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Eight Habits of Highly Effective Antimicrobial Stewardship Programs to Meet the Joint Commission Standards for Hospitals

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In an effort to decrease antimicrobial resistance and inappropriate antibiotic use, The Joint Commission (TJC) recently issued new antimicrobial stewardship standards, consisting of 8 elements of performance, applicable to hospitals effective January 1, 2017. These standards coincide with those recommended by the Infectious Diseases Society of America (IDSA) and the Society of Healthcare Epidemiology (SHEA) guidelines. Little guidance exists on the "how" from these guidance documents. We review the 8 standards and provide real-world experience from established antimicrobial stewardship programs (ASPs) on how institutions can comply with these guidelines to reduce inappropriate antibiotic usage, decrease antimicrobial resistance, and optimize patient outcomes. TJC antimicrobial stewardship standards demonstrate actions being taken at the national level to make quality and patient safety a priority.

Keywords. antimicrobial stewardship; joint commission standards; antimicrobial resistance.

Approximately 700 000 people die every year from antibiotic resistant infections, with this number projected to surpass 10 million per year by 2050 [1]. To help curb rates of resistance, The Joint Commission (TJC) recently issued New Antimicrobial Stewardship Standards, consisting of 8 elements of performance, applicable to hospitals effective January 1, 2017 [2]. As hospital administrators direct their attention to assure compliance with these standards, antibiotic stewards, who are the "boots on the ground" clinicians, need to assure that these new standards improve antimicrobial use and patient outcomes.

The standards align with those recommended by the Infectious Diseases Society of America (IDSA)/Society of Healthcare Epidemiology (SHEA) guidelines [3]. However, little guidance exists on the "how" from these guidance documents [2, 3]. To paraphrase author Stephen Covey, we foresee the 8 stewardship standards becoming 8 highly successful habits of every clinician who prescribes antibiotics [4]. Therefore, this article will review TJC 8 standards and provide real-world experience from established antimicrobial stewardship programs (ASPs) on how institutions can comply with these guidelines and optimize patient outcomes.

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LEADERS ESTABLISH ANTIMICROBIAL STEWARDSHIP AS AN ORGANIZATIONAL PRIORITY

As emphasized by TJC standards and IDSA guidelines, strong leadership commitment is critical to the success of an ASP. This goal can be achieved via identifying healthcare leaders and promoting ASP as a patient care, safety, and quality issue. The physician and pharmacist co-leading ASP requires strong leadership skills, including trust, confidence, and willingness to stand on principles. Simply appointing a person to lead ASP does not qualify the individual as a leader. The ASP Director needs to be able to engage, motivate, inspire, influence others, and not fear confrontation [4].

We recommend the following strategies be employed to engender institutional support:

- Endorsement of the ASP policy by hospital administration.
- Develop a business plan to present to administration, emphasizing the potential for improvement in antimicrobial use and quality of care. Albeit a consequence of an effective ASP, the goal should not solely be cost-based.
- Identify barriers and provide strategies for resolution. Barriers include adequate provision of resources for support of trained pharmacists and physicians and information technology (IT). Emphasize the requirement for protected time and financial compensation for key members of an ASP, including an infectious diseases (ID) pharmacist and physician, data manager, and IT.
- Provide plans for assessing the impact of an ASP with the anticipation of documenting improvement in quality of care metrics.

- Acknowledge ASP goals are in alignment with professional societies, accrediting agencies, and payers, including IDSA, TJC, and CMS.

HOSPITALS EDUCATE STAFF AND LICENSED INDEPENDENT PRACTITIONERS INVOLVED IN ANTIMICROBIAL ORDERING, DISPENSING, ADMINISTRATION, AND MONITORING ABOUT ANTIMICROBIAL RESISTANCE AND ANTIMICROBIAL STEWARDSHIP PRACTICE

Antibiotics are prescribed universally by clinicians without regulation or certification. Although antibiotic guidelines often are put in place in hospitals, there are rarely consequences for clinicians that do not comply. As highlighted by Goldstein et al., approaches to modifying the behavior of these noncompliant clinicians include identifying and understanding the local problems, planning and achieving hospital administration and medical staff support, as well as effective communication and education to these clinicians on evidence-based recommendations [5]. Therefore, all healthcare professionals (HCPs) must receive continuing education about antimicrobial resistance and appropriate antibiotic use, with ASP physicians/pharmacists leading this education. Didactic sessions alone cannot be used as they provide limited impact for sustained effect in changing antimicrobial prescribing [6].

