**Supplementary Figures:**



**Supplementary Figure S1.** Independent risk factors associated with disease severity (severe/critically ill) of COVID-19 were selected by LASSO regression analyses. (A) LASSO coefficient profiles and (B) Mean-Squared Error plot.

**Supplementary Tables:**

|  |
| --- |
| Table S1. Laboratory indices of severe and critically ill patients with COVID-19 on admission. |
| **Laboratory Indices** | **Normal Range** | **Disease severity** | **Clinical outcomes** |
| Severe (n=73) | Critically ill (n=42) | *P* value | Survivors (n=93) | Non-survivors (n=22) | *P* value |
| Leukocytes, n (%) | 3.5-9.5 g/L |  |  | 0.000 ‡ \* |  |  | 0.014 ‡ \* |
| ＞9.5, n (%) |  | 8 (11%) | 22 (52.4%) |  | 19 (20.4%) | 11 (50%) |  |
| ＜3.5, n (%) |  | 9 (12.3%) | 4 (9.5%) |  | 10 (10.8%) | 3 (13.6%) |  |
| Neutrophils,＞6.3, n (%) | 1.8-6.3 g/L | 12 (16.4%) | 27 (64.3%) | 0.000 § \* | 24 (25.8%) | 15 (68.2%) | 0.000 § \* |
| Neutrophil percentage,＞75%, n (%) | 40-75% | 21 (28.8%) | 35 (83.3%) | 0.000 § \* | 35 (37.6%) | 21 (95.5%) | 0.000 § \* |
| Lymphocytes,＜1.1, n (%) | 1.1-3.2 g/L | 34 (46.6%) | 36 (85.7%) | 0.000 § \* | 48 (51.6%) | 22 (100%) | 0.000 § \* |
| Lymphocyte percentage,＜20%, n (%) | 20-50% | 33 (45.2%) | 35 (83.3%) | 0.000 § \* | 48 (51.6%) | 20 (90.9%) | 0.001 § \* |
| Eosinophils,＜0.02, n (%) | 0.02-0.52 g/L | 16 (21.9%) | 21 (50%) | 0.002 § \* | 23 (24.7%) | 14 (63.6%) | 0.000 § \* |
| Eosinophil percentage,＜0.4, n (%) | 0.4-8% | 14 (19.2%) | 32 (76.2%) | 0.000 § \* | 28 (30.1%) | 18 (81.8%) | 0.000 § \* |
| Monocytes,＞0.6, n (%) | 0.1-0.6 g/L | 10 (13.7%) | 6 (14.3%) | 0.930 § | 15 (16.1%) | 1 (4.5%) | 0.285 ‡ |
| Monocyte percentage,＞10%, n (%) | 3-10% | 9 (12.3%) | 0 (0%) | 0.044 ‡ \* | 9 (9.7%) | 0 (0%) | 0.281 ‡ |
| CRP,＞8, n (%) | 0-8 mg/L | 43 (58.9%) | 39 (92.9%) | 0.000 § \* | 60 (64.5%) | 22 (100%) | 0.001 § \* |
| Procalcitonin, ≥0.05, n (%) | <0.05 ng/ml | 41 (56.2%) | 39 (92.9%) | 0.000 § \* | 58 (62.4%) | 22 (100%) | 0.001 § \* |
| Platelet count,＜125, n (%) | 125-350 g/L | 6 (8.2%) | 13 (31%) | 0.002 § \* | 10 (10.8%) | 9 (40.9%) | 0.002 ‡ \* |
| D-dimer,＞0.5, n (%) | 0-0.5 ug/ml | 36 (49.3%) | 37 (88.1%) | 0.000 § \* | 54 (58.1%) | 19 (86.4%) | 0.013 § \* |
| PT,＞16.0, n (%) | 11.0-16.0 s | 5 (6.8%) | 6 (14.3%) | 0.329 ‡ | 6 (6.5%) | 5 (22.7%) | 0.053 ‡ |
| APTT,＞45.0, n (%) | 27.0-45.0 s | 8 (11%) | 10 (23.8%) | 0.068 § | 13 (14%) | 5 (22.7%) | 0.491 § |
| AST,＞40, n (%) | 8-40 U/L | 16 (21.9%) | 25 (59.5%) | 0.000 § \* | 24 (25.8%) | 17 (77.3%) | 0.000 § \* |
| ALT,＞40, n (%) | 5-40 U/L | 25 (34.2%) | 23 (54.8%) | 0.032 § \* | 37 (39.8%) | 11 (50%) | 0.382 §  |
