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# Antibiotic Stewardship in Small Hospitals: Barriers and Potential Solutions

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(See the Editorial Commentary by Sexton and Moehring on pages 697–8.)

Antibiotic stewardship programs (ASPs) improve antibiotic prescribing. Seventy-three percent of US hospitals have <200 beds. Small hospitals (<200 beds) have similar rates of antibiotic prescribing compared to large hospitals, but the majority of small hospitals lack ASPs that satisfy the Centers for Disease Control and Prevention's core elements. All hospitals, regardless of size, are now required to have ASPs by The Joint Commission, and the Centers for Medicare and Medicaid Services has proposed a similar requirement. Very few studies have described the successful implementation of ASPs in small hospitals. We describe barriers commonly encountered in small hospitals when constructing an antibiotic stewardship team, obtaining appropriate metrics of antibiotic prescribing, implementing antibiotic stewardship interventions, obtaining financial resources, and utilizing the microbiology laboratory. We propose potential solutions that tailor stewardship activities to the needs of the facility and the resources typically available.

**Keywords.** antibiotic stewardship; small community hospital; antibiotic prescribing appropriateness.

Antibiotic resistance is a public health threat jeopardizing advances in healthcare and the health of everyone worldwide. With approximately 20%–50% of antibiotic use being deemed unnecessary or inappropriate [1], improving antibiotic use represents an important opportunity to address the threat of antibiotic resistance. In hospitals, this is typically done through an antibiotic stewardship program (ASP).

Given the existing evidence of the effectiveness of ASPs [2, 3] in reducing inappropriate antibiotic use, regulatory and accreditation bodies have either approved or proposed requiring that all hospitals have ASPs in place, regardless of size or critical access designation of the facilities [4, 5]. A significant portion of US healthcare takes place in small hospitals. In 2015, 73% of US hospitals had <200 beds (4057 hospitals) and 10% had <25 beds, many of which have critical access hospital (CAH) designation [6].

## THE NEED FOR ANTIBIOTIC STEWARDSHIP IN SMALL HOSPITALS

Data on antibiotic use and selection patterns in small hospitals are limited [7, 8]. A recent study from Utah compared

antibiotic use in small hospitals to large community hospitals in the same network [9]. Usage rates and spectrum of antibiotics used were no different when comparing small to large facilities. A 1-day antibiotic use point prevalence survey performed by the Centers for Disease Control and Prevention (CDC) also demonstrated similar prescribing patterns in small and large facilities [10]. Additional studies have also confirmed that hospital size is not a predictor of total antibiotic use [11–13]. Given these findings, it comes as no surprise that small hospitals have been found to have similar or higher rates of *Clostridium difficile* infections [14, 15] and drug-resistant bacteria [16] compared with larger hospitals. Multiple studies have found that smaller hospitals are less likely to have an active ASP and pharmacy support [17–20]. In 2015, the CDC surveyed hospitals submitting data to the National Healthcare Safety Network (NHSN) on 7 “core elements” of antibiotic stewardship [20]. Only 49% of hospitals with <200 beds met all 7 core elements compared with 66% of hospitals with >200 beds. Only 31% of CAHs had ASPs that met the core elements.

The published experience on implementing ASPs in small hospitals is similarly limited. Five published studies have described single-center experiences in implementing ASPs in hospitals of <200 beds (Table 1) [21–25]. While all of the programs utilized an infectious diseases (IDs) physician in some capacity, most of the pharmacists were not formally trained in ID. The studies used different approaches and all demonstrated improvements in antibiotic cost and usage; none measured improvement in antibiotic prescribing appropriateness.

