COVID-19 Outpatient Screening: A Novel Risk Score to Early Predict Admission in Isolation Care Units

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INTRODUCTION

In December 2019, a newly identified virus spread throughout China and has rapidly extend worldwide causing a major public health crisis in the six continents [1]. This pathogen belongs to the Coronaviridae family of viruses and was designed as “Severe Acute Respiratory Syndrome Coronavirus 2” (SARS-CoV-2) by the Coronaviridae Study Group of the International Committee on Taxonomy of Viruses [2]. The disease itself was termed coronavirus disease in 2019 (COVID-19) by the World Health Organization [3]. After the SARS-CoV and the Middle East respiratory syndrome MERS-CoV, SARS-CoV-2 caused the third coronavirus outbreak in last 20 years [4]. Human coronaviruses mainly target the human respiratory system [5]. In fact, COVID-19 encompassed different clinical representations of emerging acute respiratory infection ranging from asymptomatic infection or mild upper respiratory disease to acute respiratory distress syndrome with multiple organ failure representing a clinical challenge for physicians [6,7]. The first confirmed case of COVID-19 in Tunisia was reported on 2 March 2020 [8]. The strategy of the country was to screen on suspects and their entourage [9]. However, the very limited screening capacity has resulted in undetected cases of infection and increased mortality [10]. Besides, delays in hospitalization of patients with a severe form of COVID-19 contribute to increased morbidity and mortality [11]. Therefore, an early warning model is needed to predict the risk of hospitalization of COVID-19 patients and thereby to improve the prognosis [6]. In light of this, this study aimed to perform a reliable and easy-to-use risk scoring system to early predict admission in COVID-19 isolation care units.

ABSTRACT

The coronavirus disease in 2019 (COVID-19) pandemic is the defining global health crisis of our time. Delays in hospitalization of patients with a severe form of COVID-19 contribute to increased morbidity and mortality. This study aimed to perform a reliable and easy-to-use risk scoring system to early predict admission in COVID-19 isolation care units. It was a prospective study including all patients, consulting to the COVID-19 sorting box at Hedi Chaker university hospital, and who were clinically suspected COVID-19 during the first epidemic wave between March and June 2020. Of all,388 patients were enrolled in the study. Multivariate analysis showed that factors independently associated with admission to COVID-19 isolation tertiary-care unit were oxygen saturation<88% (Adjusted Relative Risk (ARR)=16.91;p=0.013), hypotension (ARR=11.71;p=0.004), oxygen saturation between 88 and 92% (ARR=5.90;p=0.001), respiratory wrestling signs (ARR=4.63;p=0.042), dyspnea (ARR=3.22;p<0.001), chronic hypertension (ARR=2.76;p=0.027) and ischemic heart diseases (ARR=2.67;p=0.035). The score had an AUROC of 0.75. At a cut-off point=3, the scoring system had a sensitivity of 82.7%, a specificity of 53.8%, a positive predictive value of 53% and a negative predictive value 83.1%. When the cut-off was raised to 3, the sensitivity dropped (44%) and the specificity increased appreciably (92.9%).

Keywords: COVID-19, hospitalization, screening

MATERIALS AND METHODS

Study Design and Settings

This was a prospective study including all patients, consulting to the COVID-19 sorting box at Hedi Chaker university hospital, and who were clinically suspected COVID-19 during the first epidemic wave between March and June 2020. This sorting box was the only COVID-19 triage center in Sfax and it received all patients from both private or public sectors. All cases were diagnosed in the triage center and then notified to the regional directorate of health.

Inclusion Criteria and Case Definitions

Patients were sorted on the basis of a score established according to the Tunisian national guidelines, including exposure with close contact; fever; cough or dyspnea; sore throat; shortness of breath; breathlessness; chest pain; headache; back pain; fatigue; abdominal pain; nausea; vomiting; diarrhea; chills; muscle aches; and other symptoms such as myalgia, anosmia, and ageusia. The study was approved by the institutional review board of the Hedi Chaker University Hospital.

