Evaluation of Pharmacist Impact on Culture Review Process for Patients Discharged From the Emergency Department

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ABSTRACT

Background: Accurate and timely review of microbiological test results is a core component of antimicrobial stewardship. There is documented success of these programs in the inpatient setting; however, emergency department (ED) patients are typically not included in these initiatives.

Objectives: To assess the impact of an emergency medicine pharmacist (EMP)–facilitated review process of positive microbiological test results from patients discharged from the ED as measured by time to positive result review and number of indicated interventions completed.

Methods: This was a retrospective study that compared EMP-facilitated to ED charge nurse (CN)–facilitated physician review of randomly selected positive microbiological test results. Groups were compared concurrently within the time frame of July 1, 2012 through December 31, 2012.

Results: One hundred seventy-eight positive microbiological test results were included (EMP, $n = 91$; CN, $n = 87$). The median (IQR) time to initial review was 3 (1.0–6.3) hours for the EMP and 2 (0.3–5.5) hours for the CN group ($p = .35$). Four percent (1/25) of indicated interventions were not completed in the EMP group versus 47% (14/30) in the CN group ($p = .0004$).

Conclusion: An EMP was significantly less likely to miss an intervention when indicated with no difference in time to review of positive microbiological results. These findings support the role of the EMP in antimicrobial stewardship in the ED.

Key Words—antimicrobial stewardship, clinical pharmacist, culture, emergency department, intervention

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Antimicrobial stewardship is a collection of strategies aimed at optimizing the use of antimicrobials while minimizing unintended consequences of therapy, such as the emergence of resistance due to overuse.¹⁻³ Selecting the correct dose, route, and duration of therapy accompanied by educational initiatives are among the core principles of these programs. Another core principle is the

interpretation of microbiological test results in order to streamline antimicrobial therapy.²⁻⁵ While proven effective in the inpatient setting, many antimicrobial stewardship programs do not include emergency department (ED) patients in their initiatives.^{2,4}

The Infectious Diseases Society of America (IDSA) and the Society for Healthcare and Epidemiology of America (SHEA) have identified the clinical

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pharmacist as a crucial member of antimicrobial stewardship programs, because they are knowledgeable on the interpretation of culture and sensitivity results, the appropriate use of antimicrobials, medication dosing, recognition of allergies, route of administration, duration of therapy, and drug interactions.²⁻⁵ Review of microbiological test results and subsequent modification of empiric antimicrobial therapy may be a daunting task for ED health care personnel due to high patient volume and frequent interruptions. The emergency medicine pharmacist (EMP) is perfectly positioned and equipped with the proper knowledge and tools to review these results and facilitate appropriate modifications to therapy when necessary.³⁻⁵

Antimicrobials are the second most prescribed drug class in the ED and are reportedly used in 12.4% of ED patients.^{4,6} Due to the rapid throughput and large volume of patients seen in the ED, many traditional aspects of antimicrobial stewardship are not applied; however, because of the quantity of antimicrobials initiated in the ED, it is an area where the aforementioned principles should be utilized.^{4,5} The American Society of Health-System Pharmacists (ASHP) has issued a statement declaring that pharmacists in the ED should develop systems to promote safe and effective medication use and optimize patient care. Expansion of clinical pharmacy services in the ED may include the review of positive microbiological test results for patients discharged from the ED. This represents an opportunity for the clinical pharmacist to enhance the safety and care for this patient population.⁷⁻¹¹

The purpose of this study is to determine the impact of an EMP on the review process of positive microbiological test results from patients discharged from the ED. The primary outcome was evaluated by concurrently comparing time to initial positive result review between the EMP and the ED charge nurse (CN) groups. The secondary outcomes compared the frequency of indicated interventions completed between the EMP-facilitated physician review group versus the ED CN-facilitated physician review group and compared return visits and hospital admissions between groups.

CURRENT PRACTICE

A pharmacotherapy specialist with advanced clinical training is present in the ED Monday through Friday, from 7:00 a.m. to 11:00 p.m. During this time, the EMP facilitates the review of all positive microbiological test results for the ED physician. During weekends and holidays, the ED CN facilitates this

review. The EMP is the medication expert with regard to dosing, drug interactions, and selection of appropriate antibiotics. The ED CN group is composed of highly skilled nurse leaders. The EMP provides clinical recommendations after reviewing patient-specific characteristics, whereas the CN presents only the culture and sensitivity data to the ED physician.

Positive microbiological test results are available through a shared electronic folder in the medical center's electronic medical record (EMR) when finalized. The microbiological test result review process begins at 7:00 a.m. each day. Per institutional policy, the EMP or ED CN screens the result(s) and notifies the available ED attending physician of results that warrant further evaluation. If no further intervention is necessary, that result is marked as complete in the EMR. If an intervention is required, the patient is contacted and informed of the positive result and new plan of care. This is documented in the EMR.

