Table S1. Demographic characteristics, vital sign measures, laboratory characteristics, and percentage of missing data.

Characteristics	MIMIC-IV	Percentage of Missing Data, %	eICU-CRD	Percentage of Missing Data, %
ACEI/ARB, n (%)	6704	0.00%	3718	0.00%
Age, year	6704	0.00%	3718	0.00%
Aids, n (%)	6704	0.00%	3718	0.00%
AKI stage, n (%)	6704	0.00%	3713	0.13%
Albumin, g/dL	2041	69.56%	2032	45.35%
ALP, IU/L	3225	51.89%	0	100.00%
ALT, IU/L	3252	51.49%	1742	53.15%
Amylase, IU/L	458	93.17%	104	97.20%
Aniongap, mEq/L	6652	0.78%	2774	25.39%
APTT, sec	6043	9.86%	1120	69.88%
AST, IU/L	3264	51.31%	1765	52.53%
Atypical Lymphocytes, %	638	90.48%	0	100.00%
Bands, %	693	89.66%	247	93.36%
Basophils, %	3025	54.88%	1816	51.16%
Absolute Basophil Count, K/μL	1402	79.09%	0	100.00%
Bicarbonate, mEq/L	6661	0.64%	3398	8.61%
Bilirubin direct, mg/dL	227	96.61%	485	86.96%
Bilirubin indirect, mg/dL	219	96.73%	0	100.00%
Bilirubin total, mg/dL	3266	51.28%	1748	52.99%
BNP, pg/mL	506	92.45%	447	87.98%
BUN, mEq/L	6659	0.67%	3546	4.63%
CABG, n (%)	6704	0.00%	3718	0.00%
Calcium, mEq/L	6017	10.25%	3501	5.84%
Cancer, n (%)	6704	0.00%	3718	0.00%
Cerebrovascular Disease, n (%)	6704	0.00%	3718	0.00%
Chloride, mEq/L	6663	0.61%	3534	4.95%
Chronic Pulmonary Disease, n (%)	6704	0.00%	3718	0.00%
CK, IU/L	2678	60.05%	847	77.22%
CKD, n (%)	6704	0.00%	3718	0.00%
CKMB, ng/mL	2862	57.31%	565	84.80%
Creatinine, mg/dL	6671	0.49%	3554	4.41%
CRP, mg/L	145	97.84%	79	97.88%
DBP, mmHg	6653	0.76%	3355	9.76%
D-Dimer, ng/mL	14	99.79%	0	100.00%
Dementia, n (%)	6704	0.00%	3718	0.00%
Diabetes, n (%)	6704	0.00%	3718	0.00%
Digoxin, n (%)	6704	0.00%	3718	0.00%
Diuretic, n (%)	6704	0.00%	3718	0.00%
Eosinophils, %	3025	54.88%	1958	47.34%
Absolute Eosinophil Count, K/μL	1402	79.09%	0	100.00%

Ethnicity, n (%)	6704	0.00%	3718	0.00%
Fibrinogen, mg/dL	1967	70.66%	207	94.43%
Gender, n (%)	6704	0.00%	3718	0.00%
GGT, IU/L	42	99.37%	0	100.00%
Globulin, g/dL	77	98.85%	0	100.00%
Glucose, mg/dL	6679	0.37%	3536	4.90%
Heart rate, beats/min	6679	0.37%	3439	7.50%
Height, cm	4330	35.41%	3703	0.40%
Hematocrit, %	6639	0.97%	3375	9.23%
Hemoglobin, g/dL	6631	1.09%	3363	9.55%
Hospital Expire Flag, n (%)	6704	0.00%	3718	0.00%
Hypertension, n (%)	6701	0.04%	3718	0.00%
Immature granulocytes	1142	82.97%	0	100.00%
INR	6073	9.41%	1644	55.78%
KRT, n (%)	6704	0.00%	3718	0.00%
Lactate, mmol/L	4814	28.19%	1199	67.75%
LDH, IU/L	2239	66.60%	137	96.32%
Liver Disease, n (%)	6704	0.00%	3718	0.00%
Lymphocytes, %	3027	54.85%	2091	43.76%
Absolute Lymphocyte Count, K/µL	1406	79.03%	0	100.00%
MAP, mmHg	6679	0.37%	838	77.46%
MCH, pg	6630	1.10%	3088	16.94%
MCHC, %	6630	1.10%	3284	11.67%
MCV, fL	6630	1.10%	3283	11.70%
Mechvent, n (%)	6704	0.00%	3718	0.00%
Metamyelocytes, %	652	90.27%	0	100.00%
Monocytes, #/µL	3025	54.88%	2086	43.89%
Absolute Monocyte Count, K/µL	1402	79.09%	0	100.00%
Myocardial infarction, n (%)	6704	0.00%	3718	0.00%
Neutrophils, %	3025	54.88%	0	100.00%
Absolute Neutrophil Count, K/µL	1402	79.09%	0	100.00%
NRBC, #/µL	314	95.32%	0	100.00%
PCI/PTCA, n (%)	6704	0.00%	3718	0.00%
PCO2, mmHg	4872	27.33%	1794	51.75%
Peptic Ulcer Disease, n (%)	6704	0.00%	3718	0.00%
Peripheral Vascular Disease, n (%)	6704	0.00%	3718	0.00%
pH, units	4991	25.55%	1837	50.59%
Platelet, K/µL	6635	1.03%	3328	10.49%
PO2, mmHg	4873	27.31%	1842	50.46%
Potassium, mg/dL	6654	0.75%	3564	4.14%
PT, sec	6073	9.41%	1605	56.83%
RBC, K/µL	6631	1.09%	3326	10.54%