We recommend the following:

- Mandate educational ASP competencies, including appropriate drug, dose, duration, and pharmacokinetic/pharmacodynamic principles, for all HCPs *involved in antibiotic ordering, dispensing, administration, and monitoring* on an annual basis through online and case-based learning [7].
- Encourage face-to-face interaction by ASP members when providing recommendations to HCPs. This provides real-time education, leads to immediate action in antibiotic management of patients, and develops rapport with other disciplines [8].

HOSPITALS EDUCATE PATIENTS AND FAMILIES REGARDING THE APPROPRIATE USE OF ANTIMICROBIAL MEDICATIONS

Patients' lack of knowledge on consequences of inappropriate use (i.e., collateral damage and antimicrobial resistance) contributes to increased demand for antibiotics. Whether real or perceived, patients' expectations for antibiotics affect physicians' prescribing behavior in both the inpatient and outpatient settings [9]. Education to patients and families on appropriate antimicrobial use is available through the Centers for Disease Control and Prevention (CDC), which provides free downloadable brochures, entitled "Get Smart, Know When Antibiotics Work" [10]. ASPs should work with their public relations department to distribute this information throughout the hospital.

ASPs can also create their own hospital-specific message that can be viewed through various communication venues. For example, television screens in the hospital lobby, cafeteria, patients' rooms, and computer screens in patients' rooms can be used to describe ASP and its mission. At The Ohio University Wexner Medical Center (OSUWMC), stewardship messages, such as "antibiotics should only be given to the right patient, at the right time, at the right dose, for the right duration" have been incorporated on patients' computer screens. These messages can be altered to align with current ASP projects or goals.

Additionally, social media platforms such as Twitter, a space where patients are already active, provide a key mode for hospitals to deliver short tweets and links to various articles and videos on stewardship topics [11]. Social media can also provide hospitals the ability to have real-time conversations with patients by answering their questions and concerns about appropriate antibiotic use.

THE HOSPITAL HAS AN ANTIMICROBIAL STEWARDSHIP MULTIDISCIPLINARY TEAM

ASPs should be led by ID-trained physicians and pharmacists, who should receive protected time supported by hospital administration to conduct stewardship activities. This may be difficult in hospitals with limited resources; however, several ASP training programs (Table 1) and resources (i.e., guidelines, education modules) from institutions (Table 2) are available to assist HCPs. Facilities with limited ID expertise can still achieve substantial returns by focusing on basic interventions, as revealed in a pharmacist-led study over 5 years that demonstrated an 18.1% reduction in overall antibiotic consumption ($P < .001$) by integrating nonspecialized pharmacists into the ASP [12]. In rural settings, access to a remotely located ASP can be achieved through virtual web-based technology (i.e., "telemedicine"), and this team can be effectively leveraged across multiple facilities [13–15]. A detailed step-by-step process of a successful telemedicine-based ASP was recently published by McMahon and colleagues [16].

THE HOSPITAL'S ASP INCLUDES THE 7 CORE ELEMENTS OF HOSPITAL ASPS FROM THE CDC

We describe Summa Health's step-by-step ASP implementation process and how the program meets the CDC's 7 core elements [17].

Leadership Commitment, Accountability, Drug Expertise. The implementation process started with the ID physician/pharmacist presenting a business plan to leadership in 2008, including a 3-month pilot project focusing on evaluating antibiotic use in one of the intensive care units (ICUs). Through a prior medication use evaluation of 50 patients prescribed linezolid, 50%

Table 1. Antimicrobial Stewardship Training Programs in the United States

Organization	Fee	Program type	Target audience	Location	Website
Infectious Diseases Society of America	Yes	Workshop	Physicians Pharmacists	IDWeek annual meeting	http://www.idweek.org/premeeting-workshop/#stewardship
Infectious Diseases Association of California	Yes	Workshop	Physicians, Pharmacists, Infection Preventionists	California	http://idac.org
Making a Difference in Infectious Disease	Yes	Certification	Physicians, Pharmacists	Online and Annual meeting	http://mad-id.org
Society of Infectious Diseases Pharmacists	Yes	Certification	Pharmacists	Online	http://sidp.org/Stewardship-Certificate
Society for Healthcare Epidemiology of America	Yes	2 Workshops: 1) Research Methods Workshop 2) Antibiotic Stewardship Training Course	Physicians, Pharmacists, Epidemiologists, Infection Preventionists, Public health	California	http://www.asresearchworkshop.org/ http://sheaspring.org/program/agenda/
Stanford University	No	Workshop	Physicians, Pharmacists	Online	http://med.stanford.edu/cme/courses/online/antimicrobial.html

was found to be inappropriate. In this project, the ID pharmacist prospectively evaluated 138 patients ordered linezolid for appropriateness. A recommendation was made to discontinue linezolid in 30 patients, with a 100% acceptance rate. This led to an average 6-day reduction of linezolid therapy, leading to an average savings of $845–$1103 per patient. Extrapolating the cost savings for 1 year, ASPs could save approximately $126 750–$165 450 if focused on just 1 antibiotic. A broader program could see even larger savings and improvement in appropriate antibiotic use. Subsequently, a comprehensive ASP was initiated in 2010.