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**Table 1. Summary of Published Antibiotic Stewardship Studies in Acute Care Hospitals With <200 Beds**

Study	Setting	Key ASP Members	Intervention	Results
Day et al [22]	70-bed hospital	ID physician	ID physician traveled to the hospital weekly and reviewed medical records of all patients receiving antibiotics and made recommendations to staff. Available by phone all other times	(1) Improved <i>Pseudomonas aeruginosa</i> susceptibilities, (2) decrease in DDD/1000 PD for levofloxacin; piperacillin/tazobactam; and doripenem, and (3) decrease in antibiotic costs per patient-day
Bartlett et al [23]	135-bed hospital	ASP pharmacist and 2 hours of ID physician support daily, Mon–Fri	ASP pharmacist reviewed all patients on antibiotics and made interventions per policy. Reviewed cases with the ID physician as needed	(1) Decreased antibiotic acquisition costs, (2) decreased cost of antibiotics per discharge, (3) Decreased total DDD/1000 PD, and (4) increased IV-to-oral antibiotic conversion
Storey et al [21]	100-bed hospital	ID physician, clinical pharmacy supervisor, pharmacy director	1 hour twice weekly, the ID physician and one of the pharmacists audited medical records of all patients receiving antibiotics for >2 days. Written recommendations were placed in the medical record	(1) Decrease in DDD of all antibiotics per 100 admissions and 1000 PD, (2) reduction in antibiotic costs
Yam et al [24]	141-bed hospital	ID physician, chief medical officer, director of pharmacy	Daily review of all patients on piperacillin/tazobactam, imipenem, ertapenem, vancomycin, linezolid, and daptomycin. Recommendations given to treatment team. A remote ID physician spent 30 minutes per week teleconference “rounding” with the pharmacy staff	(1) Reduction in antibiotic purchase costs, (2) possible decrease in hospital-acquired <i>Clostridium difficile</i> infection
LaRocco [25]	120-bed hospital	ID physician and clinical pharmacist	3 days a week, the ASP team reviewed medical records of patients receiving multiple, prolonged, or high-cost antibiotic therapy. Written recommendations given to treatment team	Reduction in antibiotic costs

Abbreviations: ASP, antibiotic stewardship program; DDD, defined daily dose; ID, infectious diseases; IV, intravenous; PD, patient-days.

With the changing regulatory landscape, small hospitals will need to tailor ASPs according to their resources, needs, and staffing structure. The goal of this review is to describe barriers commonly encountered in the implementation of ASPs in small hospitals and propose practical advice and potential solutions that have been effective in overcoming these barriers. We present the collective experience of 4 community hospital systems (Intermountain Healthcare, Kaiser Permanente [KP] Southern California, Colorado Hospital Association [CHA], and Hospital Corporation of America [HCA]) that have significant experience in operationalizing ASPs in small hospitals.

## CONSTRUCTING THE ANTIBIOTIC STEWARDSHIP TEAM

### Infectious Diseases Physician and Pharmacy Leadership

The Infectious Diseases Society of America (IDSA)/Society for Healthcare Epidemiology of America (SHEA) guidelines recommend that ASPs be led by ID physicians with advanced stewardship training or codirected by an ID physician and a clinical pharmacist with advanced ID training [4, 26]. An ID physician- and pharmacist-led ASP provides key experience and clinical knowledge along with access to formal ID consultation, which is known to improve clinical outcomes [27]. However, a common barrier small hospitals face is a lack of dedicated ID-trained staff to support the ASP. Previous surveys of smaller hospitals have shown that only 50%–58% of hospitals have access to ID physicians [28, 29]. In Utah, only 1 of 15 small hospitals within the Intermountain network had access to an inpatient ID consultation in 2014 [30].

The following are potential solutions to increase ID leadership in small hospital ASPs.

1. Part-time ID support and pooling resources: All of the published studies in small hospitals have utilized some form of ID physician resource sharing or contracting (Table 1). In geographically isolated small hospitals, contracting with a part-time ID physician may not be feasible. However, in urban centers, small hospitals may have the opportunity to contract with local ID physicians to lead ASPs. Clarifying the most appropriate compensation method for ID physicians in their role as contracted leaders of an ASP is an area of active debate. The IDSA has a number of useful documents to assist ID physicians in their negotiations [31]. As antibiotic stewardship leaders become involved in regulatory mandates, patient safety, and infection control measures, ID physicians must advocate for physician executive positions when negotiating compensation.