RDW, %	6630	1.10%	3165	14.87%
Rheumatic Disease, n (%)	6704	0.00%	3718	0.00%
RR, beats/min	6679	0.37%	3413	8.20%
SBP, mmHg	6653	0.76%	3358	9.68%
Sepsis, n (%)	6704	0.00%	3718	0.00%
Sodium, mEq/L	6662	0.63%	3553	4.44%
Temperature, °C	6191	7.65%	3563	4.17%
Thrombin, sec	9	99.87%	0	100.00%
Total protein, g/dL	178	97.34%	1763	52.58%
Troponin I, ng/mL	0	100.00%	1557	58.12%
Troponin T, ng/mL	2734	59.22%	163	95.62%
Vasopressor, n (%)	6704	0.00%	3718	0.00%
WBC, K/μL	6633	1.06%	3347	9.98%
Weight, kg	6580	1.85%	3645	1.96%
β-blockers, n (%)	6704	0.00%	3718	0.00%

ACEI/ARB: angiotensin-converting enzyme inhibitors/angiotensin receptor blockers; Aids: acquired immune deficiency syndrome: AKI: acute kidney injury; ALP, alkaline phosphatase; ALT: alanine aminotransferase; APTT: activated partial thromboplastin time; AST: glutamic oxalacetic transaminase; Bands: immature white blood cells; BNP, brain natriuretic peptide; BUN: urea nitrogen; CABG: coronary artery bypass grafting; CK, creatine kinase; CKD: chronic kidney disease; CKMB: creatine kinase isoenzyme; CRP: c-reactive protein; DBP: diastolic blood pressure; GGT: γ-glutamyltranspeptidase; INR: international standardized ratio; KRT: blood oxygen partial pressure; MAP: mean arterial pressure; MCH: mean erythrocyte hemoglobin volume; MCHC: mean erythrocyte hemoglobin concentration; MCV: mean red blood cell volume; Mechvent: mechanical ventilation; NRBC: nucleated red blood cell volume; PCI: percutaneous coronary intervention; PTCA： percutaneous transluminal coronary angioplasty; PCO2: blood partial pressure of carbon dioxide; pH: pH value; PO2: blood oxygen partial pressure; PT: prothrombin time; RBC: red blood cells; RDW: red blood cell distribution width; RR: respiratory rate; SBP: systolic blood pressure; WBC: white blood cell count; β-blockers: β-adrenergic receptor blockers.

Table S2. Demographic and clinical characteristics of the training set, internal validation set, and external validation set.

Characteristic	**Training cohort** N = 1,521	**Internal validation** N = 269	**Under-sampled cohort** N = 1,790	**External validation** N = 3,602
Hospital expire flag, n (%)				
Survival	748(49.18%)	147(54.65%)	895(50.00%)	3,035(84.26%)[#]
Death	773(50.82%)	122(45.35%)	895(50.00%)	567(15.74%)[#]
Ethnicity, n (%)				
White	1,064(69.95%)	182(67.66%)	1,246(69.61%)	2,628(72.96%)[#]
Asian	39(2.56%)	7(2.60%)	46(2.57%)	82(2.28%)[#]
African	128(8.42%)	26(9.67%)	154(8.60%)	677(18.80%)[#]
Other	290(19.07%)	54(20.07%)	344(19.22%)	215(5.97%)[#]
Gender, n (%)				
female	627(41.22%)	130(48.33%)[*]	757(42.29%)	1,535(42.62%)
male	894(58.78%)	139(51.67%)[*]	1,033(57.71%)	2,067(57.38%)

