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ORIGINAL RESEARCH

Pediatrics

Decreasing review and notification times of genital and urine cultures in a pediatric emergency department: An observational before and after study

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Abstract

Objectives: The review of positive culture results by clinical pharmacists in pediatric patients discharged from the emergency department (ED) has not been described. This study aimed to compare review and family notification times of genital and urine cultures before and after initiation of review of positive cultures by clinical pharmacists in a pediatric ED.

Methods: This was a retrospective review of charts for the study period of 1 year before and 1 year after initiation of review of positive cultures by clinical pharmacists. Positive culture timing results as well as types and rates of interventions were obtained from the electronic chart records.

Results: A total of 681 urine and 171 genital cultures were analyzed. The number of genital and urine cultures were similar in the nurse-driven and pharmacist-driven periods. For urine cultures, the cumulative percentage of notifications in the pharmacist-driven period exceeded that in the nurse-driven period until about 24 hours and again between 24 and 48 hours. By 12 hours, 5.4% of families had been notified in the pharmacist-driven period compared with 1.8% in the nurse-driven period ($P = 0.011$). More positive cultures were reviewed early in the pharmacist-driven period as well, but by 12 hours, the cumulative percentages were similar: 30.4% in the pharmacist-driven period compared with 27.7% in the nurse-driven period ($P = 0.431$). For genital cultures, the distribution of notification and review times were similar in both periods.

Conclusions: The review of positive cultures by clinical pharmacists in a pediatric ED can shorten review and notification times compared with nurses, especially in the first 12 hours.

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KEYWORDS
clinical pharmacists, emergency department, genital cultures, pediatric emergency medicine, urine cultures

1 | INTRODUCTION

The American Society of Health-System Pharmacists published a position statement in 2008 regarding the role clinical pharmacists should play in the emergency department (ED). It states that "every hospital pharmacy department should provide its ED with the pharmacy services that are necessary for safe and effective emergency care."[1] This statement was further expanded on in the guidelines published by the American Society of Health-System Pharmacists in 2011.[2] These guidelines recommend that pharmacists in an ED should be present not only during resuscitations but also provide medication reconciliation and documentation in addition to a host of other leadership and administrative functions.[2]

Studies done in adult patients performed in adult EDs have shown that the addition of ED clinical pharmacists to review cultures performed during ED visits have positive effects. Some of these include reduced time to positive culture review and reduced time to primary physician notification,[3] modification of antibiotic regimen in some cases,[4–6] and decreased ED and/or hospital readmissions.[7,8] Although there are studies that have been done in pediatric urgent care centers linked to a pediatric hospital,[9,10] to our knowledge there are no pediatric studies that have reported similar findings in pediatric patients discharged from a pediatric ED.

1.1 | Importance

The purpose of this study is to describe the role of pediatric ED clinical pharmacists in the review of positive urine and genital cultures for patients discharged from the ED. The primary aim is to determine if the initiation of a pharmacist-driven culture review decreases the time to notification of patients/families of these results. Secondary aims include whether the pharmacist-driven review process decreases the time from when a culture result is positive to initial review by a nurse or pharmacist. We also hope to describe the types of interventions and to compare intervention rates during the nurse-driven and pharmacist-driven periods.

2 | MATERIALS AND METHODS

2.1 | Study design and setting

This was an observational study conducted as a retrospective review of patient charts 1 year before and 1 year after initiation of review of positive cultures by clinical pharmacists in a pediatric ED. Only cultures that had an intervention were included in the study, as these required family notification. The study was approved by the UT Southwestern Institutional Review Board. Our tertiary pediatric ED has about 160,000 visits annually, from 2 campuses: the downtown main campus and a suburban campus. Each ED is staffed 24 hours daily by pediatric emergency physicians.

The implementation of clinical pharmacists in this role was done in part to help decrease the time to review positive culture results, hypothesized to be clinically important within the first 12 hours.

2.2 | Study period

The study is divided into the nurse-driven period of January 1, 2010 to December 31, 2010 and the pharmacist-driven period of February 1, 2011 to January 31, 2012. A pilot period—July 26, 2010 through August 6, 2010–was excluded from the analysis.