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significant. were summed to produce an overall weighted score. The calculating the optimal cutoff values in accordance with the discriminatory power of the prediction value was determined the individual weighted scores corresponding to the predictors (AUROC). The sensitivity, the specificity, the positive and the standard methods and calculated at different cutoff values. A p rounding to the nearest integer \[13,14\]. Then, for each patient, coefficient by half of the smallest regression coefficient and ward. The regression coefficients were converted to weighted the prediction of hospitalization in the COVID-19 isolation regression model was converted into an applicable score for the pre-established fact sheet. Demographic data, exposure symptoms at presentation and results of clinical examination were also reported.

Data Collection

Data were collected by a team of expert physicians on a pre-established fact sheet. Demographic data, exposure history, smoking status, pre-existing comorbid conditions, symptoms at presentation and results of clinical examination were also reported.

Statistical Analysis

Data were entered, checked for errors, and analyzed using SPSS 20 software. Categorical variables were summarized as absolute and relative frequencies. Means, medians and interquartile ranges (IQRs) were used. Statistical analysis of the categorical data was performed using univariate binary logistic regression (Crude Relative risk (CRR); 95% Confidence Interval (CI); p). Then, variables associated with hospitalization in the COVID-19 isolation tertiary-care unit was made on the basis of clinical evaluation. Hypotension was defined as a systolic blood pressure <90 mmHg or/ and diastolic blood pressure <60 mmHg. Hypertension was defined as a systolic blood pressure >140 mmHg or/ and diastolic blood pressure >100 mmHg. Bradycardia was defined as a heart rate <60 beats per min and tachycardia as a heart rate >90 beats per min.

Ethical Considerations

This study did not involve human beings, intervention or experiments and participation was entirely voluntary. Anonymity and confidentiality were guaranteed and maintained.

RESULTS

Characteristics of the Study Population

Of all, 388 patients were enrolled in the study, among whom 224 cases were males (57.7%), with a sex ratio (Male/ Female) of 1.36. The median age of the study population was 37 years (IQR= [28 – 52.5 years]). Three hundred and nine patients (79.6%) were aged between 15 and 60 years. According to residency, 320 patients (83%) were living in urban areas. A travel history in the last 14 days was noted in 13 patients (3.4%) and 45 cases (11.6%) had contact with a relative who had acute respiratory signs. Seventeen patients (4.4%) were active smokers. The most common comorbidity was chronic respiratory diseases (n=43; 11.1%). One hundred and seventy-nine patients (46.1%) had an onset of symptoms seven days or more before the consultation. The most prevalent general sign was headache (n=155; 39.9%) and the main respiratory symptom was dyspnoea (n = 198; 51%). On clinical examination, 13 patients (3.4%) had hypotension. In situation of rest, bradycardia and tachycardia were noted in respectively 11 (2.8%) and 156 (40.2%) patients. Twenty-nine patients (7.5%) had a respiratory rate > 30 breaths per min. Oxygen saturation less than 88% was noted in 11 patients (2.8%). One hundred and fifty patients (38.7%) were hospitalized in the COVID-19 isolation tertiary-care unit (Table 1).

Predictive Factors of Hospitalization in the COVID-19 Isolation Tertiary-Care Unit

Results of univariate logistic analysis showed that predictive factors of hospitalization in the COVID-19 isolation tertiary-care unit were oxygen saturation <88% (CRR=20.44; p=0.004), bradycardia (CRR=16.92; p=0.007), respiratory wrestling signs (CRR=10.68; p<0.001), hypotension (CRR=9.33; p=0.004) and oxygen saturation between 88 and 92%.

