**Online Supplements for:**

# Machine Learning Algorithms Predict Successful Weaning from Mechanical Ventilation Before Intubation

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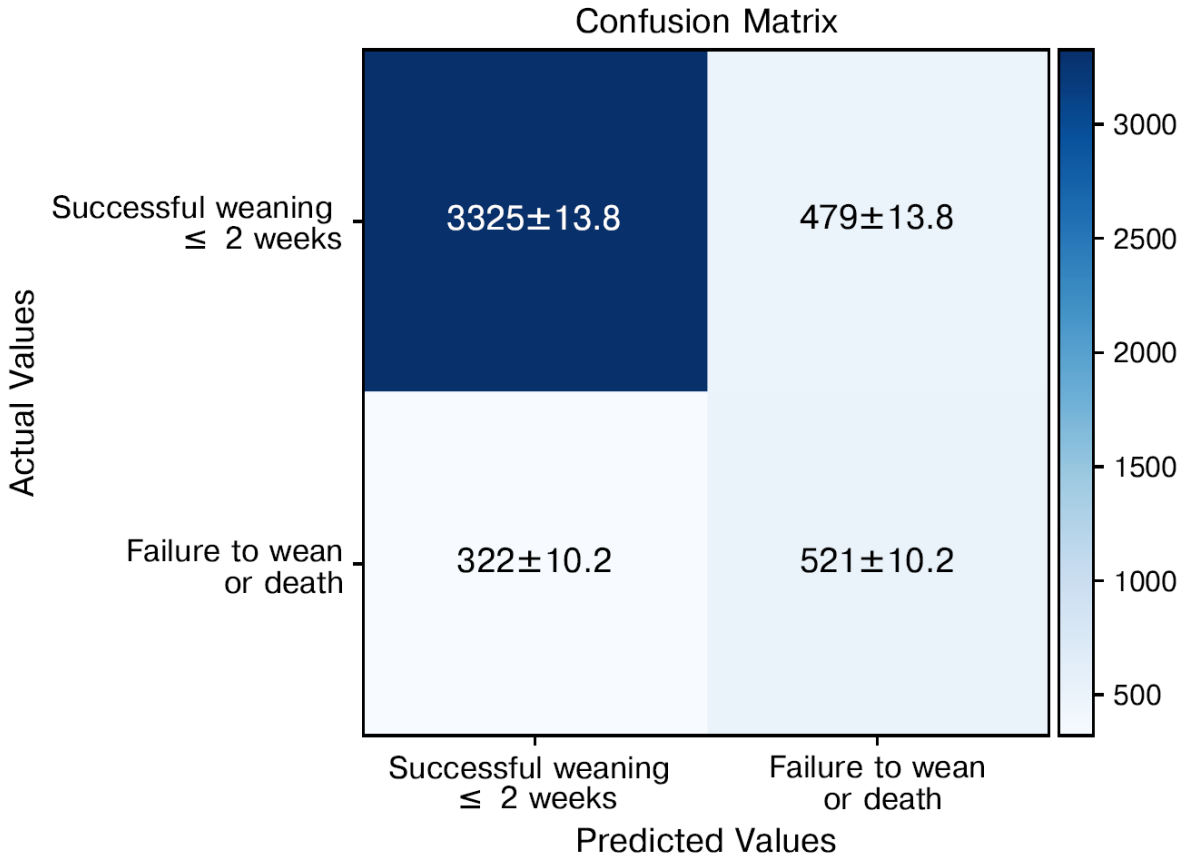
**Supplementary Table 1.** Additional Detailed Information on Patients in the Intensive Care Unit According to Successful Weaning from Mechanical Ventilation within 14 Days

