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Use of Copan's WASPLab PhenoMATRIX Artificial Intelligence to Improve the Efficiency of Urine Culture Interpretation

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REVISED ABSTRACT

Background: Urine cultures are one of the most common cultures set up in clinical bacteriology laboratories. The person time spent sorting and discriminating between plates with no growth, no significant growth, mixed growth, and significant growth is significant. We evaluated the use of Copan's WASPLab PhenoMATRIX artificial intelligence to improve the efficiency of culture interpretation.

Methods: From July 2017 through December 2017, the WASPLab PhenoMATRIX trained on a random selection of 2000 voided urine culture plates (set up by WASP automated specimen processor using 1µL loops using Oxoid Brilliance UTI clarify/CNA biplates) that had been read by routine clinical laboratory technologists using the WASPLab App in a single tertiary care academic institution's microbiology laboratory. The trained system was then tested for its performance on 2872 consecutive voided urine culture plates from April 19, 2018 through May 9, 2018. Percent classified and accuracy of plates classified were calculated.

Results: WASPLab PhenoMATRIX interpreted voided urine cultures as no growth, no significant growth, significant counts of *Escherichia coli*, or significant counts of growth other than *Escherichia coli*. In addition, it segregated those plates belonging to females of child-bearing age to facilitate closer investigation for Group B streptococci. A total of 1767 out of 2872 (61.5% CI 59.7-63.3%) voided urine culture plates were classified in this way. Of those classified, 99.4% (95% CI 98.9%-99.7%) were accurately classified as positive (significant counts of *Escherichia coli*, or significant counts of growth other than *Escherichia coli*) or negative (no growth, no significant growth, or mixed growth). The overall sensitivity of those classified was 94.8% (95%CI 89.9%-97.5%) and specificity was 99.8% (95%CI 99.4%-100%).

Conclusions: The use of Copan's WASPLab PhenoMATRIX artificial intelligence streamlined segregation of a significant proportion of voided urine cultures with high accuracy. Combining the use of this technology with expertise in the laboratory has the potential to significantly improve microbiology laboratory efficiency. Work on the efficiencies gained by introducing this promising technology and expansion beyond the utility with urine cultures is ongoing.

INTRODUCTION

- Urine cultures are one of the most common cultures set up in clinical bacteriology laboratories. The person time spent sorting and discriminating between plates with no growth, no significant growth, mixed growth, and significant growth is significant.
- We evaluated the use of Copan's WASPLab PhenoMATRIX artificial intelligence to improve the efficiency of culture interpretation.

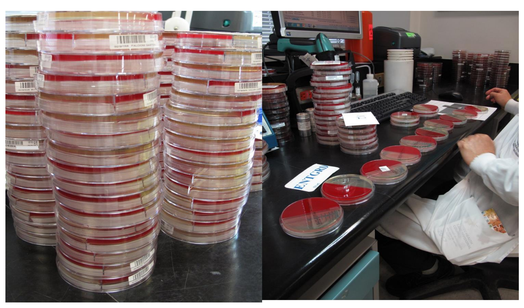


Figure 1: Manual sorting of urine cultures at UHN/SHS Department of Microbiology prior to WASPLab

METHODS

- From July 2017 through December 2017, the WASPLab PhenoMATRIX trained on a random selection of 2000 voided urine culture plates (set up by WASP automated specimen processor using 1µL loops using Oxoid Brilliance UTI clarify/CNA biplates) that had been read by routine clinical laboratory technologists using the WASPLab App in a single tertiary care academic institution's microbiology laboratory.
- The trained system was then tested for its performance on 2872 consecutive voided urine culture plates from April 19, 2018 through May 9, 2018.
- Percent classified and accuracy of plates classified were calculated. Discrepancies were reviewed manually by experienced technologists.

RESULTS

- WASPLab PhenoMATRIX interpreted voided urine cultures as no growth, no significant growth, significant counts of *Escherichia coli*, or significant counts of growth other than *Escherichia coli*.
- In addition, it segregated those plates belonging to females of child-bearing age to facilitate closer investigation for Group B streptococci.
- A total of 1767 out of 2872 (61.5% CI 59.7-63.3%) voided urine culture plates were classified in this way.
- Of those classified, 99.4% (95% CI 98.9%-99.7%) were accurately classified as positive (significant counts of *Escherichia coli*, or significant counts of growth other than *Escherichia coli*) or negative (no growth, no significant growth, or mixed growth**)**. On discrepancy analysis, a number of human errors in interpretation were detected that were accurately interpreted by PhenoMATRIX.
- The overall sensitivity of those classified was 94.8% (95%CI 89.9%-97.5%) and specificity was 99.8% (95%CI 99.4%-100%). All missed "significant growth" cultures were lactobacilli on MALDI and were interpreted as no significant growth by the laboratory.

