Involvement of pharmacist-reviewed urine cultures and sexually transmitted infections in the emergency department reduces time to antimicrobial optimization

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Purpose. To streamline workflow of the culture review process in the emergency department (ED), a transition from a nurse-driven to a pharmacist-initiated process was implemented.

Methods. This was a single-center retrospective study conducted at an adult urban level 1 trauma academic medical center. The pharmacist-initiated culture review process was compared to the previous nurse-initiated process. The primary objective was time from final culture result to patient contact by an advanced practice provider. Secondary objectives included incidence of treatment failure and hospital admission within 30 days of ED visit.

Results. A total of 283 patients met inclusion criteria: 144 patients in the pre-intervention group and 139 patients in the postintervention group. Patients were contacted a median time of 15.7 hours (95% confidence interval [CI], 9.88-18.83) earlier for definitive urinary tract infection antibiotic therapy and 46.7 hours (95% CI, 33.34-61.62) earlier for definitive sexually transmitted infection therapy in the pharmacist-initiated workflow compared to the nurse-initiated workflow ($P < 0.001$). Treatment failure occurred in 0.01% of patients in the postintervention group and 6.3% in the pre-intervention group ($P = 0.01$). Hospital admission within 30 days of the ED visit occurred in 0% of patients in the postintervention group and 4.2% in the pre-intervention group ($P = 0.03$).

Conclusion. Pharmacist-initiated culture review in the ED at an academic medical center reduced time from final culture to patient contact for optimal antibiotic therapy and decreased hospital admission and treatment failure rates. A change in the culture review workflow involving pharmacists appears to have a positive impact on clinical outcomes.

Keywords: culture review, emergency department, pharmacist, sexually transmitted infection, urinary tract infection, workflow

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Urinary tract infections (UTIs) and sexually transmitted infections (STIs) are frequently encountered conditions in the emergency department (ED). In the United States, UTIs are among the most common ED discharge diagnoses. Annually, more than 2 million ED visits are made solely due to UTIs.[1,2] The Infectious Diseases Society of America and Centers for Disease Control and Prevention recommend performing cultures for these patients as a way to identify a causative pathogen for treatment. Due to the delay between culture collection and speciation of an organism, treatment is empirically directed toward the most likely pathogens. Once a definitive pathogen is known, antibiotic therapy modification may be needed to ensure adequate treatment.[3-6]

Numerous workflows exist for identifying final culture results that require follow-up.[7-14] These workflows often involve nonphysician healthcare members, including nurses, pharmacists, and advanced practice providers

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(APP). Commonly, nurses in EDs and clinics are responsible for identifying final cultures that require follow-up. Emergency department pharmacist involvement in culture review has previously been demonstrated to decrease inappropriate antimicrobial use, ED revisits, and hospital admissions.[7-14]

Identification of the most efficient workflow for final culture review processes has the potential to further improve time to antibiotic optimization and clinical outcomes, as well as streamline processes to allow healthcare members to dedicate more time to other patient-care responsibilities. We hypothesized that a pharmacist-initiated culture follow-up process in the ED would reduce the time to patient contact for definitive antibiotic treatment. In addition, clinical outcomes such as treatment failure and hospital admission rates would improve when compared to the previous nurse-driven workflow.

Materials and Methods

Final culture review process. Prior to implementation of the pharmacist-initiated culture review process, registered nurses were responsible for reviewing all reported electronic final culture results. Nurses would send results electronically to a message inbox that was reviewed by APPs or pharmacists to assess if postdischarge interventions were potentially indicated. Interventions were determined to be required by the nurse if the culture contained any organisms that were not treated by the prescribed regimen or any other issues the nurse felt needed additional review or intervention. Nurse assessment of culture results was not consistently completed each day due to competing work demands, which caused delays in follow-up.

Cultures were electronically sent and then evaluated daily by either an APP or ED pharmacist. Culture review occurred predominately between 9:00 AM and 11:00 AM. If cultures were reviewed by the ED pharmacist, therapeutic recommendations would be forwarded to APPs. For those cultures not previously reviewed by the ED pharmacist, APPs may consult pharmacists for recommendations on resistant organisms or complex antibiotic allergy considerations, introducing an additional step to the review process. Ultimately, all routed final cultures were reviewed by APPs who determined the final treatment plan. APPs then contacted patients by phone with the new treatment plan, if applicable. If the APP was unable to contact the patient via phone call, a letter was sent.

