

Online Resource 5: Screening results differentiated by different methods to treat missing values

1. Method

Studies on the predictive ability of screening tools use a variety of methods to handle EMS' documentation deficiencies. To allow comparability between studies, we report screening results using different methods of handling missing values for screening relevant variables such as temperature or heart rate:

- Method #1: All missing values were considered as normal/healthy values
- Method #2: Eligible cases had to have at least two screening-relevant variables documented in *all* screening tools alike
- Method #3: Eligible cases had to have at least two variables filled which are necessary for the *respective* screening tool
- Method #4: Missing values were imputed using multiple imputation (see Appendix 3) and main paper

All methods enabled EMS cases to reach a score threshold that either equals positive or negative screening results.

The sepsis guidelines mention qSOFA, MEWS, SIRS and NEWS2 for adults [1], whereas the pediatric guidelines do not recommend any specific tool [2]. Thus, the following results base on persons age ≥ 18 only.

2. Results

The following results base on the linked EMS + health claims data set (dataset #3) that allowed analyses of the screening tools' ability to predict an inpatient sepsis. Independent of how missing values were treated, qSOFA had the highest specificity and positive predictive value, while NEWS2 had the highest sensitivity, negative predictive value and area under the ROC curve (AUROC) of all tools (see Tab. 1).

Tab. 1: Screening results with qSOFA, MEWS, SIRS and NEWS2 differentiated by method for treating missing values (varying sample sizes, based on linked dataset #3; patient age ≥ 18 years)

	Method #1				Method #2				Method #3				Method #4			
	Cases with missing values treated as “healthy” values (n=4,979)				Cases with at least two screening-relevant variables per tool filled in <i>all</i> screening tools (n=2,061)				Cases with at least two screening-relevant variables filled for the <i>respective</i> screening tool				Cases with imputed data (n=4,503)			
	qSOFA	MEWS	SIRS	NEWS2	qSOFA	MEWS	SIRS	NEWS2	qSOFA (n=3,873)	MEWS (n=4,235)	SIRS (n=2,101)	NEWS2 (n=4,258)	qSOFA	MEWS	SIRS	NEWS2
% of positive screening results per respective tool	2.3% [1.9; 2.7]	6.6% [5.9; 7.3]	3.7% [3.1; 4.2]	15.5% [14.5; 16.5]	4.0% [3.1; 4.8]	11.6% [10.2; 13.0]	8.6% [7.4; 9.8]	22.0% [20.2; 23.8]	3.0% [2.4; 3.5]	7.8% [7.0; 8.6]	8.7% [7.5; 9.9]	18.1% [17.0; 19.3]	3.7% [3.2; 4.3]	12.5% [11.6; 13.5]	6.1% [5.4; 6.8]	19.4% [18.3; 20.6]
Sensitivity (Se; %)	18.4% [17.3; 19.5]	37.9% [36.6; 39.3]	21.8% [20.7; 23.0]	63.2% [61.9; 64.6]	26.0% [24.1; 27.9]	56.0% [53.9; 58.1]	38.0% [35.9; 40.1]	84.0% [82.4; 85.6]	23.2% [21.9; 24.5]	44.0% [42.5; 45.5]	36.5% [34.5; 38.6]	73.3% [72.0; 74.7]	23.1% [21.8; 24.3]	48.7% [47.3; 50.2]	28.2% [26.9; 29.5]	73.1% [71.8; 74.4]
Specificity (Sp; %)	98.0% [97.6; 98.4]	93.9% [93.3; 94.6]	96.7% [96.2; 97.2]	85.4% [84.4; 86.3]	96.6% [95.8; 97.4]	89.5% [88.2; 90.8]	92.1% [90.9; 93.3]	79.6% [77.8; 81.3]	97.4% [96.9; 97.9]	92.9% [92.1; 93.7]	92.0% [90.9; 93.2]	82.9% [81.8; 84.0]	96.6% [96.1; 97.1]	88.1% [87.2; 89.1]	94.3% [93.6; 95.0]	81.6% [80.4; 82.7]
Positive predictive value	13.9%	10.0%	10.4%	7.1%	15.9%	11.7%	10.7%	9.3%	13.9%	10.0%	10.4%	7.1%	10.7%	6.7%	8.0%	6.5%
Negative predictive value	98.5%	98.8%	98.6%	99.2%	98.1%	98.8%	98.4%	99.5%	98.6%	98.9%	98.3%	99.4%	98.6%	99.0%	98.7%	99.4%
Area under the ROC curve	0.582	0.659	0.593	0.743	0.613	0.728	0.650	0.818	0.603	0.684	0.643	0.781	0.598	0.684	0.613	0.773

(AUROC, Scores dichotomous)	[0.514 ; 0.650]	[0.591 ; 0.728]	[0.525 ; 0.660]	[0.683 ; 0.803]	[0.522 ; 0.704]	[0.643 ; 0.812]	[0.561 ; 0.740]	[0.758 ; 0.877]	[0.526 ; 0.680]	[0.612 ; 0.757]	[0.555 ; 0.731]	[0.723 ; 0.840]	[0.526 ; 0.670]	[0.615 ; 0.753]	[0.541 ; 0.684]	[0.716 ; 0.831]
Positive Likelihood Ratio (LR+)	9.1	6.3	6.6	4.3	7.6	5.3	4.8	4.1	8.9	6.2	4.6	4.3	6.8	4.1	5.0	4.0
Negative Likelihood Ratio (LR-)	0.8	0.7	0.8	0.4	0.8	0.5	0.7	0.2	0.8	0.6	0.7	0.3	0.8	0.6	0.8	0.3
% of positive cases in <i>all</i> four screenings tools	0.5% (Se: 5.7%; Sp: 99.6%; PPV: 20.8%; NPV: 98.3%, AUROC: 0.527)				1.2% (Se: 10.0%; Sp: 99.1%; PPV: 20.8%; NPV: 97.8%; AUROC: 0.545)				Not applicable due to different sample sizes per tool				0.8% (Se: 7.7%; Sp: 99.3%; PPV: 16.7%; NPV: 98.4%, AUROC: 0.535)			
% of positive cases in <i>any</i> of the four screenings tools	17.4% (Se: 65.5%; Sp: 83.5%; PPV: 6.6%; NPV: 99.3%, AUROC: 0.745)				26.2% [Se: 88.0%; Sp: 75.4%, PPV: 8.2%; NPV: 99.6%; AUROC: 0.817)				Not applicable due to different sample sizes per tool				24.2% (Se: 76.9%; Sp: 76.7%; PPV: 5.5%; NPV: 99.5%, AUROC: 0.768)			

References

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