Table 1. Comparison of PhenoMATRIX Interpretation of 2872 consecutive urine cultures compared to the clinical laboratory interpretation
NSG = no significant growth, F12-60 = female of child-bearing age, ID AST = refers to plates with significant growth other than *E. coli* that require identification (ID) and antimicrobial susceptibility testing (AST); BP AST refers to significant growth of *E. coli* that require ID and AST, POS = significant growth

Clinical Laboratory Interpretation

PhenoMATRIX Interpretation	No Growth	NSG	Mixed	POS	Total	
No Growth	827	2		1	830	28.9%
NSG	16	367	1		384	13.4%
NSG F12-60	3	395		7	405	14.1%
ID AST		1		40	41	1.4%
ID AST F12-60		1		13	14	0.5%
BP AST				68	68	2.4%
BP AST F12-60		1		24	25	0.9%
Review	12	185	45	361	603	21.0%
Review F12-60	14	274	12	202	502	17.5%
Total	872	1226	58	716	2872	
	30.4%	42.7%	2.0%	24.9%		

- **62% of urine cultures (n=105/d) read by PhenoMATRIX**
  38% (n=65/d) to be manually reviewed
- 59% (n=100/d) (NG, NSG, BP AST) auto-reported with the push of one button
- 56% (n=95/d) (NG, NSG) have no hands-on plate time

	Agreement	1734	60.4%
	False Positive	3	0.1%
	False Negative	8	0.3%
	Acceptable Discrepancy	22	0.8%
	For Manual Review	1105	38.5%

FOR THOSE CLASSIFIED BY PhenoMATRIX:

	LAB POS	LAB NEG	
PhenoMATRIX POS	145	3	148
PhenoMATRIX NEG	8	1611	1619
	153	1614	1767
	Sn	Sp	
	94.8%	99.8%	

Figure 2: Oxoid Brilliance UTI Clarity/CNA Biplate
Escherichia coli appears burgundy-pink on Oxoid Brilliance UTI Clarity; the CNA agar allows for fastidious Gram-positive growth

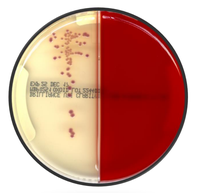
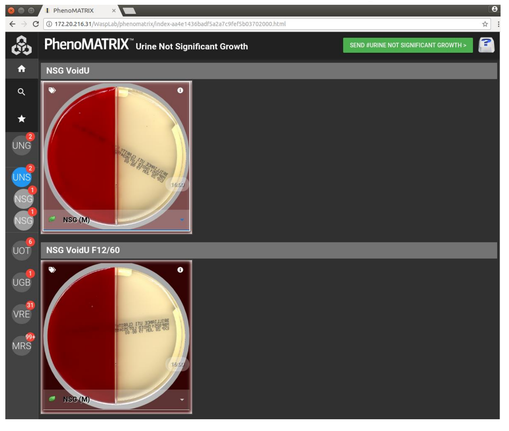


Figure 3. A Screenshot of PhenoMATRIX Post Implementation in our Laboratory
UNG = urine no growth
UNS = urine no significant growth
UOT = urine other
UBG = urine GBS
[There were no plates with burgundy-pink (*E. coli*) at the time of the screenshot]



DISCUSSION & CONCLUSIONS

- The use of Copan's WASPLab PhenoMATRIX artificial intelligence streamlined segregation of a significant proportion of voided urine cultures with high accuracy.
- Combining the use of this technology with expertise in the laboratory has the potential to significantly improve microbiology laboratory efficiency.
- Work on the efficiencies gained by introducing this promising technology and expansion beyond the utility with urine cultures is ongoing.

Acknowledgements:

We would like to acknowledge the enthusiasm, support, and time of the Copan WASPLab team in working with us to complete the implementation of Copan's WASPLab PhenoMATRIX artificial intelligence to improve the efficiency of urine culture interpretation.