2.3 | Personnel

Before January 30, 2011, the ED charge nurse or the clinical nurse liaison reviewed positive cultures. The clinical nurse liaison is a certified nurse who primarily functions to communicate directly with the community pediatricians and providers external to our hospital network. The clinical nurse liaison function remotely via telecommunication. The ED charge nurse is responsible for nurse delegation of duties and addresses any patient and nonpatient issues that may occur within the ED. Our clinical pharmacists are board certified and complete a 1-year clinical pharmacy residency training during which they rotate through various departments within the hospital.

2.4 | Culture review

The clinical nurse liaison or ED charge nurse would review positive cultures and note the positive culture in various areas in the medical record (please see process flow map, Supplemental Appendix A). The charge pediatric emergency physician attending on shift would then be contacted to give a recommendation that is noted by the clinical nurse liaison or charge nurse within the medical record. The clinical pharmacists in our ED have a pharmacist that is dedicated to reviewing all cultures between 6 am and 2:30 pm daily. They review all positive culture results, ensuring appropriate antibiotics have been prescribed for every patient (please see process flow map, Supplemental Appendix B). Any recommendation by the clinical pharmacist would be in the same area as per their protocol—an "ED culture results section." Cultures that had either a Referral and Evaluation for At Risk Children

(REACH) consult done in the ED or had a follow-up appointment in a REACH clinic are directed to the REACH physician who follows up with these results. For those who have no documented contact with REACH, these are followed up by the clinical pharmacists (please see Supplemental Appendix B). Each of these steps is time stamped in the same area—ED culture results section–in the patient's medical record.

2.5 | Data source

Patients were identified using positive culture results from the Children's Medical Center hospital laboratory reports (EPIC Beaker and Cerner). Charts were reviewed of all patients 0 to 18 years of age who had urine and genital cultures collected in the ED that resulted positive and were discharged home. Medical records were then accessed to obtain culture type, culture source, time culture resulted, time of initial review both by pharmacists and by ED charge nurse or clinical nurse liaison, time the antibiotic choice was made, time the patient/family were notified (as applicable), number of interventions made, and intervention type.

2.6 | Interventions

Interventions were all done via telephone and typically occurred during 1 telephone call if no further assistance was needed. In cases of language barriers, an interpreter may be used to facilitate communication, as per hospital policy. Interventions are defined as antibiotic initiation for untreated positive results, therapy change from empiric antibiotic treatment to most appropriate antibiotic treatment based on susceptibility report, dose changes in prescribed antibiotic, frequency changes in prescribed antibiotic, changes in duration of therapy, and assessment to determine need for further interventions. Further interventions included caregiver and patient education with regard to medication administration and primary care physician follow-up or return to the ED or involvement of subspecialty services for some medically complex patients. If the pharmacist felt that the patient/family did not understand the instructions via telephone or they were unlikely to follow-up with a physician by expressing that they cannot get an appointment soon enough or do not have one, then they were advised to return to the ED. This is general practice in our ED.

2.7 | Outcomes

The primary outcome of this study was time from positive culture result to time to notification of patient/family. Secondary outcomes included time from positive culture result to time to initial review of positive culture result. In addition, the type and rate of interventions made in both the nurse-driven and pharmacist-driven periods were determined.

Types and sources of cultures and outcome measures were collected from the patient medical record by 6 of 7 study team members. The seventh study team member validated 1% of the data collected. Data collected were entered into a password-protected electronic database.

The Bottom Line

Earlier review of urine and genital cultures by clinical pharmacists can expedite interventions in patients discharged from a pediatric emergency department. Notably, in this study, this resulted in earlier review and notification of families by about 12 hours.

2.8 | Data analysis

The primary outcome was time to notification, evaluated as cumulative percentage versus time in hours. Times from positive result to first review and notification as well as rates and types of interventions made were summarized by culture types and periods. Mean and median times to notification of families and review times in hours are also reported by culture type and period. Pre-differences and post-differences in cumulative percent of time from positive to first review and notification within 12 hours were tested using likelihood-ratio chi-square statistics. Continuous times from positive to first review and notification were summarized and aggregated by result positive month and tested using rank-sum statistics. All analyses were programmed in SAS/STAT version 9.4 (SAS Institute Inc., Cary, NC).