Age, years	72.77 (12.09)	72.82 (11.61)	72.78 (12.02)	67.77 (13.69)[#]
Weight, kg	86.28 (27.74)	84.90 (27.38)	86.07 (27.69)	90.18 (30.69)[#]
Heart rate, beats/min	89.87 (20.75)	87.77 (20.53)	89.55 (20.72)	87.17 (20.92)[#]
SBP, mmHg	120.14 (26.05)	124.46 (27.63)[*]	120.79 (26.33)	125.19 (32.38)[#]
DBP, mmHg	65.77 (19.57)	67.02 (20.29)	65.96 (19.68)	67.63 (19.54)[#]
RR, beats/min	20.48 (6.43)	19.44 (5.84)[*]	20.32 (6.35)	21.23 (6.73)[#]
Temperature, °C	36.57 (1.25)	36.56 (1.26)	36.57 (1.25)	36.63 (0.86)[#]
WBC, K/μL	13.89 (11.50)	12.75 (8.21)	13.72 (11.07)	11.80 (9.66)[#]
RBC, K/μL	3.49 (0.79)	3.55 (0.83)	3.50 (0.80)	3.50 (0.75)
Hematocrit, %	31.90 (6.87)	32.25 (6.84)	31.95 (6.87)	31.65 (6.41)
Hemoglobin, g/dL	10.34 (2.27)	10.44 (2.29)	10.35 (2.27)	10.24 (2.10)
MCH, pg	29.81 (2.73)	29.68 (2.92)	29.79 (2.76)	29.37 (2.66)[#]
MCHC, %	32.39 (1.72)	32.39 (1.67)	32.39 (1.72)	32.35 (1.42)
MCV, fL	92.11 (7.44)	91.72 (7.82)	92.05 (7.50)	90.82 (7.47)[#]
Platelet, K/μL	207(108.56)	206.69 (99.57)	206.95 (107.23)	196.58 (89.37)[#]
RDW, %	15.78 (2.45)	15.84 (2.54)	15.79 (2.46)	16.46 (2.43)[#]
Bicarbonate, mEq/L	22.88 (5.57)	22.96 (4.99)	22.89 (5.49)	24.55 (5.84)[#]
BUN, mEq/L	39.20 (28.22)	37.98 (24.18)	39.02 (27.65)	49.64 (28.18)[#]
Creatinine, mEq/L	1.26 (1.04)	1.28 (1.07)	1.26 (1.04)	3.55 (2.87)[#]
Calcium, mEq/L	8.34 (0.91)	8.45 (0.78)[*]	8.35 (0.89)	8.47 (0.79)[#]
Chloride, mEq/L	102.66 (7.27)	102.36 (6.63)	102.61 (7.17)	101.44 (6.85)[#]
Sodium, mEq/L	138.09 (5.70)	137.92 (5.30)	138.06 (5.64)	137.18 (5.50)[#]
Potassium, mg/dL	4.38 (0.82)	4.39 (0.75)	4.38 (0.81)	4.47 (0.88)[#]
Glucose, mg/dL	160.35 (78.54)	164.32 (79.11)	160.94 (78.62)	155.56 (96.34)[#]
ACEI/ARB, n (%)	552(36.29%)	94(34.94%)	646(36.09%)	354(9.83%)[#]
Digoxin, n (%)	183(12.03%)	33(12.27%)	216(12.07%)	151(4.19%)[#]
Blocker, n (%)	1,119(73.57%)	195(72.49%)	1,314(73.41%)	1,184(32.87%)[#]
Vasopressor, n (%)	934(61.41%)	146(54.28%)[*]	1,080(60.34%)	830(23.04%)[#]
Diuretic, n (%)	1,278(84.02%)	229(85.13%)	1,507(84.19%)	1,166(32.37%)[#]
KRT, n (%)	277(18.21%)	35(13.01%)[*]	312(17.43%)	951(26.40%)[#]
Mechvent, n (%)	725(47.67%)	141(52.42%)	866(48.38%)	1,153(32.01%)[#]
CABG, n (%)	107(7.03%)	18(6.69%)	125(6.98%)	58(1.61%)[#]
PCI/PTCA, n (%)	53(3.48%)	5(1.86%)	58(3.24%)	37(1.03%)[#]
CKD, n (%)	626(41.16%)	109(40.52%)	735(41.06%)	2,551(70.82%)[#]
AKI stage, n (%)				
0	131(8.61%)	36(13.38%)	167(9.33%)	1,333(37.01%)[#]
1	231(15.19%)	45(16.73%)	276(15.42%)	576(15.99%)[#]
2	496(32.61%)	86(31.97%)	582(32.51%)	16(0.44%)[#]
3	663(43.59%)	102(37.92%)	765(42.74%)	1,677(46.56%)[#]
Myocardial Infarct, n (%)	547(35.96%)	104(38.66%)	651(36.37%)	719(19.96%)[#]
Hypertension, n (%)	351(23.08%)	64(23.79%)	415(23.18%)	2,587(71.82%)[#]
Peripheral Vascular Disease, n (%)	275(18.08%)	56(20.82%)	331(18.49%)	375(10.41%)[#]

Cerebrovascular Disease, n (%)	275(18.08%)	45(16.73%)	320(17.88%)	568(15.77%)#
Dementia, n (%)	69(4.54%)	7(2.60%)	76(4.25%)	116(3.22%)
Chronic Pulmonary Disease, n (%)	581(38.20%)	103(38.29%)	684(38.21%)	961(26.68%)#
Rheumatic Disease, n (%)	60(3.94%)	11(4.09%)	71(3.97%)	114(3.16%)
Peptic Ulcer Disease, n (%)	39(2.56%)	8(2.97%)	47(2.63%)	124(3.44%)
Liver Disease, n (%)	214(14.07%)	38(14.13%)	252(14.08%)	118(3.28%)#
Diabetes, n (%)	660(43.39%)	117(43.49%)	777(43.41%)	1,869(51.89%)#
Cancer, n (%)	197(12.95%)	40(14.87%)	237(13.24%)	417(11.58%)
Aids, n (%)	3(0.20%)	0(0.00%)	3(0.17%)	8(0.22%)
Sepsis, n (%)	1,074(70.61%)	181(67.29%)	1,255(70.11%)	584(16.21%)#

