

# Antimicrobial Stewardship Metrics: Prospective Audit with Intervention and Feedback

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## INTRODUCTION

Prospective audit with intervention and feedback (PAIF) is one of two core antimicrobial stewardship program (ASP) strategies recommended by the Infectious Diseases Society of America (IDSA) and Society for Healthcare Epidemiology of America.<sup>1</sup> The PAIF strategy consists of a case-by-case review of patients prescribed antibiotics, typically by an infectious diseases (ID) physician or clinical pharmacist. Cases are reviewed for antibiotic appropriateness and feedback is delivered directly to the provider caring for the patient, with the goal of improving antibiotic use while minimizing unintended consequences such as bacterial resistance and adverse effects. A PAIF can be employed in a variety of ways depending on the healthcare setting (inpatient vs. outpatient), available resources, and can target a variety of interventions (e.g. duplicate antibiotic coverage, unnecessary antibiotic use, dose adjustments, route changes, indication/infection-specific, treatment duration). While PAIF can be costly and labor intensive, providers are able to maintain their prescribing autonomy. In addition, PAIF allows the antimicrobial stewardship team to provide education to prescribers at the time of intervention.<sup>1</sup> In this article, we review PAIF in various healthcare settings including inpatient acute care hospitals, long-term care facilities, and outpatient settings.

## INPATIENT ACUTE CARE HOSPITALS

The first ASP guidelines were primarily focused on the establishment of antimicrobial stewardship (AMS) strategies in inpatient acute care settings.<sup>2</sup> In comparison to outpatient settings, the implementation of AMS strategies in acute care settings is easier since members of the AMS team, provider, and patient are usually in the same location. Published literature on the implementation of PAIF has shown this strategy to improve antibiotic utilization and reduce antibiotic resistance, without negatively affecting patient outcomes.<sup>3-5</sup> A 7-year prospective study evaluated the impact of a limited PAIF on patients receiving parenteral third-generation cephalosporins, aztreonam, parenteral fluoroquinolones, or imipenem. It noted a 22% decrease in the use of parenteral broad-spectrum antibiotics nosocomial *C. difficile* infections, and nosocomial resistant Enterobacteriaceae.

The structure of PAIF can vary depending on the resources

of the practice setting. One study prospectively evaluated the impact of two different PAIF methods compared to no PAIF in adult intensive care units (ICU).<sup>4</sup> The first PAIF method involved an ID specialist physician who communicated with the ICU team via the ICU pharmacist. The second PAIF included the ID physician participating in interdisciplinary ICU rounds three times a week with the ICU pharmacist participating daily. Both PAIF methods resulted in improved rates of appropriate antimicrobial selection and lower frequencies of resistance emergence compared to no PAIF. This study demonstrated that different PAIF methods improve antibiotic use without any deleterious effects. Another study conducted in a 253-bed community hospital using limited resources demonstrated a 64% reduction in antibiotic days of therapy per 1000 patient-days and a 37% decrease in antibiotic expenditures.

In the inpatient setting, clinical decision support software (CDSS) systems are also utilized to assist in PAIF. These systems are able to target specific patient populations, antibiotics, or culture results based on the needs of the ASP. A study<sup>7</sup>, utilizing CDSS to target patients who were on redundant antibiotic combinations, found that CDSS decreased the number of patients requiring review by 84% and of the patients reviewed, an intervention was made in 71%. Recommendations to discontinue redundant therapy were accepted in 98% of cases. This study involving 137 patients concluded an annualized cost savings of approximately \$48,000. While PAIF can be labor intensive, adopting a computerized support system can increase efficiency and maximize intervention opportunities.

PAIF allows for a multidisciplinary approach to optimize patient care and enhance appropriate antibiotic use in the inpatient setting. The implementation of PAIF is one of the most valuable strategies in a comprehensive ASP.

## LONG-TERM CARE FACILITIES (LTCFS)

Antimicrobials represent almost half of all prescriptions in LTCFs, and approximately 50%-70% of residents receive at least one antibiotic course annually.<sup>8</sup> Many of these prescriptions, unfortunately, represent overuse or inappropriate use of antibiotics.<sup>8</sup> The implementation of PAIF can likely improve antibiotic use in LTCFs.