| Variables | Total (n = 23,242) | Successful weaning (N = 19,025) | Prolonged mechanical ventilation or mortality (n = 4,217) | *P* |
|---|---|---|---|---|
| GCS score-eye | | | | < 0.001 |
| No eye opening | 13458 (57.9) | 11235 (59.1) | 2223 (52.7) | |
| Eyes open to pain | 1923 (8.3) | 1559 (8.2) | 364 (8.6) | |
| Eyes open to verbal command | 2820 (12.1) | 2362 (12.4) | 458 (10.9) | |
| Eyes open spontaneously | 5041 (21.7) | 3869 (20.3) | 1172 (27.8) | |
| GCS score-motor | | | | < 0.001 |
| No motor response | 11021 (47.4) | 9470 (49.8) | 1551 (36.8) | |
| Decerebrate posture | 224 (1.0) | 138 (0.7) | 86 (2.0) | |
| Decorticate posture | 231 (1.0) | 114 (0.6) | 117 (2.8) | |
| Withdraws from pain | 2214 (9.5) | 1601 (8.4) | 613 (14.5) | |
| Purposeful movement for painful stimulus | 3000 (12.9) | 2464 (13.0) | 536 (12.7) | |
| Obeys commands | 6552 (28.2) | 5238 (27.5) | 1314 (31.2) | |
| Admission type | | | | < 0.001 |
| Medical | 13625 (58.6) | 10418 (54.8) | 3207 (76.0) | |
| Unscheduled surgical | 8286 (35.7) | 7307 (38.4) | 979 (23.2) | |
| Scheduled surgical | 1331 (5.7) | 1300 (6.8) | 31 (0.7) | |
| Public insurance | 11641 (50.1) | 9259 (48.7) | 2382 (56.5) | < 0.001 |
| English as the primary language | 20951 (90.1) | 17186 (90.3) | 3765 (89.3) | 0.04 |
| Married | 10969 (47.2) | 9286 (48.8) | 1683 (39.9) | < 0.001 |
| Ethnicity | | | | 0.009 |
| White | 18932 (81.5) | 15491 (81.4) | 3441 (81.6) | |
| Black | 1759 (7.6) | 1399 (7.4) | 360 (8.5) | |
| Hispanic | 762 (3.3) | 646 (3.4) | 116 (2.8) | |
| Asian | 597 (2.6) | 491 (2.6) | 106 (2.5) | |
| Others | 1192 (5.1) | 998 (5.2) | 194 (4.6) | |
| Care unit | | | | < 0.001 |
| Medical | 5157 (22.2) | 3625 (19.1) | 1532 (36.3) | |
| Surgery | 15478 (66.6) | 13488 (70.9) | 1990 (47.2) | |
| Others | 2607 (11.2) | 1912 (10.0) | 695 (16.5) | |
| Underlying comorbidities | | | | |
| Congestive heart failure | 6119 (26.3) | 4841 (25.4) | 1278 (30.3) | < 0.001 |
| Chronic pulmonary disease | 5736 (24.7) | 4640 (24.4) | 1096 (26.0) | 0.030 |

| | | | | |
|---|---|---|---|---|
| Diabetes without complication | 5454 (23.5) | 4463 (23.5) | 991 (23.5) | 0.952 |
| Myocardial infarction | 4536 (19.5) | 3708 (19.5) | 828 (19.6) | 0.830 |
| Chronic kidney disease | 4191 (18.0) | 3207 (16.9) | 984 (23.3) | < 0.001 |
| Cerebrovascular disease | 3454 (14.9) | 2379 (12.5) | 1075 (25.5) | < 0.001 |
| Peripheral vascular disease | 3011 (13.0) | 2409 (12.7) | 602 (14.3) | 0.005 |
| Mild liver disease | 2810 (12.1) | 1944 (10.2) | 866 (20.5) | < 0.001 |
| Malignant cancer | 2373 (10.2) | 1716 (9.0) | 657 (15.6) | < 0.001 |
| Diabetes with complication | 2068 (8.9) | 1690 (8.9) | 378 (9.0) | 0.858 |
| Severe liver disease | 1326 (5.7) | 877 (4.6) | 449 (10.6) | < 0.001 |
| Paraplegia | 1067 (4.6) | 716 (3.8) | 351 (8.3) | < 0.001 |
| Metastatic solid tumor | 1029 (4.4) | 679 (3.6) | 350 (8.3) | < 0.001 |
| Rheumatic disease | 704 (3.0) | 564 (3.0) | 140 (3.3) | 0.233 |
| Peptic ulcer disease | 632 (2.7) | 495 (2.6) | 137 (3.2) | 0.021 |
| Dementia | 595 (2.6) | 424 (2.2) | 171 (4.1) | < 0.001 |
| AIDS | 109 (0.5) | 86 (0.4) | 23 (0.5) | 0.454 |