3 | RESULTS

A total of 681 urine and 171 genital cultures were analyzed (Figure 1). The number of genital and urine cultures were similar in the nurse-driven and pharmacist-driven periods. Results from the pilot period were excluded from the analyses.

For urine cultures, the cumulative percent of notifications in the pharmacist-driven period exceeded that in the nurse-driven period until about 24 hours and again between 48 and 72 hours (Figure 2). Within 12 hours, the hypothesized clinically relevant time for this study, there were 5.4% of notifications in the pharmacist-driven period compared with 1.8% in the nurse-driven period ($P = 0.011$). Beyond 72 hours, the overall notification rates were similar. This trend was seen again in the review of positive urine cultures; earlier review of positive cultures by 12 hours was noted in the pharmacist-driven period compared with the nurse-driven period (30.4% vs 27.7%; $P = 0.431$; Figure 3). Thereafter, rates of review were similar in both periods. For genital cultures, rates of notification (29.7% vs 33.8%; $P = 0.567$) and review (36.3% vs 37.5%; $P = 0.867$) within 12 hours were similar in both periods and remained similar thereafter.

Aggregated monthly notification and review times during the entire study period are shown in Figure 4. Families were notified earlier, and

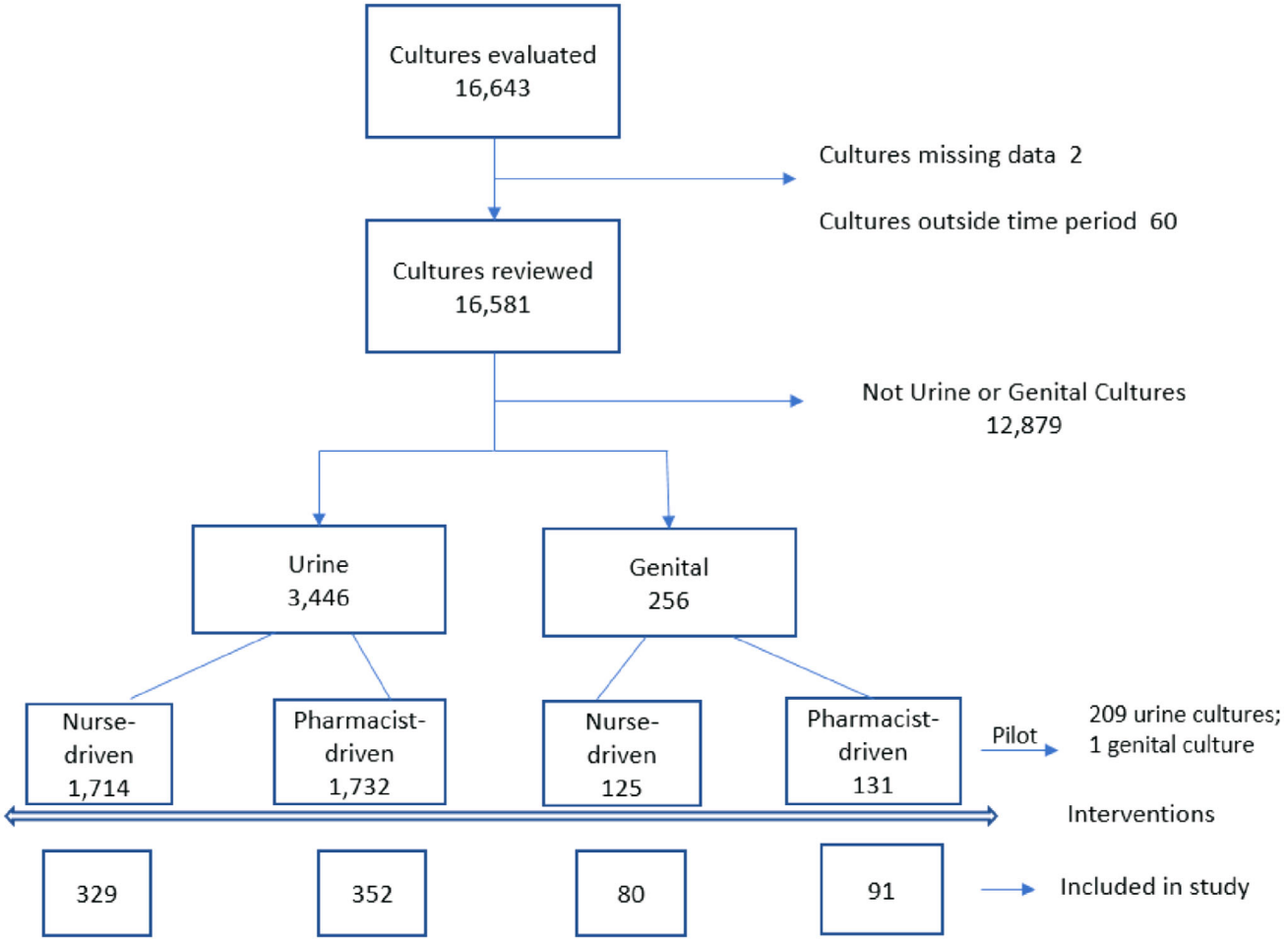

FIGURE 1 Schematic of study

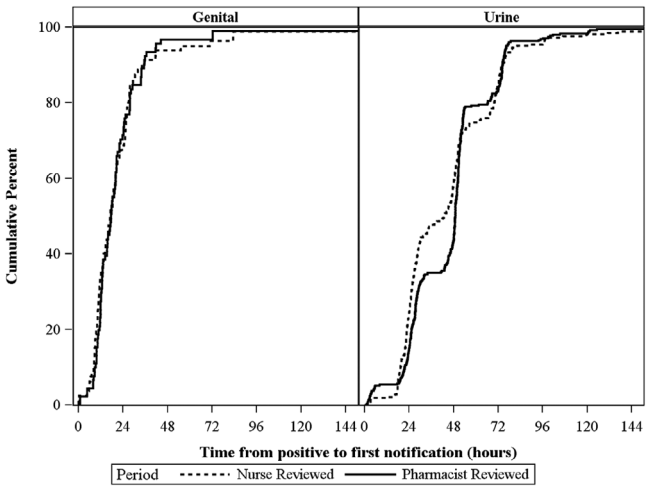

FIGURE 2 Cumulative distributions of time from positive to first notification

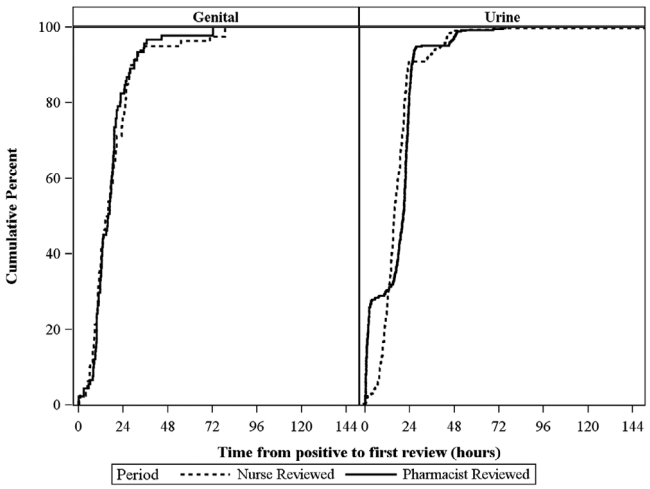

FIGURE 3 Cumulative distributions of time from positive to first review

results were reviewed earlier in the pharmacist-driven period compared with the nurse-driven period: $P = 0.019$ and $P = 0.005$, respectively. For genital cultures, notification and review times were not significantly different: $P = 0.743$ and $P = 0.991$, respectively.