Limited published evidence is available for determining

the most effective AMS strategies in LTCFs, and even fewer studies specifically evaluate PAIF. A prospective quasi-experimental study implementing an ASP team consisting of an ID-trained pharmacist and physician targeted urinary tract infections (UTIs) at three community LTCFs.<sup>9</sup> Two seven-month phases included baseline data collection on facility-level antimicrobial utilization and susceptibility patterns, followed by an intervention phase with weekly site visits by the ID pharmacist who conveyed recommendations to the primary treating provider via telephone or fax. Only 8% of residents started on antibiotics for UTI met Loeb criteria<sup>10</sup> for antibiotic initiation. There were 292 antibiotic prescriptions pre-intervention and 183 during the intervention, of which only 104 could be reviewed by the ID pharmacist. The remaining 79 prescriptions were either initiated in the acute care setting or the entire antibiotic course was completed in between the weekly visits. A therapy change recommendation was made in 38% of those reviewed, but only 10 (25%) were accepted. The most common recommendations included discontinuing antibiotics (24%), shortening the course (11%) and streamlining therapy (2%). Despite the low acceptance rate, an immediate 26% decrease in UTI antibiotic prescriptions was seen during the intervention phase with a 6% reduction continuing through the rest of the period (95% CI -8 to -3%), and an immediate 25% reduction in all antibiotic prescriptions with a continued 5% reduction throughout the phase. The authors concluded that this approach has the potential to be effective but also identified many barriers which need to be overcome in order for the PAIF strategy to be successful in LTCFs.

One barrier identified in this study was the difficulty in establishing relationships with prescribers in this setting.<sup>10</sup> Lack of a prior provider-to-provider relationship and the absence of face-to-face interaction are limitations in LTCFs since much of the medical care occurs remotely. Provider buy-in and recommendation acceptance can prove challenging if this relationship deficiency exists. The addition of educational seminars, face-to-face meetings and collaboration in design of the program with an identified ASP champion from within the LTCF may help strengthen the benefits of a PAIF strategy.

Secondly, there were many missed opportunities for intervention with an antibiotic review completed once weekly. Since duration of therapy for UTI is often 7 days or less, many treatment courses were completed in between the weekly review or close to completion, and feedback to providers was not provided in these cases (81% of opportunities).<sup>10</sup> If a once weekly frequency is all that is feasible, feedback to providers on completed antibiotic courses should be attempted in an effort to broadly change prescribing habits for future cases. An ASP with more frequent review might prove to be more useful, though this is unlikely to be feasible with limited resources and general unavailability of ID physicians and pharmacists in LTCFs. Although utilization of ID specialists

for PAIF would be ideal, involving any physicians, mid-level practitioners, pharmacists or nurses trained in antimicrobial stewardship to act as peer champions may be a more practical approach. Fortunately, there are AMS certification or informal training programs which provide learning opportunities for interested practitioners.<sup>11,12</sup> Additional ways to improve access to ID specialists include sharing consultants amongst facilities, utilizing telemedicine, and partnering with local hospitals or academic medical centers which may be able to incorporate LTCF activities into medical and pharmacy residency and student training.

While once weekly PAIF is already less than ideal, even this frequency may not be feasible in many LTCFs. In most cases, a comprehensive medication review is completed by a consultant pharmacist once per month on each resident. While this method could be used to provide a retrospective review with feedback to providers for future case improvement, prospective audit at this frequency would likely be a futile effort. Many LTCFs use central pharmacies which fill prescriptions for several institutions. With additional AMS training, central-fill pharmacists are in a unique position to ensure the antibiotic has an appropriate indication, dose, duration and is the best choice for the resident based on the facility's antibiogram and treatment pathways; however, these pharmacists likely lack protected time for these activities and often do not have access to resident medical records which would be necessary requirements for them to play a role in PAIF.<sup>8</sup>

Aside from limited personnel resources, the availability of antibiotic use data could be a challenge in some LTCFs. An electronic record with the ability to generate reports (e.g. active antibiotic orders, antibiotics completed within the last 48 hours, etc.) could serve as an ideal system for identifying opportunities; however, some LTCFs still utilize paper records or electronic systems without robust reporting capabilities. In such cases, the ASP clinician would need to rely on manual tracking mechanisms often filled out by nursing personnel which may be incomplete and add an additional task to nursing's daily workload.

Lastly, family expectations are an important barrier to primary provider acceptance of PAIF recommendations. Providers report feeling pressured by nursing staff, residents and families to send urinalyses and cultures for indications such as cloudy urine or temporary behavioral changes, and to prescribe antibiotics.<sup>8</sup> A recent study of 35 Boston-area nursing homes reported increased antibiotic use (adjusted OR 3.43, 95% CI 1.94-6.05) and hospital transfer (adjusted OR 3.00, 95% CI 1.19-7.53) when health care proxies were involved in decisions on residents with advanced dementia.<sup>13</sup> It is therefore extremely important to involve families, residents and nurses in educational opportunities discussing the risks associated with antibiotic misuse in order to increase the acceptance of PAIF recommendations in LTCFs.

## OUTPATIENT

The Centers for Disease Control recently reported that approximately half of outpatient antibiotic prescribing may be suboptimal, due to antibiotic selection, dosing and duration, and at least 30% of prescriptions are unnecessary.<sup>14</sup> With this much room for improvement, there may be opportunity for a PAIF strategy, although data regarding how best to implement this on the outpatient side is even more lacking than in LTCFs. Audit and feedback strategies in outpatient clinics have been described with success in decreasing antibiotic misuse; however, these mechanisms utilize retrospective data and peer prescriber comparisons as feedback mechanisms.<sup>15</sup> A truly prospective mechanism in which a member of an ASP provides patient-specific recommendations to outpatient providers in real time is not well described.

