Antimicrobial Stewardship Begins at the Door: Promoting Prudent Antimicrobial Use in the Emergency Department

Kenneth Klinker, PharmD and
Veena Venugopalan, PharmD, BCPS
University of Florida College of Pharmacy,
Gainesville, FL

Numerous antimicrobial stewardship programs across the US have established a track record of success in reducing antimicrobial consumption, curtailing bacterial resistance, decreasing hospital length of stay, and antimicrobial costs.[1-3] This being said, it is widely accepted that there are still areas within the acute care setting with need for greater antimicrobial stewardship oversight. The high patient turn-over rate, quick pace of practice, and shift-based work model, which increases the number of providers, all present unique challenges to the integration of antimicrobial stewardship initiatives in the emergency department (ED).[4] Despite these barriers, the ED presents tremendous opportunity for antimicrobial steward-ship as it is the gateway for most hospital admissions. Some examples of ASP strategies successfully implemented in the ED are presented in Table 1.

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ED providers often serve as the primary decision-maker determining whether antimicrobial therapy is started for patients requiring inpatient or outpatient management. In view of their role in establishing appropriate care, adherence to antimicrobial policies is paramount. Further, a majority of antimicrobial dollars spent in the US occurs within outpatient settings, which includes services provided by the ED.[5] These services are responsible for 154 million outpatient prescriptions annually.[6] Unfortunately, approximately 30% are considered unnecessary, especially for the management of respiratory conditions.[6] Beyond increasing the risk for the selection of multidrug-resistant organisms, patients may also experience adverse sequelae. An estimated 142,000 ED visits occur annually due to adverse events from antibiotics.[7] Compounding the problem is an unwillingness to change course of therapy once initiated within the ED. ED physicians are highly respected clinicians; therefore, they play a vital role in establishing empiric therapy, which is continued by the primary providers.[8] In combination, these data highlight the importance of integrating stewardship initiatives into ED workflow to maximize outcomes and minimize adverse events.

Initial steps for establishing ASP initiatives in the ED involve identifying a clinician champion and a dedicated clinical pharmacist. Together, these members collaborate on developing/implementing new initiatives, providing real-time feedback to providers, providing real-time follow-up of microbiologic and susceptibility reports, promoting medication safety through thorough patient evaluation, and facilitating transitions-in-care.[8] Benefits of these partnerships include reductions in medication errors, shortening of treatment duration, and decreasing cost of care.[9] In particular, real-time follow-up of microbiologic cultures results in decreased time between positive culture review and time to follow-up with patient or primary provider.[10] Nearly 1 in 4 patients discharged from an ED may require therapy modification due to pathogen non-susceptibility.[11] Further, microbiologic review results in reductions in return ED visits and 30-day hospital readmissions.[11] These data emphasize the

Table 1. Examples of ASP strategies successfully implemented in the emergency department

Stewardship approach or strategy	Description	Primary outcome measured	Results	Reference
Prospective review and feedback	Prospective cohort study of a pharmacist driven urine culture review process in the ED.	To assess the reduction in antimicrobial use resulting from pharmacist intervention.	136 patients were treated for a total of 426 antibiotic days. Pharmacist intervention resulted in 29% reduction in potential antibiotic days.	Zhang et al[24]
Use of rapid diagnostics	Single-center study of the impact on antimicrobial use of the implementation of rapid diagnostic testing (RDT) methodology in the ED for *N. gonorrhoeae* (NG) and *C. trachomatis* (CT).	To compare the percentage of patients who received appropriate antimicrobial treatment using traditional testing methods versus RDT for NG/CT.	Initial antimicrobial treatment was considered appropriate in 60% in traditional testing group vs. 72.5% in the RDT group. Additionally, median time to test results was significantly reduced in the RDT arm.	Rivard et al[21]
Development of treatment pathways or protocols	Pre- and post-study of the impact of implementation of a febrile young infant clinical pathway in the ED.	To evaluate timeliness and effectiveness of care using rates of pathway specific antibiotics and antivirals prescribed.	Post-implementation of the pathway, mean time to first antibiotic was reduced by 36 minutes. Also, use of pathway resulted in significant improvements in proportion of infants receiving pathway specific antibiotics and antivirals.	Murray et al[25]
Penicillin skin testing	Prospective study of outcomes of penicillin and amoxicillin skin testing in the ED of patients with self-reported penicillin allergy.	To determine if penicillin skin testing followed by graded oral challenge could safely delabel patients presenting for emergency care with a self-reported penicillin allergy.	Of the 100 patients who completed the study, 17 patients had evidence of IgE mediated hypersensitivity. Eighty-one percent of patients in the study safely tolerated an oral challenge of amoxicillin and were labelled as non-allergic to penicillin.	Marwood et al[26]

