DERIVATION OF A SCORE TO PREDICT ADMISSION TO INTENSIVE CARE UNIT IN PATIENTS WITH COVID-19: THE ABC-GOALS SCORE

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NOTE: This preprint reports new research that has not been certified by peer review and should not be used to guide clinical practice.
SUMMARY

This prospective study derived a prognostic score for admission to ICU in COVID-19 patients. The predictive models include a clinical, clinical plus laboratory, and clinical plus laboratory plus imaging score that may apply to different clinical situations aiding clinical decision making and patient referral.
ABSTRACT

Background. COVID-19 pandemic poses a burden on hospital resources and intensive care unit (ICU) occupation. The study aimed to derive a scoring system that, assessed upon patient first-contact evaluation, predicts the need for admission to ICU.

Methods. All consecutive patients admitted to a COVID-19 reference center were prospectively assessed. Patients were segregated into a group that required admission to ICU during their hospitalization and a group that never required ICU admission and was already discharged from hospitalization. Three models including clinical, laboratory and imaging findings were derived by logistic regression analysis and internally validated. A score, defined as the ABC-GOALS score was created by assigning values based on the variables weighted odd ratios.

Results. The study comprised 329 patients, 115 (35%) required ICU admission and 214 (65%) were hospitalized and discharged from general wards. The clinical prediction model (ABC-GOALS_cl) included sex, obesity, the Charlson comorbidity index, dyspnea, arterial pressure and respiratory rate at triage evaluation. The clinical plus laboratory model (ABC-GOALS_cll) added serum albumin, glucose, lactate dehydrogenase and S/F ratio to the clinical model. The model that included imaging (ABC-GOALS_clix) added the CT scan finding of >50% lung involvement. All three models outperformed other pneumonia-specific scores with area under the curve of 0.79 (0.74-0.83), 0.86 (0.82-0.90) and 0.88 (0.84-0.92) for the clinical, laboratory and imaging model, respectively.

Conclusion. The ABC-GOALS score is a tool to evaluate patients with COVID-19 at admission to the emergency department that allows to timely predict their risk of admission to an ICU and may help optimize healthcare capacities.
INTRODUCTION

The presence of a new severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first reported in China and has subsequently spread to all regions of the world, straining the health systems of many countries\(^1\). Viral pneumonia associated with SARS-CoV-2 has been officially denominated as coronavirus disease 2019 (COVID-19)\(^2\).

Approximately 5 to 33% of patients with COVID-19 pneumonia will be admitted to an intensive care unit (ICU)\(^3\)–\(^5\). Previous studies have identified several risk factors associated with a severe course of COVID-19 pneumonia and its progression to acute respiratory distress syndrome \(^6\),\(^7\). These risk factors may be categorized into patient characteristics obtained through the medical interview (e.g. age, comorbidities, symptoms)\(^6\)–\(^11\); vital signs obtained from triage evaluation (e.g. respiratory rate, arterial pressure)\(^12\),\(^13\); laboratory abnormalities including inflammatory, coagulation and organ-specific studies (e.g. lactate dehydrogenase, D-dimer, fibrinogen, cardiac troponins, liver function tests, among others)\(^6\),\(^7\),\(^9\)–\(^11\),\(^14\); and lung imaging findings (e.g. number of affected lobes, estimated pneumonia extension)\(^15\),\(^16\).

In several countries, including Mexico, hospital reconversion and temporary care centers have been implemented to cope with the large number of COVID-19 patients \(^17\). However, many of these centers are prepared to care for patients with supplemental oxygen requirements but just a few patients who require admission to an intensive care unit (ICU) and mechanical ventilation.
The aim of the study was to derive risk prediction models to anticipate the need for admission to an ICU. These models include clinical, laboratory and image findings obtained at the first-contact evaluation to aid triage, decision making and timely referral to maintain healthcare system capacity.

METHODS

This is a prospective observational cohort study. All consecutive adult (>18 years) patients hospitalized at Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán, a referral center for COVID-19 patients at Mexico City, were evaluated for this analysis. These patients were hospitalized between March 16th and April 30th and followed until May 8th. The study was approved by the local Research and Ethics Board (CAI-3368-20-20-1) that waived the use of an informed consent form due to the study’s nature.

The study population was segregated into two groups: 1) patients who required admission to an ICU at any time during their hospitalization, and 2) patients admitted to general wards who were discharged from hospitalization without ever been considered for admission to an ICU. Patients were censored for each group once they were admitted to the ICU or by the date of discharge from hospitalization, respectively. All patients who remained hospitalized in general wards by the end of the study were discarded for this analysis as it was considered that their risk for ICU admission is still active.
All patients had COVID-19 pneumonia diagnosed by chest computed tomography (CT) and SARS-CoV-2 infection confirmed in respiratory specimens using real-time reverse-transcriptase polymerase chain reaction (RT-PCR) assay by local testing and confirmed at a central laboratory. Patients were considered positive if the initial test results were positive, or if it was negative but repeat testing was positive.

The following variables were obtained by the time of the triage and emergency department (ED) evaluation: demographic variables, previous medical and medication history including smoking; symptoms, physical examination including weight, height and vital signs; laboratory evaluation including arterial blood gas analysis, inflammatory biomarkers, troponin-I levels, complete blood count and blood chemistries; and chest CT-scan findings. All patients underwent chest CT-scans that were evaluated by experienced specialists; lung involvement was semi quantitatively classified as mild (<20%), moderate (20-50%) or severe (>50%).

For each patient, we calculated the Charlson comorbidity index (an index that predicts 10-year survival in patients with multiple comorbidities) \(^{18}\), National Early Warning Score (NEWS) \(^{19}\), Sequential Organ Failure Assessment (SOFA) score \(^{20}\), CURB-65 score for pneumonia severity \(^{21}\), the MuLBSTA score for viral pneumonia mortality \(^{22}\), the ROX index to predict the risk of intubation \(^{23}\) and the CALL score model for prediction of progression risk in COVID-19 \(^{24}\). All scores were calculated at admission to the ED. Although most of these scores were not derived to evaluate the risk of admission to an ICU, we evaluated their value if repurposed for this end.
The need for admission to critical care was determined by the medical team in charge of the patient and included the need for mechanical ventilation or high-dose vasopressors. Patients hospitalized in medical wards were treated with supplementary oxygen (nasal cannula or non-rebreathing oxygen mask) but were never considered for intubation and ICU admission. All patients in this group were censored once discharged from hospitalization after improvement. Clinical outcomes for patients admitted to ICU were monitored up to May 8th, 2020.

Statistical analysis

The distribution of continuous variables was evaluated by the Kolmogorov-Smirnov test. Variables are described as number (relative frequency) or median (interquartile range [IQR]) as appropriate. Characteristics at admission between study groups were compared by the Mann-Whitney U test. There were less than 2% missing values for all variables. In the case of missing data, variables were imputed by using multiple imputations.