Pharmacists in community dispensing pharmacies could play a role in PAIF; however, pharmacy business models would need to change before this type of activity could occur. These pharmacists are not allotted time for clinical activities, lack access to clinic medical records, and usually do not have an established relationship with prescribers unless a collaborative practice agreement is in place. While these pharmacists can play a vital role in counseling patients regarding their prescribed antibiotic, large drugstore companies need to invest in AMS nationwide efforts before community pharmacists could truly participate in PAIF.

Opportunities for PAIF in the outpatient setting may exist with ambulatory care pharmacists. Many clinic settings now have pharmacists on site to provide medication therapy management services. With additional training in AMS, these pharmacists could serve as clinic ASP champions along with a physician or mid-level practitioner and may be able to develop mechanisms to evaluate antibiotic prescriptions prior to patients leaving the office visit. Similar barriers as discussed above in LTCFs could be identified, including reporting abilities in electronic records, lack of ID training and expertise, protected time to perform these services, and patient and family pressure to prescribe antibiotics.

As AMS efforts expand beyond acute care hospitals, it is critical that LTCFs and outpatient practices start thinking outside the box to implement important strategies such as PAIF.

## References

1. Barlam TF, Cosgrove SE, Abbo LM, MacDougall C, Schuetz AN, Septimus EJ, et al. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Clin Infect Dis*. 2016 May 15;62(10):e51-77.
2. Dellit TH, Owens RC, McGowan JE Jr, Gerding DN, Weinstein RA, Burke JP, et al. Infectious Diseases Society of America and the Society of Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis*. 2007 Jan 15;44(2):159-77.
3. Carling P, Fung T, Killion A, Terrin N, Barza M. Favorable impact of a multidisciplinary antibiotic management program conducted during 7 years. *Infect Control Hosp Epidemiol*. 2003; 24:699-706.
4. DiazGranados CA. Prospective audit for antimicrobial stewardship in intensive care: impact on resistance and clinical outcomes. *Am J Infect Control*. 2012 Aug;40(6):526-9.
5. Newland JG, Stach LM, De Lurgio SA, Hedicani E, Yu D, Herigon JC, et al. Impact of a prospective-audit-with feedback antimicrobial stewardship program at a children's hospital. *J Pediatr Infect Dis*. 2012; 1:179-86.
6. Vettese N, Hendershot J, Irvine M, Wimer S, Chamberlain D, Massoud N. Outcomes associated with a thrice-weekly antimicrobial stewardship programme in a 253-bed community hospital. *J Clin Pharm Ther*. 2013; 38:401-4.
7. Glowacki RC, Schwartz DN, Itokazu GS, Wisniewski MF, Kieszkowski P, Weinstein RA. Antibiotic Combinations with Redundant Antimicrobial Spectra: Clinical Epidemiology and Pilot Intervention of Computer-Assisted Surveillance. *Clin Infect Dis*. 2003; 37:59-64.
8. Morrill HJ, Caffrey AR, Jump RLP, Dosa D, LaPlante K. Antimicrobial stewardship in long-term care facilities: a call to action. *J Am Med Dir Assoc*. 2016;17:183.e1-183.e16.
9. Doernberg SB, Dudas V, Trivedi K. Implementation of an antimicrobial stewardship program targeting residents with urinary tract infections in three community long-term care facilities: a quasi-experimental study using time-series analysis. *Antimicrob Resist Infect Control*. 2015;4:54.
10. Loeb M, Bentley DW, Bradley S, Crossley K, Garibaldi R, Gantz N, et al. Development of minimum criteria for the initiation of antibiotics in residents in long-term-care facilities: results of a consensus conference. *Infect Control Hosp Epidemiol*. 2001;22(2):120-4.
11. Society of Infectious Disease Pharmacists. Antimicrobial Stewardship A Certificate Program for Pharmacists. Available at: <http://www.proce.com/SIDP-ASP/>.
12. Making a Difference in Infectious Disease. Antimicrobial Stewardship Programs. Available at: <http://mad-id.org/antimicrobial-stewardship-programs/>
13. Givens JL, Spinella S, Ankuda CK, et al. Healthcare proxy awareness of suspected infections in nursing home residents with advanced dementia. *J Am Geriatr Soc*. 2015;63:1084-1090.
14. Sanchez GV, Fleming-Dutra KE, Roberts RM, Hicks LA. Core Elements of Outpatient Antibiotic Stewardship. *MMWR Recomm Rep*. 2016;65(No. RR-6):1-12.
15. Drekonja DM, Filice GA, Greer N, et al. Antimicrobial stewardship in outpatient settings: a systematic review. *Infect Control Hosp Epidemiol*. 2015;36:142-152.

## Disclaimer

The views expressed herein are those of the authors and do not necessarily reflect the views of The Miriam Hospital and Kent Hospital.

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