Action, Tracking, Reporting. Patients are prospectively evaluated daily (5 days/week) by an ID physician and dedicated ID pharmacist using a computer decision support software program (SafetySurveillor) to identify patients requiring intervention. Stewardship rounds are conducted on the general wards and ICUs, with the team's recommendations communicated to the prescribing service in real time. Acceptance rates were 96.2% in 2015, which were tracked in SafetySurveillor (Politis P; Summa Pharmacy Department, personal communication).

Education. Summa Health's ASP provides education via face-to-face discussions with HCPs, presenting at other disciplines' monthly meetings, and publishing on the impact of these stewardship initiatives on patient care. Prescriber feedback is assessed through the face-to-face discussions and by an ASP survey. In 2015, 60% of prescribers responded to a survey with 96% expressing satisfaction (68% "very satisfied") with the process [18].

THE HOSPITAL'S ASP USES ORGANIZATIONAL-APPROVED MULTIDISCIPLINARY PROTOCOLS

How to operationalize guidelines in hospitals is a common barrier to stewardship. We provide real-world examples of protocols from established programs.

Antibiotic Formulary Restrictions. Implementation of antibiotic formulary restrictions have been shown to reduce antibiotic use [19, 20]. We propose replacing the term "restricted" antibiotics with "protected." ASPs should consider protecting new antibiotics and those associated with significant collateral damage. For example, new antibiotics such as ceftolozane/tazobactam or ceftazidime/avibactam should be protected as they target multidrug-resistant organisms that are best managed by ID expertise. Further, antibiotics such as fluoroquinolones are associated with significant collateral damage; therefore, their use needs to be protected. Importantly, specific antimicrobials can be protected in the absence of ID trained specialists with the establishment of use criteria and guidelines.

How to Implement a Guideline. ASPs should focus on disease state(s) that are of high priority and consistent with the institution's goals in creating facility-specific guidelines. This can be accomplished via collaborating with the quality department to obtain the quantity of patients discharged with a specific disease state, as well as clinical and financial data. Various syndromes can be targeted, including acute bacterial skin and skin structure infections (ABSSSIs), community acquired pneumonia (CAP), and *Clostridium difficile* infection (CDI).

Next, ASPs should work closely with other departments to ensure a comprehensive guideline. For example, if ASPs are working on an institutional guideline for CAP management, input should be obtained from pulmonologists, hospitalists, emergency department physicians, and microbiologists. By practicing broad-spectrum collaboration, ASPs can ensure that the guideline will be utilized throughout the institution. Incorporation of internal data and evidence-based literature into the guidelines is also important. Clinicians should be able to readily access guidelines through the institution's website or pocket cards. To make an impact at the point of prescribing, we recommend a hyperlink in the electronic medical record (EMR) to the institution's guideline related to the appropriate antimicrobial or microbiology result.

Table 2. Antimicrobial Stewardship Resources

Antimicrobial stewardship program	Content	Website
Cleveland Clinic	Disease state treatment guidelines Drug specific (including dosing) guidelines Microbiology guidelines	http://www.clevelandclinicmeded.com/medicalpubs/antimicrobial-guidelines/
Johns Hopkins Medicine	Disease state treatment guidelines Drug specific (including dosing) guidelines Microbiology guidelines	http://www.hopkinsmedicine.org/amp/guidelines/Antibiotic_guidelines.pdf
Nebraska Medicine	Disease state treatment guidelines Drug specific (including dosing) guidelines Microbiology guidelines Visiting scholar preceptorship	http://www.nebraskamed.com/careers/education-programs/asp
Sinai Health System	Disease state treatment guidelines Antimicrobial stewardship fellowship General antimicrobial stewardship	http://www.antimicrobialstewardship.com/
Stanford Medicine	Disease state treatment guidelines Drug specific (including dosing) guidelines Microbiology guidelines	http://med.stanford.edu/bugsanddrugs/guidebook.html
The Ohio State University	Disease state treatment guidelines Microbiology guidelines	http://rx.osumc.edu/asp2/index.html
University of California Los Angeles	Disease state treatment guidelines Drug specific (including dosing) guidelines Microbiology guidelines	http://www.asp.mednet.ucla.edu
University of California San Francisco	Disease state treatment guidelines Drug specific guidelines	http://idmp.ucsf.edu/ucsf-medical-center-guidelines
University of Miami Health System	Disease state treatment guidelines Antimicrobial dosing guidelines	http://www.ugotabug.med.miami.edu
University of Pennsylvania Medical Center	Disease state treatment guidelines Drug specific (including dosing) guidelines Microbiology guidelines	http://www.uphs.upenn.edu/bugdrug/antibiotic_manual/table%20of%20contents.htm
University of Wisconsin	Disease state treatment guidelines Drug specific guidelines (including dosing)	http://www.uwhealth.org/antimicrobial-stewardship/main/36408
Wake Forest	Disease state treatment guidelines Drug specific guidelines (including dosing) Antibiotic stewardship curriculum	http://www.wakehealth.edu/School/CAUSE