To streamline the workflow of the culture review process, an ED pharmacist-initiated process was implemented. All final results from urine cultures and STIs are sent electronically to a message inbox to be reviewed by pharmacists without registered nurse involvement. Pharmacists then provide written recommendations and electronically send the culture with recommendations to the APPs. When appropriate, recommendations include initiation of antibiotics, change of antibiotic class or dose based on susceptibility or patient factors (eg, allergies, renal dysfunction), increase or decrease of treatment duration, or discontinuation of therapy.

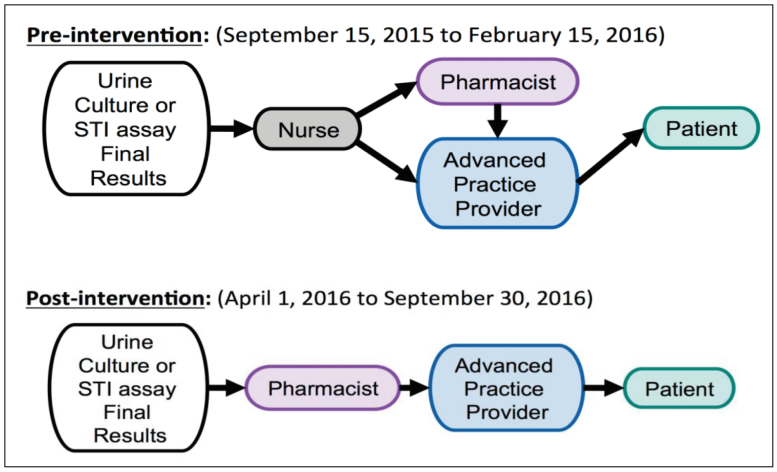
At this institution, pharmacists provide 24/7 coverage in the ED. Each ED pharmacist has a rotating 7 day on and off schedule. A day pharmacist is present in the ED from 7:00 AM to 5:00 PM, and an evening pharmacist is present from 2:00 PM to 12:00 AM. Coverage from 12:00 AM to 7:00 AM is shared with intensive care unit coverage. The culture review process occurs periodically, at a minimum of every 12 to 24 hours between 7:30 AM and 12:00 AM daily including weekends. The review process occurs periodically, at a minimum of every 12 to 24 hours between 7:30 AM and 12:00 AM daily.

The APPs complete the final step by contacting the patient for definitive therapy between 9:00 AM and 11:00 AM each morning and throughout the day when able. Results that are determined by the pharmacists to not need changes are not forwarded to the APPs for review. The change in workflow decreased the previous process from three steps (nurse identification, APP evaluation with or without pharmacist consult, APP modification) to two steps (pharmacist identification and evaluation, APP evaluation and modification) (Figure 1).

Study design. This was a single-center retrospective study conducted at an adult urban level 1 trauma academic medical center with approximately 72,000 ED visits per year. Approval for this study was obtained by the institutional review board.

The primary outcome was time from final culture result to patient contact by an APP. Secondary endpoints included the incidence of treatment failure, hospital admission within 30 days of ED visit for related conditions (UTI, pyelonephritis,

Figure 1. Culture review process.



sepsis secondary to a UTI), percentage of all accepted pharmacist recommendations, and pharmacist recommendations to discontinue.

Urinary tract infections and pyelonephritis were determined by the ED provider diagnosis. Complicated UTIs were defined as patients with structural or functional abnormality of the genitourinary tract, male gender, or pregnant. All other UTIs were considered uncomplicated. Treatment failure was defined as patient return to our ED within 72 hours for the same medical problem.

Pharmacists reviewed the entire patient chart including reported symptoms, physician review of symptoms, physical exam documented by the physician, laboratory values, STI assay results, urinalysis, and sensitivities to each positive urine culture. Recommendations were made to initiate antibiotics, change antibiotic class or dose based on susceptibility or patient factors (eg, allergies, renal dysfunction), increase or decrease treatment duration, or discontinue therapy. Discontinuation of therapy was considered if the patient had no UTI symptoms during the ED encounter, was not pregnant, and would be able to report no developed symptoms upon APP follow-up.

