

Unlocking the Complete Blood Count: Derivation of a Single-Panel Laboratory Test that includes Monocyte Distribution Width to Create a Universal Sepsis Screening Tool

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Background | Sepsis & CBC

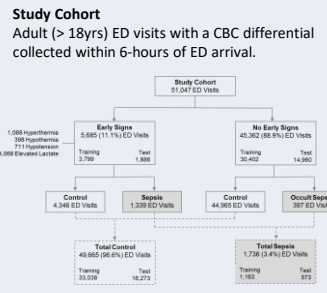
Sepsis
3 million cases annually; 15-30% mortality
 Timely initiation of simple measures is **life-saving**
 Septic patients presenting **without obvious signs** have reported delays to treatment and increased risk of mortality.

Complete Blood Count (CBC)
Unlocking the CBC for early detection of sepsis in the Emergency Department (ED) may have enormous impact, due to it's routine (and early) availability.

Monocyte Distribution Width (MDW) is a morphometric parameter that reflects variability in monocyte cell volume. It has emerged as a useful biomarker for early sepsis detection.



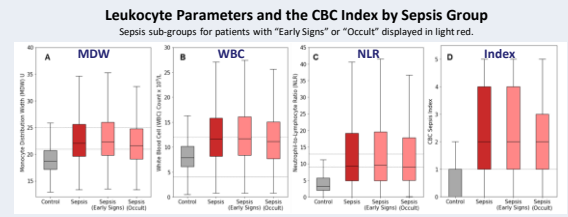
Methods | Study Flow Diagram



Early Signs Group
 The presence of any early vital sign indicator:
 • Abnormal temperature > 38°C or < 36°C at triage
 • Hypotension [< 90 mmHg at triage]
 • Elevated lactate (> 2 mmol/L) known prior to the CBC result.

No Early Signs ("Occult")
 No early vital sign at triage and no elevated lactate prior to the CBC result.

Results | CBC Index Performance



CBC Index Diagnostic Performance Metrics

Cohort sub-groups for patients presenting with "Early Signs" or "No Early Signs (Occult)".

Total Cohort						
Index Score	Sensitivity	Specificity	PPV	NPV	LR+	LR-
≥ 1	82.9 (79.8-86.0)	65.9 (62.2-69.7)	7.9 (7.2-8.6)	99.1 (98.9-99.3)	2.43	0.26
≥ 2	61.1 (57.7-64.5)	85.0 (84.5-85.5)	12.1 (11.3-13.0)	98.4 (98.2-98.6)	4.07	0.46
≥ 3	42.2 (38.2-46.3)	93.8 (93.4-94.3)	19.1 (17.3-21.4)	97.9 (97.7-98.1)	6.76	0.62
≥ 4	25.1 (21.6-28.7)	97.5 (97.3-97.8)	26.5 (22.8-30.3)	97.4 (97.3-97.6)	10.25	0.77
≥ 5	11.0 (8.4-13.6)	99.4 (99.3-99.5)	38.4 (33.4-44.5)	96.9 (96.7-97.2)	17.7	0.9

Early Signs						
Index Score	Sensitivity	Specificity	PPV	NPV	LR+	LR-
≥ 1	81.9 (78.3-85.5)	41.9 (39.3-44.4)	30.1 (27.5-32.7)	88.3 (88.0-88.7)	1.41	0.43
≥ 2	61.2 (56.7-65.8)	66.2 (63.7-68.6)	35.6 (32.2-39.5)	84.8 (82.7-86.9)	1.81	0.59
≥ 3	45.1 (38.5-47.7)	83.3 (81.7-85.3)	44.5 (39.8-49.2)	82.0 (80.8-83.1)	2.63	0.68
≥ 4	30.8 (22.6-39.0)	93.4 (92.1-94.6)	55.1 (48.5-61.8)	80.7 (78.8-82.4)	4.03	0.78
≥ 5	11.1 (8.2-14.0)	98.2 (97.5-98.9)	65.3 (58.6-76.3)	78.4 (76.5-80.3)	6.18	0.91

Occult						
Index Score	Sensitivity	Specificity	PPV	NPV	LR+	LR-
≥ 1	86.4 (80.5-92.2)	68.3 (67.5-69.0)	2.4 (1.9-2.8)	99.8 (99.7-99.9)	2.72	0.2
≥ 2	60.6 (52.2-68.8)	86.8 (86.2-87.4)	3.9 (3.1-4.8)	99.9 (99.9-100.0)	4.6	0.45
≥ 3	39.4 (31.1-47.7)	94.7 (94.4-95.1)	6.3 (4.6-7.9)	99.4 (99.3-99.6)	7.5	0.64
≥ 4	19.7 (12.9-26.5)	98.0 (97.7-98.2)	7.9 (5.0-10.8)	99.3 (99.1-99.6)	9.64	0.82
≥ 5	10.6 (6.4-15.9)	99.3 (99.4-99.6)	15.1 (8.2-23.3)	99.1 (99.1-99.3)	20.97	0.9

Results | CBC Index



CBC Index Point System Derived by Logistic Regression on Training Set

Measure	Total	Control	Sepsis	Odds Ratio	95% CI	CBC Sepsis Index Points
MDW [Reference = < 21]	21	5098 (24.7)	1937 (14.3)	0.792 (0.73)	0.719 (0.59 - 1.31)	1
NLR [Reference = < 1]	> 1	2273 (16.8)	3950 (9.9)	3.56 (2.7)	4.47 (3.79 - 5.38)	2
WBC [Reference = < 9]	9 - 13	2223 (16.2)	1987 (6.0)	1.64 (1.2)	2.30 (1.89 - 2.80)	1
MDW [Reference = < 12]	> 12	2989 (17.4)	2124 (6.4)	4.02 (3.0)	4.45 (3.12 - 6.41)	2
MDW [Reference = < 12]	> 12	1642 (8.9)	1627 (6.9)	0.5 (0.5)	0.81 (0.57 - 1.16)	0
NLR	1.4 - 3.2	1051 (4.8)	4489 (13.6)	3.46 (3.3)	3.05 (2.3 - 4.0)	1

Background | Monocyte Distribution Width



MDW as a Diagnostic Marker for Sepsis

Study	Sample Size	MDW Cutoff	Sensitivity (95% CI)	Specificity (95% CI)
Summary	20		0.81 (0.79-0.83)	0.56 (0.43-0.69)
Summary	22.6		0.81 (0.74-0.88)	0.73 (0.67-0.78)

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