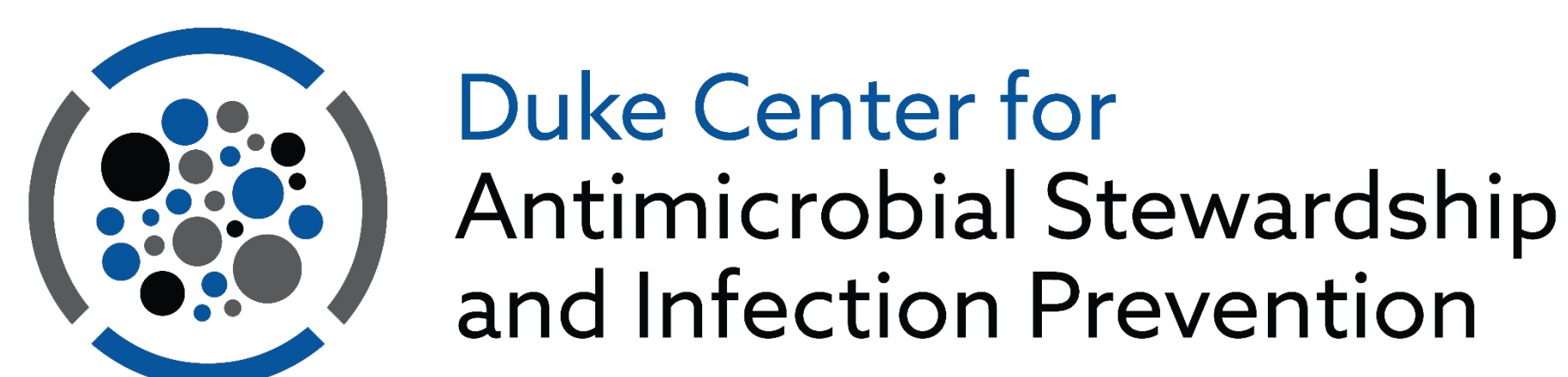


Optimizing Reflex Urine Cultures: Using a Population-Specific Approach to Diagnostic Stewardship

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Introduction

- Clinicians and laboratories routinely use urinalysis (UA) results to determine if urine cultures and/or antimicrobials are indicated for patients with suspected urinary tract infection.
- Yet, the performance of individual UA parameters and common clinical thresholds for action are not well defined.
- Our objectives were to compare the performance of different UA parameters in predicting significant bacteriuria irrespective of symptoms, and to assess performance of pyuria based on age, sex, and presence of indwelling catheter.

Methods

- Design and Setting:** We performed a retrospective review from 2015 to 2020 in 3 hospitals (1 academic and 2 community) and >150 outpatient clinics in North Carolina
- Paired UA and urine cultures were included if UA was ordered <= 24 hours prior to urine culture
- Definitions:** Urine culture results were categorized as positive, negative, or mixed. A positive culture with bacterial growth >100,000 colony forming units/mL was considered to be significant bacteriuria.
- We used this definition to evaluate the performance of relevant UA parameters and result thresholds including sensitivity, specificity, negative predictive value (NPV) and positive predictive value (PPV).
- Analysis:** We also combined 18 different UA criteria and used receiver operating characteristic curves to identify the top 5 performing models for predicting significant bacteriuria (sensitivity and specificity).

Table 1A: Performance of Individual Urinalysis Parameters for Predicting Significant Bacteriuria

Leukocyte Esterase	≥Trace	≥1+	≥2+
Sensitivity	0.87	0.78	0.58
Specificity	0.55	0.67	0.83
PPV	0.43	0.48	0.57
NPV	0.91	0.89	0.84
WBC Count/hpf	≥5	≥10	≥20
Sensitivity	0.78	0.61	0.41
Specificity	0.55	0.73	0.86
PPV	0.32	0.38	0.44
NPV	0.90	0.87	0.84
Nitrite	Positive		
Sensitivity	0.41		
Specificity	0.95		
PPV	0.75		
NPV	0.80		
Bacteria Count/hpf	5-50	>50	
Sensitivity	0.93	0.77	
Specificity	0.37	0.74	
PPV	0.40	0.57	
NPV	0.92	0.88	
Yeast Count/hpf	Positive		
Sensitivity	0.60		
Specificity	0.95		
PPV	0.53		
NPV	0.96		

Table 1B: Complete Parameter Estimates for Models with Top 5 Area Under the Receiver Operating Characteristic curve (AUROC) Performance

Model	Test Rule	AUROC	Sensitivity	Specificity	PPV	NPV
6	≥20 WBCs OR positive nitrites	0.77	0.79	0.75	0.60	0.88
9	≥20 WBCs OR ≥2+ leukocyte esterase OR positive nitrites	0.75	0.86	0.65	0.56	0.90
3	≥2+ leukocyte esterase OR positive nitrites	0.76	0.73	0.80	0.59	0.88
5	≥10 WBCs OR positive nitrites	0.75	0.86	0.64	0.53	0.90
2	≥1+ leukocyte esterase OR positive nitrites	0.75	0.85	0.65	0.49	0.91

WBC- white blood cell, hpf- high powered field, PPV-positive predictive value, negative predictive value

Results

- There were 221,933 encounters during the 6-year period; 10% were catheterized, 29% were positive, 30.7% were negative.
- No single UA parameter had both - high sensitivity and high specificity.
- Absence of leukocyte esterase and pyuria had a high NPV for significant bacteriuria (Table 1A).
- In terms of NPV, combined UA parameters did not perform better than pyuria alone (Table 1B).
- The high NPV >=0.90 of pyuria was maintained among most patient age and sex subgroups with the exception of females ≥65 and patients with indwelling catheters (Table 2).

Table 2: Comparing NPV of Pyuria based on Age, Sex, and Source of Collection

WBC Count/hpf	≥5
Male, <65 years of age	0.94
Male, ≥65 years of age	0.92
Female, <65 years of age	0.90
Female, ≥65 years of age	0.86
Non-catheterized specimen	0.91
Catheterized specimen	0.87

Conclusions

- UA parameters should be leveraged for their NPV instead of sensitivity, when used as a part of diagnostic workup.
- Future reflex urine culture workflows and diagnostic stewardship algorithms should incorporate population-specific UA criteria and/or focus on populations where NPV of pyuria is high.

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