ACEI/ARB: angiotensin-converting enzyme inhibitors/angiotensin receptor blockers; AKI: acute kidney injury; AIDS: acquired immune deficiency syndrome; BUN: blood urea nitrogen; CABG: coronary artery bypass grafting; CKD: chronic kidney disease; DBP: diastolic blood pressure; diuretic; RBC: red blood cell count; RDW: red blood cell distribution width; RR: respiratory rate; SBP: systolic blood pressure; WBC: white blood cell count; MCH: mean erythrocyte hemoglobin volume; MCHC: mean erythrocyte hemoglobin concentration; MCV: mean red blood cell volume; Vasopressor: vasoactive agent; KRT: renal replacement therapy; PCI: percutaneous coronary intervention; PTCA : percutaneous transluminal coronary angioplasty;Mechvent: mechanical ventilation; β-blockers:β-adrenergic receptor blockers. The derivation cohort included training and internal validation cohorts. $P < 0.05$ vs. the training cohort, #$P < 0.05$ vs. the undersampled cohort.

Table S3. Internal validation performance of a machine learning model for predicting in-hospital deaths

Models	AUC	Sensitivity	Specificity	PPV	NPV	Accuracy	F1 socre
ANN	0.816	0.762	0.735	0.705	0.788	0.747	0.732
ET	0.854	0.713	0.803	0.750	0.771	0.762	0.731
LR	0.848	0.754	0.782	0.742	0.793	0.770	0.748
RF	0.842	0.738	0.769	0.726	0.779	0.755	0.732
GBM	0.846	0.730	0.776	0.730	0.776	0.755	0.730
KNN	0.795	0.656	0.796	0.727	0.736	0.732	0.690
LightGBM	0.839	0.738	0.796	0.750	0.785	0.770	0.744
DT	0.633	0.607	0.660	0.597	0.669	0.636	0.602
AdaBoost	0.832	0.754	0.776	0.736	0.792	0.766	0.745
SVM	0.841	0.738	0.803	0.756	0.787	0.773	0.747
XGboost	0.847	0.721	0.796	0.746	0.775	0.762	0.733

These indices represent the performance of the ML model in the internal validation queue. AdaBoost: adaptive boosting; ANN: artificial neutral network; AUC: area under the receiver-operating-characteristic curve; DT: decision tree; ET: extra tree; GBM: gradient boosting machine; KNN: K-nearest neighbor; LightGBM: light gradient boosting machine; LR: logistic regression; ML: machine learning; NPV: negative predictive value; PPV: positive predictive value; RF: random forest; SVM: support vector machine; XGboost: eXtreme gradient boosting.

Table S4. Performance of ANN models with different quantitative characteristics for predicting in-hospital deaths.

	AUC	Sensitivity	Specificity	PPV	NPV	Accuracy	F1 socre
46	0.816	0.762	0.735	0.705	0.788	0.747	0.732

45	0.809	0.754	0.714	0.687	0.778	0.732	0.719
44	0.819	0.779	0.714	0.693	0.795	0.743	0.734
43	0.811	0.770	0.735	0.707	0.794	0.751	0.737
42	0.820	0.738	0.728	0.692	0.770	0.732	0.714
41	0.824	0.779	0.721	0.699	0.797	0.747	0.736
40	0.823	0.746	0.782	0.740	0.788	0.766	0.743
39	0.827	0.746	0.735	0.700	0.777	0.740	0.722
38	0.815	0.746	0.714	0.684	0.772	0.729	0.714
37	0.814	0.746	0.782	0.740	0.788	0.766	0.743
36	0.809	0.721	0.721	0.682	0.757	0.721	0.701
35	0.807	0.721	0.735	0.693	0.761	0.729	0.707
34	0.823	0.762	0.762	0.727	0.794	0.762	0.744
33	0.818	0.746	0.769	0.728	0.785	0.758	0.737
32	0.831	0.738	0.748	0.709	0.775	0.743	0.723
31	0.822	0.779	0.735	0.709	0.800	0.755	0.742
30	0.830	0.738	0.769	0.726	0.779	0.755	0.732
29	0.838	0.746	0.776	0.734	0.786	0.762	0.740
28	0.837	0.746	0.782	0.740	0.788	0.766	0.743
27	0.837	0.738	0.728	0.692	0.770	0.732	0.714
26	0.828	0.754	0.755	0.719	0.787	0.755	0.736
25	0.822	0.738	0.755	0.714	0.776	0.747	0.726
24	0.827	0.762	0.735	0.705	0.788	0.747	0.732
23	0.827	0.746	0.782	0.740	0.788	0.766	0.743
22	0.837	0.754	0.762	0.724	0.789	0.758	0.739
21	0.842	0.721	0.789	0.739	0.773	0.758	0.730
20	0.830	0.697	0.789	0.733	0.758	0.747	0.714
19	0.822	0.697	0.789	0.733	0.758	0.747	0.714
18	0.824	0.713	0.789	0.737	0.768	0.755	0.725

