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Expanded PCR Panel for identification of Uropathogens and antimicrobial resistance in Urinary Tract Infections

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INTRODUCTION

Urinary tract infections (UTIs) are common polymicrobial infections that have a high economic burden on the healthcare system, especially in at-risk population (>65 yo). Moreover, increase in antimicrobial resistance is an important public health concern as they limit possible options and leads to recurrent UTIs. Standard Urine Culture (SUC) is considered the gold standard for detection of UTIs. However, it is an imperfect method, is labor intensive and takes days to yield a result which can delay appropriate antibiotic therapy. PCR testing using a panel of the UTI-causing pathogens can identify pathogens with a faster turnaround time and identify potential coinfecting pathogens. The goal of this study was to compare the performance of an expanded PCR panel against SUC for pathogen detection in suspected UTI.

METHODS

Urine specimens were collected from 56 subjects presenting with UTI symptoms. All samples were simultaneously tested using SUC and Urine-ID™. Urine-ID™ is an expanded PCR panel that analyzes up to 74 pathogens as well as 49 antimicrobial resistance (AMR) targets using the TaqMan® OpenArray plates on the QuantStudio 12K Flex Real-Time PCR System. Results obtained using PCR panel and SUC were compared for identification of organisms associated with UTIs. Antimicrobial resistance results obtained using Urine-ID™ AMR and culture-based Minimum Inhibitory Concentration (MIC) assay were also compared.

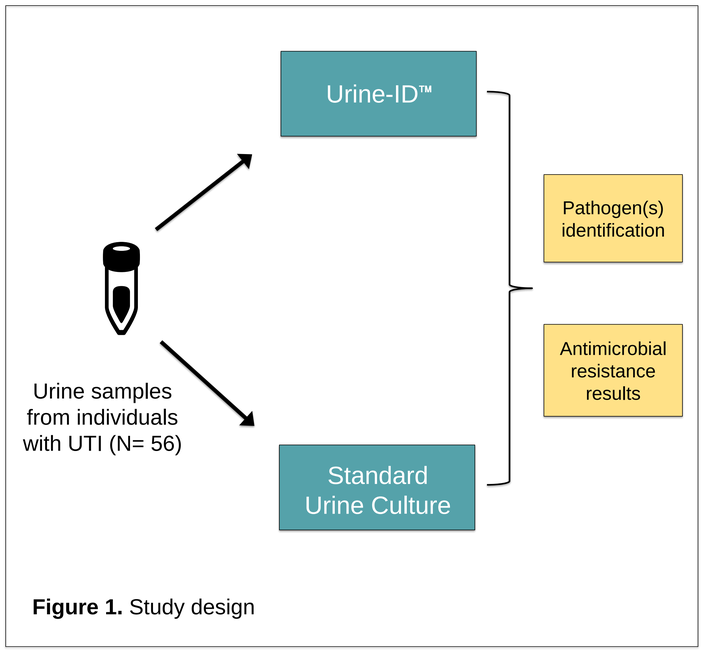

Figure 1. Study design

RESULTS

Of the 56 suspected UTI cases, SUC identified at least one organism in only 50% (N= 28/56) whereas the PCR panel was able to identify at least one organism in 93% (N= 52/56) of the specimens (Figure 2). While PCR and SUC showed 100% agreement in 20% (11/56) of the samples, PCR identified additional pathogens commonly associated with UTIs (co-infections) in 46% (26/56) that was not identified using SUC (Figure 3). PCR and SUC were discordant in 12.5% (7/56) of samples where both methods did not agree on the pathogens identified (Table 1).

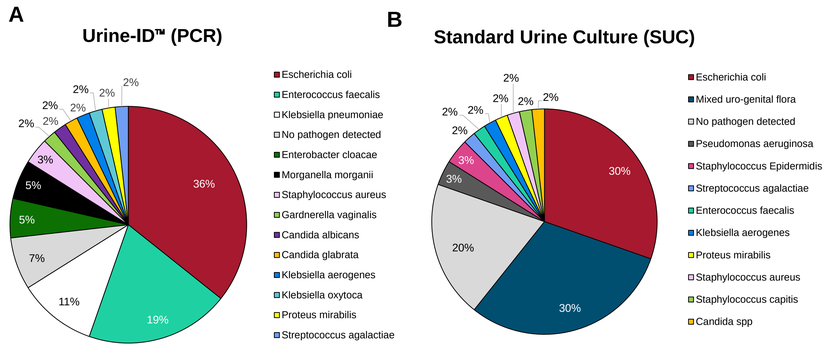

Figure 2: Relative prevalence of the primary organisms identified using the **A/** Urine-ID™ (PCR) and **B/** Standard Urine Culture (SUC) among all collected specimens.

