

# AUTOMATED FLOW CYTOMETRY OF URINARY WHITE BLOOD CELLS IS A HIGHLY SENSITIVE SCREENING TEST FOR URINARY TRACT INFECTION IN CHILDREN: A CROSS-SECTIONAL STUDY

Khalid ISMAILI MD PhD<sup>1</sup>; Andrea SALAS MD<sup>1</sup>; Hong Phuoc DUONG MD<sup>1</sup>; Nathalie Tram MD<sup>1</sup>; Georges MASCART MD<sup>3</sup>; Philippe LEPAGE MD PhD<sup>2</sup>; Michelle HALL MD<sup>1</sup>; Karl Martin WISSING MD PhD<sup>4</sup>

Department of Pediatric Nephrology<sup>1</sup> and Infection Diseases<sup>2</sup>, Hôpital Universitaire des Enfants – Reine Fabiola; Université Libre de Bruxelles (ULB).  
Departments of Microbiology<sup>3</sup> and Nephrology<sup>4</sup>, Hôpital Universitaire Brugmann; Université Libre de Bruxelles (ULB).  
Email: wissing@ulb.ac.be



## 1. Objectives:

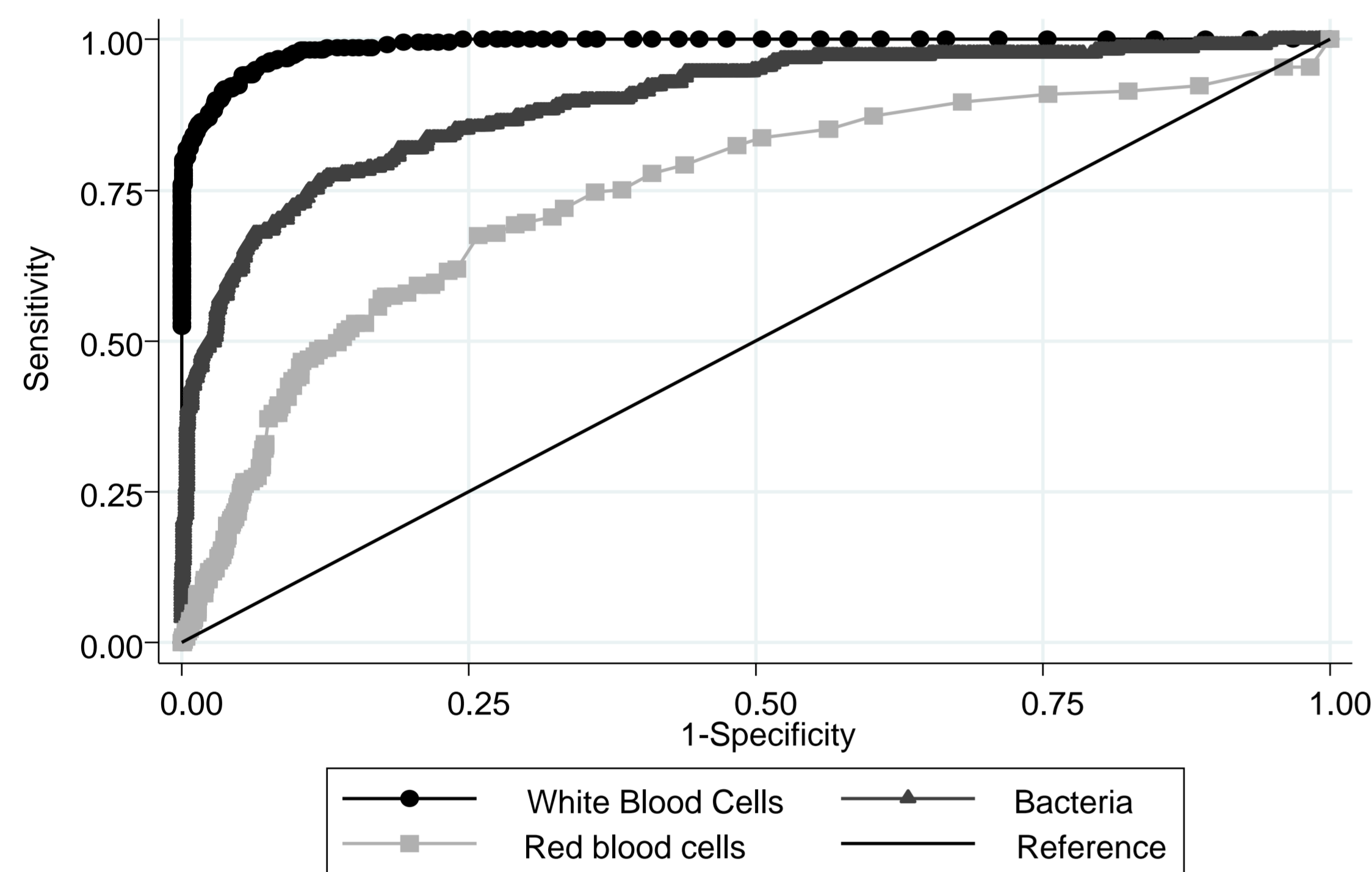
- Investigate the diagnostic performance of automated flow cytometer WBC count, and dipstick urinalysis for nitrites and LE, as screening test for urinary tract infection (UTI) in febrile children.
- Determine the urinary WBC count cut-off that is optimal to detect UTI.
- Model the positive and negative predictive values for pediatric populations with different prevalence of UTI.