17	0.829	0.730	0.796	0.748	0.780	0.766	0.739
16	0.826	0.730	0.769	0.724	0.774	0.751	0.727
15	0.828	0.746	0.776	0.734	0.786	0.762	0.740
14	0.840	0.689	0.782	0.724	0.752	0.740	0.706
13	0.838	0.730	0.789	0.742	0.779	0.762	0.736
12	0.839	0.762	0.755	0.721	0.793	0.758	0.741
11	0.836	0.754	0.816	0.773	0.800	0.788	0.763
10	0.831	0.754	0.776	0.736	0.792	0.766	0.745
9	0.829	0.762	0.782	0.744	0.799	0.773	0.753
8	0.815	0.738	0.741	0.703	0.773	0.740	0.720
7	0.816	0.738	0.776	0.732	0.781	0.758	0.735
6	0.809	0.746	0.714	0.684	0.772	0.729	0.714
5	0.825	0.762	0.714	0.689	0.784	0.736	0.724
4	0.815	0.648	0.823	0.752	0.738	0.743	0.696
3	0.767	0.689	0.673	0.636	0.723	0.680	0.661
2	0.772	0.795	0.633	0.642	0.788	0.706	0.711
1	0.685	0.852	0.517	0.594	0.809	0.669	0.700

These indices represent the performance of ANN models with different quantitative characteristics in the internal validation groups.

ANN: artificial neural network; AUC: area under the receiver-operating-characteristic curve; NPV: negative predictive value; PPV: positive predictive value; RF: random forest.

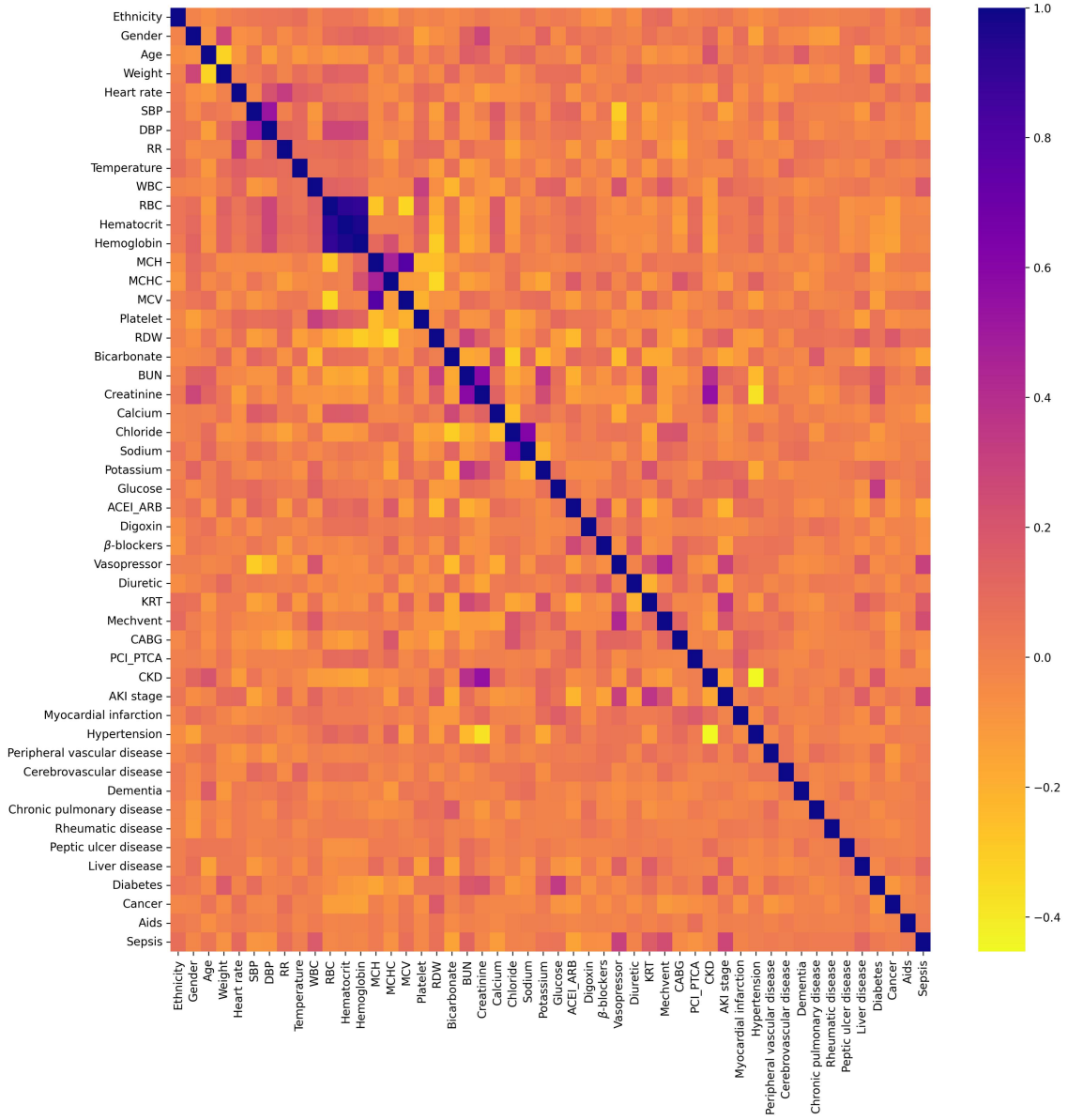
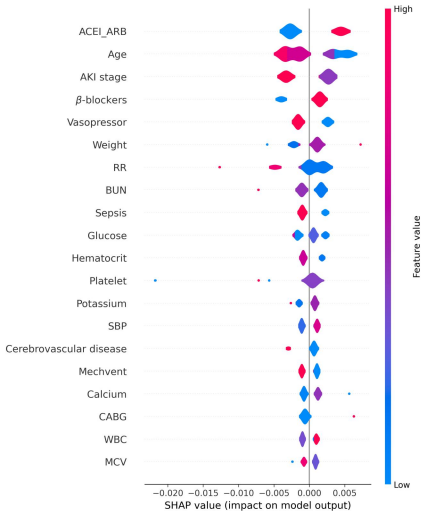
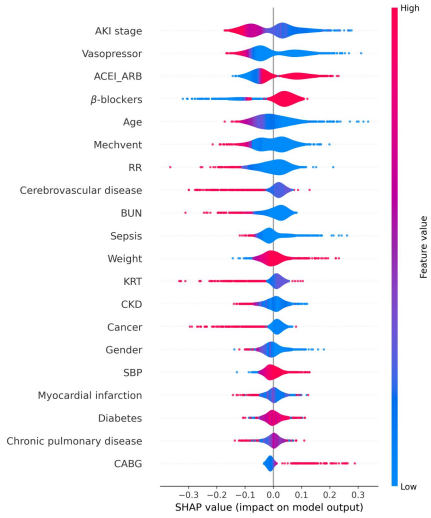