After approval of institution-specific guidelines, ASPs should evaluate the use and outcomes of guidelines at an appropriate time frame dependent on the institution (3 months to 1 year). These metrics may include length of stay, mortality, and readmissions. ASPs must continue to evaluate internal and external data to incorporate updates as appropriate.

Creating an ABSSSI Protocol

An ABSSSI guideline was introduced at Summa Health similar to the algorithm in the 2014 IDSA SSTI guidelines [21]. Most nonsuppurative infections are caused beta-hemolytic *Streptococcus* spp. [22]; however, these patients were frequently treated with a combination of an antipseudomonal and anti-MRSA agent. Through face-to-face education with attending physicians on appropriate SSTI management, ASP-intervened patients versus a historical control led to a lower mean length of stay (4.4 vs 6.2 days; $P < .001$) and 30-day ABSSSI readmission rate (3.33% vs 6.27%) [23]. Overall, ASP interventions reduced the use of resources in the management of patients admitted with ABSSSIs.

Creating a CDI Protocol

A key strategy implemented by ASPs to improve the overall management of patients with CDI is the use of care bundles. One study evaluated compliance with an ASP-implemented care bundle in patients with CDI compared with historical controls [24]. The primary outcome, compliance with overall bundle elements, was achieved when the following measures were accomplished: (1) appropriate CDI antimicrobial therapy based on the institutional treatment algorithm, (2) discontinuation of acid-suppressant therapy in the absence of a prespecified indication, and (3) discontinuation of unnecessary antimicrobials. Compliance with overall bundle endpoints was significantly higher in the bundle group versus control group (81% vs 45%; $P < .001$). Individual components that were significantly improved in the bundle group included discontinuation of nonessential acid suppressants (90% vs 18%; $P < .001$) and administration of appropriate CDI therapy (82% vs 64%; $P < .009$). We recommend use of care bundles for effective CDI management.

Guidelines for Antimicrobial Dose Optimization in Adults

ASPs play a significant role in the appropriate dosing and optimization of antimicrobials. For example, β-lactams via extended infusion (EI) (3–4 hours) should be considered for critically ill patients or those infected with an organism with a high minimum inhibitory concentration (MIC). ASPs should collaborate with the microbiology laboratory to evaluate the MIC distribution of specific organisms and infection sites in targeting EI antimicrobial administration. For instance, cefepime is often used for the treatment of *P. aeruginosa*. If the cefepime MIC distribution for the majority of *P. aeurginosa* isolates from invasive sites (blood, respiratory) is ≤ 2 mg/L, cefepime EI is potentially not warranted. In contrast, if the majority of MICs are ≥ 4 mg/L, ASPs should consider cefepime EI to optimize pharmacokinetics/ pharmacodynamics.

In 2010, OSUWMC implemented cefepime EI (4 hours) for all patients regardless of hospital location, with the first dose administered over 30 minutes. After implementation, cefepime EI resulted in decreased mortality in the treatment of *P. aeruginosa* bacteremia or pneumonia [25].

THE HOSPITAL COLLECTS, ANALYZES, AND REPORTS DATA ON ITS ASP

Measuring the impact of an ASP is vital to direct program focus, provide benchmarking tools, and maintain administrative support. Antimicrobial use quantification is often hindered by the accessibility of electronic data. As discussed earlier in the manuscript, IT resources are mandatory in obtaining antimicrobial use. Antimicrobial use is most commonly presented as days of therapy or defined daily doses. The metric selected must be consistent for each stewardship intervention in order to appropriately reflect antimicrobial use over time. Clinical outcomes, including length of stay, mortality, and readmission should also be collected, analyzed, and reported in addition to antimicrobial use. ASPs need to present antimicrobial use and outcomes to hospital and pharmacy administration on an annual or semi-annual basis.