For score derivation, all variables were evaluated by bivariate logistic regression analysis. All variables with p-values <0.05 were considered for the multivariate logistic regression analysis. The best logistic regression analysis model was constructed by the forward stepwise selection method using maximum likelihood estimation and r-square values. Three models were constructed: a first model including only clinical variables (ABC-GOALS\textsubscript{c}), a second model that included clinical and laboratory variables (ABC-GOALS\textsubscript{cl}) and a third model that included
clinical, laboratory and x-ray findings (ABC-GOALS\textsubscript{clx}). The predictive performance of each model was measured by the concordance index (C-index) and internal calibration was evaluated by 1000 bootstrap samples. The goodness of fit was evaluated by the Hosmer-Lemeshow test. To create the final scores, points were assigned by the weighted odd-ratios and approached to the closest integer for each model.

The performance of the derived scores as well as for all other scores determined at admission to predict the risk of hospitalization into an ICU were assessed by receiver operating characteristic (ROC) curves and their 95% confidence intervals. All analyses were performed with SPSS version 24.0 (IBM, Armonk, NY, USA) and GraphPad Prism 6.0 (GraphPad Software, San Diego, CA, USA).

**RESULTS**

**Patient characteristics at admission**

A total of 410 patients with COVID-19 pneumonia and SARS-CoV-2 positive test were hospitalized during the study period. Seventy-nine patients who remained hospitalized in general wards and two patients who were discharged by discharge against medical advice were excluded from the analysis. A total of 115 patients that required ICU admission and 214 patients that had been hospitalized and discharged from general wards were finally included for analysis. The median age of the study population was 49 years (IQR 41-60), 211 (64%) subjects were male with a median Charlson comorbidity index of 1 point (IQR 0-2). There were 100
subjects with no previous comorbidity. The median days from the start of symptoms to the evaluation at the ER were 7 days (IQR 5-10). All patients received supplementary oxygen. For the group admitted to ICU, the median time from ER admission to ICU admission was 2 days (IQR 0-3 days, range 0 to 12). The median length of hospitalization for the group hospitalized in general wards was 6 days (IQR 4-9 days, range 1 to 20).

Several differences in the admission variables were observed between patients who required critical care and those hospitalized in general wards and are described in Table 1 and Supplementary Table 1.

Factors associated with the need of admission to a critical care unit

An extended table with all the results obtained from the bivariate logistic regression analysis is shown in Supplementary Table 2. The best predictive models derived from multivariable logistic regression analysis are shown in Table 2. The clinical model included: male sex, the Charlson comorbidity index, obesity (BMI>30kg/m², not included in the Charlson index), referred dyspnea, respiratory rate and systolic arterial pressure at the triage or ER evaluation. The clinical plus laboratory model included the same clinical variables plus serum albumin <3.5g/dL, lactate dehydrogenase above the upper limit of normal and the hemoglobin oxygen saturation to fraction of inspired oxygen ratio <300 (S/F ratio). The clinical plus laboratory model included all previous variables except for referred dyspnea and serum albumin, and added reported lung involvement >50% in the lung CT scan.
The c-statistics for clinical, clinical plus laboratory, and clinical plus laboratory plus x-ray models were 0.79, 0.87 and 0.88, respectively.

**Derivation of the ABC-GOALS scores**

A predictive point score was constructed based on the weighted OR’s from each logistic regression model. The derived scores were defined as the ABC-GOALS (Arterial pressure, Breathlessness, Charlson, Glucose, Obesity, Albumin, LDH and S/F ratio) and labeled as clinical (ABC-GOALS\(_c\)), clinical plus laboratory (ABC-GOALS\(_{cl}\)) and clinical plus laboratory plus x-ray (ABC-GOALS\(_{clx}\)) scores (Table 3). All three ABC-GOALS score variations demonstrated good accuracy in estimating the risk of admission to an ICU, with area under the curve of 0.79 (95%CI 0.74-0.83), 0.86 (95%CI 0.82-0.90) and 0.88 (95%CI 0.84-0.92) for the ABC-GOALS\(_c\), ABC-GOALS\(_{cl}\) and ABC-GOALS\(_{clx}\) scores, respectively (Figure 1). Calibration plots showed good agreement between the estimated and observed scores (Figure 2).

By segregating the scores into three levels of risk of admission to ICU, the ABC-GOALS\(_c\) classified patients into low- (0-2 points, mean risk 8%, 95%CI 7-9%), moderate- (3-7 points, mean risk 32%, 95%CI 30-34%) and high-risk (≥8 points, mean risk 73%, 95%CI 70-75%) of admission ICU. The respective groups for the ABC-GOALS\(_{cl}\) were low- (0-3 points, mean risk 4%, 95%CI 3-4%), moderate- (4-9 points, mean risk 30%, 95%CI 27-32%) and high-risk (≥10 points, mean risk 80%, 95%CI 78-82%) for ICU admission. Finally, the groups for the ABC-GOALS\(_{clx}\) were low- (0-4 points, mean risk 6%, 95%CI 5-6%), moderate- (5-9 points, mean 32%,
95%CI 29-34%) and high-risk (≥10 points, mean 80%, 95%CI 78-82%) for ICU admission (Table 3). The sensitivity and specificity for selected cutoffs of these scores are shown in Table 4.

The ABC-GOALS variants outperformed other scores that were repurposed for the prediction of admission to ICU, based on the area under the curve values (Table 4). As previously stated, most of these scores were not created to predict this outcome. For practicality, the three ABC-GOALS scores are planned to be implemented into an application for mobile devices.

**Outcomes**

By the end of this study (May 8th), all patients from the group that was hospitalized in general wards were discharged to home after improvement. Only two patients (0.9%) were readmitted and discharged again without admission to ICU during the study period. Sixty-one (53%) patients from the group admitted to ICU have died, 25 (22%) have been discharged to their homes after improvement, and 29 (25%) remain hospitalized. The ABC-GOALS_c, ABC-GOALS_cl and ABC-GOALS_clx scores predicted mortality with a sensitivity of 31%, 58%, and 64%, and specificity of 97%, 92% and 94%, respectively, (AUC of 0.79, 0.86 and 0.88 for mortality, respectively).
DISCUSSION

We derived a prognostic score that, evaluated upon patient admission to the ED, helps predict the probability of admission to ICU during patient hospitalization. This tool may prove useful for patient assessment at first-contact evaluation and to timely refer patients to other units in case of a lack of or overcrowding of local ICUs. The ABC-GOALS score predicts the need for admission to an ICU with greater accuracy than other scores that were created for the prediction of other outcomes in sepsis or pneumonia, such as mortality.

To date, more than 4 million SARS-CoV-2 infections have been reported worldwide with almost 300,000 total deaths. The fast spread of the disease and the large number of patients admitted to hospitals has strained and overwhelmed local health systems. Among hospitalized patients, 5 to 33% will require admission to an ICU and 75% to 100% of them will require support with mechanical ventilation. An effective evaluation of patients with severe disease may be critical to maintain healthcare system functional for as long as possible.