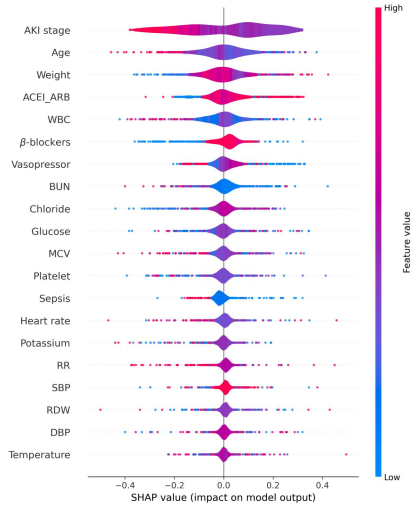
Figure S1. Heatmap of Spearman correlation analysis between characteristics. Patient characteristics in the MIMIC-IV dataset were included in the Spearman correlation analysis. Supplemental Table S1 characteristics (with the exception of those with a deletion rate of more than 25%) selected for Spearman correlation analysis, and the correlation values are displayed in the form of heatmaps. ACEI/ARB: angiotensin-converting enzyme inhibitors/angiotensin receptor blockers; AKI: acute kidney injury; AIDS: acquired immune deficiency syndrome; BUN: blood urea nitrogen; CABG: coronary artery bypass grafting; CKD: chronic kidney disease; DBP: diastolic blood pressure; diuretic; RBC: red blood cell count; RDW: red blood cell distribution width; RR: respiratory rate; SBP: systolic blood pressure; WBC: white blood cell count; MCH: mean erythrocyte hemoglobin volume; MCHC: mean erythrocyte hemoglobin concentration; MCV: mean red blood cell volume; Vasopressor: vasoactive agent; KRT: renal replacement therapy; PCI: percutaneous coronary intervention; PTCA： percutaneous transluminal coronary angioplasty;Mechvent: mechanical ventilation; β-blockers:β-adrenergic receptor blockers.


ACEI_ARB
Age
AKI stage
β-blockers
Vasopressor
Weight
RR
BUN
Sepsis
Glucose
Hematocrit
Platelet
Potassium
SBP
Cerebrovascular disease
Mechvent
Calcium
CABG
WBC
MCV
−0.020 −0.015 −0.010 −0.005 0.000 0.005
SHAP value (impact on model output)
High
Feature value
Low

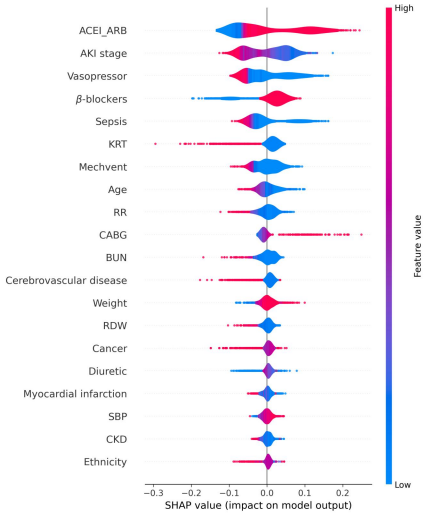
(A)


AKI stage
Vasopressor
ACEI_ARB
β-blockers
Age
Mechvent
RR
Cerebrovascular disease
BUN
Sepsis
Weight
KRT
CKD
Cancer
Gender
SBP
Myocardial infarction
Diabetes
Chronic pulmonary disease
CABG
−0.3 −0.2 −0.1 0.0 0.1 0.2 0.3
SHAP value (impact on model output)
High
Feature value
Low

