Optimization of Clinical Microbiology Laboratory Workflow Utilizing the COPAN WASPLab™ for Urine Cultures and MRSA Cultures

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Abstract

Background: The COPAN WASPLab™ is a fully automated plate streaker and incubator, capable of acquiring images of cultures for digital plate reading. This study was designed to evaluate the reading of digital images by clinical microbiologists and the impact of WASPLab™ implementation on overall laboratory workflow.
Methods: Urine specimens for bacterial culture were plated quantitatively using a 1µL loop on sheep blood and MacConkey agar bi-plates by WASPLab™. Images were captured after 0 and 18 h incubation. For initial validation 1,000 urine cultures were reviewed. MRSA and MSSA screening cultures were plated semi-quantitatively on WASPLab™ using a 10µL loop. Images were captured at 0 and 24 h incubation. For initial validation 500 MRSA Cultures were reviewed. Digital image review of the cultures was compared to manually reviewed culture plates. Discrepant results were resolved by a blinded microbiology supervisor. All reports were generated by a trained clinical microbiologist. Laboratory performance metrics were determined for final result, turn-around-time, and labor.
Results: Comparison of routine culture review to digital review for positive urine cultures resulted in agreement of 96.7%. Upon review of the discrepant results, all of the discrepancies on the digital system were sent for manual review and the final result agreed with the digital image result. For MRSA culture there was 100% agreement between the digital image review and the manual culture review. When evaluated for culture turn-around-time (TAT), cultures read using the WASPLab™ were resulted a median of 6.0 hours sooner than if they were reviewed manually. A personnel review demonstrated an 8.1 decrease in FTE per 500 cultures when urine cultures were assessed on the digital imaging system compared to manual culture review. This reflected a 49% decrease in labor cost per culture.
Conclusions: The results of this study demonstrate that the COPAN WASPLab™ is an effective tool for plating, incubation, and digital imaging for urine and MRSA screening cultures. Implementation of the system results in improved TAT and decreased labor requirements for these cultures.

Introduction

The pre-analytical phase of laboratory testing accounts for 60% of the diagnostic process and pre-analytical errors account for 84.5% of all testing errors.[1] In addition, urine cultures and MRSA/MSSA screening cultures are high volume, low priority sample types. Because of this, these sample types are processed after more urgent sample types such as CSF and positive blood culture bottles. Prior to implementation, we introduced some manual lean process improvements to our urine culture workflow to optimize efficiency. In 2016, we implemented Copan WASP™ and WASPLab™ to further improve our workflow. The goal of this study was to evaluate the introduction of automation into the microbiology laboratory for increased efficiency and reduction of turn-around-time and error rate.

[1]Streitberg GS. Journal of Laboratory Automation. 2009:14(2) 94-101

Methods

Prior to implementation, we transitioned all of our swab collections to eSwabs and all of our urine culture transportation containers to urine transport tubes at all sites.
We validated each piece of the automated line as its own entity before training the technologists who would be using the WASPLab™. These validations included plate-streaking, incubation, images captured by the cameras, and the LIS interface.
All technologists were previously trained on urine cultures. 50 urine cultures were plated 6 times by the WASP™ and incubated in the WASPLab™ for screening and reading by the technologists. We utilized three sets for a total of 900 urine cultures for screening and reading in the WASPLab™. Each technologist was required to screen and read all 50 cultures. Results were compared between techs and to the reference method.

In addition, we evaluated our current-state workflow and developed a new post WASPLab™ workflow. Our new workflow moves all of the pure culture work-up tasks (spotting the MALDI-TOF targets and setting up the Phoenix ID broths as well as inoculating the Phoenix AST panels utilizing the BD Phoenix automated pipette (AP) system) from our technologists to our technicians.

Results

Figure 1. COPAN WASPLab™ at TriCore Reference Laboratories in Albuquerque, New Mexico

Urine Culture WASPLab Technologist Validation								
		WASPLab Result						
		NG	NGUF	GNR	CONTAM	CRFI	Total	% Agreement
Manual Read Urine Bench Result	NG	50	9	0	0	1	60	**93.94**
	NGUF	7	24	0	0	3	34	
	GNR	0	0	39	0	1	40	97.50
	CONTAM	0	0	0	3	0	3	100.00
	CRFI	0	0	0	1	12	13	92.31
	Total						**150**	**96.00**

Table 1. Agreement between manual and WASPLab Screening and Reading of Urine Cultures NG = No Growth ,NGUF = Normal GU Flora, CONTAM = Three or more morphologies present (no further work-up), GNR = 1-2 pick points for ID/AST, CRFI = Sub Culture – Further work-up required (includes Gram positive or yeast work up and reincubation).