## 3. Results:

A total of 1224 febrile children (1247 episodes).

UTI was diagnosed in 198 patients (221 episodes). The prevalence of UTI was of 17.7 % (95%CI :15.6 to 19.8%)

### 3.1. Flow cytometer WBC count has superior diagnostic performance as compared to RBC and bacteria



## 2. Methods:

- Cross sectional study between July 2006 and July 2008.
- Inclusion criteria: Unwell children with fever  $\geq 38^{\circ}\text{C}$ 
  - Two of the following criteria: CRP  $\geq 4.0$  mg/dl; Leukocytosis  $\geq 15,000/\text{m}$ ; Signs of systemic infection
- Dipstick urinalysis for nitrites and LE
- Quantitative assessment of RBC, WBC and bacteria in fresh uncentrifugated urine with automated flow cytometer (Sysmex UF-100)
- Gold standard diagnosis of UTI:  $\geq 100,000$  CFU of a single pathogen in the urine culture

### 3.2. The $\geq 35$ WBC/ $\mu\text{L}$ positivity cut-off provides the best compromise of very high sensitivity with good specificity as screening test for UTI infection in children

WBC/ $\mu\text{L}$	UTI	Other infection	Total	Sensitivity <sup>1</sup>	Specificity <sup>1</sup>	Correctly Classified <sup>1</sup>
(0-9)	0	366	366	100.00%	0.00%	17.72%
(10-34)	1	461	462	100.00%	35.67%	47.07%
(35-99)	23	169	192	99.55%	80.60%	83.96%
(100-499)	52	30	82	89.14%	97.08%	95.67%
(500-999)	41	0	41	65.61%	100.00%	93.91%
(1000-4999)	78	0	78	47.06%	100.00%	90.62%
(5000-9999)	13	0	13	11.76%	100.00%	84.36%
( $\geq 10000$ )	13	0	13	5.88%	100.00%	83.32%
<b>Total</b>	<b>221</b>	<b>1026</b>	<b>1247</b>			

<sup>1</sup> Sensitivity, specificity, and correctly classified are calculated for leucocyte counts equal or above the lower border of the indicated range.

