Modified Early Warning Score as a Predictor of COVID-19: Experience from the First Wave

Early Warning Score Modificado como Preditor de COVID-19: Experiência da Primeira Vaga

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Palavras-chave: COVID-19; Pneumonia; Serviço Urgência Hospitalar; Unidades de Cuidados Respiratórios

Dear Editor,

The COVID-19 pandemic brought significant challenges for healthcare systems, which had to be reorganized in order to avoid hospital-acquired coronavirus infection.

Our institution responded by creating a COVID-19 center in one campus, while the other accommodated uninfected individuals. Acute patients underwent pre-hospital triage and suspicious cases were referred to the COVID-19 campus. Otherwise, or in absence of prior triage, patients entered the non-COVID-19 campus. In the emergency department (ED) all patients were tested for SARS-CoV-2. Those in need of hospitalization were moved to a new medical ward (COVID-19 'buffer'-ward) while awaiting results. Herein we describe our experience.

In our COVID-19 'buffer'-ward, in order to reduce intra-hospital infection, we triaged patients according to the pre-test probability of COVID-19 using an adjustment of the 'Early Warning Score' (EWS).[1] EWS uses clinical, analytical, and radiological data: signs of pneumonia on computed tomography (CT) scan (5 points); history of close contact with COVID-19 confirmed patients (5 points); fever (3 points); age ≥ 44 years old (1 point); male gender (1 point); maximum temperature (defined as the highest body temperature from illness onset to first hospital admission) ≥ 37.8º C (1 point); one or more meaningful respiratory symptoms, including cough, phlegm and dyspnea (1 point); and neutrophil-to-lymphocyte ratio ≥ 5.8. The final score is calculated as the sum of the score for each variable. The patient is considered suspicious if score is ≥ 10.[1] Since not all our patients performed a chest CT, we used an adjustment of the EWS replacing chest CT for chest x-ray whenever the former was not available.

Statistical analysis was performed with IBM® SPSS® 25 Continuous variables were expressed as mean with standard deviation. Categorical variables were presented as proportions. As EWS establishes cutoff points for each parameter (e.g., patient age 44), continuous variables were recoded into categorical variables using the limits described above. Fisher's exact test or the chi-square test, whenever reasonable, were used to evaluate the association of the variables with the swab result. Logistic regression was used to assess the effect of EWS on the swab result (*i.e.* if the score could predict the swab result). Independent risk factor analysis was performed using multivariable logistic regression analyses for all the EWS parameters. A *p*-value less than 0.05 was considered statistically significant.

We assessed 924 patients, 19 of which were SARS-CoV-2 positive. The mean EWS was 4.25 (± 3.44), and amongst positive individuals was 7.32 (± 4.69). Patients with EWS ≥ 10 were more likely to be infected to those with EWS < 10 [$p = 0.021$; OR 3.84; 95% CI (1.35 - 10.95)]. The findings were similar for consolidation on chest x-ray [$p = 0.005$; OR 3.79; 95% CI (1.52 - 9.46)] and contact with infected people [$p < 0.001$; OR 15.82; CI (4.69 - 53.34)]. The EWS correctly classified 71.4% of cases. Sensitivity was 26.3% and specificity 91.5%. Only consolidation on chest x-ray [$p = 0.007$; OR 4.70; 95% CI (1.53-14.48)] and contact with infected individuals [$p < 0.001$; OR 13.57; 95% CI (3.20 - 57.72)] significantly and correctly predicted a positive swab (Table 1).

Our analysis had some limitations. Effective pre-hospital screening led to the majority of positive patients being immediately admitted to the COVID-19 campus. Moreover, our 'buffer'-ward was located in the non-COVID-19 campus, where all patients in need of hospitalization performed a SARS-CoV-2 test as a pre-admission procedure. Taken together, this resulted in a small number of positive swabs in our 'buffer'-ward, and consequently, in the non-COVID-19 campus. Secondly, some SARS-CoV-2 positive patients had a low EWS, as they were not suspicious and were only tested as a pre-admission procedure. In fact, the presentation of COVID-19 can be asymptomatic.[2] Finally, EWS uses non-specific parameters that can be present in other conditions.

We described our experience during the first wave of

Table 1 – Multivariable associations between the predictor variables and SARS-CoV-2 positivity of nasopharyngeal swab

Parameters	ß (SE)	Wald χ^2 value	OR (95% CI)	*p*-value
Signs of pneumonia on x-ray/CT	1.55 (0.574)	7.27	4.70 (1.53 - 14.48)	0.007
History of contact with infected people	2.61 (0.738)	12.52	13.57 (3.20 - 57.72)	< 0.001
Fever	-0.79 (1.037)	0.57	0.46 (0.06 - 3.48)	0.449
Sex	0.37 (0.504)	0.53	1.45 (0.54 - 3.88)	0.465
Temperature	0.99 (1.039)	0.91	2.70 (0.35 - 20.71)	0.339
Respiratory symptoms	-0.56 (0.610)	0.84	0.57 (0.17 - 1.90)	0.358
Neutrophil-to-lymphocyte *ratio*	-0.88 (0.560)	2.42	0.42 (0.14 - 1.26)	0.102

Variable age is not included as all patient were ≥ 44 years-old (the cut-off established by the authors of the EWS.
CT: computed tomography

COVID-19. The second and third waves required the admission of COVID-19 patients in both campuses. However, 'buffer'-wards remained critical in order to better manage hospital admissions.

With vaccination minimizing COVID-19 hospital admissions, the need for 'buffer'-wards has decreased. Nevertheless, we believe our experience could be replicated in case of future COVID-19 waves or of other infectious pandemics. Based on our experience, hospitals can triage COVID-19 patients according to the EWS thus reducing the risk of intra-hospital transmission. Finally, we believe that signs of pneumonia on chest X-rays and known exposure to an infected person should be considered as "red flags" for having a positive SARS-CoV-2 test.

AUTHORS CONTRIBUTION

JNC: Draft of the manuscript, data acquisition, statistics analysis.

SRS: Data acquisition, statistics analysis, critical review of the manuscript.

JCJ: Data acquisition, draft of the manuscript, final review of the paper.

TA: Data acquisition, final review of the paper, supervision of the work.

PROTECTION OF HUMANS AND ANIMALS

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the Helsinki Declaration of the World Medical Association updated in 2013.

DATA CONFIDENTIALITY

The authors declare having followed the protocols in use at their working center regarding patients' data publication.

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ETHICS STATEMENT

This study was approved by the Ethics Committee of the authors' institution.

INFORMED CONSENT

Informed consent was waived after approval of the local Ethics Committee, given the retrospective design of the study, its non-interventional nature and sample volume (> 900).

COMPETING INTERESTS

The authors have declared that no competing interests exist.

REFERENCES

1. Song CY, Xu J, He JQ, Lu YQ. COVID-19 early warning score: a multi-parameter screening tool to identify highly suspected patients. medRxiv. 2020. doi: 10.1101/2020.03.05.20031906.
2. Wu D, Wu T, Liu Q, Yang Z. The SARS-CoV-2 outbreak: what we know. Int J Infect Dis. 2020;94:44-8.

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