METHODS

Design

This is a single-center, retrospective study concurrently comparing the review of positive microbiological test results facilitated by an EMP to the ED CN for patients discharged from the ED. The study setting is an academic medical center ED with approximately 72,000 visits annually. Microbiological test results were identified through a query of the medical center's EMR for patients discharged from the ED between July 1, 2012 and December 31, 2012.

All microbiological test results were screened against inclusion and exclusion criteria during the study period and were classified into groups according to facilitator, EMP or CN (**Figure 1**). Positive results were included for analysis. Positive microbiological results were defined as documented growth from urine, skin and soft tissue, throat, blood, or stool cultures or positive results stemming from other non-culture-based microbiological tests (eg, nucleic acid amplification). Results from incarcerated patients, patients younger than 18 years of age, admitted patients, and those not reviewed within 24 hours were excluded. Results reviewed after 24 hours were excluded because the discipline (EMP or CN) completing the review was not the initial discipline responsible for the review. Including those results would have artificially inflated time to review for the discipline ultimately completing the review.

Time to initial review was determined for each positive result. This was defined as time, in hours, rounded to the nearest quarter hour, from 7:00 a.m.

until either the first evidence of review was documented or the result was marked as complete.

Positive microbiological test results were reviewed and assessed to determine whether an intervention was indicated. Interventions in this study were defined as the need to discontinue, change, or start an antimicrobial regimen based on cultures and sensitivities or other positive microbiological results. Time to initial review was determined for each completed intervention. This was defined as time in hours, rounded to the nearest quarter hour, from 7:00 a.m. until either the first evidence of review was documented or the result was marked as complete. For patients in whom an intervention was indicated, all-cause return visits and hospital admissions were measured if they occurred within 96 hours of ED discharge.

A standardized data abstraction form was used to accrue data throughout the study period. One researcher abstracted the data. Ten percent of the data was re-abstracted by another researcher to confirm accuracy. Two members of the research team, the EMP and a board-certified infectious diseases physician, reviewed all positive results for the appropriateness of treatment decisions. The infectious diseases physician was blinded to the study arms. Disputes on adequacy or need for interventions were determined by chart review and discussion, with the ultimate decision resulting on the clinical judgment of the infectious diseases physician. Institutional review board approval was obtained for this study.

Data Analysis

With an $\alpha = 0.05$, a sample size of 172 positive microbiological test results (86 EMP facilitated and 86 CN facilitated) provided 90% power to detect a mean difference of 6 hours to initial positive microbiological test result review between groups.

Descriptive statistics were reported to summarize demographic characteristics. Nonparametric Mann-Whitney *U* tests were used to compare time to initial review and time to review when an intervention indicated was completed. Chi-square tests were used to compare the frequency of indicated interventions that were completed and frequency of return visits or admissions to the medical center. A kappa value was calculated to measure the agreement between the 2 reviewers for the positive results. All statistical analyses were conducted in SAS version 9.2 (SAS Inc., Cary, NC).

RESULTS

The query identified 743 microbiological results during the study period. These were screened against the inclusion and exclusion criteria (Figure 1). Baseline demographics are shown in Table 1. A total of 178 positive results were included for analysis: 91 in the EMP group and 87 in the CN group. A majority of positive culture results consisted of urine ($n = 43$ vs 44) and skin and soft tissue ($n = 26$ vs 15) in the EMP and CN groups, respectively.

The median (IQR) time to initial review of a positive microbiological test result in the EMP group was 3 (1.0-6.3) hours compared to 2 (0.3-5.5) hours in the CN group ($p = .35$). The median (IQR) time to review of a positive microbiological test result when an intervention was indicated and completed was 6.6 (3.5-8.1) hours and 8.1 (4.1-9.1) hours in EMP and CN groups, respectively ($p = .39$) (Figure 2).

Twenty-seven percent (25/91) of positive results reviewed required an intervention in the EMP group compared to 34% (30/87) in the CN group ($p = .31$). Four percent (1/25) of required interventions were missed in the EMP group compared to 47% (14/30) in the CN group ($p = .0004$) (Figure 3). The missed interventions included a positive sexually transmitted disease (STD) result in the EMP group compared to positive STD ($n = 2$), urine culture ($n = 8$), blood culture ($n = 1$), throat culture ($n = 1$), and skin and soft tissue culture ($n = 2$) results in the CN group. Of the interventions that were not completed, 67% (10/15) did not have an anti-infective prescribed at discharge and 33% (5/15) had an anti-infective prescribed to which the organism that grew was not susceptible. Enterococcus was involved in 26.7% (4/15) of missed interventions. The number of patients who had a return visit to the ED or were admitted to the medical center within 96 hours of being discharged from the ED was 9 and 10 in the EMP and CN groups, respectively ($p = .84$). A simple kappa coefficient was calculated to be 0.9314 between reviewers, indicating agreement beyond chance for the appropriateness of treatment decisions for the positive results. The reviewers agreed upon the decisions made on 176 of 178 positive results.