The ABC-GOALS score summarizes many of the previously reported factors that have been shown to independently associate with severe COVID-19 disease. We found that age and comorbidities predictive performance is enhanced when integrated in the Charlson comorbidity index. It has been reported in other studies that there may be interactions between age and some comorbidities such as diabetes. Also, the Charlson comorbidity index offers the advantage of integrating several comorbidities into one score that has been previously associated with survival. Among clinical symptoms, dyspnea or shortness of breath is the most
consistently reported symptom associated with COVID-19 severity and mortality \cite{6,9,12,29} and was independently associated with ICU admission in this study. Obesity is a long-recognized factor for severe pulmonary infections \cite{30} and has been consistently associated with adverse outcomes in COVID-19 \cite{31}. Low systolic arterial pressure and respiratory rate at triage evaluation complete the clinical ABC-GOALS. Among the three derived scores in this study, the clinical ABC-GOALS has an inferior performance and remains to be externally validated, as some reported models based exclusively in demographic (but not physical examination) information have been shown to decrease their performance after external validation\cite{12}.

The scores integrating clinical with laboratory (ABC-GOALS$_{cl}$) and imaging (ABC-GOALS$_{clx}$) findings seem to perform better for prediction of admission to an ICU. Both models include values of glucose, lactate dehydrogenase and oxygenation at admission that have been previously reported to be associated with prognosis in COVID-19 \cite{9,11,32,33}. Lactate dehydrogenase has been previously integrated into a predictive model \emph{(see below)}. In contrast to other laboratory tests that may increase during the progression of the disease, such as D-dimer and cardiac troponin levels \cite{34,35}, LDH has proved to be the most robust laboratory predictor for admission to ICU when evaluated at first-contact. Glucose and oxygenation were also included in these models. Oxygenation, reflected by the S/F ratio, probably reflects the disease extension along with the imaging findings. It is worth noting that the model that included imaging findings (ABC-GOALS$_{clx}$) only mildly improved the model performance, therefore, it may not be necessary to perform imaging in a
patient who is planned to be referred based on the clinical plus laboratory model (ABC-GOALS)).

Recently, a scoring model to predict COVID-19 progression risk (the CALL score) was derived from a Chinese population \(^{24}\). This score includes the presence of any comorbidity, age, lymphocyte count, and LDH levels. The score had a lower performance in our cohort than in the original Chinese cohort. Most patients in our study presented with lymphopenia below the set cut-off for the CALL score, therefore reducing the predictive value of this parameter. Besides, we found several other independent predictors may that increase the predictive yield for ICU admission.

We showed that repurposing of other scores employed in pneumonia may not be perform adequately to predict the need for admission to ICU in COVID-19 pneumonia. For example, the MuLBSTA score \(^{22}\) has been validated for mortality prediction in viral pneumonia, but may have a lower performance in COVID-19 pneumonia. This score points the number of affected lobes by viral pneumonia, however, all patients in our study showed multi-lobar lung infiltrates reducing the performance of this parameter. Other variables included in this score, such as bacterial coinfection, may not perform well when evaluated at admission, as bacterial coinfection more frequently occurs later in the disease evolution.

Finally, although the ABC-GOALS score seems to have a good performance for mortality prediction, this data should be taken with caution as one-fourth of patients admitted to an ICU were still on follow-up by the end of this study. Therefore, the
prognostic performance of this score for mortality prediction should be further evaluated in other studies.

The study has some strengths. First, all data were collected prospectively with very few missing data for all collected variables. Second, there was an appropriate number of patients in the group that required admission to an ICU which allowed the study of multiple predictors. Third, the study is reported based on TRIPOD guidelines

There are limitations of this study. The study involves only derivation of the score and therefore, the score still needs further validation in our population as well as external validation in other populations. However, the actual need for a tool to predict ICU admission and to timely refer patients compelled us to start using this tool locally and to validate it over the progress of the pandemic. Another limitation is that medical practice and admission criteria to ICU may vary between institutions and countries, especially in stressed health systems. This score was derived from a population living in Mexico City at >7300 feet over the sea level. The mean partial pressure of oxygen at this altitude has been estimated at around 66mmHg (estimated normal baseline P/F ratio = 314)\textsuperscript{37,38}. We therefore used the S/F ratio to account for respiratory compensation and the right-shift of the hemoglobin dissociation curve that takes place at higher altitudes (higher p50 values in Mexico City). Then, local validation is needed for this score. Finally, the thresholds set to define the risk groups should be adapted to local needs.

In summary, the ABC-GOALS score represents a tool to evaluate patients with COVID-19 at admission to the ED, designed to timely predict their risk of admission...
to an ICU. This score may help early referral and planning of attention during the COVID-19 pandemic.

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None.

**CONFLICT OF INTEREST.**

All authors declare there is no conflict of interest with the content of this manuscript.