| Albumin,＜33, n (%) | 33-55 g/L | 34 (46.6%) | 29 (69%) | 0.020 § \* | 48 (51.6%) | 15 (68.2%) | 0.160 §  |
| Lactate dehydrogenase,＞245, n (%) | 109-245 U/L | 26 (35.6%) | 38 (90.5%) | 0.000 § \* | 43 (46.2%) | 21 (95.5%) | 0.000 § \* |
| Alkaline phosphatase,＞150, n (%) | 40-150 U/L | 0 (0%) | 3 (7.1%) | 0.088 ‡ | 2 (2.2%) | 1 (4.5%) | 1.000 ‡ |
| Creatine kinase,＞194, n (%) | 24-194 U/L | 5 (6.8%) | 7 (16.7%) | 0.180 ‡ | 6 (6.5%) | 6 (27.3%) | 0.013 ‡ \* |
| Creatinine,＞111, n (%) | 57-111 μmol/L | 8 (11%) | 7 (16.7%) | 0.382 § | 9 (9.7%) | 6 (27.3%) | 0.064 § |
| Urea,＞8.2, n (%) | 2.9-8.2 mmol/L | 11 (15.1%) | 21 (50%) | 0.000 § \* | 18 (19.4%) | 14 (63.6%) | 0.000 § \* |
| Total bilirubin,＞20, n (%) | 3.0-20 μmol/L | 2 (2.7%) | 13 (31%) | 0.000 § \* | 7 (7.5%) | 8 (36.4%) | 0.001 ‡ \* |
| Troponin, ≥26.2, n (%) | <26.2 ng/L | 6 (8.2%) | 14 (33.3%) | 0.001 § \* | 6 (6.5%) | 14 (63.6%) | 0.000 ‡ \* |
| Abbreviations: NLR, Neutrophil-to-Lymphocyte Ratio; CRP, C-Reactive Protein; PT, Prothrombin Time; APTT, Activated Partial Thromboplastin Time; AST, Aspertate Aminotransferase; ALT, Alanine Aminotransferase. IQR, interquartile range; COVID-19, 2019 novel coronavirus disease. †: Mann-Whitey U test; §: Chi-squared test; ‡: Fisher's Exact Test. \*: P < 0.05. |

|  |
| --- |
| Table S2. Clinical characteristics of critically ill patients with COVID-19 on admission. |
| **Clinical Characteristics** | **Critically ill patients** | ***P* value** |
| Survivors (n=20) | Non-survivors (n=22) |
| Age, Median (IQR), y | 66 (57-70) | 63 (60-71) | 0.840 †  |
| Age, n (%) |  |  | 0.592 §  |
| ≤60 | 6 (30%) | 5 (22.7%) |  |
| ＞60 | 14 (70%) | 17 (77.3%) |  |
| Men, n (%) | 14 (70%) | 7 (31.8%) | 0.013 § \* |
| Symptoms, n (%) |  |  |  |
| Fever | 13 (65%) | 19 (86.4%) | 0.207 ‡ |
| Dry cough | 20 (100%) | 19 (86.4%) | 0.265 ‡ |
| Dyspnea | 14 (70%) | 19 (86.4%) | 0.361 ‡ |
| Expectoration | 9 (45%) | 6 (27.3%) | 0.231 § |
| Myalgia/Fatigue | 5 (25%) | 7 (31.8%) | 0.625 § |
| Diarrhea | 1 (5%) | 4 (18.2%) | 0.401 ‡ |
| Dizziness/Headache | 2 (10%) | 2 (9.1%) | 1.000 ‡ |
| Comorbidities, n (%) |  |  |  |
| Hypertension | 10 (50%) | 10 (45.5%) | 0.768 § |
| Diabetes | 3 (15%) | 6 (27.3%) | 0.554 ‡ |
| Chronic respiratory diseases | 5 (25%) | 0 (0%) | 0.043 ‡ \* |
| Malignancy | 0 (0%) | 3 (13.6%) | 0.265 ‡ |
| Chronic kidney disease | 1 (5%) | 1 (4.5%) | 1.000 ‡ |
| Chronic liver disease | 3 (15%) | 1 (4.5%) | 0.531 ‡ |
| Coexisted comorbidities, n (%) |  |  |  |
| Treatment, n (%) |  |  |  |
| Antiviral therapy | 19 (95%) | 18 (81.8%) | 0.401 ‡ |
| Antibacterial | 19 (95%) | 20 (90.9%) | 1.000 ‡ |
| Glucocorticoid therapy | 15 (75%) | 16 (72.7%) | 0.867 § |