Mean times of notification and review times were similar in both pharmacist-driven and nurse-driven periods for genital cultures: 21.7 hours versus 22.8 hours ($P = 0.762$) and 17.4 hours versus 18.4 hours ($P = 0.628$). For urine cultures, however, the mean notification time

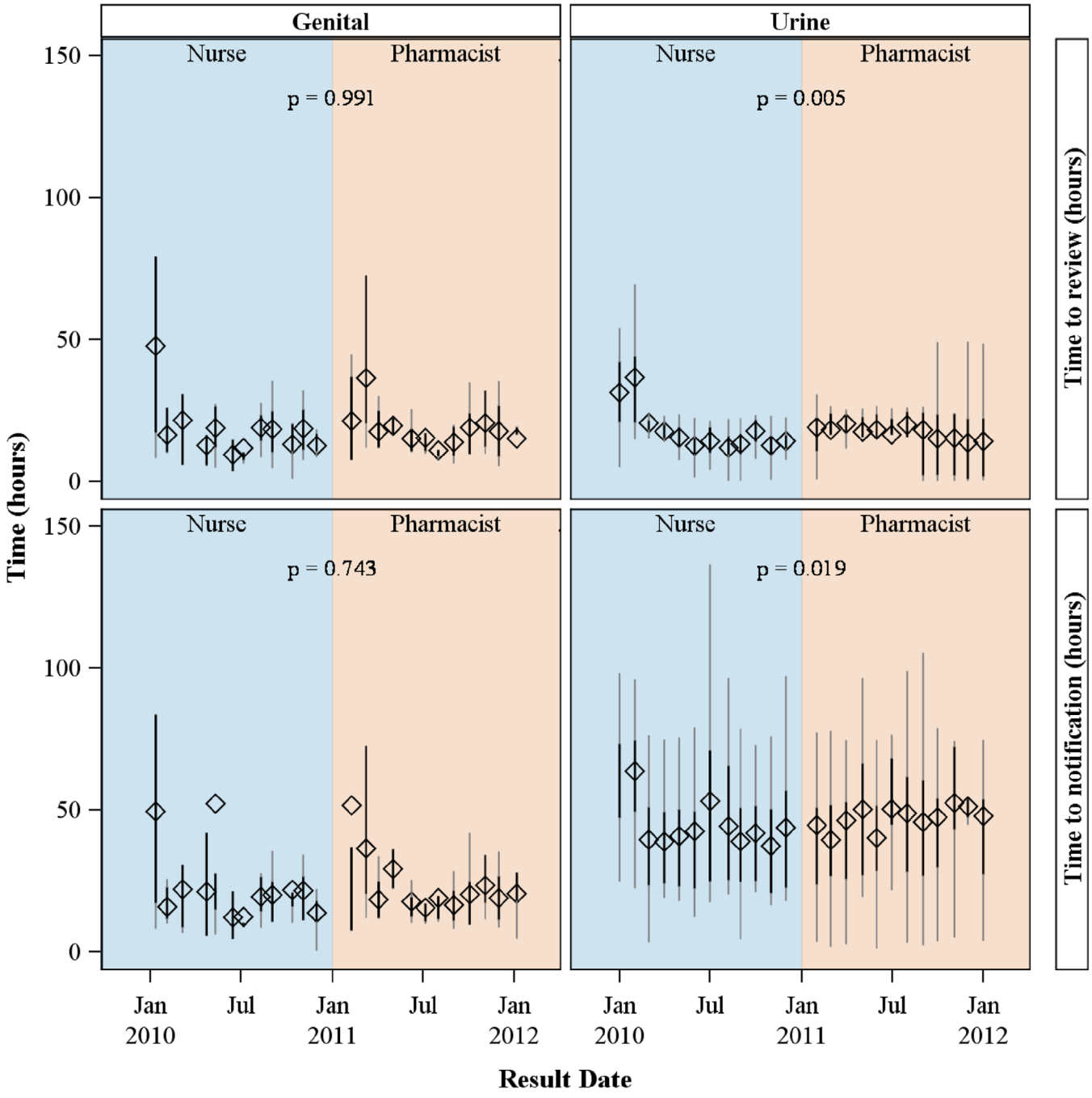

FIGURE 4 Monthly distributions of times for genital and urine cultures. *P* values for rank-sum comparisons between periods. Dark vertical bars extend from the first to the third quartiles. Light vertical bars extend to the ranges of the data or a maximum of 2.5 interquartile ranges. Diamonds mark the means

