

Use of Digital Image Analysis to Interpret Urine Cultures on Blood and MacConkey Agar

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Introduction

Urine culture interpretation can be complicated by several variables, including the presence of small numbers of colonies and the growth of more than one bacterial type. In general, voided-urine cultures containing $\geq 10,000$ CFU/mL should be reported as potential pathogens as long as there are not more than 3 pathogens or these organisms are not normal skin flora. This complexity of interpretation requires significant hands-on time and technical expertise, which imposes a significant work burden on the clinical laboratory. In this multicenter study, we evaluated the accuracy of the WASPLab (Copan, Brescia, IT) software to differentiate negative and non-negative urine cultures from sheep blood, MacConkey, and Columbia CNA agar compared to manual analysis.

Method

Urine specimens submitted for bacterial culture from 3 different sites were plated on sheep blood, MacConkey, and CNA agar (CNA only site 1). All specimens were processed by the WASPLab using a 1- μ L loop, and images were captured after 0 and 18 h incubation. The software quantitated each plate and reported the specimen as non-negative if any plate contained more than 10 colonies (10,000 CFU/mL). Results were then compared to manual interpretation as either positive or negative for pathogens based on each laboratory's urine culture policy. These data were also analyzed by separating laboratory-negative specimens depending on site-specific rules when growth was detected, but no further work up was needed due to either > 3 pathogens present or no significant growth (skin or fecal contamination). Manual-positive, automation-negative cultures were reviewed by a second technologist.