| Immunoabsorption | 1 (5%) | 3 (13.6%) | 0.670 ‡ |
| Oxygen support, n (%) |  |  | 0.850 ‡ |
| High ﬂow nasal cannula | 7 (35%) | 9 (40.9%) |  |
| Noninvasive ventilation | 9 (45%) | 8 (36.4%) |  |
| Invasive mechanical ventilation | 4 (20%) | 5 (22.7%) |  |
| Time from illness onset to hospital admission, Median (IQR), day | 16 (13-26) | 10 (8-14) | 0.004 † \*  |
| Hospital stay, Median (IQR), day | 42 (28-52) | 7 (3-15) | 0.000 † \*  |
| Survival time, Median (IQR), day | 62 (49-62) | 7 (3-15) | 0.000 † \*  |
| Abbreviations: IQR, interquartile range; NA, not applicable; COVID-19, 2019 novel coronavirus disease. †: Mann-Whitey U test; §: Chi-squared test; ‡: Fisher's Exact Test. \*: P＜0.05. |

|  |
| --- |
| Table S3. Laboratory indices of critically ill patients with COVID-19 on admission. |
| **Laboratory Indices** | **Normal Range** | **Critically ill patients** | ***P* value** |
| Survivors (n=20) | Non-survivors (n=22) |
| Leukocytes, Median (IQR) | 3.5-9.5 g/L | 10.8 (5.1-13.0) | 9.7 (6.3-13.0) | 0.880 † |
| Leukocytes, n (%) |  |  |  | 0.622 ‡ |
| ＞9.5, n (%) |  | 11 (55%) | 11 (50%) |  |
| ＜3.5, n (%) | 　 | 1 (5%) | 3 (13.6%) | 　 |
| Neutrophils, Median (IQR) | 1.8-6.3 g/L | 8.8 (3.6-11.4) | 8.7 (5.2-12.4) | 0.782 † |
| ＞6.3, n (%) |  | 12 (60%) | 15 (68.2%) | 0.580 § |
| Neutrophil percentage, Median (IQR) | 40-75% | 82.1 (70.8-89.9) | 90.4 (84.8-93.5) | 0.006 † \* |
| ＞75%, n (%) | 　 | 14 (70%) | 21 (95.5%) | 0.072 § |
| Lymphocytes, Median (IQR) | 1.1-3.2 g/L | 0.9 (0.8-1.1) | 0.5 (0.3-0.7) | 0.000 † \* |
| ＜1.1, n (%) |  | 14 (70%) | 22 (100%) | 0.020 ‡ \* |
| Lymphocyte percentage, Median (IQR) | 20-50% | 9.9 (6.3-19.5) | 5.2 (4.0-8.2) | 0.008 † \* |
| ＜20%, n (%) |  | 15 (75%) | 20 (90.9%) | 0.333 ‡ |
| NLR, Median (IQR) | 　 | 8.3 (3.7-14.1) | 19.1 (10.6-26.8) | 0.003 † \* |
| Eosinophils, Median (IQR) | 0.02-0.52 g/L | 0.0 (0.0-0.1) | 0.0 (0.0-0.0) | 0.067 † |
| ＜0.02, n (%) |  | 7 (35%) | 14 (63.6%) | 0.064 § |
| Eosinophil percentage, Median (IQR) | 0.4-8% | 0.3 (0.1-1.2) | 0.1 (0.0-0.3) | 0.047 † \* |
| ＜0.4, n (%) | 　 | 14 (70%) | 18 (81.8%) | 0.592 ‡ |
| Monocytes, Median (IQR) | 0.1-0.6 g/L | 0.4 (0.3-0.7) | 0.3 (0.1-0.4) | 0.023 † \* |
| ＞0.6, n (%) |  | 5 (25%) | 1 (4.5%) | 0.147 ‡ |
| Monocyte percentage, Median (IQR) | 3-10% | 5.9 (3.6-8.1) | 3.0 (1.9-4.6) | 0.001 † \* |
| ＞10%, n (%) | 　 | 0 | 0 | NA |
| CRP, Median (IQR) | 0-8 mg/L | 31.9 (8.9-55.1) | 81.8 (32.5-117.7) | 0.006 † \* |
| ＞8, n (%) | 　 | 17 (85%) | 22 (100%) | 0.199 ‡ |
| Procalcitonin, Median (IQR) | <0.05 ng/ml | 0.1 (0.1-0.2) | 0.7 (0.1-1.4) | 0.000 † \* |
| ≥0.05, n (%) | 　 | 17 (85%) | 22 (100%) | 0.199 ‡ |