during the pharmacist-driven period was shorter: 46.4 ± 23.8 hours compared with 67.4 ± 407.1 hours during the nurse-driven period ($P = 0.354$; Figure 5 and Supplemental Appendix C). The median ± interquartile range of notification and review times for genital cultures were also similar in both periods: 17.6 ± 13.0 hours versus 17.1 ± 15.6 hours ($P = 0.743$) and 15.9 ±9.7 hours versus 15.2 ± 13.7 hours ($P = 0.991$). For urine cultures, the median ± interquartile range of notification times were 48.8 ± 25.6 hours versus 43.3 ± 37.2 hours ($P = 0.019$) for the pharmacist and nurse reviewed periods, respectively. The median review times for urine cultures were 20.5 ± 20.8 (pharmacist reviewed) and 15.7 ± 9.2 (nurse reviewed; $P = 0.005$; Figure 5 and Supplemental Appendix C).

The most common intervention in both cultures were follow-up with PCP: 54.1% for genital cultures and 26.6% for urine cultures (Figure 6). Drug discontinuation, drug change, and dose change interventions did not occur in genital cultures (Figure 6).

Antibiotics were initiated in 31.3% in the urine culture group versus 10.8% in the genital group.

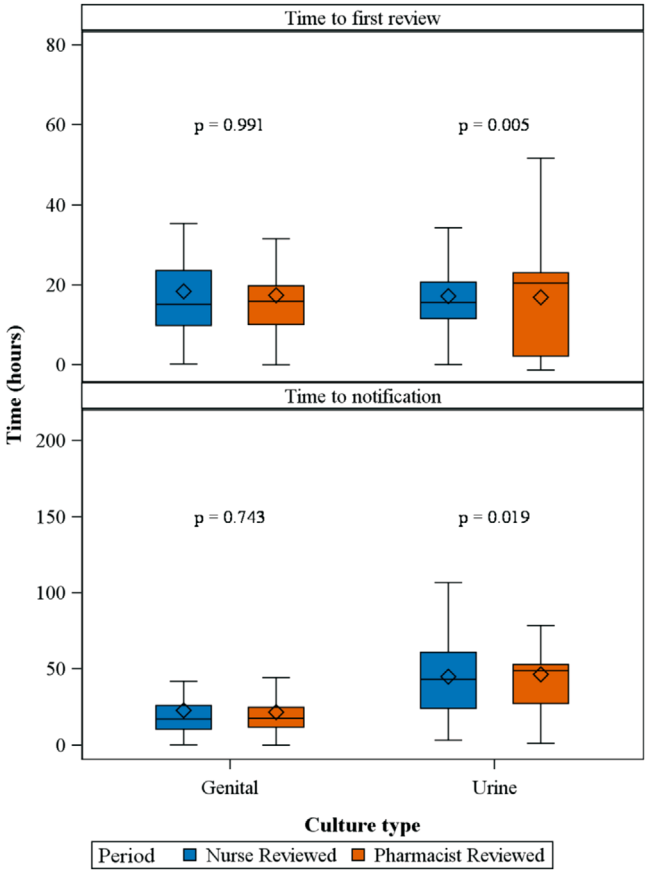

FIGURE 5 Box and whisker plots of mean and median times to notification and review. *P* values for rank-sum comparison between periods. Boxes extend from the first to the third quartiles. Whiskers extend to the ranges of data or a maximum of 2.5 interquartile ranges. Medians are marked by horizontal lines within the boxes; means are marked by diamonds