Small hospitals are often paired with larger “sister” hospitals within healthcare networks, necessitating shared human resources. KP recently built a small hospital (KP Ontario) and paired it with a larger medical center (KP Fontana) that was administratively responsible for both. KP Ontario developed a business plan using a shared ID pharmacist to augment stewardship support services to both facilities. Using the shared model, ASP recommendations increased from 7.5 to 18 per 1000 patient-days per month and led to a reduction of antipseudomonal antibiotics (24%) and vancomycin (10%).

2. Utilize healthcare system resources to provide antibiotic stewardship and ID support: Intermountain Healthcare is a network of 22 hospitals, 16 of which have <150 beds. To provide antibiotic stewardship support at all of its small hospitals, Intermountain formed an ID and Antibiotic Stewardship TeleHealth Program. The small hospitals in this program tailor antibiotic stewardship practices to their facility and take responsibility for most aspects of ASP while the centralized TeleHealth team provides data, mentorship, and ID consultation remotely. The business case for this program was developed by the ID Division at Intermountain Medical Center and delivered to Intermountain Healthcare using an approach detailed recently by Spellberg et al [32]. Telehealth staff are acceptable members of antibiotic stewardship teams per The Joint Commission regulations [4]. Similarly, HCA supports their small hospitals with ID physician and pharmacy leadership via their corporate and regional divisional structure.
3. Taking advantage of state-based efforts and collaboratives: State health departments are now being funded to support efforts to reduce antibiotic resistance, including antibiotic stewardship. Many health departments are now providing training, expertise, and assistance to hospitals on stewardship. There are also a number of collaborative efforts on stewardship being conducted through Hospital Engagement Networks (now Hospital Improvement and Innovation Networks). For example, CHA has implemented a statewide antibiotic stewardship collaborative open to all Colorado hospitals. The collaborative is committed to helping member hospitals and health systems form new ASPs or enhance existing ones. Currently, 27 nonaffiliated hospitals of varying size and patient mix are participating.
4. Commercial telehealth support: Many hospitals lack the support of healthcare systems and regional collaboratives. In these facilities, commercial telehealth vendors are available to support local antibiotic stewardship initiatives. Funding third-party applications is challenging at small hospitals.

#### **Utilizing Non-Infectious Diseases-Trained Physicians and Pharmacists**

When no ID physician or pharmacist is available, as is almost always the case in CAHs, hospitalists and general pharmacists can effectively lead ASPs [33, 34]. Identifying a respected, well-known, on-site leader can have a great impact in securing commitments from medical staff and hospital administrators. When non-ID clinicians lead ASPs, it is essential they have appropriate training in antibiotic stewardship principles and best practices. Pharmacy-based training programs are available from the Society for Infectious Disease Pharmacists and Making a Difference in ID [35, 36]. SHEA offers an annual conference focused on training stewardship providers, and the annual “Best Practices for ASPs” workshop held at IDWeek provides training appropriate for non-ID physicians and pharmacists.

In addition, antibiotic stewardship online courses are available from SHEA and Coursera.

#### **Allies to the Antibiotic Stewardship Team**

Robust antibiotic stewardship teams often include representation from infection prevention, hospital administration, quality improvement, microbiology, information technology (IT), and nursing [26, 37]. A multidisciplinary approach can help bolster support for the ASP, engage providers, and ensure adherence to stewardship policies. In small hospitals, having multidisciplinary representation is ideal but not always feasible due to limited staff and competing clinical initiatives. In such environments, it is essential to engage front-line staff and ensure that nursing and infection preventionists are active members of the team. Maximizing the support available and implementing interventions that play to the strengths of the engaged members of the team needs to be a focus of ASPs in small hospitals.

Integrating an ASP into an existing committee or developing a subcommittee from a larger committee can be an effective method of engaging most of the key team members without adding significant additional time commitment. For example, at Southwest Memorial Hospital, a CAH in Colorado, the ASP committee was formed as a subcommittee from its pharmacy and therapeutics (P & T) committee and includes representatives from nursing, intensive care unit, administration, inpatient and outpatient providers, wound care, and pharmacy. The ASP subcommittee meets quarterly and reports to the larger committee. A number of Intermountain’s small hospitals have embedded the ASP meetings into P & T, infection control, and medical staff committees as the members of these committees tend to be similar to the members of the ASP committee.

