07) accomplished by chi-square test for differences in rates.
and the pharmacists conducting the interventions. The reinforcement by hospital administration was thought to contribute to this improvement.

Another contributing factor was the increase in the frequency with which physicians were discontinuing therapy. The theory behind this observation is that the continued daily evaluation by a pharmacist and frequent contact with the physicians to change therapy may have positively influenced the frequency in which streamlining occurred independent of a pharmacist’s recommendation.

Finally, the ability to establish an objective measurement of the program at baseline through accurate measurement of utilization and cost allowed the pharmacists to identify clinical opportunities. Reliable metrics and external benchmarks assisted with the interpretation of the data and the measurement of progress as the program continued.

**Limitations**

The success of Suburban Hospital’s ASP must be considered in the context of several limitations. First, the program was implemented without waiting to capture baseline quality data. The process measures collected during concurrent chart review over the course of 2 years provide a snapshot of the program’s potential and will be evaluated over time to identify trends suggestive of improvements as well as those that call for additional education and intervention. Secondary outcomes such as changes in length of stay were not calculated due to the difficulty in capturing the data for this subpopulation via electronic record query. Although antimicrobial resistance patterns were evaluated frequently, objective evaluation of the program’s impact on resistance patterns was not performed.

Second, small sample sizes for the restricted drugs limited the ability to detect statistically significant changes for many of the parameters measured. However, in almost all cases, trends were detected that suggested that the ASP had a noteworthy impact on decreasing cost and utilization while increasing quality of care. Seasonal variations in drug acquisition and utilization are a factor for every hospital, yet this seasonality did not change markedly year to year and we noted an overall decline each year despite such fluctuations. Finally, the narrowing in variance (reductions in the standard deviations in Table 1) around each metric in the year-to-year comparisons may reflect the tighter control over utilization achieved by monitoring every patient who was prescribed the target drugs.

**CONCLUSION**

The results of the 3-year analysis of the program showed that an ASP could be successfully implemented in a hospital despite the absence of an ID physician or ID pharmacist strictly dedicated to the stewardship program. In this institution, collaboration among pharmacy, administration, and the medical staff and access to an offsite advisor, along with standardized data collection tools, were instrumental in helping the pharmacy institute an ASP without having to add any additional personnel. The multidisciplinary approach, combined with drug use criteria, automatic protocols, and formulary management, allowed the facility to achieve a 5.2% decrease in antimicrobial utilization and an estimated savings of $290,000 over a 2-year period. Quality of care indicators for select drugs improved, and further improvements are anticipated as staffing roles and responsibilities are adjusted to place appropriate emphasis in areas deserving concerted effort. This initial analysis provided support for the program, which is currently in existence today.

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**Conflicts of interest:** The consultant conducting the data analysis has no relationship with Cardinal Health or Suburban Hospital and does not benefit from the outcome of the study.

**REFERENCES**