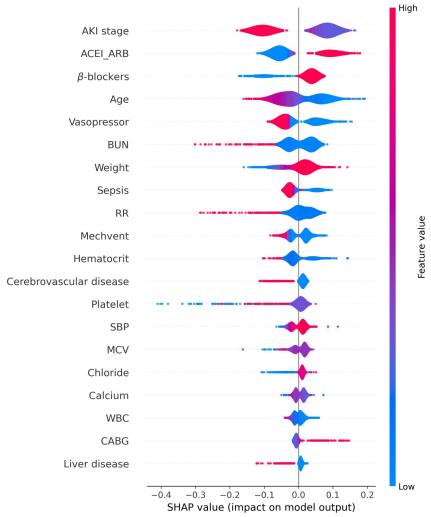
(B)


AKI stage
Age
Weight
ACEI_ARB
WBC
β-blockers
Vasopressor
BUN
Chloride
Glucose
MCV
Platelet
Sepsis
Heart rate
Potassium
RR
SBP
RDW
DBP
Temperature
−0.4 −0.2 0.0 0.2 0.4
SHAP value (impact on model output)
High
Feature value
Low

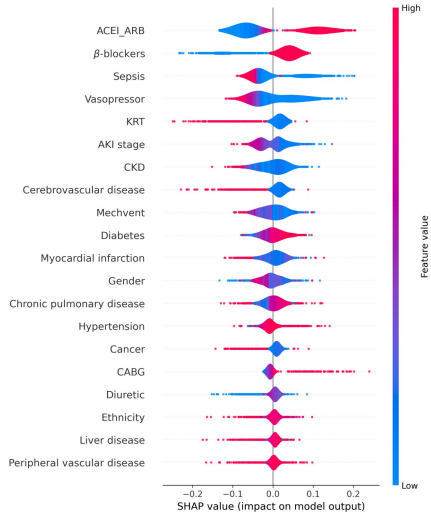
(C)


ACEI_ARB
AKI stage
Vasopressor
β-blockers
Sepsis
KRT
Mechvent
Age
RR
CABG
BUN
Cerebrovascular disease
Weight
RDW
Cancer
Diuretic
Myocardial infarction
SBP
CKD
Ethnicity
−0.3 −0.2 −0.1 0.0 0.1 0.2
SHAP value (impact on model output)
High
Feature value
Low

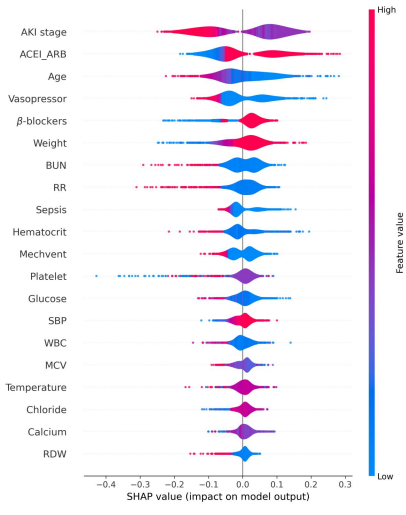
(D)


AKI stage
ACEI_ARB
β-blockers
Age
Vasopressor
BUN
Weight
Sepsis
RR
Mechvent
Hematocrit
Cerebrovascular disease
Platelet
SBP
MCV
Chloride
Calcium
WBC
CABG
Liver disease
−0.4 −0.3 −0.2 −0.1 0.0 0.1 0.2
SHAP value (impact on model output)
High
Feature value
Low

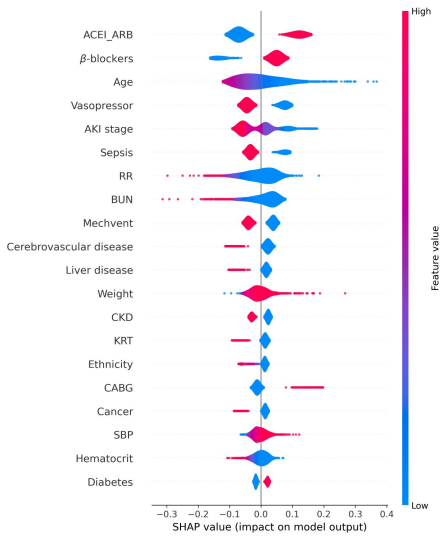
(E)


ACEI_ARB
β-blockers
Sepsis
Vasopressor
KRT
AKI stage
CKD
Cerebrovascular disease
Mechvent
Diabetes
Myocardial infarction
Gender
Chronic pulmonary disease
Hypertension
Cancer
CABG
Diuretic
Ethnicity
Liver disease
Peripheral vascular disease
−0.2 −0.1 0.0 0.1 0.2
SHAP value (impact on model output)
High
Feature value
Low

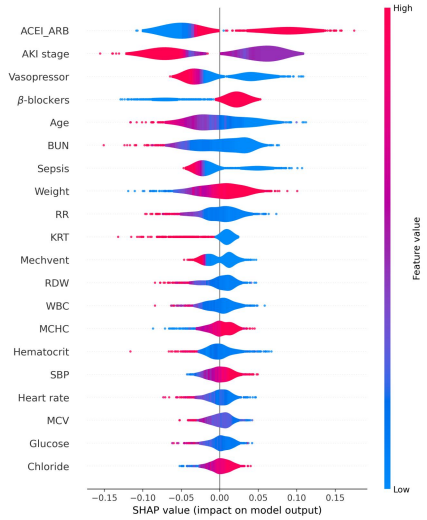
(F)