#### **MEASUREMENT—DATA COLLECTION AND ANALYSIS**

A complete discussion of the types of quality measures available for ASPs is outside the scope of this review, but many excellent reviews are available [26, 38–41]. Measuring antibiotic consumption is the most common type of measure used by ASPs and is integral to identify opportunities for improvement, evaluate the impact of interventions, and participate in interhospital benchmarking [42]. Obtaining consistent antibiotic use data requires some degree of IT support and hence poses challenges in many small hospitals. For small hospitals that are part of a larger system, leveraging IT resources from the central healthcare system can permit access to usage data.

Days of therapy (DOT) per 1000 patient-days present has become the United States’ antibiotic consumption metric of choice [26]. The CDC’s NHSN Antibiotic Use Option affords all hospitals, including small ones, the opportunity to not only assess their rates of antibiotic use in DOTs, but to compare their use to other hospitals using a risk-adjusted benchmark measure. The complexities of obtaining DOT data and enrolling in the

Antibiotic Use Option can pose challenges in small hospitals without IT support. However, Southwest Memorial Hospital was recently able to overcome those barriers by using Medici AU (<http://mediciau.com>), a third-party vendor, to successfully enroll and submit data for \$50 per month, allowing for external benchmarking and assessing the impact of interventions.

Defined daily doses (DDD) per 1000 patient-days is an acceptable alternative usage metric endorsed by national guidelines [26]. DDD can be calculated from many sources of antibiotic data (eg, purchased, dispensed, or administered), does not require significant computer programming effort, and easily allows comparisons between institutions. As such, DDD is more commonly used as a measure of antibiotic usage in small hospitals.

Regardless of antibiotic consumption metric used, small hospitals will be plagued with small numbers that result in significant variation. One patient on 2 antibiotics for 1 week (14 DOT) can cause a significant increase in antibiotic use rates in a CAH. Aggregating antibiotic use measures into quarterly or 6-month averages help reduce this variation. As such, complex statistical measures and time series analyses will be difficult. Relying on quality improvement methods, tools, and annotated run charts to assess the impact of an intervention is a more efficient and simple method for small hospitals.

In CAHs, manual records review of admitted patients can be a cost-effective and reliable method to collect antibiotic usage and appropriateness data because few patients per day are on antibiotics. Denominator data can be obtained from administrative data. Hospitals where review of all records is impractical can focus on obtaining antibiotic prescribing data on key conditions that commonly result in antibiotic prescribing. The CHA collaborative chose to collect antibiotic prescribing data on urinary tract infections and skin infection treatment only. Prescribing data were manually abstracted from patients' records. Usage patterns were assessed quarterly and results made available to the individual facilities, which resulted in a change in antibiotic prescribing [43].

External software programs and clinical decision support systems are available for small hospitals to contract with to obtain usage data and real-time antibiotic stewardship alerts. Often, small hospitals can access these programs through licensing agreements from their hospital network (as is the case with Intermountain Healthcare and HCA). These systems can be extremely effective; however, implementation and maintenance of these systems can be costly.

## STEWARDSHIP INTERVENTIONS

Once a facility has developed an ASP, it must then decide on where best to focus efforts to improve antibiotic prescribing. A point prevalence survey and an antibiotic appropriateness evaluation can be accomplished in small hospitals and help guide efforts. A point prevalence survey assesses all patients on

an antibiotic on a certain day or during a specific time interval. CAHs may need to assess antibiotic use for an entire month to obtain an appropriate sample. Patients on antibiotics are assessed for indication, antibiotic type, and route of delivery [10]. In conjunction with the point prevalence survey, the ASP can assess for antibiotic prescribing appropriateness. The CDC has developed appropriateness surveys that can be used for specific antibiotics or specific syndromes [44].