Table 1. Patients’ characteristics

| Variables                              | N  | %   |
|---------------------------------------|----|-----|
| **Demographic characteristics**       |    |     |
| Gender                                |    |     |
| Men                                   | 224| 57.7|
| Women                                 | 164| 42.3|
| Age groups (years)                    |    |     |
| < 15                                  | 17 | 4.4 |
| [15-60]                               | 309| 79.6|
| ≥ 60                                  | 62 | 16  |
| Residence                             |    |     |
| Urban                                 | 322| 83  |
| Rural                                 | 66 | 17  |
| **Exposure history**                  |    |     |
| Travel history in the last 14 days    | 13 | 3.4 |
| Contact with a relative who has acute respiratory signs | 45 | 11.6 |
| **Current smoking**                   | 17 | 4.4 |
| **Pre-existing comorbid conditions**  |    |     |
| Chronic respiratory diseases          | 43 | 11.1|
| Cardiovascular diseases               |    |     |
| Chronic hypertension                  | 35 | 9   |
| Ischemic heart diseases               | 32 | 8.2 |
| Thromboembolic diseases               | 7  | 1.8 |
| Diabetes                              | 33 | 8.5 |
| Other endocrine disorders             | 15 | 3.9 |
| Hyperlipemia                          | 18 | 4.6 |
| Chronic renal failure                 | 14 | 3.6 |
| Malignant tumour                      | 5  | 1.3 |
| Having ≥ 2 comorbidities              | 46 | 11.9|
| Surgical history                      | 101| 26  |
| Allergic history                      | 17 | 4.4 |

\(N\): Number; \%: percentage; SBP: Systolic blood pressure; DBP: Diastolic blood pressure
Table 1 (continued). Patients’ characteristics

| Variables                              | N  | %      |
|----------------------------------------|----|--------|
| **Onset ≥ 7 days before consultation** |    |        |
| Headache                               | 155| 39.9   |
| Arthralgia                             | 88 | 22.7   |
| Myalgia                                | 70 | 18     |
| Asthenia                               | 16 | 4.1    |
| **Respiratory signs**                  |    |        |
| Dyspnea                                | 198| 51     |
| Dry cough                              | 193| 49.7   |
| Dry throat                             | 150| 38.7   |
| Productive cough                       | 79 | 20.4   |
| Rhinorrhea                             | 64 | 16.5   |
| Chest pain                             | 16 | 4.1    |
| Respiratory wrestling signs            | 21 | 5.4    |
| **Digestive symptoms**                |    |        |
| Diarrhea                               | 94 | 24.2   |
| Nausea or vomiting                     | 72 | 18.6   |
| Constipation                           | 4  | 1      |
| Epigastralgia                          | 3  | 0.8    |

**Clinical examination**

| Fever >38.5 °C                          | 48 | 12.4   |
| Blood pressure (mmHg)                   |    |        |
| Hypotension (SBP<90 or/and DBP<60 mmHg) | 13 | 3.4    |
| Hypertension (SBP>140 or/and DBP>100 mmHg)| 25 | 6.4    |
| Pulse (beats per min)                   |    |        |
| Bradycardia (> 60 beats per min)        | 11 | 2.8    |
| Tachycardia (> 90 beats per min)        | 156| 40.2   |
| Respiratory rate (breaths per min)      |    |        |
| <25                                    | 133| 36.6   |
| [25-30]                                | 23 | 5.9    |
| >30                                    | 29 | 7.5    |
| Oxygen saturation (%)                   |    |        |
| >92                                    | 344| 88.7   |
| (88–92)                                | 33 | 8.5    |
| <88                                    | 11 | 2.8    |

**Hospitalizations in the COVID-19 isolation tertiary-care unit**

| 150 | 38.7 |

(CRR=19.19; p<0.001). Besides, ischemic heart diseases (CRR=3.91; p=0.001), having at least two comorbidities (CRR=3.46; p<0.001), dyspnea (CRR=3.46; p=0.001), respiratory rate exceeding 30 cycles per minute (CRR=3.42; p=0.003), diabetes (CRR=3.06; p=0.003), chronic hypertension (CRR=2.97; p=0.003) and chronic respiratory diseases (CRR=2.19; p=0.016) were associated with higher risk of hospitalization. Moreover, coming from rural areas (CRR=1.75; p=0.039), productive cough (CRR=1.73; p=0.03) and an onset of symptoms seven days or more before the consultation (CRR=1.60; p=0.024) were also predictive factors of hospitalization in the COVID-19 isolation tertiary-care unit. However, dry cough (CRR=0.28; p<0.001), myalgia (CRR=0.33; p=0.001), age between 15 and 60 years (CRR=0.34; p=0.033), rhinorrhea (CRR=0.42; p=0.006), dry throat (CRR=0.42; p<0.001), headache (CRR=0.54; p=0.006) and diarrhea (CRR=0.56; p=0.024) were associated with lower risk of hospitalization (Table 2).