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### TABLES

#### Table 1. Subject characteristics on first evaluation at the emergency department.

|                          | All patients n=329 | Critical Care n=115 | General wards n=214 | p-value  |
|--------------------------|--------------------|----------------------|----------------------|----------|
| **Age, years**           | 49 (41-60)         | 53 (43-62)           | 49 (39-59)           | 0.009    |
| **Male gender, n (%)**   | 211 (64)           | 88 (77)              | 123 (58)             | <0.001   |
| **Current/past smoker, n (%)** | 23 (7)          | 10 (9)               | 13 (6)               | 0.497    |
| **Comorbidities**        |                    |                      |                      |          |
| Diabetes mellitus, n (%) | 80 (24)            | 37 (32)              | 43 (20)              | 0.016    |
| Hypertension, n (%)      | 88 (27)            | 33 (29)              | 55 (26)              | 0.602    |
| Obesity, n (%)           | 132 (40)           | 59 (51)              | 73 (34)              | 0.003    |
| CKD, n (%)               | 19 (6)             | 7 (6)                | 12 (6)               | 0.807    |
| None, n (%)              | 100 (30)           | 18 (16)              | 82 (38)              | <0.001   |
| **Charlson index, points** | 1 (0-2)          | 1 (0-3)              | 1 (0-2)              | 0.001    |
| 0 points                 | 141 (43)           | 36 (31)              | 105 (49)             | 0.002    |
| 1-2 points               | 125 (38)           | 47 (41)              | 78 (36)              |          |
| ≥3 points                | 63 (19)            | 32 (28)              | 31 (15)              |          |
| **Clinical Presentation**|                    |                      |                      |          |
| Fever, n (%)             | 302 (92)           | 104 (90)             | 198 (93)             | 0.532    |
| Cough, n (%)             | 285 (87)           | 103 (90)             | 182 (85)             | 0.309    |
| Myalgia / arthralgia, n (%) | 148 (45)         | 40 (35)              | 108 (51)             | 0.007    |
| Sore throat, n (%)       | 100 (30)           | 36 (31)              | 64 (30)              | 0.803    |
| Rhinorrhea, n (%)        | 51 (16)            | 19 (17)              | 32 (15)              | 0.750    |
| Headache, n (%)          | 162 (49)           | 56 (49)              | 106 (50)             | 0.908    |
| Dyspnea, n (%)           | 229 (70)           | 98 (85)              | 131 (61)             | <0.001   |
| Diarrhea, n (%)          | 56 (17)            | 21 (18)              | 35 (16)              | 0.759    |
| Anosmia, n (%)           | 17 (5)             | 4 (4)                | 13 (6)               | 0.435    |
| Days with symptoms       | 7 (5-10)           | 7 (5-9)              | 8 (5-10)             | 0.595    |
| **Physical examination** |                    |                      |                      |          |
| Body mass index, kg/m²   | 29.0 (26.5-31.2)   | 29.6 (26.9-33.4)     | 28.9 (26.3-30.6)     | 0.006    |
| Systolic AP<100 mmHg     | 16 (5)             | 11 (10)              | 5 (2)                | 0.001    |
| Respiratory rate, per min | 24 (21-30)       | 28 (24-36)           | 24 (20-28)           | <0.001   |
| **Laboratory evaluation**|                    |                      |                      |          |
| Total leucocytes, x10⁹/µL | 7.1 (5.3-9.5)    | 9.0 (5.8-12.1)       | 6.7 (5.1-8.7)        | <0.001   |
| Neutrophils, x10⁹/µL     | 5.9 (2.8-8.2)      | 7.7 (4.8-10.7)       | 5.2 (3.6-7.1)        | <0.001   |
| Lymphocytes, x10⁹/µL     | 0.8 (0.6-1.1)      | 0.7 (0.5-1.0)        | 0.9 (0.7-1.1)        | <0.001   |
| Monocytes, x10⁹/µL       | 0.4 (0.3-0.6)      | 0.4 (0.3-0.5)        | 0.4 (0.3-0.6)        | 0.526    |
| Hemoglobin, g/dL         | 15.5 (14.4-16.6)   | 15.5 (14.4-16.5)     | 15.6 (14.2-16.6)     | 0.843    |
| Platelets, x10⁹          | 208 (165-257)      | 215 (166-266)        | 206 (165-256)        | 0.515    |
| Total bilirubin, mg/dL   | 0.55 (0.43-0.75)   | 0.62 (0.46-0.84)     | 0.53 (0.43-0.69)     | 0.005    |
| Direct bilirubin, mg/dL  | 0.16 (0.11-0.22)   | 0.18 (0.14-0.27)     | 0.14 (0.11-0.21)     | <0.001   |
| ALT, U/L                 | 34.3 (23.3-52.7)   | 37.3 (23.9-52.7)     | 33.7 (22.3-52.6)     | 0.574    |
| AST, U/L                 | 39.3 (27.9-57.6)   | 46.6 (33.3-67.8)     | 36.5 (26.5-51.2)     | <0.001   |
| Alkaline phosphatase, mg/dL | 83 (68-105)    | 84 (70-107)          | 83 (67-103)          | 0.608    |
| Serum albumin, g/dL      | 3.8 (3.4-4.1)      | 3.5 (3.2-3.9)        | 3.9 (2.6-4.1)        | <0.001   |
| Serum globulins, g/dL    | 3.2 (3.0-3.5)      | 3.3 (3.0-3.6)        | 3.2 (2.9-3.5)        | 0.608    |
| Glucose, mg/dL           | 115 (100-147)      | 138 (111-213)        | 107 (97-128)         | <0.001   |
| BUN, mg/dL               | 14.0 (10.5-19.8)   | 16.6 (12.8-24.0)     | 12.7 (9.7-17.9)      | <0.001   |
| Creatinine, mg/dL        | 0.93 (0.75-1.15)   | 1.00 (0.85-1.24)     | 0.89 (0.72-1.10)     | <0.001   |
| Sodium, mEq/L            | 135 (132-137)      | 134 (132-138)        | 135 (133-137)        | 0.200    |
|                        | Median (IQR)          | Median (IQR)          | Median (IQR)          | p-value |
|------------------------|-----------------------|-----------------------|-----------------------|---------|
| Potassium, mEq/L       | 4.0 (3.7-4.3)         | 4.0 (3.6-4.3)         | 4.0 (3.7-4.3)         | 0.823   |
| Chloride, mEq/L        | 101 (98-104)          | 100 (97-104)          | 102 (99-104)          | 0.042   |
| Total serum CO₂, mmol/L| 23.2 (21.5-25.0)      | 22.6 (20.8-24.4)      | 23.4 (21.9-25.2)      | 0.001   |
| Creatine kinase, U/L   | 103 (61-222)          | 142 (72-276)          | 88 (57-166)           | 0.003   |
| Lactate dehydrogenase, U/L | 336 (259-456)   | 474 (344-578)        | 288 (230-380)         | <0.001  |
| C reactive protein, ng/dL | 12.6 (5.4-19.3)  | 18.3 (12.6-25.7)     | 7.8 (3.4-15.6)        | <0.001  |
| Ferritin, ng/mL        | 506 (254-939)         | 740 (423-1092)        | 375 (207-784)         | <0.001  |
| Troponin I >ULN (%)    | 35 (10.6)             | 28 (24.3)             | 7 (3.3)               | <0.001  |
| Fibrinogen, mg/dL      | 604 (457-723)         | 688 (542-807)         | 499 (434-678)         | <0.001  |
| D-dimer, ng/mL         | 628 (398-1072)        | 761 (495-1323)        | 523 (358-958)         | <0.001  |

**Arterial blood gas analysis**

|                        | Median (IQR)          | Median (IQR)          | Median (IQR)          | p-value |
|------------------------|-----------------------|-----------------------|-----------------------|---------|
| pH                     | 7.44 (7.42-7.47)      | 7.44 (7.39-7.46)      | 7.45 (7.42-7.47)      | <0.001  |
| Bicarbonate, mmol/L    | 21.5 (19.9-22.9)      | 21.0 (18.6-23.5)      | 21.6 (20.5-22.8)      | 0.122   |
| Lactate, mmol/L        | 1.2 (0.9-1.6)         | 1.5 (1.0-2.1)         | 1.1 (0.9-1.4)         | <0.001  |
| PaO₂/FiO₂ ratio        | 247 (175-291)         | 177 (107-247)         | 269 (229-305)         | <0.001  |
| SaO₂/FiO₂ ratio        | 330 (211-426)         | 193 (149-325)         | 410 (315-433)         | <0.001  |

**Chest CT scan**

|                      | Median (IQR)          | Median (IQR)          | Median (IQR)          | p-value |
|----------------------|-----------------------|-----------------------|-----------------------|---------|
| Multi-lobar          | 329 (100)             | 115 (100)             | 214 (100)             | 1.000   |
| Extension            |                       |                       |                       |         |
| Mild (<20%)          | 57 (17)               | 3 (3)                 | 54 (25)               | <0.001  |
| Moderate (21-50%)    | 141 (43)              | 26 (22)               | 115 (54)              |         |
| Severe (>50%)        | 131 (40)              | 86 (75)               | 45 (21)               |         |

* Continuous variables are expressed as median (interquartile range).