Once an improvement opportunity has been identified, the intervention must be operationalized and integrated into clinical care. The type and scope of the intervention should be driven by the expertise and resources of the ASP. Basic interventions to improve antibiotic prescribing principles can be implemented in any hospital regardless of ID expertise availability. Creating clinical algorithms for common syndromes requiring antibiotics will typically direct prescribing for the majority of patients. Implementing an antibiotic time-out to reassess the continuing need and choice of antibiotics can be integrated into pharmacy or physician work flow, nursing, or care coordination conferences. Developing basic antibiotic education for providers can emphasize clinical algorithms, common errors in antibiotic prescribing, and clinical updates. Requiring every antibiotic order to have an indication will allow pharmacy staff to optimize drug selection and dose. Integrating principles of antibiotic stewardship into other quality improvement efforts will increase the scope of ASPs in small hospitals (eg, improving compliance with sepsis measures).

Advanced stewardship interventions often require ID expertise and/or significant time and training. Implementing a post-prescription review system allows for a daily assessment of prescribing appropriateness, the intensity of which can be adjusted based on staffing at individual facilities. Restricting designated antibiotics, either by not having certain antibiotics on the formulary or by requiring approval from a member of the ASP, can be used to guide prescribers to make appropriate empiric antibiotic choices. Reviewing designated microbiology culture results and laboratory testing can be done as a patient safety measure to ensure an appropriate treatment plan is in place. Daily review of positive blood cultures should receive the highest priority. These reviews can be completed by any member of the ASP team, including infection preventionists, and results flagged for review by the local physician champion.

## COST

To be successful, ASPs need clear support from hospital leadership. This support can come in many forms but dedicating the necessary human, financial, and/or IT resources is paramount. Contracting for ID leadership, providing funding for ASP training, contracting with IT vendors, and protecting time all require a financial investment from hospital leadership. In both large and small hospitals, developing a detailed and thought-out business case to present to the hospital administration is a critical

step in obtaining the necessary funding to establish an ASP [32]. However, key differences exist in small and large hospitals that may affect the business case. Reducing length of stay is often used as a financial incentive in an ASP business case. Reducing length of stay may not be financially beneficial in small hospitals that traditionally have lower bed occupancy rates than large hospitals. In addition, differences in payer mix (ie, diagnosis-related group (DRG) reimbursement vs fee-for-service reimbursement) will impact the financial effect on reducing antibiotic consumption, another targeted financial measure in most business cases. Reducing daptomycin use under a DRG model lowers the variable costs for a hospital. Alternatively, in a fee-for-service model, reducing well-reimbursed drugs, such as daptomycin, can have a negative effect on revenue. Working closely with the hospital's financial department is essential to develop a well thought-out business case for small hospitals.

Compared to large community/academic hospitals that often require 1–3 full-time equivalents to develop and maintain an ASP, small hospitals require a much smaller investment in human resources, if any. On average, the typical time spent dedicated to stewardship activities is <5 hours per week among Intermountain's smallest hospitals (<70 beds) and 5–10 hours per week for hospitals with 70–150 beds. However, time estimates are dependent on the intensity, reach, and the experience of the program. With the diverse clinical and administrative responsibilities at small hospitals, it is critical that the time for stewardship initiatives is protected and/or prioritized by senior leadership if new staff are not hired. Often times, this takes reallocation and/or reprioritization of clinical and administrative tasks.

## MICROBIOLOGY LIMITATIONS

An up-to-date antibiogram is essential for developing pre-prescription review policies, hospital-specific guidelines, and in understanding local resistance patterns. Unfortunately, small hospitals often lack enough clinical isolates to develop robust antibiograms. In these cases, small hospitals can extrapolate resistance data from a regional facility, coordinate with state health departments to create or obtain antibiograms, include emergency department and outpatient clinical isolates into the denominator, and/or collaborate with other small facilities in the region to aggregate data and develop a regional antibiogram.

ASPs are just as critical in small hospitals as they are in large hospitals, but small hospitals face unique challenges in implementing ASPs. Utilizing a collaborative approach and tailoring ASPs activities to the needs of the facility and the resources available can lead to successful programs.

## Notes

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