Multivariate analysis showed that factors independently associated with admission to COVID-19 isolation tertiary-care unit were oxygen saturation <88% (ARR=16.91; p=0.013), hypotension (ARR=11.71; p=0.004), oxygen saturation between 88 and 92% (ARR=5.90; p=0.001), respiratory wrestling signs (ARR=4.63; p=0.042), dyspnea (ARR=3.22; p<0.001), chronic hypertension (ARR=2.76; p=0.027) and ischemic heart diseases (ARR=2.67; p=0.035) (Table 2).

**Risk Scoring System Predictive of Hospitalization in the COVID-19 Isolation Tertiary-Care Unit**

A weighted score was assigned to each factor found to be independently associated with hospitalization in the COVID-19 isolation tertiary-care unit as follows: ischemic heart diseases: 2 points; chronic hypertension: 2 points; dyspnea: 2 points; respiratory wrestling signs: 3 points; oxygen saturation ≤92%:

Table 2. Predictive factors of hospitalisation in the COVID-19 isolation tertiary-care unit: results of univariate and multivariate logistic regression analysis

| Variables                              | Crude RR [95% CI] | p value | Adjusted RR [95% CI] | p value |
|----------------------------------------|-------------------|---------|----------------------|---------|
| **Demographic characteristics**        |                   |         |                      |         |
| Gender                                  |                   |         |                      |         |
| Men                                     | 1                 |         |                      |         |
| Women                                   | 0.97 [0.64-1.47]  | 0.900   |                      |         |
| Age groups (years)                      |                   |         |                      |         |
| <15                                     | 1                 |         |                      |         |
| [15-60]                                 | 0.34 [0.12-1.91]  | 0.033   |                      |         |
| ≥60                                     | 1.18 [0.39-3.54]  | 0.75    |                      |         |
| Residency                               |                   |         |                      |         |
| Urban                                   | 1                 |         |                      |         |
| Rural                                   | 1.75 [1.02-2.98]  | 0.039   |                      |         |
| **Exposure history**                    |                   |         |                      |         |
| Travel history in the last 14 days      |                   |         |                      |         |
| No                                      | 1                 |         |                      |         |
| Yes                                     | 0.69 [0.21-2.30]  | 0.554   |                      |         |
| Contact with a relative who has acute respiratory signs | | | | |
| No                                      | 1                 |         |                      |         |
| Yes                                     | 0.61 [0.31-1.20]  | 0.155   |                      |         |
| Current smoking                         |                   |         |                      |         |
| No                                      | 1                 |         |                      |         |
| Yes                                     | 2.35 [0.87-6.33]  | 0.089   |                      |         |
| **Pre-existing comorbid conditions**   |                   |         |                      |         |
| Chronic respiratory diseases            |                   |         |                      |         |
| No                                      | 1                 |         |                      |         |
| Yes                                     | 2.19 [1.15-4.16]  | 0.016   | 1.78 [0.81-3.92]     | 0.151   |
| Cardiovascular diseases                 |                   |         |                      |         |
| Chronic hypertension                    |                   |         |                      |         |
| No                                      | 1                 |         |                      |         |
| Yes                                     | 2.97 [1.44-6.10]  | 0.003   | 2.76 [1.12-6.81]     | 0.027   |
| Ischemic heart diseases                 |                   |         |                      |         |
| No                                      | 1                 |         |                      |         |
| Yes                                     | 3.91 [1.80-8.53]  | 0.001   | 2.67 [1.07-6.65]     | 0.035   |
| Thromboembolic diseases                 |                   |         |                      |         |
| No                                      | 1                 |         |                      |         |
| Yes                                     | 2.14 [0.47-9.72]  | 0.322   |                      |         |
| Diabetes                                |                   |         |                      |         |
| No                                      | 1                 |         |                      |         |
| Yes                                     | 3.06 [1.46-6.43]  | 0.003   |                      |         |
| Other endocrine disorders               |                   |         |                      |         |
| No                                      | 1                 |         |                      |         |
| Yes                                     | 2.46 [0.86-7.08]  | 0.093   |                      |         |