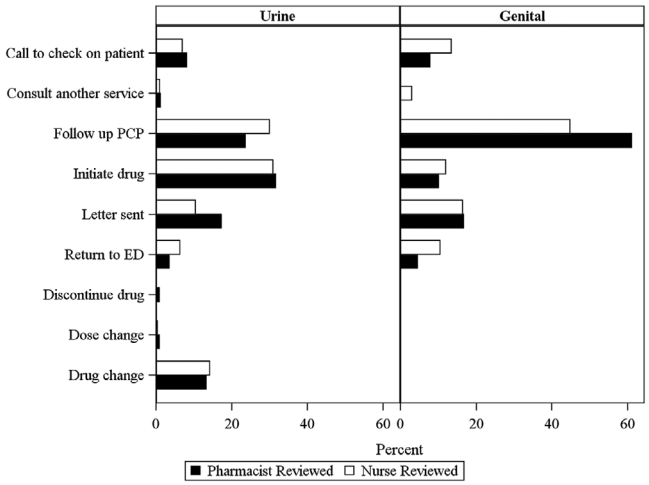

FIGURE 6 Types and rates of interventions. ED, emergency department; PCP, primary care physician

Letters were sent to patients/families when they could not be reached by phone calls after 3 attempts. This accounted for 13.7% of all urine cultures and 15.2% of all genital cultures.

Results from the pilot period showed that 209 urine cultures and 1 genital culture were evaluated. There was a 7.3% error rate (all cultures) with regard to inappropriate antibiotics prescribed and 20.8% of pharmacist-initiated antibiotic change (type of antibiotic or dose change). The 72-hour ED return rate was 5.4% (all cultures) with hospital readmissions at 4.3% (urine cultures).

4 | LIMITATIONS

The main limitation of this study is that the uncontrolled before/after observational design cannot rule out secular trends that may have affected notification and review times independent of the review by ED pharmacists. However, this design is typical of before/after improvement studies. Data on ED return visits were not collected in this study. This may have given better insight into the effect of the pharmacists in this role on ED return visits. Misclassification during the transition between pre and post periods can also affect the results, but this was minimized by excluding a 1-month interval between the pre and post periods from the analysis. In addition, the study was conducted at a single center using retrospective review of charts. Typical of a retrospective study, if no review time was documented, it was assumed that a culture review did not occur. Similarly, if no interventions were documented, then it was assumed that no interventions occurred. Finally, only urine and genital cultures were included in this study. Thus, results may not necessarily be extrapolated to include all other culture types. In addition, ED return visits were not analyzed—this may have given more insight to the effect of earlier notification of patients/families with positive results.

5 | DISCUSSION

Urine and genital cultures were predetermined to be included in this study as these are the most common cultures that patients require a telephone call for after discharge from the ED.

These telephone calls are done typically to check on a patient's status, such as if the patient still has fever or if the patient's appetite has improved. The clinical status of the patient often determines the next step in the recommendation, such as reinforcement that the patient should follow-up with his or her primary care physican if the patient's clinical status has improved or a recommendation that the patient physically return to the ED if the patient's clinical status has not improved, such as still not feeding well, patient continues to be febrile, or per parents' concern.

We found that there were similar rates of positive urine and genital cultures in the nurse-driven and pharmacist-driven periods. Although documentation of positive culture results was similar for both study periods, the documentation of time to first review and time to notification was uniform, that is, occurred in the same area in the medical

record only in the pharmacist-driven period. This was also similar for any interventions completed. This is per the pharmacist documentation practice. Previously, there was no guideline or policy regarding documentation of communication by the clinical nurse liaison or ED charge nurse.

The literature is sparse with regard to the role of pharmacists in the review of positive culture results in pediatric patients evaluated in a pediatric ED and discharged home from the ED. Although there are studies advocating for pharmacists in this role, all of them have been in adult patients or in an adult ED.[3,6,11,12] To our knowledge, no similar study exists that was done in a pediatric ED setting, particularly one with a very high patient census such as ours.

Our study evaluated the role of the pharmacist in the review of positive urine and genital cultures in a pediatric ED in patients discharged home from the ED. Our results indicate that with the initiation of clinical pharmacists in this role, the review of positive urine results and notification times of patients/families from the time results were positive were decreased compared with previous methods that were nurse driven. This is consistent with previous studies.[3,6,12,13,14] We hypothesize that having a dedicated pharmacist review positive cultures during a dedicated time frame on a daily basis may in part account for the decreased times to review and notification. In addition, the notification times may have also been shorter because before discussion with the pediatric emergency physician attending about the results, the pharmacist would have made recommendations in the medical record; a process that was previously not done. When the review of positive cultures was nurse driven, the ED charge nurse may defer review when the ED is busy. Similarly, the clinical nurse liaison might do the same when occupied with other referral patient information/duties, thus delaying review times. However, having a dedicated pharmacist whose sole purpose is to review cultures at specific times probably contributed to the decrease time to review and subsequently time to notification of patients/families. Our study did not specifically review time to different intervention types but did review time to notification of families and positive culture results at specific time intervals (Figures 2 and 3) and the cumulative percentage (Figure 4).