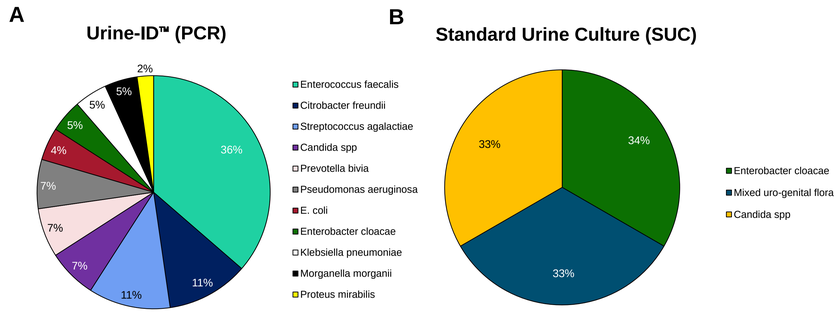

Figure 3: Relative prevalence of the secondary coinfecting organisms identified using the **A/** Urine-ID™ (PCR) and **B/** Standard Urine Culture (SUC) among all positive specimens.

	Urine-ID™ (PCR)	Standard Urine Culture (SUC)
Sample #	**Result**	**Result**
1	No pathogen detected	Staphylococcus epidermis (not on PCR panel)
2	Klebsiella pneumoniae	Proteus mirabilis
3	Escherichia coli	Pseudomonas aeruginosa
4	Candida albicans	Staphylococcus capitis (not on PCR panel)
5	Enterococcus faecalis	Escherichia coli
6	No pathogen detected	Streptococcus agalactiae
7	Enterococcus faecalis	Staphylococcus epidermis (not on PCR panel)

Table 1: Discordant results obtained for the primary organisms identified with PCR or SUC.

RESULTS (Contd.)

Of the 9 positive specimens in which PCR and culture identified the same pathogens, similar antimicrobial resistance results (at least partially) were obtained from MIC and AMR for 7 samples (Table 2). The average time to result from sample collection to organism identification was ≤48 hours using PCR as compared to 3-4 days for SUC (Table 3).

	Urine-ID™ (PCR)			Standard Urine Culture (SUC)		
Sample #	Primary organism	Secondary organism	Resistance	Primary organism	Secondary organism	Resistance
1	Escherichia coli	-	Beta-lactams; Quinolones	Escherichia coli	-	Ampicillin; Gentamicin
2	Candida glabrata	-	None	Yeast	-	None
3	Enterococcus faecalis	Candida	Tetracycline; Macrobid	Enterococcus faecalis	Yeast	Tetracycline
4	Escherichia coli	-	Beta lactams; Quinolones	Escherichia coli	-	Ampicillin; Ciprofloxacin; Levofloxacin
5	Escherichia coli	-	None	Escherichia coli	-	Ampicillin; Sulfamethoxazole/ Trimethoprim
6	Escherichia coli	-	Beta-lactams; Sulfamethoxazole/ Trimethoprim; Macrolides	Escherichia coli	-	Ampicillin Sulfamethoxazole/ Trimethoprim Amoxicillin/Clavulanic acid Cefazolin
7	Staphylococcus aureus	-	Methicillin; Macrolides	Staphylococcus aureus	-	Penicillin; Ciprofloxacin; Levofloxacin
8	Enterobacter cloacae	Pseudomonas aeruginosa	Beta-lactams	Pseudomonas aeruginosa	Enterobacter cloacae	Cefazolin; Ceftriaxone; Amoxicillin/Clavulanic acid
9	Klebsiella aerogenes	-	None	Klebsiella aerogenes	-	Cefazolin; Cefuroxime; Amoxicillin/Clavulanic acid

Table 2: Comparison of antimicrobial resistance results for the 9 positive specimens in which PCR and culture identified at least 1 identical pathogen.
In green: Resistance results that were matching between MIC and AMR assays.
In red: Resistance results that were discordant between MIC and AMR assays.

	Urine-ID™ (PCR)	Standard Urine Culture (SUC)
Average Time	**≤48 hours**	**3-4 days**

Table 3: Sample processing times for each method

CONCLUSIONS

Expanded PCR panel are more sensitive than standard urine culture for the identification of pathogens causing UTIs and can detect antimicrobial resistance among co-infecting pathogens.