| Platelet count, Median (IQR) | 125-350 g/L | 213.0 (139.5-286.5) | 158.5 (93.0-217.5) | 0.028 † \* |
| ＜125, n (%) | 　 | 4 (20%) | 9 (40.9%) | 0.143 § |
| D-dimer, Median (IQR) | 0-0.5 ug/ml | 3.6 (1.0-7.6) | 2.6 (1.0-8.3) | 0.970 † |
| ＞0.5, n (%) | 　 | 18 (90%) | 19 (86.4%) | 1.000 ‡ |
| PT, Median (IQR) | 11.0-16.0 s | 14.2 (12.6-14.7) | 13.9 (13.1-16.0) | 0.465 † |
| ＞16.0, n (%) | 　 | 1 (5%) | 5 (22.7%) | 0.231 ‡ |
| APTT, Median (IQR) | 27.0-45.0 s | 36.3 (34.1-45.2) | 37.8 (33.6-44.9) | 0.687 † |
| ＞45.0, n (%) | 　 | 5 (25%) | 5 (22.7%) | 1.000 ‡ |
| AST, Median (IQR) | 8-40 U/L | 32.5 (24.0-61.8) | 54.4 (40.8-75.0) | 0.084 † |
| ＞40, n (%) | 　 | 8 (40%) | 17 (77.3%) | 0.014 § \* |
| ALT, Median (IQR) | 5-40 U/L | 45.0 (23.5-107.5) | 39.0 (24.8-85.0) | 0.606 † |
| ＞40, n (%) | 　 | 12 (60%) | 11 (50%) | 0.516 § |
| Albumin, Median (IQR) | 33-55 g/L | 28.4 (25.6-35.0) | 26.7 (24.5-34.0) | 0.537 † |
| ＜33, n (%) | 　 | 14 (70%) | 15 (68.2%) | 0.899 § |
| Lactate dehydrogenase, Median (IQR) | 109-245 U/L | 349.0 (284.0-454.8) | 559.0 (430.8-838.5) | 0.004 † \* |
| ＞245, n (%) | 　 | 17 (85%) | 21 (95.5%) | 0.531 ‡ |
| Alkaline phosphatase, Median (IQR) | 40-150 U/L | 73.0 (55.3-96.3) | 78.0 (54.3-108.8) | 0.870 † |
| ＞150, n (%) | 　 | 2 (10%) | 1 (4.5%) | 0.932 ‡ |
| Creatine kinase, Median (IQR) | 24-194 U/L | 57.0 (33.3-105.0) | 141.5 (92.3-268.8) | 0.000 † \* |
| ＞194, n (%) | 　 | 1 (5%) | 6 (27.3%) | 0.129 ‡ |
| Creatinine, Median (IQR) | 57-111 μmol/L | 69.1 (63.6-74.9) | 89.4 (53.3-115.3) | 0.174 † |
| ＞111, n (%) | 　 | 1 (5%) | 6 (27.3%) | 0.129 ‡ |
| Urea, Median (IQR) | 2.9-8.2 mmol/L | 7.0 (5.2-9.3) | 10.9 (5.9-14.7) | 0.059 † |
| ＞8.2, n (%) | 　 | 7 (35%) | 14 (63.6%) | 0.064 § |
| Total bilirubin, Median (IQR) | 3.0-20 μmol/L | 12.6 (10.3-20.3) | 13.5 (8.8-25.2) | 0.830 † |
| ＞20, n (%) | 　 | 5 (25%) | 8 (36.4%) | 0.426 § |
| Troponin, Median (IQR) | <26.2 ng/L | 7.1 (3.4-17.0) | 42.0 (19.7-189.5) | 0.000 † \* |
| ≥26.2, n (%) | 　 | 0 (0%) | 14 (63.6%) | 0.001 § \* |
| Abbreviations: NLR, Neutrophil-to-Lymphocyte Ratio; CRP, C-Reactive Protein; PT, Prothrombin Time; APTT, Activated Partial Thromboplastin Time; AST, Aspertate Aminotransferase; ALT, Alanine Aminotransferase. IQR, interquartile range; COVID-19, 2019 novel coronavirus disease. †: Mann-Whitey U test; §: Chi-squared test; ‡: Fisher's Exact Test. \*: P＜0.05. |

|  |
| --- |
| Table S4. Chest CT imaging characteristics of critically ill patients with COVID-19 on admission. |
| **Imaging Characteristics** | **Critically ill patients** | ***P* value** |
| Survivors (n=20) | Non-survivors (n=22) |
| Distribution, n (%) |  |  | 0.808 ‡  |
| Subpleural  | 3 (15%) | 5 (22.7%) |  |