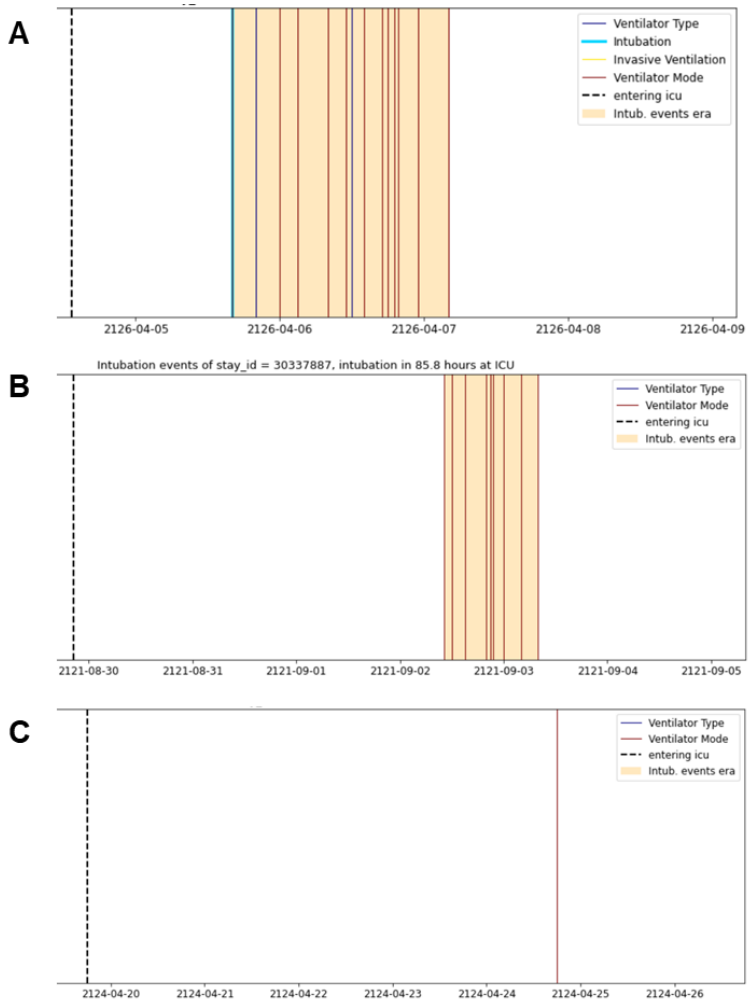
Numbers are presented as counts (percentiles). Abbreviations: GCS, Glasgow Coma Scale; AIDS, acquired immunodeficiency syndrome.