**Abbreviations.** CKD, chronic kidney disease; AP, arterial pressure; ALT, alanine transaminase; AST, aspartate transaminase; BUN, blood urea nitrogen; CO₂, total diluted carbon dioxide; PaO₂/FiO₂ ratio, ratio of arterial pressure of oxygen to fraction of inspired oxygen; SaFiO₂/FiO₂, ratio of the percentage of hemoglobin saturation by oxygen to fraction of inspired oxygen; NEWS-2, National Early Warning Score 2; SOFA – PaO₂/FiO₂, Sequential Organ Failure Assessment score with respiratory points obtained by PaO₂/FiO₂ ratio; SOFA-SaO₂/FiO₂, Sequential Organ Failure Assessment score with respiratory points obtained by SaO₂/FiO₂.
Table 2. Models to predict the risk of admission to an intensive care unit

|                      | Bivariate |          |          | Multivariate |          |
|----------------------|-----------|----------|----------|--------------|----------|
|                      | OR        | 95%CI    | p-value  | OR           | 95%CI    | p-value  |
| Model 1: clinical    |           |          |          |              |          |          |
| Male gender          | 2.41      | 1.45-4.01| 0.001    | 1.82         | 1.01-3.30| 0.049    |
| Obesity, BMI>30kg/m² | 2.04      | 1.28-3.23| 0.003    | 2.56         | 1.56-4.55| 0.001    |
| Dyspnea              | 3.65      | 2.04-6.55| <0.001   | 2.39         | 1.22-4.67| 0.022    |
| SBP<100mmHg          | 4.42      | 1.50-13.06| 0.007   | 5.10         | 1.37-18.9| 0.015    |
| Respiratory rate     |           |          |          |              |          |          |
| <24 per min          | 1.00      | reference| reference| 1.00         | reference| reference|
| 24-28 per min        | 2.253     | 1.223-4.150| 0.009  | 2.12         | 1.08-4.17| 0.029    |
| ≥28 per min          | 8.063     | 4.279-15.19| <0.001 | 5.14         | 2.50-10.7| <0.001   |
| Charlson index       |           |          |          |              |          |          |
| 0 points             | 1.00      | reference| reference| 1.00         | reference| reference|
| 1-2 points           | 1.76      | 1.04-2.97| 0.035    | 2.33         | 1.28-4.27| 0.029    |
| ≥3 points            | 3.01      | 1.62-5.61| 0.001    | 4.96         | 2.32-10.6| <0.001   |
| Model 2: clinical + laboratory | | | | | | |
| Male gender          | 2.41      | 1.45-4.01| 0.001    | 2.48         | 1.28-4.81| 0.007    |
| Obesity, BMI>30kg/m² | 2.04      | 1.28-3.23| 0.003    | 2.97         | 1.59-5.55| 0.001    |
| Dyspnea              | 3.65      | 2.04-6.55| <0.001   | 2.24         | 1.08-4.61| 0.029    |
| Charlson index ≥3    | 2.28      | 1.30-3.98| 0.004    | 2.84         | 1.31-6.15| 0.008    |
| SBP<100mmHg          | 4.42      | 1.50-13.06| 0.007  | 5.71         | 1.31-24.9| 0.020    |
| Glucose >200g/dL     | 3.10      | 1.67-5.74| <0.001   | 3.00         | 1.35-6.67| 0.007    |
| Albumin <3.5g/dL     | 4.15      | 2.52-6.83| <0.001   | 2.13         | 1.14-3.99| 0.018    |
| LDH>ULN              | 8.55      | 4.11-17.79| <0.001 | 3.39         | 1.47-7.79| 0.004    |
| S/F ratio<300        | 8.48      | 5.07-14.19| <0.001 | 5.41         | 2.93-9.97| <0.001   |
| Model 3: clinical + laboratory + image | | | | | | |
| Male gender          | 2.41      | 1.45-4.01| 0.001    | 2.14         | 1.09-4.18| 0.026    |
| Obesity, BMI>30kg/m² | 2.04      | 1.28-3.23| 0.003    | 2.58         | 1.37-4.85| 0.003    |
| Charlson index ≥3    | 2.28      | 1.30-3.98| 0.004    | 2.90         | 1.32-6.37| 0.008    |
| SBP<100mmHg          | 4.42      | 1.50-13.06| 0.007  | 5.15         | 1.12-23.6| 0.035    |
| Glucose >200mg/dL    | 3.10      | 1.67-5.74| <0.001   | 2.64         | 1.14-6.12| 0.023    |
| LDH>ULN              | 8.55      | 4.11-17.79| <0.001 | 2.83         | 1.20-6.66| 0.017    |
| S/F ratio<300        | 8.48      | 5.07-14.19| <0.001 | 4.43         | 2.35-8.35| <0.001   |
| CT lung involvement >50% | 11.1 | 6.53-18.99| <0.001 | 4.62         | 2.47-8.64| <0.001   |

Abbreviations. OR, odds ratio; 95%CI, 95% confidence intervals; SBP, systolic blood pressure; LDH, lactate dehydrogenase serum levels; S/F ratio, ratio of percentage of hemoglobin saturation to fraction of inspired oxygen; CT, computed tomography.
Table 3. ABC-GOALS scoring system

| Parameter                  | ABC-GOALS clinic | ABC-GOALS clinic + laboratory | ABC-GOALS + imaging |
|----------------------------|------------------|-------------------------------|---------------------|
| Male sex                   | 1                | 1                             | 1                   |
| Arterial BP Systolic <100mmHg | 4                | 4                             | 4                   |
| Breathlessness             | 1                | 1                             | -                   |
| Charlson index             |                  |                               |                     |
| 1-2 points                 | 1                | -                             | -                   |
| ≥ 3 points                 | 3                | 2                             | 2                   |
| Glucose > 200 mg/dL        | -                | 2                             | 2                   |
| Obesity, BMI >30 kg/m²     | 2                | 2                             | 2                   |
| Albumin < 3.5 g/dL         | -                | 1                             | -                   |
| Lactate dehydrogenase >ULN | -                | 2                             | 2                   |
| SaO2 / FiO2 ratio < 300    | -                | 4                             | 3                   |
| CT lung involvement > 50%  | -                | -                             | 4                   |
| Respiratory Rate           |                  |                               |                     |
| 24-28 per minute           | 1                | -                             | -                   |
| > 28 per minute            | 4                | -                             | -                   |
| **TOTAL SCORE**            | **0-15**         | **0-19**                      | **0-20**            |