Data was extracted from electronic health records and transcribed into an electronic data collection sheet. Workflow change from nurse- to pharmacist-driven review occurred February 16, 2016. Data collection for the pre-intervention group was collected from August 15, 2015, to February 15, 2016, and compared to the postintervention data collected from April 1, 2016, to September 30, 2016. No notable changes within the system, such as follow-up efforts with primary care physicians, had occurred during this time period that may influence patient adherence. Culture and assay reviewers in each group were unaware of the study. Statistical analysis of baseline variables and outcomes were performed using χ^2 tests to compare categorical data and Mann-Whitney *U* tests to compare continuous data.

Patients were included in the study if they were discharged from the ED and subsequently required an intervention based on final urine culture or STI assay results. Patients were excluded if they were younger than 18 years of age, admitted for inpatient treatment during the same visit, or discharged to hospice care.

Results

A total of 283 patients met inclusion criteria: 144 patients in the pre-intervention group and 139 patients in the postintervention group. No significant differences between baseline characteristics in the study groups were identified (Table 1). The majority of patients included in the comparator groups were females diagnosed with UTIs. Patients were contacted a median time of 15.7 hours earlier for definitive UTI antibiotic therapy in the pharmacist-initiated workflow compared to the nurse-initiated workflow ($P < 0.001$). Patients requiring treatment for positive STI final assay results were contacted a median time of 46.7 hours earlier compared to the previous workflow ($P < 0.001$). In both groups combined, patients were contacted 19.9 hours earlier for definitive antibiotic therapy in the pharmacist-initiated workflow compared to the previous process ($P < 0.001$) (Table 2). Treatment failure occurred in 0.01% of patients in the postintervention group and 6.3% in the pre-intervention group ($P = 0.01$). Hospital admission within 30 days of the ED visit occurred in 0% of patients in the postintervention group and 4.2% in the pre-intervention group ($P = 0.03$).

A variety of therapy recommendations was provided by pharmacists in the postintervention group. Recommendations provided were to initiate antibiotics, switch antibiotic agents due to sensitivities or patient factors such as allergies or renal function, change treatment duration, or discontinue antibiotic therapy (Table 3). The recommendations made to discontinue antibiotics were provided for cultures with any growth if the patient was asymptomatic and not pregnant. The recommendations to initiate antibiotics were provided for patients who were pregnant or if the patient had developed UTI symptoms upon APP follow-up. Pharmacist recommendations were accepted by the APPs in 137 out of 139 (99%) of patients. Two of these recommendations were not considered accepted because documentation for

Table 1. Patient Characteristics

Variable	Pre-intervention (*n* = 144)	Postintervention (*n* = 139)	*P*
Age, Mean (SD), y	41 (21.5)	38 (21.1)	0.1
Female, No. (%)	116 (80.5)	113 (81)	0.9
UTI, No. (%)	99 (68.8)	89 (64)	0.4
STI, No. (%)	45 (31)	50 (36)	0.4
Uncomplicated UTI, No. (%)	52 (36)	56 (40.3)	0.2
Complicated UTI, No. (%)	47 (32.6)	33 (23.7)	0.2
Pregnant, No. (%)	21 (14.6)	24 (17)	0.6

Abbreviations: STI, sexually transmitted infection; UTI, urinary tract infection.

Table 2. Median Time from Final Culture Result to Patient Contact for Optimal Therapy

Groups	No. Patients	Median Time (IQR), h	Median Time Difference (95% CI), h	*P*
Pre-intervention UTI + STI	144	26.47 (50.15-21.68)	19.87 (17.62-22.3)	<0.001
Postintervention UTI + STI	139	9.06 (21.92-2.6)		
Pre-intervention UTI	99	24.63 (32.12-21.43)	15.68 (9.88-18.83)	<0.001
Postintervention UTI	89	13.28 (21.77-2.52)		
Pre-intervention STI	45	56.3 (93.7-30.33)	46.68 (33.34-61.62)	<0.001
Postintervention STI	50	6.95 (21.77-3.05)		

Abbreviations: STI, sexually transmitted infection; UTI, urinary tract infection.