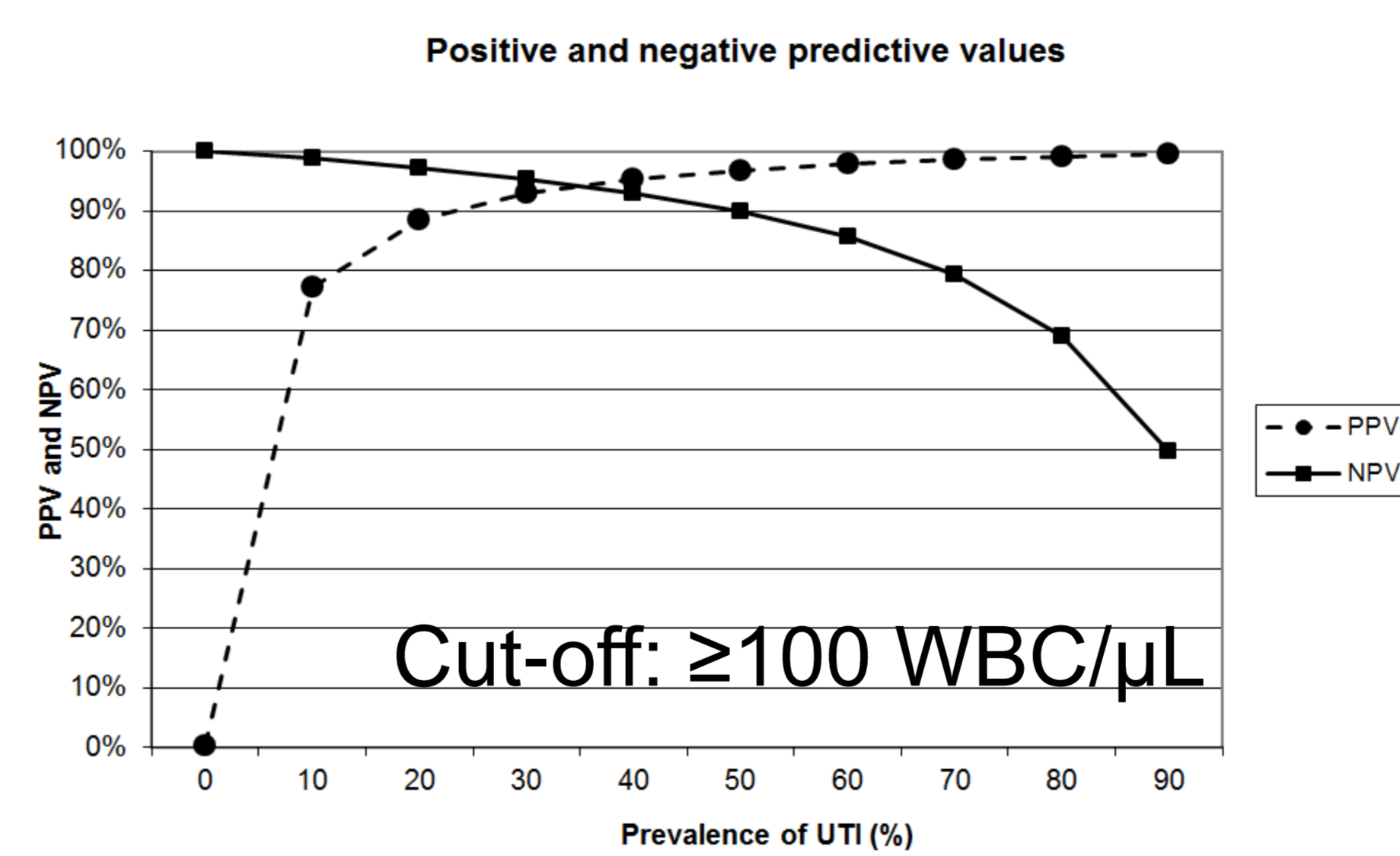
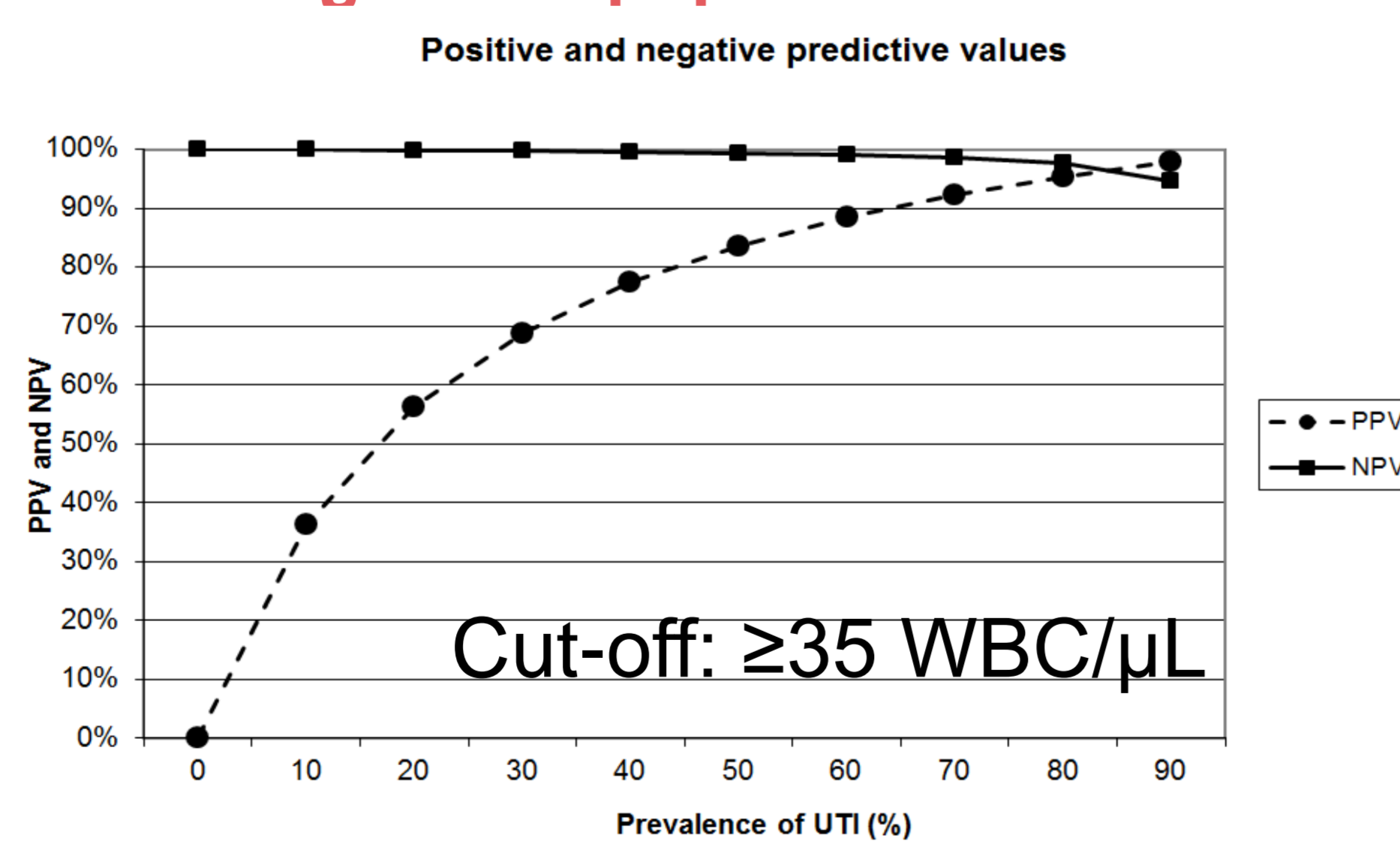
### 3.3. Sensitivity, specificity, and predictive values of dipstick in predicting positive urine culture