**Supplementary Figure 1.** Confusion matrix of the final ensemble voting classifier model.



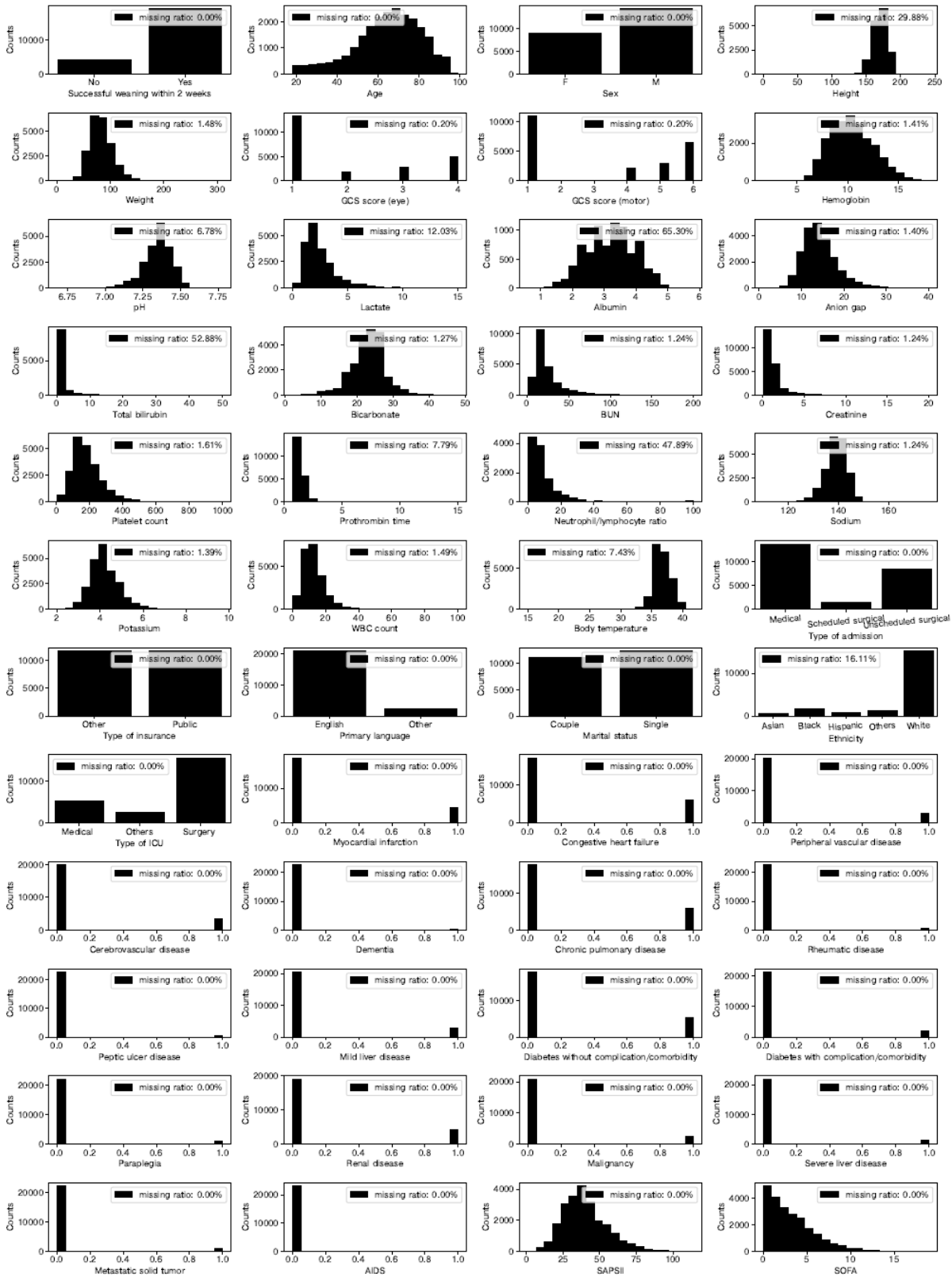

The confusion matrix was computed using Cohen's kappa, maximizing the threshold value. The maximum value of Cohen's kappa was 0.456, with a threshold of 0.31. The numbers in the confusion matrix cells are the mean and standard deviation, calculated using a 5-fold cross-validation set. The upper left cell represents a true negative, the upper right cell a false positive, the lower left cell a false negative, and the lower right cell a true positive.

**Supplementary Figure 2.** Examples of the patient selection according to keywords in the procedure or chart events.




(*A*) An example with "intubation" and "invasive ventilation" appears first, followed by repeated recordings about ventilator modes. (*B*) An example without "intubation" or "invasive ventilation" records but with recordings of ventilator modes ≥ five times within 24 hours. (*C*) An example without "intubation" or "invasive ventilation" recordings and only a single recording of ventilator mode. Patients A and B were considered to have been intubated, whereas patient C was not.

**Supplementary Figure 3.** Distributions of all explanatory variables along with SOFA scores and SAPS II.




The rates of missing variables are shown in the legend.

**Supplementary Appendix 1. Variables included for model development.**

To minimize the impact of intubation on each variable, we selected variables that are less likely to change dramatically after intubation. They were as follows: age, sex, height, weight, GCS score (eye), GCS score (motor), hemoglobin, pH, lactate, albumin, anion gap, total bilirubin, bicarbonate, BUN, creatinine, platelet count, prothrombin time, neutrophil/lymphocyte ratio, sodium, potassium, WBC count, body temperature, type of admission (medical, scheduled surgical, unscheduled surgical), type of insurance (public, other), primary language (English, other), marital status (couple, single), ethnicity (White, Black, Hispanic, Asian, others), type of ICU (medical, surgery, others), and underlying comorbidities (myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, rheumatic disease, peptic ulcer disease, mild liver disease, diabetes without complication, diabetes with complication, paraplegia, renal disease, malignancy, severe liver disease, metastatic solid tumor, AIDS).