RR: Relative risk; CI: Confidence interval; SBP: Systolic blood pressure; DBP: Diastolic blood pressure
Table 2 (continued). Predictive factors of hospitalisation in the COVID-19 isolation tertiary-care unit: results of univariate and multivariate logistic regression analysis

| Variables                                | Crude RR [95% CI] | p value | Adjusted RR [95% CI] | p value |
|-------------------------------------------|-------------------|---------|----------------------|---------|
| **Pre-existing comorbid conditions**      |                   |         |                      |         |
| Hyperlipemia                              | No                | 1       |                      |         |
|                                           | Yes               | 2.05 [0.79-5.32] | 0.139   |         |
| Chronic renal failure                     | No                | 1       |                      |         |
|                                           | Yes               | 1.61 [0.55-4.70] | 0.379   |         |
| Malignant tumour                          | No                | 1       |                      |         |
|                                           | Yes               | 1.05 [0.17-6.41] | 0.951   |         |
| Having ≥ 2 comorbidities                  | No                | 1       |                      |         |
|                                           | Yes               | 3.46 [1.81-6.61] | <0.001  |         |
| Surgical history                          | No                | 1       |                      |         |
|                                           | Yes               | 1.31 [0.63-2.08] | 0.240   |         |
| Allergic history                          | No                | 1       |                      |         |
|                                           | Yes               | 0.47 [0.15-1.48] | 0.199   |         |
| Pregnancy                                 | No                | 1       |                      |         |
|                                           | Yes               | 0.79 [0.14-4.37] | 0.788   |         |
| **Presenting symptoms**                   |                   |         |                      |         |
| Onset ≥ 7 days before consultation        | No                | 1       |                      |         |
|                                           | Yes               | 1.60 [1.06-2.42] | 0.024   |         |
| **General signs**                         |                   |         |                      |         |
| Headache                                  | No                | 1       |                      |         |
|                                           | Yes               | 0.54 [0.35-0.84] | 0.006   |         |
| Arthralgia                                | No                | 1       |                      |         |
|                                           | Yes               | 0.68 [0.41-1.12] | 0.134   |         |
| Myalgia                                   | No                | 1       |                      |         |
|                                           | Yes               | 0.33 [0.17-0.62] | 0.001   |         |
| Asthenia                                  | No                | 1       |                      |         |
|                                           | Yes               | 0.51 [0.16-1.63] | 0.252   |         |
| **Respiratory symptoms**                  |                   |         |                      |         |
| Dyspnea                                   | No                | 1       |                      |         |
|                                           | Yes               | 3.46 [2.24-5.34] | <0.001  | 3.22 [1.92-5.39] | <0.001 |
| Dry cough                                 | No                | 1       |                      |         |
|                                           | Yes               | 0.28 [0.18-0.44] | <0.001  |         |
| Dry throat                                | No                | 1       |                      |         |
|                                           | Yes               | 0.42 [0.27-0.65] | <0.001  |         |
| Productive cough                          | No                | 1       |                      |         |
|                                           | Yes               | 1.73 [1.05-2.86] | 0.030   |         |
| Rhinorrhea                                | No                | 1       |                      |         |
|                                           | Yes               | 0.42 [0.23-0.79] | 0.006   |         |
| Chest pain                                | No                | 1       |                      |         |
|                                           | Yes               | 2.76 [0.98-7.76] | 0.054   |         |
| Respiratory wrestling signs               | No                | 1       |                      |         |
|                                           | Yes               | 10.68 [3.08-36.93] | <0.001  | 4.63 [1.05-20.24] | 0.042 |
| **Digestive symptoms**                    |                   |         |                      |         |
| Diarrhea                                  | No                | 1       |                      |         |
|                                           | Yes               | 0.56 [0.33-0.92] | 0.244   |         |
| Nausea or vomit                           | No                | 1       |                      |         |
|                                           | Yes               | 0.87 [0.51-1.48] | 0.623   |         |
| Constipation                              | No                | 1       |                      |         |
|                                           | Yes               | 1.59 [0.22-11.44] | 0.643   |         |
| Epigastralgia                             | No                | 1       |                      |         |
|                                           | Yes               | 3.20 [0.28-35.63] | 0.344   |         |
| **Clinical examination**                  |                   |         |                      |         |
| Fever >38.5 °C                            | No                | 1       |                      |         |
|                                           | Yes               | 0.69 [0.36-1.31] | 0.262   |         |
| Blood pressure (mmHg)                     |                   |         |                      |         |
| Hypotension (SBP<90 or/ and DBP<60 mmHg)  | No                | 1       |                      |         |
|                                           | Yes               | 9.33 [2.04-42.74] | 0.004  | 11.71 [2.21-61.87] | 0.004 |
| Hypertension (SBP>140 or/ and DBP>100 mmHg)| No                | 1       |                      |         |
|                                           | Yes               | 1.50 [0.66-3.39] | 0.324   |         |
| Pulse (beats per min)                     |                   |         |                      |         |
| Bradycardia (>60 beats per min)           | No                | 1       |                      |         |
|                                           | Yes               | 16.92 [2.14-133.64] | 0.007   |         |
| Tachycardia (>90 beats per min)           | No                | 1       |                      |         |
|                                           | Yes               | 0.94 [0.62-1.43] | 0.781   |         |
| Respiratory rate (breaths per min)        |                   |         |                      |         |
| <25                                       | 1                 | 0.007   |                      |         |
| 25-30                                     |                   | 1.65 [0.70-3.85] | 0.247   |         |
| >30                                       |                   | 3.42 [1.54-7.59] | 0.003   |         |
| Oxygen saturation (%)                     |                   |         |                      |         |
| >92                                       | 1                 | <0.001  | 1                     | <0.001  |
| 86-92                                     |                   | 9.19 [3.69-22.91] | <0.001  | 5.90 [2.10-16.55] | 0.001 |
| <88                                       |                   | 20.44 [2.58-161.66] | 0.004  | 16.91 [1.79-159.06] | 0.013 |