HOSPITALS TAKE ACTION ON IMPROVEMENT OPPORTUNITIES IDENTIFIED IN ITS ASP

Stewards can become overwhelmed at the breadth of interventions required to conduct a successful ASP [26]. ASPs can be successful at selecting both obtainable targets and complicated management issues. Initial targets for new programs include intravenous-to-oral conversions, batching of intravenous antimicrobials, therapeutic substitution, and formulary management. ASPs should initially focus on staged and systematic interventions that address obvious areas of need, providing early successes for the program. These interventions will lead to more complex ASP interventions. For the remainder of the section, we focus on 2 complex interventions, including allergy assessment and rapid diagnostic testing.

Allergy Assessment

A key area of patient care improvement for ASPs is providing an allergy assessment and recommending either skin testing or alternative antibiotic for patients. Approximately 10–15% of hospitalized patients are labeled as having a penicillin allergy, whereas 80–90% of these patients are negative on penicillin skin testing [27]. Further errors in antibiotic allergy labeling occur due to an overestimation of β-lactam cross-reactivity between and among β-lactams. Drug allergy assessments have been associated with improved antibiotic stewardship, reduced alternative antibiotic use, decreased length of hospital stay and costs, and increased guideline adherence [28, 29]. Park et al. showed that integrating trained pharmacists and allergists led to increased β-lactams in patients with a history of penicillin allergy [30]. ASPs should support such methods to advocate allergy assessments.

In Summa Health, when assessing a patient's history of β-lactam allergy, many patients provided an "unknown" response or "my mother said I'm allergic" with no documented history of any reaction. Based on literature, a standardized algorithm was developed [31]. A trained pharmacist, who provides a recommendation on when to use β-lactams, interprets responses to the algorithm. Of interest, the anesthesia department was a leading advocate because the designation of "penicillin" allergy significantly delayed administration of a prophylactic antimicrobial.

Rapid Diagnostic Tests

The capability of providing accurate and fast microbiology results in a clinically meaningful time frame, near the point of care, can be game-changing for ASPs [32]. Rapid diagnostic tests provide collaborative opportunities for ASPs to improve patient outcomes and decrease antimicrobial use but are of little value if ASPs do not have an active role as an educator of the results. Relevant microbiologic tests should be implemented based on prevalent or problematic organisms within the hospital setting, with consideration given to the sensitivity and specificity of each test. Microbiologists with ASPs should consider the instrument cost, test supplies, laboratory space, and complexity of the test. It is mandatory that microbiology and stewards work together to determine the best approach to justify institutional costs of the technology. Depending on the institution, a 3 month to 1year study should be considered to demonstrate clinical and economic outcomes associated with the rapid diagnostic test with ASP interventions.

Rapid diagnostics with an ASP has been shown to impact clinical and economic outcomes. Bauer and colleagues studied the Xpert MRSA/SA BC assay in combination with ID pharmacist intervention in *S. aureus* bacteremia. The mean time to switch from empiric vancomycin to either nafcillin or cefazolin in patients with MSSA bacteremia was 1.7 days shorter post-implementation ($P = .002$) [33]. The mean length of stay (6.2 days shorter; $P = .07$) and hospital costs ($21 387 less per patient; $P = .02$) was also significantly lower. Huang et al. evaluated the impact of MALDI-TOF MS and stewardship intervention in patients with bacteremia or candidemia [34]. Compared with traditional methods, the impact of MALDI-TOF MS combined with real-time notification to a member of the ASP improved time to optimal antibiotic therapy (80.9 vs 23 hours; $P < .001$). Importantly, mortality among patients during the intervention period was lower (21% vs 8.9%; $P = .01$). We recommend rapid diagnostics used in combination with ASP.

CONCLUSIONS

We have provided real-world step-by-step processes to aide institutions in implementing TJC Standards. As we reflect on these 8 steps, we recognize that other institutions, such as those referenced on the CDC website, have applied similar strategies to optimize their ASP [17]. Further, California and countries such as the United Kingdom have had antimicrobial stewardship as an accreditation standard for sometime, with a recent article describing the road maps for success in these selected regions [35].

Simply asking clinicians to do a better job at prescribing antimicrobials *has not* and *does not* work. Unraveling years of overprescribing antimicrobials will require behavior change. TJC Standards will garner the attention of hospital administration, resulting in the formation of ASPs. However, these standards should not be implemented to simply "check the box" to fulfill having an ASP. Having a required established ASP at every US hospital allows clinicians to impact antimicrobial prescribing, optimize patient outcomes, and decrease resistance.

Notes

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