**RISK CATEGORIES**

| Low                        | 0-2 points        | 0-3 points        | 0-4 points        |
|                           | *Mean risk (95% CI)* | *Mean risk (95% CI)* | *Mean risk (95% CI)* |
|                           | 8% (7%-9%)         | 4% (3%-4%)        | 6% (5%-6%)        |
| Moderate                  | 3-7 points         | 4-9 points        | 5-9 points        |
| *Mean risk (95% CI)*      | 32% (30%-34%)      | 30% (27%-32%)     | 32% (29%-34%)     |
| High                      | ≥8 points          | ≥10 points        | ≥10 points        |
| *Mean risk (95% CI)*      | 73% (70%-75%)      | 80% (78%-82%)     | 80% (78%-82%)     |
Table 4. Predictive performance of all evaluated scores for admission to an ICU.

| Score          | Area under the curve | Cut-off | Sensitivity | Specificity |
|----------------|----------------------|---------|-------------|-------------|
| ABC-GOALS<sub>c</sub> | 0.79 (0.74-0.83)   | ≥5      | 74          | 68          |
| ABC-GOALS<sub>cl</sub> | 0.86 (0.82-0.90)  | ≥6      | 89          | 67          |
|                 |                     | ≥7      | 78          | 79          |
| ABC-GOALS<sub>clx</sub> | 0.88 (0.84-0.92) | ≥6      | 88          | 72          |
|                 |                     | ≥7      | 85          | 77          |
| NEWS-2         | 0.76 (0.70-0.81)   | ≥7      | 77          | 60          |
|                 |                     | ≥9      | 41          | 88          |
| CALL           | 0.72 (0.67-0.78)   | ≥9      | 75          | 56          |
|                 |                     | ≥10     | 67          | 67          |
| SOFA           | 0.77 (0.71-0.82)   | ≥1      | 85          | 54          |
|                 |                     | ≥2      | 64          | 80          |
| CURB-65        | 0.71 (0.65-0.77)   | ≥1      | 74          | 63          |
| MuLBSTA        | 0.63 (0.57-0.70)   | ≥8      | 69          | 54          |
|                 |                     | ≥9      | 64          | 67          |
|                 |                     | ≥12     | 12          | 94          |
| ROX index      | 0.81 (0.76-0.86)   | ≤5      | 38          | 97          |

* All scores were obtained at admission to the emergency room. SOFA respiratory points were assigned based on the S/F ratio.

**Abbreviations.** ABC-GOALSc, score including only clinical variables; ABC-GOALS<sub>cl</sub>, score including both clinical and laboratory variables; ABC-GOALS<sub>clx</sub>, score including clinical, laboratory and x-ray findings; NEWS-2, National Early Warning Score version 2; CALL, comorbidity, age, lymphocyte, LDH score for predicting progression of COVID-19; SOFA, Sequential Organ Failure Assessment score; CURB-65, confusion, urea, respiratory rate, blood pressure, age>65 years score for risk of mortality from pneumonia; MuLBSTA, Multi-lobar infiltrate, Lymphocyte count, Bacterial co-infection, Smoking history, hypertension, Age>65 years score for mortality from viral pneumonia; ROX index, S/F ratio divided by the respiratory rate to predict the risk of intubation in hypoxemic respiratory failure.
FIGURES

Figure 1. Receiver-operating curves for the three ABC-GOALS scores.
Figure 2. Predicted and observed percentages of patients admitted to an ICU by each point increment in the ABC-GOALSc (A), ABC-GOALSc1 (B) and ABC-GOALSc1x (C) scores.
## SUPPLEMENTARY MATERIAL

### Supplementary Table 1. Characteristics at admission to the emergency department of all the included subjects.

| Characteristics at admission to the emergency department | All patients n=329 | Critical Care n=115 | General wards n=214 | p-value |
|----------------------------------------------------------|--------------------|---------------------|---------------------|---------|
| Age, years                                               | 49 (41-60)         | 53 (43-62)          | 49 (39-59)          | 0.009   |
| Male gender, n (%)                                       | 211 (64)           | 88 (77)             | 123 (58)            | <0.001  |
| Current/past smoker, n (%)                               | 23 (7)             | 10 (9)              | 13 (6)              | 0.497   |
| Comorbidities                                            |                    |                     |                     |         |
| Diabetes mellitus, n (%)                                 | 80 (24)            | 37 (32)             | 43 (20)             | 0.016   |
| Hypertension, n (%)                                      | 88 (27)            | 33 (29)             | 55 (26)             | 0.602   |
| Obesity, n (%)                                           | 132 (40)           | 59 (51)             | 73 (34)             | 0.003   |
| CKD, n (%)                                               | 19 (6)             | 7 (6)               | 12 (6)              | 0.807   |
| None, n (%)                                              | 100 (30)           | 18 (16)             | 82 (38)             | <0.001  |
| Charlson index, points                                   |                    |                     |                     |         |
| 0 points                                                 | 141 (43)           | 36 (31)             | 105 (49)            | 0.002   |
| 1-2 points                                               | 125 (38)           | 47 (41)             | 78 (36)             |         |
| ≥3 points                                                | 63 (19)            | 32 (28)             | 31 (15)             |         |
| Clinical Presentation                                    |                    |                     |                     |         |
| Fever, n (%)                                             | 302 (92)           | 104 (90)            | 198 (93)            | 0.532   |
| Cough, n (%)                                             | 285 (87)           | 103 (90)            | 182 (85)            | 0.309   |
| Myalgia / arthralgia, n (%)                              | 148 (45)           | 40 (35)             | 108 (51)            | 0.007   |
| Sore throat, n (%)                                       | 100 (30)           | 36 (31)             | 64 (30)             | 0.803   |
| Rhinorrhea, n (%)                                        | 51 (16)            | 19 (17)             | 32 (15)             | 0.750   |
| Headache, n (%)                                          | 162 (49)           | 56 (49)             | 106 (50)            | 0.908   |
| Dyspnea, n (%)                                           | 229 (70)           | 98 (85)             | 131 (61)            | <0.001  |
| Diarrhea, n (%)                                          | 56 (17)            | 21 (18)             | 35 (16)             | 0.759   |
| Anosmia, n (%)                                           | 17 (5)             | 4 (4)               | 13 (6)              | 0.435   |
| Days with symptoms                                       | 7 (5-10)           | 7 (5-9)             | 8 (5-10)            | 0.595   |
| Physical examination                                     |                    |                     |                     |         |
| Body mass index, kg/m²                                    | 29.0 (26.5-31.2)   | 29.6 (26.9-33.4)    | 28.9 (26.3-30.6)    | 0.006   |
| Mean AP, mmHg                                            | 90 (83-98)         | 89 (82-97)          | 91 (84-99)          | 0.152   |
| Systolic AP<100 mmHg                                      | 16 (5)             | 11 (10)             | 5 (2)               | 0.001   |
| Respiratory rate, per min                                | 24 (21-30)         | 28 (24-36)          | 24 (20-28)          | <0.001  |
| <24 per minute                                           | 122 (37)           | 21 (18)             | 101 (47)            | <0.001  |
| 24-28 per minute                                         | 116 (35)           | 37 (32)             | 79 (37)             |         |
| >28 per minute                                           | 91 (28)            | 57 (50)             | 34 (16)             |         |
| Laboratory evaluation                                   |                    |                     |                     |         |
| Total leukocytes, x10³/L                                 | 7.1 (5.3-9.5)      | 9.0 (5.8-12.1)      | 6.7 (5.1-8.7)       | <0.001  |
| Neutrophils, x10³/L                                     | 5.9 (2.8-8.2)      | 7.7 (4.8-10.7)      | 5.2 (3.6-7.1)       | <0.001  |
| Lymphocytes, x10³/L                                     | 0.8 (0.6-1.1)      | 0.7 (0.5-1.0)       | 0.9 (0.7-1.1)       | <0.001  |
| Monocytes, x10³/L                                       | 0.4 (0.3-0.6)      | 0.4 (0.3-0.5)       | 0.4 (0.3-0.6)       | 0.526   |
| Hemoglobin, g/dL                                         | 15.5 (14.4-16.6)   | 15.5 (14.4-16.5)    | 15.6 (14.2-16.6)    | 0.843   |
| Platelets, x10³                                        | 208 (165-257)      | 215 (166-266)       | 206 (165-256)       | 0.515   |
| Total bilirubin, mg/dL                                  | 0.55 (0.43-0.75)   | 0.62 (0.46-0.84)    | 0.53 (0.43-0.69)    | 0.005   |
| Direct bilirubin, mg/dL                                 | 0.16 (0.11-0.22)   | 0.18 (0.14-0.27)    | 0.14 (0.11-0.21)    | <0.001  |
| ALT, U/L                                                 | 34.3 (23.3-52.7)   | 37.3 (23.9-52.7)    | 33.7 (22.3-52.6)    | 0.574   |
| AST, U/L                                                 | 39.3 (27.9-57.6)   | 46.6 (33.3-67.8)    | 36.5 (26.5-51.2)    | <0.001  |
| Alkaline phosphatase, mg/dL                             | 83 (68-105)        | 84 (70-107)         | 83 (67-103)         | 0.608   |
Scores at presentation