importance of understanding local susceptibility profiles, developing robust antimicrobial guidelines to facilitate appropriate antimicrobial selection, and establishing an effective strategy for patient/provider follow up. Implementation of such processes results in improvements in care and minimizes overuse of critical resources.

Beyond the benefits of prompt culture and susceptibility assessment, there are several additional strategies available to improve antimicrobial stewardship within the ED. These include establishing ED-specific antibiograms, developing clinical protocols/pathways, developing real-time alerts using electronic health records, and integrating rapid diagnostic testing. ED-specific antibiograms are powerful tools. Through collaboration with the microbiology department, development of antibiograms provides insight into organism frequency and susceptibility profiles needed to maximize empiric therapy selection. Drilling down on organism susceptibility by infection source, patient disposition, or presence of comorbid conditions may assist with clinical pathway development. For example, *E. coli* susceptibility patterns may vary significantly

between young healthy patients and those with comorbidities.[12] Further, ED-specific antibiograms may differ from institutional antibiograms.[13] Therefore, a thorough understanding of patient data used for antibiogram reporting assists with maximizing empiric therapy. Lastly, antibiograms allow clinicians to track susceptibility profiles over time. Following development, it is important to provide routine education and dissemination to housestaff for effective interpretation.[8]

Over the last decade, use of comprehensive electronic health records (EHR) has significantly increased.[14] Data in 2014 highlighted that nearly 97% of non-federal, acute care hospitals had adopted a certified EHR, with one-third integrating a comprehensive system.[14] Adoption of EHR allows for efficiency in communication and care coordination within a practice, thus providing an opportunity to develop real-time alerts that impact clinical care.[15,16] Fehrenbacher and colleagues identified a 15% reduction in antimicrobial use when linking diagnosis codes to treatment algorithms for acute bronchitis.[17] Further, the alert resulted in a shift towards appropriate therapy in 18% of patients. Khurana and colleagues developed an automated alert system that continuously monitors EHR, detecting patients with severe sepsis and those at increased risk for in-hospital mortality, including ED patients.[18] Overall, both strategies highlight the value of real-time assessment of patient characteristics that directs clinicians towards appropriate treatment.

An area of intense focus is the use of rapid diagnostic testing or biomarkers (i.e., procalcitonin) to optimize treatment decisions. These tools may play a substantial role in ED management by providing timely detection of infectious organisms or identifying biomarkers associated with bacterial infections. Ultimately, these tools give physicians an opportunity to initiate more targeted antibiotic selection. An analysis by Blaschke and colleagues identified a reduction in ancillary testing (i.e., cultures, chest radiographs) and antibiotic prescriptions when integrating rapid influenza testing into practice.[19] May and colleagues identified an increase in targeted antimicrobial therapy when testing for the presence of methicillin resistance in *S. aureus* cultured from skin and skin structure infections.[20] Lastly, implementation of rapid testing for *C. trachomatis* and *N. gonorrhoeae* decreased unnecessary antimicrobial use and decreased time to patient notification.[21] Consistent with rapid diagnostic testing, procalcitonin may be useful in modifying treatment decisions for patients presenting to the ED with lower respiratory infections. Available data highlight significant reductions in antimicrobial use for patients randomized to procalcitonin-guided therapy.[22,23] Currently, trials are underway in the U.S. to study these effects in non-critically ill patients presenting to the ED. (Clinical trials.gov). Additional data will assist in identifying where procalcitonin can aid in directing care.

The ED offers a myriad of opportunities for creative antimicrobial stewardship interventions impacting the healthcare continuum. Antibiotics prescribed in the ED have far-reaching consequences, therefore, attention and resources need to be shifted to this setting to ensure the delivery of appropriate therapy. The ultimate goal is to provide prompt quality care to our ED patients. Investing in strategies to improve decision making will result in maximizing outcomes and minimizing adverse events.

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