We observed no significant differences between manual reading at 18-24 hours and WASPLab™ reading at 18 hours. Variation for No Growth and NUGF was due to differences in low numbers of colonies present in cultures and additional growth of NGUF in the WASPLab ™. Additional discrepancies occurred due to decision points for which cultures with multiple pathogens were evaluated off line

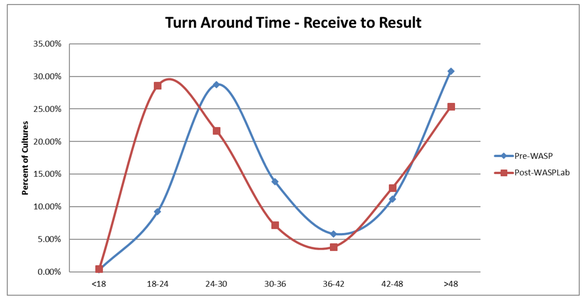


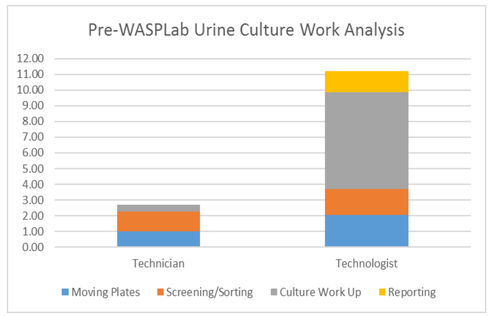
Figure 2. Turn around Time Pre and Post WASPLab implementation

Hours*	Pre-WASP	Post-WASPLab
<18	0.32%	0.44%
18-24	9.28%	28.60%
24-30	28.73%	21.69%
30-36	13.86%	7.16%
36-42	5.86%	3.85%
42-48	11.16%	12.89%
>48	30.80%	25.37%

Urine culture Turn-around-time

Table 2. Hours of urine culture incubation (from set up to final) Pre and Post WASPLab™

With the implementation of WASPLab™ 28.6% of cultures were finalized at 18-24 hours of incubation, compared to 9.28% of cultures prior to WASPLab™. By 30 hours of incubation, implementation of WASPLab resulted in 50.73% of cultures finalized by 30 hours of incubation, compared with only 38.8% prior to implementation of WASPLab™.



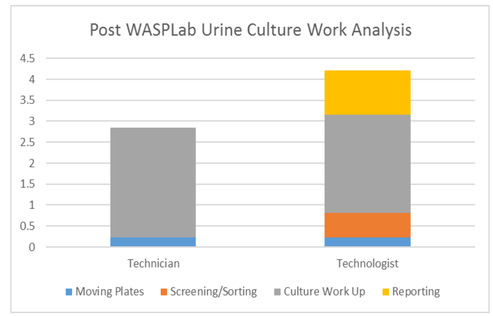


Figure 3. Workload Analysis Pre and Post WASPLab™ by Job Title. Note the difference in the Y-axis scales.

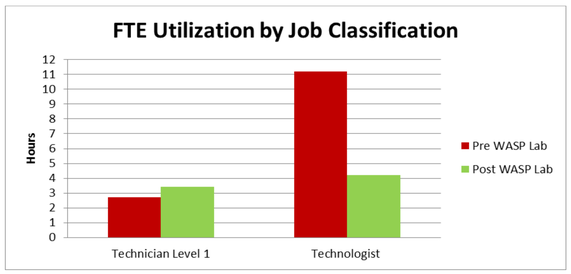


Figure 4. FTE Utilization by Job Classification Pre- and Post-WASPLab™ Implementation

	Annual Labor	Per Culture Labor
Pre WASPLab	$90,483.50	$0.47
Post WASPLab	$45,424.25	$0.24

Table 3. Labor Costs Pre- and Post-WASPLab™ Implementation

Prior to implementing WASPLab™, 13.9 hours per day across two shifts were spent on urine cultures. Of this, 11.2 hours were Technologist hours. Following implementation of WASPLab™ hands-on time was reduced to 7.3 hours per day and work was redistributed to both technicians and technologists. This reallocation of work to reduce the overall FTE spend for the work performed. We have realized an 8.1 actual FTE savings per 500 cultures which has reduced our labor cost per culture by 49%.

Conclusions

Implementation of WASP™ and WASPLab™ in our laboratory has allowed us to grow in volume without requiring more technologists and more space. The redistribution of labor from technologists to technicians has allowed our more experienced technologists to focus on more complex cultures. The decrease in turn-around-time (TAT) may allow physicians to change the way they prescribe antibiotics for their UTI patients.
These improvements in labor cost, employee satisfaction and retention, TAT, and quality demonstrate that the WASPLab™ is an effective tool to optimize workflow in the clinical microbiology laboratory.

Acknowledgements

Infectious Disease Department , TriCore Reference Laboratories