- NEWS-2, points: 7 (5-8) to 8 (7-10) to 6 (4-7) <0.001
- SOFA - PaO2/FiO2: 2 (2-3) to 3 (2-4) to 2 (2-3) <0.001
- SOFA - SaO2/FiO2: 1 (0-2) to 2 (1-3) to 0 (0-1) <0.001
- CALL score, points: 9 (7-11) to 10 (8-11) to 8 (7-10) <0.001
- CURB-65 score, points: 0 (0-1) to 1 (0-2) to 0 (0-1) <0.001
- MuLBSTA score, points: 9 (5-11) to 9 (5-11) to 7 (5-9) <0.001
- ROX index: 13.6 (7.1-18.6) to 6.9 (4.5-12.9) to 16.4 (12.3-20.7) <0.001

Chest CT scan

- Multi-lobar, n (%): 329 (100) to 115 (100) to 214 (100) 1.000
- Extension, n (%): 57 (17) to 3 (3) to 54 (25) <0.001
- Mild (≤20%): 141 (43) to 26 (23) to 115 (54)
- Moderate (21-50%): 131 (40) to 86 (75) to 45 (21)

Abbreviations. CKD, chronic kidney disease; AP, arterial pressure; ALT, alanine transaminase; AST, aspartate transaminase; BUN, blood urea nitrogen; CO2, total carbon dioxide; PaO2/FiO2 ratio, ratio of arterial pressure of oxygen to fraction of inspired oxygen; SaO2/FiO2, ratio of the percentage of hemoglobin saturation by oxygen to fraction of inspired oxygen; NEWS-2, National Early Warning Score 2; SOFA – PaO2/FiO2, Sequential Organ Failure Assessment score with respiratory points obtained by PaO2/FiO2 ratio; SOFA-SaO2/FiO2, Sequential Organ Failure Assessment score with respiratory points obtained by SaO2/FiO2; MuLBSTA, Multi-lobar infiltrate, Lymphocyte count, Bacterial co-infection, Smoking history, Hypertension, Age>65 years score for mortality from viral pneumonia; ROX index, S/F ratio divided by the respiratory rate to predict the risk of intubation in hypoxemic respiratory failure ULN, upper limit of normal.
**Supplementary Table 2. Variables explored by bivariate logistic regression analysis.**

| Demographics variables | OR     | 95% CI      | p-value |
|------------------------|--------|-------------|---------|
| Age, per year          | 1.021  | 1.004-1.038 | 0.015*  |
| Age ≥50 years, vs. less| 1.716  | 1.085-2.713 | 0.021*  |
| Male gender, vs. female| 2.411  | 1.449-4.013 | 0.001*  |

| Previous medical history | OR     | 95% CI      | p-value |
|--------------------------|--------|-------------|---------|
| Current or previous smoker, vs. no | 1.473  | 0.625-3.471 | 0.376   |
| Hypertension, vs. no    | 1.163  | 0.701-1.932 | 0.559   |
| Diabetes mellitus, vs. no| 1.886  | 1.128-3.156 | 0.016*  |
| Chronic kidney disease, vs. no | 1.122  | 0.429-2.935 | 0.814   |
| Obesity (BMI>30kg/m²), vs. no | 2.035  | 1.282-3.230 | 0.003*  |
| No comorbidities, vs. yes | 0.299  | 0.168-0.530 | 0.000*  |
| Charlson index, per point | 1.235  | 1.071-1.425 | 0.004*  |
| Charlson index categories |        |             |         |
| 0 points                | 1.000  | reference   | reference|
| 1-2 points              | 1.757  | 1.041-2.967 | 0.035   |
| ≥3 points               | 3.011  | 1.616-5.610 | 0.001   |

| Clinical presentation variables | OR     | 95% CI      | p-value |
|----------------------------------|--------|-------------|---------|
| Days with symptoms, per day      | 1.010  | 0.956-1.066 | 0.729   |
| Three of more days with symptoms| 3.859  | 0.857-17.38 | 0.079   |
| Fever, vs. none                  | 0.764  | 0.342-1.706 | 0.511   |
| Cough, vs. none                  | 1.509  | 0.745-3.058 | 0.253*  |
| Fatigue/malaise, vs. none        | 0.907  | 0.576-1.428 | 0.673   |
| Mialgia/arthritis, vs. none      | 0.523  | 0.328-0.836 | 0.007*  |
| Sore throat, vs. none            | 1.068  | 0.654-1.745 | 0.793   |
| Rinorrhoea, vs. none             | 1.126  | 0.606-2.091 | 0.708   |
| Headache, vs. none               | 0.967  | 0.615-1.522 | 0.885   |
| Dyspnea, vs. none                | 3.652  | 2.037-6.548 | 0.000*  |
| Diarrhea, vs. none               | 1.143  | 0.630-2.073 | 0.661   |
| Anosmia, vs. none                | 0.557  | 0.177-1.750 | 0.316   |

