The Journal of Emergency Medicine, Vol. 46, No. 1, pp. 71–76, 2014

0736-4679/$ - see front matter

http://dx.doi.org/10.1016/j.jemermed.2013.08.042

Clinical Laboratory in Emergency Medicine

REFLECT URINE CULTURE CANCELLATION IN THE EMERGENCY DEPARTMENT

Christopher W. Jones, MD,*† Karissa D. Culbreath, PHD,‡§ Abhi Mehrotra, MD,† and Peter H. Gilligan, PHD§

*Department of Emergency Medicine, Christiana Care Health System, Newark, Delaware, †Department of Emergency Medicine, University of North Carolina Chapel Hill, Chapel Hill, North Carolina, ‡Tricore Reference Laboratories, Albuquerque, New Mexico, and §Department of Pathology and Laboratory Medicine, University of North Carolina Chapel Hill, Chapel Hill, North Carolina

Corresponding Address: Christopher W. Jones, MD, Department of Emergency Medicine, Christiana Care Hospital, 4755 Ogletown-Stanton Road, P.O. Box 6001, Newark, DE 19718

☐ **Abstract—Background: The yield of urine culture testing in the emergency department (ED) is often low, resulting in wasted laboratory and ED resources. Use of a *reflex culture cancellation* protocol, in which urine cultures are canceled when automated urinalysis results predict that culture yield will be low, may help to conserve these resources. Study Objectives: To identify a reflex culture cancellation protocol consisting of urinalysis-based criteria to limit urine culture over-utilization. Methods: We studied patients aged 5 years and older whose ED evaluation included both an automated urinalysis and urine culture. Logistic regression models incorporating individual urinalysis components were used to predict culture growth. Receiver operating characteristic curves corresponding to each model were constructed, and the area under the curve was used to identify the model that best predicted positive urine culture growth. Results: There were 1546 ED patients who met study inclusion criteria. Of these, 314 (20%) had positive urine cultures. Restriction of culture testing to samples with white blood cells > 10 per high-power field, positive nitrites, positive leukocyte esterase, or positive bacteria provided a sensitivity of 96.5% (95% confidence interval [CI] 93.6–98.1%) and specificity of 48.1% (95% CI 45.3–51.0%) for positive urine culture. Implementation of a reflex culture cancellation protocol based on these criteria would have eliminated 604 of 1546 cultures (39%); 11 of 314 positive cultures (3.5%) would have been missed. Conclusion: These results suggest that a substantial reduction in urine culture testing might be achievable by implementing this protocol. Confirmation of these findings in a validation cohort is necessary. © 2014 Elsevier Inc.**

☐ **Keywords—reflex testing; urinalysis; urine culture**

INTRODUCTION

Automated urinalysis and urine culture testing are frequently used in the emergency department (ED) setting to detect urinary tract infections. The frequent use of these tests, however, often results in a large proportion of negative cultures. The yield for urine culture is low not only when utilized in a population with undifferentiated abdominal pain, but also among uncomplicated patients with typical urinary tract infection (UTI) symptoms (1–4). More selective use of urine culture testing may improve resource stewardship and reduce costs. These costs impact both EDs and clinical laboratories, including the time and resources used to collect samples for culture, laboratory culture supplies, the time and effort required to process large numbers of negative cultures, and resources devoted to the follow-up of ED culture results.

Reflex urine culture cancellation offers one possible solution to the problem of excess urine culture utilization. Reflex laboratory testing involves using information from

This work was presented at the Society for Academic Emergency Medicine (SAEM) annual meeting in Boston, Massachusetts, June 2011.

Reprints are not available from the study authors.

RECEIVED: 16 November 2012; FINAL SUBMISSION RECEIVED: 25 May 2013;
ACCEPTED: 15 August 2013

a preliminary test to make automatic or reflexive decisions about the need for additional testing. For example, when testing for streptococcal pharyngitis, some experts recommend performing a confirmatory throat culture reflexively if an initial rapid antigen test is negative (5). This concept can be applied to urine culture utilization by implementing a laboratory protocol under which orders for urine cultures are canceled if an accompanying automated urinalysis does not meet prespecified criteria.