| Random | 0 (0%) | 0 (0%) |  |
| Diffuse | 17 (85%) | 17 (77.3%) |  |
| Attenuation, n (%) |  |  | 0.204 § |
| GGO only | 7 (35%) | 12 (54.5%) |  |
| Mixed GGO and consolidation | 13 (65%) | 10 (45.5%) |  |
| GGO score, Median (IQR) | 5 (5-6) | 6 (5-6) | 0.194 † |
| Total lung involvement score, Median (IQR)  | 15 (12-20) | 15 (11-20) | 0.411 † |
| Lung involvement score in each lobe, Median (IQR)  |  |  |  |
| Right upper lobe | 3 (1-4) | 2 (2-4) | 0.586 † |
| Right middle lobe | 2 (1-3) | 2 (2-3) | 0.371 † |
| Right lower lobe | 5 (4-5) | 4 (3-5) | 0.284 † |
| Left upper lobe | 3 (1-4) | 2 (1-3) | 0.202 † |
| Left lower lobe | 5 (3-5) | 4 (3-5) | 0.054 † |
| Reticulation, n (%) | 6 (30%) | 3 (13.6%) | 0.361 ‡  |
| Crazy paving, n (%)  | 17 (85%) | 20 (90.9%) | 0.910 ‡  |
| Pleural effusion, n (%) | 6 (30%) | 4 (18.2%) | 0.592 ‡  |
| Abbreviation: GGO, ground-glass opacity; CT, computed tomography; IQR, interquartile range; COVID-19, 2019 novel coronavirus disease. †: Mann-Whitey U test; §: Chi-squared test; ‡: Fisher's Exact Test.  |

|  |
| --- |
| Table S5. Clinical characteristics and laboratory indices of severe and critically ill patients with COVID-19 on admission. |
| **Clinical Characteristics** | **Critically ill patients** |
| Female (n=21) | Male (n=21) | *P* value |
| Age, Median (IQR), y |  |  | 0.696 †  |
| Age, n (%) |  |  | 0.292 §  |
| ≤60 | 4 (19%) | 7 (33.3%) |  |
| ＞60 | 17 (81%) | 14 (66.7%) |  |
| Comorbidities, n (%) |  |  |  |
| Hypertension | 10 (47.6%) | 10 (47.6%) | 1.000 § |
| Diabetes | 5 (23.8%) | 4 (19%) | 1.000 ‡ |
| Chronic respiratory diseases | 1 (4.8%) | 4 (19%) | 0.341 ‡  |
| Malignancy | 2 (9.5%) | 1 (4.8%) | 1.000 ‡ |
| Chronic kidney disease | 0 (0%) | 2 (9.5%) | 0.469 ‡ |
| Chronic liver disease | 1 (4.8%) | 3 (14.3%) | 0.599 ‡ |
| Coexisted comorbidities, n (%) | 12 (57.1%) | 15 (71.4%) | 0.334 § |
| Treatment, n (%) |  |  |  |
| Antiviral therapy | 16 (76.2%) | 21 (100%) | 0.057 ‡ |
| Antibacterial | 20 (95.2%) | 19 (90.5%) | 1.000 ‡ |
| Glucocorticoid therapy | 13 (61.9%) | 18 (85.7%) | 0.160 § |
| Immunoabsorption | 3 (14.3%) | 1 (4.8%) | 0.599 ‡ |
| Oxygen inhalation, n (%) |  |  | 0.035 ‡ \* |
| High ﬂow nasal cannula | 4 (19%) | 12 (57.1%) |  |
| Noninvasive ventilation | 11 (52.4%) | 6 (28.6%) |  |
| Invasive mechanical ventilation | 6 (28.6%) | 3 (14.3%) |  |
| Clinical outcomes, n (%) |  |  | 0.013 § \* |
| Survivors | 6 (28.6%) | 14 (66.7%) |  |
| Non-survivors | 15 (71.4%) | 7 (33.3%) |  |
| Abbreviations: IQR, interquartile range; NA, not applicable; COVID-19, 2019 novel coronavirus disease. †: Mann-Whitey U test; §: Chi-squared test; ‡: Fisher's Exact Test. \*: P＜0.05. |