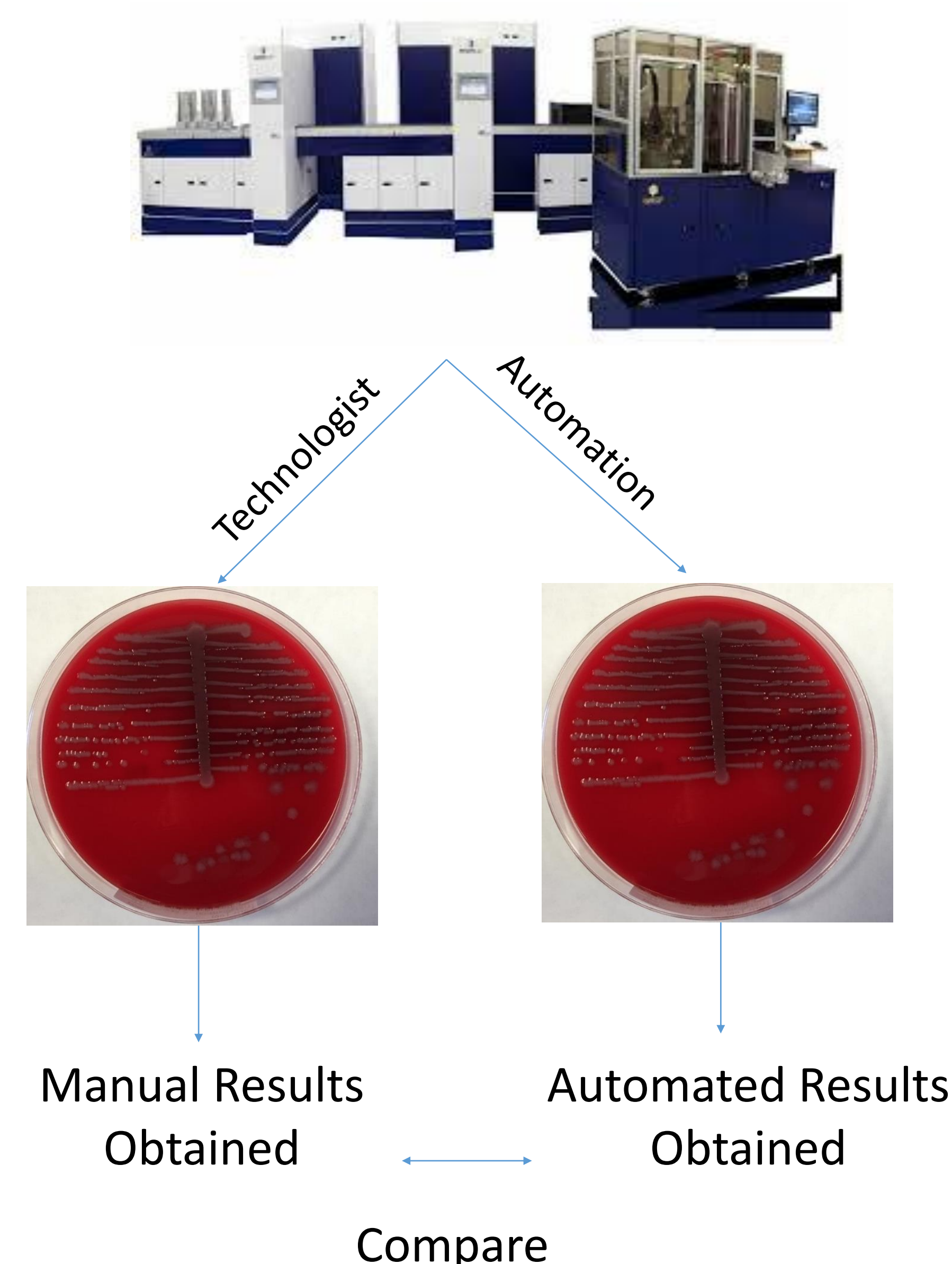


Table 1. Performance of WASPLab digital imaging software compared to manual reporting of BAP and MAC

Site ^a	No. of specimens tested	Results (no.) ^b				Performance (% [95% CI]) ^c	
		MP/AP	MN/AN	MN/AP	MP/AN	PPA ^d	NPA ^d
1	5201	3971	1141	88	1	99.9 (99-99)	92.8 (91-94)
2	5513	2013	3392	107	1	99.9 (99-99)	96.9 (96-97)
3	2751	1482	1249	19	1	99.9 (99-99)	98.5 (98-99)
Total	13465	7466	5782	214	3	99.9 (99-99)	96.4 (95-97)

^a Sites 1 and 3 used threshold of >10 CFU, Site 2 used a threshold of >50 CFU

^b MP/AP, manual Pos automation Pos; MN/AN, manual Neg/automation Neg; MN/AP, manual Neg/automation pos; MP/AN, manual pos/automation Neg.

^c CI, confidence interval.

^d PPA, Positive Percent Agreement; NPA, Negative Percent Agreement

Table 2. Overall Performance of the software compared to manual urine culture interpretation of BAP and MAC

Automation	Manual	
	Negative	Positive
Negative	5677	108 ^a
Positive	1192 ^b	5688
Total		13465

^a 105/108 MP/AN resulted from rulings that used <thresholds set (Catheters, specialty clinics, etc.)

^b 978/1192 were due to complex ruling based on organisms present

Table 4. Site 3 consideration of manual negatives based on rules for interpretation

Automation	Manual		
	No Growth	GUF ^a /MUF ^b	Positive
Negative	688	496	66
Positive	19	374	1108
Total			2751

^a Genital Urine Flora

^b Mixed Urine Flora

Table 3. Site 1 & 2 consideration of manual negatives based on rules for interpretation

Automation	Manual			
	No Growth	NFW/MMO ^a	NSG/MGN ^b	Positive
Negative	2923	691	879	42
Positive	195	675	729	4580
Total				10714

^a No Further Workup/multiple microbial organisms: contains > 3 pathogens on the plate

^b No Significant Growth/ Microbial growth: Consistent with normal skin and urethra flora

Conclusions

- High Positive percent agreement 99.9% and Negative percent agreement 96.4% for colony counting
- 88.6% of Manual Negative, Automation Positive specimen were due to complex interpretation of urine cultures that use parameters other than basic colony count including: >3 pathogens or only normal genital flora identified that do not require work-up
- After closer look at the MP/AN specimens rules such as any growth for catheters reduced the total specimens to 3 FN results.
- Expert ruling could be created to change counts based on source or location that can be specific for each site.
- Current software could improve laboratory workflow by removing 42.2% of urine cultures based on growth less than the laboratories threshold.