Urinalysis reflex testing has been previously investigated in a population of male urology clinic patients (6). It has also been recommended as a way to limit wasteful testing based on an analysis of a small group of patients in a Family Practice outpatient clinic (7). However, these algorithms have not been investigated in an ED setting. The goal of this study was to develop an easily implemented and widely applicable *reflex culture cancellation* protocol based on automated urinalysis results that could be used to limit urine culture utilization in samples unlikely to grow pathogenic organisms.

METHODS

Study Design

This was a retrospective study of patients presenting to the ED during a 6-month period between July 1, 2009 and January 1, 2010. Our Institutional Review Board approved this investigation and waived the requirement for written informed consent.

Study Setting and Population

This study was performed at the University of North Carolina Medical Center (UNC), a suburban, tertiary-care academic medical center in the Southeastern United States with an annual ED census of approximately 65,000 patients per year. This ED serves a socioeconomically and ethnically diverse population. Patients are seen either by nurse practitioners or by ED residents with supervision from board-certified emergency medicine or pediatric emergency medicine attending physicians.

All patients age 5 years and older who had both an automated urinalysis and urine culture collected during their ED visit were included. We chose to exclude patients younger than 5 years old from this analysis because urinalysis testing may be less predictive of positive culture results among infants and young children as compared to older patients, and because acceptable rates of false-negative testing may differ between this population and older patients (8). Additionally, for some providers the theoretical risk of renal scarring due to missed UTI may change the test threshold for urine culture in young children (9).

Study Protocol and Measurements

Urine samples included both clean-catch and catheter-obtained specimens. Performance of both an automated urinalysis and a urine culture at our institution requires that clinicians place a separate order for each of these tests. Automated urinalysis was performed in the UNC Medical Center core laboratory using the International Remote Imaging System IQ200 instrument (IRIS International Inc., Chatsworth, CA). This instrument provides results from chemistry testing, including measurement of nitrites and leukocyte esterase, as well as automated microscopy testing in a single step. Urine cultures were performed in our hospital's microbiology laboratory, using standard methodology. Cultures with growth of at least 10,000 colony-forming units (CFU)/mL of likely urinary pathogens, including Gram-negative rods, *Enterococcus* spp., *Staphylococcus sapprophyticus, Staphylococcus aureus,* group B streptococci, and *Aerococcus,* were considered to be positive. Cultures that grew at least 50,000 CFU/mL of unlikely urinary pathogens, including viridans group streptococci, coagulase negative staphylococci, and Candida, were considered positive. Cultures that grew *Lactobacillus*, *Gardnerella vaginalis*, or diphtheroids alone were not considered positive. Results from each positive urine culture were individually reviewed for clinical significance by a fellow in clinical microbiology (K.M.C.).

Our institution's laboratory maintains a database that includes results from all urinalyses and all urine cultures performed by the laboratory. This database was queried to provide urinalysis and urine culture data for this cohort of patients. Demographic data were obtained from the ED electronic medical record database maintained at our institution. Data from each of these sources were downloaded directly into Microsoft Excel spreadsheets (Microsoft Corporation, Redmond, WA), which were then linked via medical record number. Missing data were rare; missing values for individual urinalysis fields were considered to be zero or negative. When multiple cultures were collected from a single patient on different days during the 6-month study period, each sample was treated as an independent case for the purpose of this analysis.

Data Analysis

Bivariate analyses were performed using Mann-Whitney *U* testing for continuous variables, and using chi-squared testing for categorical variables. After the strength of the associations between individual components of the urinalysis and urine culture were determined, candidate forced-entry multivariate logistic regression models were constructed using cutoffs from individual components of the urinalysis, which were significant ($p < 0.05$) on