RR: Relative risk; CI: Confidence interval; SBP: Systolic blood pressure; DBP: Diastolic blood pressure
Table 3. Weighted scores corresponding to predictive factors of hospitalization in the COVID-19 isolation tertiary-care unit

| Variables                          | Adjusted RR [95% CI] | Regression Coefficient | Weighted Score |
|------------------------------------|----------------------|------------------------|-----------------|
| Ischemic heart diseases            | 2.67 [1.07-6.65]     | 0.98                   | 2               |
| Chronic hypertension               | 2.76 [1.12-6.81]     | 1.01                   | 2               |
| Dyspnea                            | 3.22 [1.92-5.39]     | 1.17                   | 2               |
| Respiratory wrestling signs        | 4.63 [1.05-20.24]    | 1.53                   | 3               |
| Oxygen saturation ≤92%             | 5.90 [2.10-16.55]    | 1.77                   | 4               |
| Hypertension                       | 11.71 [2.21-61.87]   | 2.46                   | 5               |

**RR:** Relative risk; **CI:** Confidence interval

Table 4. The sensitivity, specificity and predictive values of the weighted score predictive of hospitalization in the covid-19 isolation tertiary-care unit at various cutoff points

| Cutoff Points | Sensitivity (%) | Specificity (%) | PPV (%) | NPV (%) |
|---------------|-----------------|-----------------|---------|---------|
| ≥2            | 87.7            | 53.8            | 72.5    | 63.1    |
| ≥3            | 44              | 92.9            | 79      | 72      |
| ≥4            | 42.7            | 92.9            | 79      | 72      |
| ≥5            | 31.3            | 96.2            | 83.9    | 69      |
| ≥6            | 22.7            | 97.5            | 85      | 66      |
| ≥7            | 12              | 98.3            | 81.8    | 63.9    |
| ≥8            | 8.7             | 98.7            | 81.3    | 63.2    |
| ≥9            | 4.7             | 99.6            | 87.5    | 62.4    |
| ≥10           | 2.7             | 100             | 100     | 62      |