Test	UTI (N)	No UTI (N)	Sens %	Spec %	PPV %	NPV %
LE +	197	102	89	90	66	97
LE -	24	924				
Nitrites +	148	1	67	99.9	99	93
Nitrites -	73	1025				
LE and/or nitrites +	205	103	93	90	67	98
LE and/or nitrites -	16	923				
<b>Total</b>	<b>221</b>	<b>1026</b>				

### 3.4. Urinary WBC count has superior diagnostic performance to detect UTI in febrile children as compared to urinary dipstick

Test	ROC AUC (95%CI)	P vs Cytometer
<i>Flow cytometer</i>		
WBC counts	0.99 (0.98 to 0.99)	Ref.
<i>Dipstick</i>		
LE	0.92 (0.90 to 0.94)	<0.0001
Nitrites	0.83 (0.80 to 0.87)	<0.0001
LE and/or nitrites	0.91 (0.89 to 0.93)	<0.0001

### 3.5. Modelling of negative (NPV) and positive predictive value (PPV) of cytometer urinary WBC count as screening test in populations with different prevalence of UTI



## 4. Conclusions:

- Flow cytometer assessment of WBC in the urine is an excellent screening test to rule out UTI in febrile children.
- With a cut-off value of  $\geq 35$  WBC/ $\mu\text{L}$  only one of 221 episodes of UTI was missed by urine WBC cytometry.
- Urine WBC cytometry has superior diagnostic performance as compared to Leucocyte Esterase and Nitrites dosage by dipstick.
- Diagnostic performance of urine WBC cytometry remains excellent over a wide range of prevalence of UTI.