DISCUSSION

The findings in this study elucidate that the EMP-facilitated physician review is more likely to result in an intervention being completed when indicated compared to CN-facilitated physician review. Ninety-six percent of indicated interventions were documented

Figure 1. Study inclusion and exclusion criteria.

Table 1. Baseline demographics

	Emergency pharmacist facilitated (n = 91)	Charge nurse facilitated (n = 87)
Mean (range) age, years	36 (18-83)	39 (18-86)
Gender, female (%)	65	72
Ethnicity, (%)		
Caucasian	68	63
African American	28	29
Other	4	8
Positive results, (%)		
Urine culture	47	51
SST culture	29	17
STD	15	9
Influenza	3	11.5
Other ^a	6	11.5

Note: SST = skin and soft tissue; STD = sexually transmitted disease.

^aOther = stool, blood, throat and respiratory cultures.

as completed in the EMP group compared to 53% in the CN group. This resulted in a significantly smaller number of missed indicated interventions when the EMP was the reviewer (4% vs 47%). During their review, the EMP provides a clinical recommendation to the physician based on thorough review of the patient's EMR and incorporates this into their recommendations, relying on their extensive training in pharmacotherapy and knowledge of infectious diseases. However, when the CN facilitates the physician review, only the information regarding the initial discharge antimicrobial is provided. Other potential causes for missed interventions include incomplete documentation or differences in workload between the EMP and CN. However during the culture review process, there is only one EMP and CN available. Both disciplines are simultaneously providing care for patients in the ED and completing the culture review process. Missed interventions may have resulted in further progression of the patient's disease state.

Figure 2. Time to review of positive microbiological test results within 24 hours.

Figure 3. Number of interventions indicated and interventions missed by study group.

When evaluating the number of return visits to the ED or subsequent admissions to the medical center among positive results requiring an intervention, there was not a significant difference between the groups. However, the current study was not powered to measure this difference.

Studies have described the impact of the clinical pharmacists with regard to review of microbiological test results for patients discharged from the ED. In a study performed by Baker et al, the investigators measured time (days) to positive culture review of

clinical pharmacist-facilitated review compared to a historical control of mid-level practitioner-facilitated review. This study found that clinical pharmacists were able to follow-up on positive culture results and notify the patient or the patient's primary care provider faster when an intervention was necessary compared to the mid-level practitioners (2 vs 3 days; $p = .0001$, and 2 vs 3 days; $p = .01$, respectively).⁵ In a study by Randolph et al,¹⁰ the investigators measured the difference between physician and clinical pharmacist review of culture results for patients discharged

from the ED. They found that clinical pharmacist's group had an increased rate of antimicrobial modifications (15% vs 12%) and a reduced readmission rate within 96 hours (7% vs 19%; $p < .001$) compared to the physician group, respectively.

The current study differs in several ways. Previous studies compared the number of interventions between study groups, whereas the current study not only evaluates the number of interventions, but also the accuracy of interventions made. All indicated interventions in this study were reviewed with a board-certified infectious diseases physician for accuracy.

Whereas previous studies have compared historical controls to clinical pharmacist-facilitated review, the current study compares EMP and CN review of positive microbiological test results concomitantly. In addition, prior studies have measured time to culture review in days, whereas the current study measures time to review of a positive microbiological test result in hours to the nearest quarter hour.

During this study, an internal survey that we conducted revealed that CNs and ED attending physicians alike were confident that the EMP was able to review positive microbiological test results and modify therapy when necessary. The findings of this survey and study will be used in part to support the expansion of services of EMP coverage to 7 days a week, allowing the review of positive results on weekends and holidays. In addition, a collaborative practice agreement will be pursued with the ED attending physicians to permit the EMP to review positive results and independently complete interventions and follow-up when necessary.

Limitations

Limitations to this study include its retrospective nature and its completion in only one medical center. In addition, positive microbiological test results may have been reviewed and acted upon, but not documented, in the patient's EMR. Involvement of an EMP during the review process introduced a potential for bias in this study. To minimize this bias, the infectious diseases physician made the final decision on the appropriateness of actions taken in all cases reviewed. When evaluating return visits to the ED or admissions to the medical center, only patients who returned to the medical center were analyzed, excluding patients who may have obtained care at another facility.

Conclusions

The study results add to the growing body of evidence that demonstrates how clinical pharmacists are perfectly positioned in the ED to review, evaluate, and intervene on patients discharged from the ED with positive microbiological test results. They are also more likely to complete an intervention when indicated compared to CN-facilitated physician review. This in turn leads to expansion of antimicrobial stewardship practices and the optimization of care for patients discharged from the ED.

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