

Antimicrobial Stewardship with Intravenous to Oral Conversion and Future Directions of Antimicrobial Stewardship

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Antimicrobial stewardship (ASP) as defined by the Infectious Diseases Society of America (IDSA), the Society for Healthcare Epidemiology of America (SHEA), and the Pediatric Infectious Diseases Society (PIDS) are “coordinated interventions designed to improve and measure the appropriate use of antimicrobial agents by promoting the selection of the optimal antimicrobial drug regimen including dosing, duration of therapy, and route of administration” [1]. ASPs include: 1) education, 2) guidelines and clinical pathways, 3) antimicrobial cycling, 4) antimicrobial order forms or separate antimicrobial prescription charts or sections, 5) streamlining or de-escalation of therapy, 6) inflammatory marker testing to prevent initiation of antimicrobials, 7) inflammatory marker testing to discontinue antimicrobials, 8) dose optimization, 9) parenteral to oral conversion, 10) microbiological laboratory reporting and surveillance, 11) computerized clinical decision support systems (CDSS) for antimicrobial prescription, 12) an antimicrobial stewardship committee, 13) drug use evaluation (DUE) for antimicrobials (quantitative, qualitative) and feedback, 14) an

antimicrobial stewardship policy or code of practice (advice on duration of therapy, advice on monitoring serum antimicrobial levels, surgical prophylaxis guidelines, restrictions on access by pharmaceutical industry representatives, combination therapy, *etc.*), 15) antimicrobial stewardship ward rounds, and 16) automated data warehouse surveillance systems for antimicrobial usage [1-3]. Intravenous (IV) to oral conversion of antimicrobials is an important strategy; the recent IDSA ASP guidelines strongly recommend the timely conversion from IV to oral antimicrobials [1]. Conversion of the same antimicrobial from IV to oral use is less complicated than other strategies and is applicable in many healthcare settings [1]. The guidelines recommend that an IV-to-oral conversion ASP should be integrated into the routine practices of pharmacies [1].

In this issue of *Infection & Chemotherapy*, Park et al. report an intervention to facilitate conversion from IV to oral quinolones that has reduced excess use of IV fluoroquinolones and the length of hospital stays [4]. The reduced length of hospital stays in the adherent group compared to that in the non-ad-

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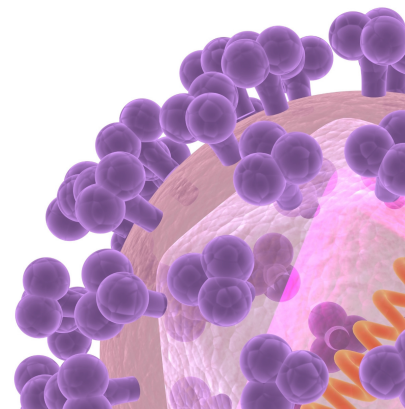
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herent group may have additional significant economic implications. This work by pharmacists and supervising infectious disease physicians on IV-to-oral conversion is a good model to follow in performing ASPs, especially considering the limited number of infectious disease physicians.

This research group has previously reported the use of an ASP to reduce unnecessary prescriptions leading to double anaerobic coverage by organizing a team of infectious disease physicians and pharmacists [5]. The group is very good at selecting strategies for the implementation of ASPs in the healthcare setting in Korea. This IV-to-oral conversion study mentions the limitations, such as this being a single center study conducted over a short period, intervention times of 2 to 3 per week rather than real time intervention, and the lack of a comprehensive economic outcome evaluation [4]. Additionally, this study is a retrospective study and has not evaluated the safety of an IV-to-oral conversion ASP. Another important issue in the implementation of the ASPs is the associated risk of adverse outcomes. Strategies should be implemented as part of ASPs to assess patients who can safely complete the therapy with an oral regimen, to reduce the need for IV catheters and avoid outpatient parenteral therapy. Therefore, objective criteria for switching to oral antimicrobial therapy in the clinical setting are required for clinical trials and observation studies in the future. In clinical practice, gastrointestinal discomfort is relatively common when oral fluoroquinolones are prescribed. Adverse effects of oral quinolones should be considered in IV-to-oral conversion.

Team members involved in ASP consist of infectious disease physicians, clinical pharmacists with infectious diseases training, clinical microbiologists, infection control staff, quality improvement (assurance) staff, nursing directors or nurses, information systems specialists, data analysts or information technology specialists, health care epidemiologists, and medical directors [1, 3]. Core members of an ASP team should include a clinical pharmacist and a physician, both of whom have training in infectious diseases [3]. British guidelines state that an antimicrobial pharmacist and a medical microbiologist are core members [2]. In Korea, ASP-trained clinical pharmacists and medical microbiologists are lacking and as such, a pharmacist or medical microbiologist is not usually a core member of an ASP team, as determined in the survey report conducted in Korea [6, 7]. An appropriately trained pharmacist dedicated to the ASP is one of the most important aspects in the daily process of implementing ASP strategies. However, the majority of hospital pharmacists are not provided for ASP efforts in Korea. Additionally, there is no financial benefit to per-

forming and maintaining ASPs in the healthcare setting in Korea. This obstacle should be removed. Financial support for the implementation of ASPs in local healthcare centers by national healthcare insurance is greatly needed. If financial support were provided by the national healthcare system, it would boost the activation of ASP initiatives by local ASP teams.

Although further accumulation of data is needed, comprehensive ASPs have the potential to decrease costs while improving both patient and institutional outcomes. However, further study is needed to clearly identify the relationship between ASPs and the reduction of resistance, such that colleagues will appreciate and accept these initiatives. The focus with regard to ASP strategies must continue to shift from cost saving towards efforts to decrease antimicrobial resistance. Antimicrobial resistance is a global problem [8]. In May 2015, the World Health Organization published a global action plan on antimicrobial resistance [8]. Encouraging ASP approaches is essential and is a reasonable action plan to preserve antimicrobial effectiveness. ASPs are most commonly found in academic hospitals and large community hospitals; however, there is an acknowledged need for development of such ASPs in smaller community hospitals, long-term care facilities, dialysis facilities, and outpatient practices.

In the future, artificial intelligence (machine learning, *etc.*) may have a role in enhancing ASPs as a decision support system [9]. This would be a more efficient approach where trained human resources are limited.

Conflicts of Interest

No conflicts of interest.

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