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Evaluation of Urinary Transport Systems in Laboratory and Clinical Settings

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ABSTRACT

Objectives: Urine specimens account for a significant proportion of routine workload of clinical laboratories. Improper storage and delay in transport to centralized laboratories from remote sites may cause misleading results due to further bacterial growth. This study was conducted in two phases. In Phase I, we evaluated two commercially available urine transport systems designed to prevent growth following specimen collection and marketed by Becton Dickinson (BD) and Starplex (SP) with simulated urine specimens (SU). In Phase II, we compared BD with unpreserved patient urines (U).

Methods: In Phase I, sterile urines were inoculated with fresh urinary isolates. The SU were used to inoculate BD and SP. All three types of specimens were kept at room temperature and CFU were determined using standard techniques at 0, 8, and 24 hours. In Phase II, U and BD were collected simultaneously from patients suspected of UTI and were cultured at the time of arrival.

Results: In Phase I, 112 specimens were evaluated. For specimens without preservative 53 and 5 SU maintained their CFU at 8 and 24 hours respectively. These numbers were 97 and 85 for the BD, and 91 and 76 for the SP systems. In Phase II, 803 specimen pairs were received. Of these, 364, 42, and 259 specimen pairs had "no growth", insignificant growth (<$10x10^6$ CFU/L), and significant growth (10-$100x10^6$, or >$100x10^6$ CFU/L) respectively. Discrepant results were seen in 138 specimens, and 88 of these had insignificant growth in BD but significant growth in U. In all but three specimen pairs, the CFU counts were lower in BD than in U.

Conclusions: In Phase I, the results of BD and SP were comparable and the transport systems were superior to unpreserved urines in maintaining urinary colony counts. In Phase II, without a urine transport system, 88/803 (11%) of patients could falsely be diagnosed as having UTI. This in turn could result in unnecessary use of antibiotics and prolongation of hospital stay.

INTRODUCTION:

Urine specimens account for a significant proportion of routine workload of clinical laboratories. Quantitative urine cultures are critical for the diagnosis of urinary tract infections (UTI). Organisms that usually cause UTI grow rapidly in urine and can double the number of CFU every 15 minutes. For this reason, urines must be either processed rapidly or refrigerated.

With centralization of microbiology services between multiple hospital sites, transport delay is a common occurrence and proper storage is not always assured. If there is a delay in transport, urine cultures with low counts at the time of collection may result in clinically significant counts by the time the specimen is processed. Consequently, patients often receive unnecessary antibiotic therapy and are exposed to potential side effects. Development of resistance to antibiotics is also a consideration.

Commercial urine transport systems containing preservatives that maintain the integrity and CFU of urine have been developed and marketed. The purpose of this study was to compare two of these systems, Starplex (SP) and Becton Dickinson (BD), for their ability to maintain accurate organism counts and viability at room temperature.

The study was conducted in two phases. In Phase I, we evaluated two commercially available urine transport systems marketed by BD and SP with simulated urine specimens (SU). In Phase II, we compared BD with unpreserved patient urines (U).

MATERIALS & METHODS

Urine Transport Systems

The SP consists of a screwcapped 10mL flat polypropylene vial with a boric acid tablet, along with a proprietary mixture of ingredients for preservation of the specimen. The tube was filled with urine between the minimum and maximum fill line.

The BD consists of an evacuated tube with a rubber-stopper containing the lyophilized preservative of boric acid, sorbitol, and sodium formate and a sterile collection cup with an integrated transfer device. The device allows a draw of 5mL of urine into the evacuated tube.

Simulated Urine Specimens

In Phase I, specimens were prepared using pooled filter sterilized urine from healthy volunteers who had not received antibiotic therapy over a two-month period. A total of 112 specimens were seeded with standard numbers of freshly isolated urinary pathogens to yield 50 CFU using a .001mL inoculum. A portion of each simulated urine was added to SP and BD according to manufacturers' instructions. All three types of specimens were kept at room temperature. After incubation for 0, 8, and 24 hours, specimens were subcultured onto Columbia agar with 5% sheep blood, and CFU were determined using standard techniques.

Patient Urine Specimens

In Phase II, mid stream urine specimens were collected using standard techniques from patients attending two busy outpatient clinics. Specimens were collected in the sterile collection cup supplied in the BD kit, and were aspirated into two sterile evacuated tubes, one of which contained CFU stabilizing compound (BD and U). U and BD were cultured at the time of arrival at the lab.

RESULTS

Phase I

Strains tested, included *Escherichia coli* (44), *Enterobacteriacae* (19), *Pseudomonas aeruginosa* (12), *Enterococcus* sp. (15), Coagulase-negative staphylococci (17), Yeasts (5).
Reductions in number of CFU were not observed at 8 and 24 hours as compared to CFU at 0 hours.
At 8 hours, 33% of SU, 2.7% of SP and 0% of BD showed 2 to 3 log increase in CFU/L compared to colony counts at 0 hour.
At 24 hours, 2 to 3 log increases were observed in 90.2% of SU, 8.0% of SP, and 0.9% of BD when compared to colony counts at 0 hour.

Phase II

Number of specimen pairs (U & BD) received were 803.
Number of urine specimens showing no bacterial growth were 364.
Number of urine specimens showing insignificant growth (<$10x10^6$ CFU/L) were 42.
Number of urine specimens with significant growth (10 -$100x10^6$ or >$100x10^6$ CFU/L) in both specimen types were 259.
Number of urine specimens with discrepant results in preserved and unpreserved urines were 138.
Of 138 discrepant results, 88 had insignificant growth in BD but significant growth in U. In all but three specimen pairs, the CFU counts were lower in BD than in U. Details of discrepant results are shown in Table 1.

Table 1 Phase II - Details of 138 Specimens Showing Discrepant Results Between U and BD

Number of BD specimens with				Number of U (unpreserved) specimens with			
No growth	<$10x10^6$ CFU/L	10-$100x10^6$ CFU/L	$100x10^6$ CFU/L	No growth	<$10x10^6$ CFU/L	10-$100x10^6$ CFU/L	$100x10^6$ CFU/L
15					15		
19						19*	
23							23
	1			1			
	26				26		
	23						23
		2			2		
		29					29**

* 3 U with mixed bacteria ** 10 U with mixed bacteria

CONCLUSIONS

SP and BD (preserved) provided superior results to SU (unpreserved) cultures in determining accurate bacterial counts at 8 and 24 hours.

The BD kit was easy to use and was readily accepted by nurses.

88/803 (10.9%) specimens had insignificant growth in BD but significant growth in U.

Without a urine transport system, these 88 patients may have been diagnosed to have a UTI. This possibly could result in unnecessary antibiotic therapy or prolonged hospital stay.

10/803 (1.2%) of patients had significant growth in BD and U, but the growth in U was mixed due to overgrowth. Without a urine transport system, these patients could have been denied necessary therapy.