| Physical examination variables | OR     | 95% CI      | p-value |
|----------------------------------|--------|-------------|---------|
| Mean arterial pressure, per mmHg | 0.989  | 0.971-1.007 | 0.233   |
| MAP<65mmHg, vs. higher           | 3.770  | 0.338-42.03 | 0.281   |
| Systolic arterial pressure, per mmHg | 0.991  | 0.978-1.004 | 0.184   |
| SAP<100mmHg, vs. higher          | 4.421  | 1.497-13.06 | 0.007*  |
| Diastolic arterial pressure, per mmHg | 0.991  | 0.973-1.010 | 0.369   |
| Respiratory rate, per 1x'        | 1.137  | 1.094-1.183 | 0.000*  |
| Respiratory rate                  |        |             |         |
| <24 per minute                    | 1.000  | reference   | reference|
| 24-28 per minute                  | 2.253  | 1.223-4.150 | 0.009   |
| >28 per minute                    | 8.063  | 4.279-15.19 | 0.000*  |
| Body mass index, per kg/m²        | 1.080  | 1.030-1.132 | 0.001*  |

| Laboratory variables | OR     | 95% CI      | p-value |
|----------------------|--------|-------------|---------|
| Total leukocytes, per 1x10³ | 1.209  | 1.127-1.296 | 0.000*  |
| Neutrophils, per 1x10³     | 1.000  | 1.000-1.000 | 0.000*  |
| Lymphocytes, per 1x10³     | 0.999  | 0.998-1.000 | 0.001*  |
| Monocytes, per 1x10³       | 1.001  | 0.999-1.001 | 0.596   |
| Hemoglobin, per g/dL       | 0.973  | 0.860-1.101 | 0.666   |
| Test                              | Lower Limit | Upper Limit  |
|----------------------------------|-------------|--------------|
| Platelets, per 1x10⁶             | 1.001       | 0.998-1.004  |
| Total bilirubin, per mg/dL       | 1.753       | 0.999-3.076  |
| Direct bilirubin, per mg/dL      | 0.963       | 0.806-1.151  |
| ALT, per U/L                     | 1.002       | 0.999-1.005  |
| AST, per U/L                     | 1.005       | 1.000-1.010  |
| AST ≥40U/L, vs. lower            | 2.310       | 1.452-3.676  |
| Alkaline phosphatase, per mg/dL  | 1.001       | 0.996-1.006  |
| Serum albumin, per mg/dL         | 0.166       | 0.094-0.294  |
| Serum albumin <3.5mg/dL, vs. higher | 4.147     | 2.516-6.834  |
| Serum globulins, per mg/dL       | 1.341       | 0.812-2.215  |
| Glucose, per mg/dL               | 1.008       | 1.005-1.012  |
| Glucose > 200 mg/dL, vs. lower   | 3.099       | 1.673-5.740  |
| Blood urea nitrogen, per mg/dL   | 1.048       | 1.023-1.073  |
| Serum creatinine, per mg/dL      | 1.638       | 1.003-2.676  |
| Sodium, per mEq/L                | 0.967       | 0.914-1.024  |
| Potassium, per mEq/L             | 1.124       | 0.853-1.481  |
| Chloride, per mEq/L              | 0.945       | 0.894-0.997  |
| Total CO₂, per mmol/L            | 0.873       | 0.803-0.948  |
| Corrected calcium, per mg/dL     | 1.008       | 0.851-1.194  |
| Phosphorus, per mg/dL            | 1.452       | 1.091-1.931  |
| Magnesium, per mg/dL             | 1.821       | 0.875-3.793  |
| Creatine kinase, per U/L         | 1.001       | 1.000-1.002  |
| Lactate dehydrogenase, per U/L   | 1.006       | 1.004-1.07   |
| ≥ upper limit of normal, vs. lower | 8.548    | 4.109-17.79  |
| C-reactive protein, per mg/dL    | 1.114       | 1.082-1.148  |
| ≥5mg/dL, vs. lower               | 29.252      | 7.026-121.8  |
| ≥10mg/dL, vs. lower              | 7.942       | 4.438-14.215 |
| Ferritin, per ng/mL              | 1.001       | 1.000-1.001  |
| ≥400ng/mL, vs. lower             | 3.579       | 2.154-5.947  |
| Troponin I, per pg/mL            | 1.006       | 1.000-1.012  |
| ≥ upper limit of normal, vs. lower | 9.471  | 3.987-22.501 |
| Fibrinogen, per mg/dL            | 1.004       | 1.002-1.005  |
| ≥500ng/mL, vs. lower             | 3.249       | 1.963-5.376  |
| D dimer, per ng/mL               | 1.000       | 1.000-1.000  |
| ≥500ng/mL, vs. lower             | 2.620       | 1.589-4.318  |

### Arterial blood gas

| Test                              | Lower Limit | Upper Limit  |
|----------------------------------|-------------|--------------|
| pH, per unit                     | 0.000       | 0.000-0.003  |
| Bicarbonate, per mmol/L          | 0.948       | 0.880-1.021  |
| Lactate, per mmol/L              | 2.352       | 1.620-3.415  |
| P/F ratio, per unit              | 0.989       | 0.985-0.992  |
| S/F ratio, per unit              | 0.990       | 0.988-0.992  |
| S/F ratio<300, vs. higher        | 8.831       | 5.264-14.815 |

### Scores

| Test                              | Lower Limit | Upper Limit  |
|----------------------------------|-------------|--------------|
| NEWS-2, per point                | 1.604       | 1.409-1.826  |
| SOFA – PaO₂/FiO₂, per point      | 1.911       | 1.551-2.355  |
| SOFA – SaO₂/FiO₂, per point      | 2.090       | 1.711-2.551  |
| CALL score, per point            | 1.483       | 1.311-1.677  |
| CURB-65, per point               | 2.409       | 1.831-3.170  |
| ROX index, per point             | 0.822       | 0.785-0.862  |
| MuLBSTA score, per point         | 1.200       | 1.099-1.310  |

### Chest CT scan
| Pneumonia extension |       |       | Reference |
|---------------------|-------|-------|-----------|
| Mild-moderate (<50%) | 1.000 | reference | Reference |
| Severe (>50%)       | 11.137 | 6.529-18.99 | <0.001 |

**Abbreviations.** BMI, body mass index; ALT, alanine aminotransferase; AST, aspartate aminotransferase; P/F ratio, ratio of arterial pressure of oxygen to fraction of inspired oxygen; S/F ratio, ratio of oxygen hemoglobin saturation to fraction of inspired oxygen; NEWS-2, National Early Warning Score 2; SOFA – PaO2/FiO2, Sequential Organ Failure Assessment score with respiratory points obtained by PaO2/FiO2 ratio; SOFA-SaO2/FiO2, Sequential Organ Failure Assessment score with respiratory points obtained by SaO2/FiO2; MuLBSTA, Multi-lobar infiltrate, Lymphocyte count, Bacterial co-infection, Smoking history, hypertension, Age>65 years score for mortality from viral pneumonia; ROX index, S/F ratio divided by the respiratory rate to predict the risk of intubation in hypoxemic respiratory failure.