Studies in adult patients have shown that clinical pharmacists involved in the review of positive cultures in patients discharged from the ED may decrease ED revisits within 72 hours and hospital readmission rates within 30 days,[3,6,12,13] decreasing time to review[3,6,12] and subsequent patient/family or primary care physician notification.[6,13] Although our study found a decrease in the times to notification of patients and families of positive culture results and a decrease in the times to review of positive results, we did not evaluate the effect of this on ED return visits. It is thus unclear of the effect of these review and notification times on ED return visits.

Intervention rates in our study were similar in the pharmacist-driven and nurse-driven periods for both urine and genital cultures. This contrasts with the findings in the study by Davis et al[6] in which a pharmacist-driven culture antimicrobial program resulted in a 30% increase in interventions for inappropriate antimicrobial therapy. They hypothesized that this may have been secondary to pharmacists being specifically trained in appropriate culture follow-up in addition to their extensive training and subsequent knowledge in pharmacotherapy. In our institution, there is a pharmacist whose sole responsibility is to review cultures for 8 hours a day. In contrast, the clinical nurse liaisons may review cultures 24 hours daily—although not on any specific schedule. This may account for one reason why we did not find a difference in our intervention rates.

The interventions that were common to both culture results were call to check on patient, consult another service, follow-up with primary care physician, initiate drug, letter sent to family, and a recommendation to return to the ED. Most of the interventions were to reinforce that patients follow-up with their primary care physician, more so with those in the genital group. We hypothesize that this may predominate in pediatric patients as opposed to adult patients as this has not previously been a reported intervention in previously published adult studies. Another service was consulted in both nurse-driven and pharmacist-driven periods in both culture groups. This was done in cases where patients were primarily under the care of the consulting service (instead of their primary care physician). Antibiotic initiation occurred more in the urine culture group compared with the genital culture group (31.3% vs 10.8%). This may be attributed to an initial negative urinalysis sample that the culture eventually was positive. In our ED, all urine collections done for concern of infection must have a urine culture done simultaneously. In addition, as per our urinary tract infection guidelines, it is a policy in our ED that when initial urinalysis results are negative, the treating physician does not have to prescribe antibiotics until culture results are obtained. In contrast, as is common practice in our ED, most patients being evaluated for genital infections are often pre-emptively treated with broad-spectrum antibiotics.

Letters sent were more in the pharmacist-driven period for urine cultures compared with the nurse-driven period (17.2% vs 10.4%). This may be an effect of pharmacist dedicated to check cultures daily during a specified time period. Presumably, more patients are contacted until a "non-response" is received.

Surprisingly, drug discontinuation, dose changes, and drug changes were done only in patients with positive urine cultures. Again, we hypothesize that this could be because most patients being treated for genital infections are often pre-emptively treated using broad-spectrum antibiotic coverage during their ED visit as is usual practice.

Similar to the study by Santiago et al, our times to review and notification of patient/family are documented in hours compared with the other studies[3,6,12,13] that are documented in days.

There was a 12-day pilot period that occurred during the study period from July 26, 2010 to August 6, 2010. The results from this pilot period were excluded from the final analyses to reduce bias in the overall results.

The implementation of a pharmacist-driven positive culture review process in discharged pediatric patients from our pediatric ED showed a decrease from time to review of positive urine cultures to time to notification of patients/families as well as a decrease in time from positive urine culture result to first review. This shows that clinical pharmacists' review and notify families earlier of positive urine culture results within 12 hours, and cumulatively, compared with nurses in the same time frame in a pediatric ED.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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