Table 3. Pharmacist Recommendations

Recommendations	Postintervention Group, No. (%)
Initiate antibiotics	62/139 (44.6)
UTI	15/89 (16.9)
STI	47/50 (94)
Change antibiotic agents	62/139 (44.6)
UTI	59/89 (66.3)
STI	3/50 (6)
Increase duration	1/139 (0.7)
UTI	1/89 (1.1)
STI	0/50 (0)
Decrease duration	2/139 (1.4)
UTI	2/89 (2.2)
STI	0/50 (0)
Discontinue antibiotics	12/139 (8.6)
UTI	12/89 (13.5)
STI	0/50 (0)

Abbreviations: STI, sexually transmitted infection; UTI, urinary tract infection.

changes in antibiotic agents was not found after recommendations were provided to modify therapy due to inadequate antibiotic coverage. All recommendations made to discontinue therapy were accepted by the APPs.

Discussion

Incorporation of pharmacists into the final culture review and follow-up process has previously resulted in improvements with antimicrobial stewardship, fewer ED revisits, and fewer hospital admissions. These findings demonstrate that pharmacist involvement within a multidisciplinary team provides value and importance to the culture follow-up process in the ED.[7-14] This study provides further evidence to support these findings, as well as demonstrates that changes in workflow involving pharmacist-initiated culture review can impact clinical outcomes. To our knowledge, this is the first study analyzing pharmacist involvement in the culture review process while incorporating workflow with APPs.

This study found a significant reduction in treatment failure defined by return to the ED within 72 hours for the same medical problem and a reduction in hospital admission rates in the group involving the pharmacist-initiated culture review workflow. These improved rates are likely related to more timely initiation of definitive therapy. The significant reduction in time may prevent further complications caused by infections because they can be treated quickly and effectively.

Although this pharmacist-initiated workflow does increase daily responsibilities for pharmacists, APPs continue contacting patients after receiving antimicrobial recommendations. In previous studies, pharmacists have been responsible for the whole process, from culture review to patient contact, potentially impacting other pharmacy services. Before this workflow was in place, pharmacists were frequently consulted for recommendations on final culture results, especially with more complex patient cases, which would introduce an additional step in the process and further delay the time patients would receive definitive antibiotic therapy. This workflow provides benefits to both APPs and pharmacists in regard to responsibilities and time commitment required in the final culture review and follow-up process. Many institutions likely use pharmacists as consultants in the antibiotic selection process, and therefore this workflow may have external validity. Additionally, a more efficient review

process may have potential cost savings. In the future, a more robust economic analysis comparing a process that includes pharmacist responsible for the whole process vs providing recommendations to the APP should be considered.

Asymptomatic bacteriuria, often treated with antibiotics, is an area pharmacists also have a large impact on by recognizing prescribing patterns and making recommendations to discontinue antibiotics. In a previous study, pharmacist intervention in discontinuing or modifying antibiotics for asymptomatic patients with positive urine cultures reduced unnecessary antibiotic exposure and was the first step in antimicrobial stewardship efforts in the ED.[10] The findings of our study found that the pharmacist workflow provides not only timely treatment optimization but also the opportunity for pharmacists to assist with discontinuation of unnecessary antibiotics.

Many benefits are provided by the implementation of a pharmacist-initiated culture review workflow. Benefits include allotting additional patient-care time for nurses and APPs and the use of pharmacist clinical skills in providing guideline recommendations and medication expertise to antibiotic therapies. These findings should encourage other institutions, inpatient or outpatient, to implement a workflow involving pharmacists in the final culture review and follow-up process similar to the present study to make improvements in patient care and antimicrobial stewardship.

This study was subject to the limitations inherent in all retrospective clinical trials. ED visits and hospital admissions were not captured if care was outside of the healthcare system. Other process outcomes were not evaluated, such as how the change in workflow impacted other clinical pharmacist duties and the salary-benefit from shifting duties from nurses to pharmacists. Data on comorbidities were not collected, which could have influenced results in each group.

Conclusion

Pharmacist-initiated culture review in the ED at an academic medical center reduced time from final culture to patient contact for optimal antibiotic therapy. As a result, this process may decrease the need for hospital admissions and reduce the rates of treatment failure. A change in the culture review workflow involving pharmacists appears to have a positive impact on clinical outcomes. Further studies should focus on prospective data collection and patient-centered outcomes such as revisits, patient adherence, and cost-effectiveness.

Disclosures

The authors have declared no potential conflicts of interest.

Previous Affiliations

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