**NPV:** negative predictive value; **PPV:** positive predictive value

DISCUSSION

The COVID-19 pandemic continues to be a global health crisis. The number of suspected patients and positive cases has increased exponentially in many countries. In Tunisia, hospitalizations associated with COVID-19 have created significant challenges in the allocation of human and infrastructural resources for public health facilities, that are already facing financial constraints, especially in rural areas [15]. The present study indicated that the prevalence of hospitalization of COVID-19 suspected patients, in the COVID-19 isolation tertiary-care unit in Sfax, was 38.7% between March and June 2020. A survey conducted in New York City revealed that the prevalence of hospitalization of COVID-19-infected patients was 27% as of April 12, 2020 [16]. Another study in Michigan of 463 patients with COVID-19 reported a hospitalization prevalence of 76.7%, from March 9 to March 27, 2020 [17]. The overwhelming influx of patients with COVID-19 to many hospitals presents a need to timely identify patients who require hospitalization. Therefore, it is important to determine factors that stratify patients at risk of requiring hospitalization.

In the current study, an oxygen saturation ≤92%, respiratory wrestling signs and dyspnea were independent predictive factors for hospital admission. Our results were largely in line with other surveys that reported that hypoxemia and dyspnoea were independently associated with worse clinical outcomes [18,19]. Indeed, a study of 463 patients with COVID-19 indicated that patients requiring hospital admission had dyspnoea and lowest oxygen saturation [17]. Another study of 140 patients with COVID-19 found that patients with oxygen saturation <90.5% were more likely to survive while dyspnoea was independently associated with mortality [18]. Likewise, a study of 5279 patients with COVID-19 reported that an oxygen saturation <88% and an oxygen saturation between 88 and 92% were among predictive factors most strongly associated with critical illness with adjusted odds ratios of 3.67 and 1.49 respectively [20]. However, in this study, chronic respiratory diseases did not feature among independent predictive factors of admission in the COVID-19 units. This was consistent with previous studies that did not report a significant association between pre-existing chronic respiratory diseases and hospital admission of COVID-19 patients [17] or the COVID-19 severity [3,21]. There is no epidemiological or pathophysiological explanation for the absence of chronic respiratory diseases as risk factor of illness severity among COVID-19 patients [20].

On the other hand, the current study confirmed that preexisting cardiovascular diseases such as chronic hypertension and ischemic heart diseases were independent predictive factors of admission in the COVID-19 isolation tertiary care units. Our findings support the observations of earlier studies, which found a high percentage of hospitalized patients with pre-existing cardiovascular diseases. Indeed, it has been reported that heart failure and hypertension were independent risk factors of hospital admission among COVID-19 patients [20]. It has been also reported that coronary heart disease was an independent risk factor associated with in-hospital death for COVID-19 patients [3]. Besides, other studies found that patients with cardiovascular diseases were more likely to develop severe forms of COVID-19 [22,23]. In fact, the angiotensin-converting enzyme 2 (ACE2) has a vital role in the regulation of heart function and the development of hypertension [24]. In addition, ACE2 has been shown to also serve as a functional receptor for coronaviruses [25], including SARS-CoV-2. Indeed, the binding of the spike protein of the virus to ACE2 triggers infection by SARS-CoV-2 [25]. Since ACE2 is highly expressed in the heart and lungs [25], symptoms of COVID-19 are more severe in patients with cardiovascular diseases.
CONCLUSION

Given the rapid increase in the number of COVID-19 patients worldwide, while no specialized treatment is yet available, the early identification of patients who require admission is essential for timely intervention. Our scoring system included ischemic heart diseases, chronic hypertension, dyspnea, respiratory wrenching signs, oxygen saturation ≤92% and hypotension. This risk score will allow patient stratification and will guide hospitalization decisions for suspected COVID-19 patients in order to facilitate their clinical management while appropriately allocating limited human and hospital resources.

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