AKI stage
ACEI_ARB
Age
Vasopressor
β-blockers
Weight
BUN
RR
Sepsis
Hematocrit
Mechvent
Platelet
Glucose
SBP
WBC
MCV
Temperature
Chloride
Calcium
RDW
−0.4 −0.3 −0.2 −0.1 0.0 0.1 0.2 0.3
SHAP value (impact on model output)
High
Feature value
Low

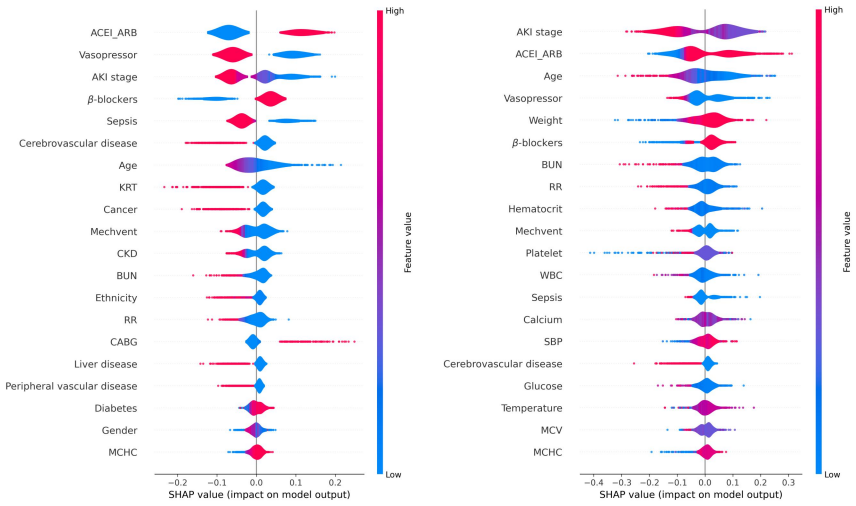
(G)


ACEI_ARB
β-blockers
Age
Vasopressor
AKI stage
Sepsis
RR
BUN
Mechvent
Cerebrovascular disease
Liver disease
Weight
CKD
KRT
Ethnicity
CABG
Cancer
SBP
Hematocrit
Diabetes
−0.3 −0.2 −0.1 0.0 0.1 0.2 0.3 0.4
SHAP value (impact on model output)
High
Feature value
Low

(H)

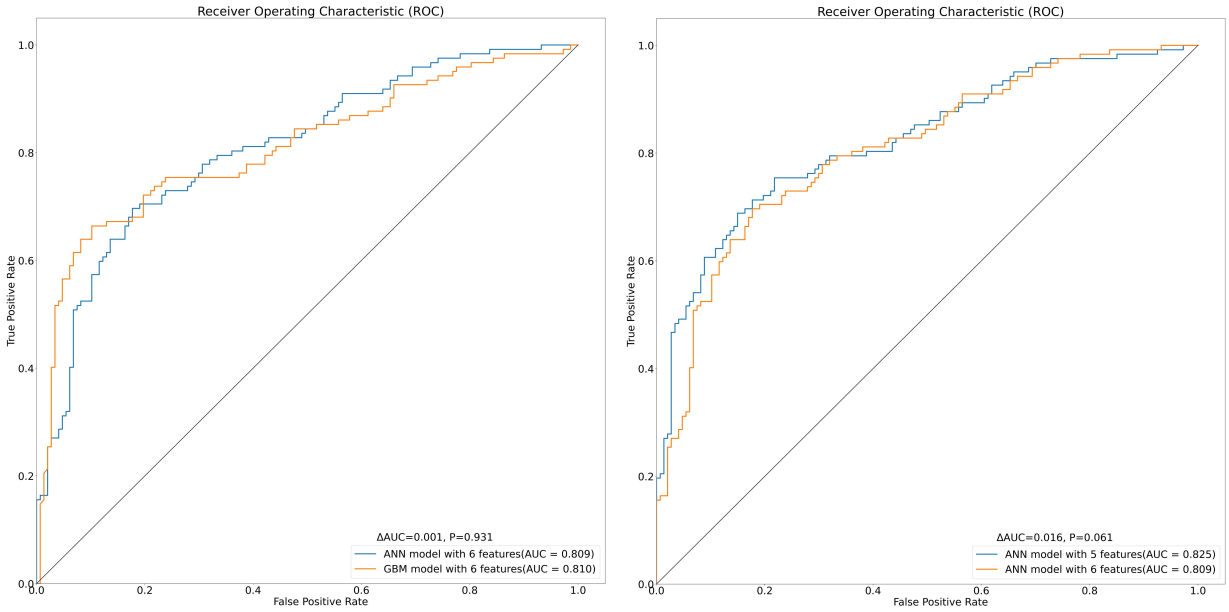

ACEI_ARB
AKI stage
Vasopressor
β-blockers
Age
BUN
Sepsis
Weight
RR
KRT
Mechvent
RDW
WBC
MCHC
Hematocrit
SBP
Heart rate
MCV
Glucose
Chloride
−0.15 −0.10 −0.05 0.00 0.05 0.10 0.15
SHAP value (impact on model output)
High
Feature value
Low

(I)



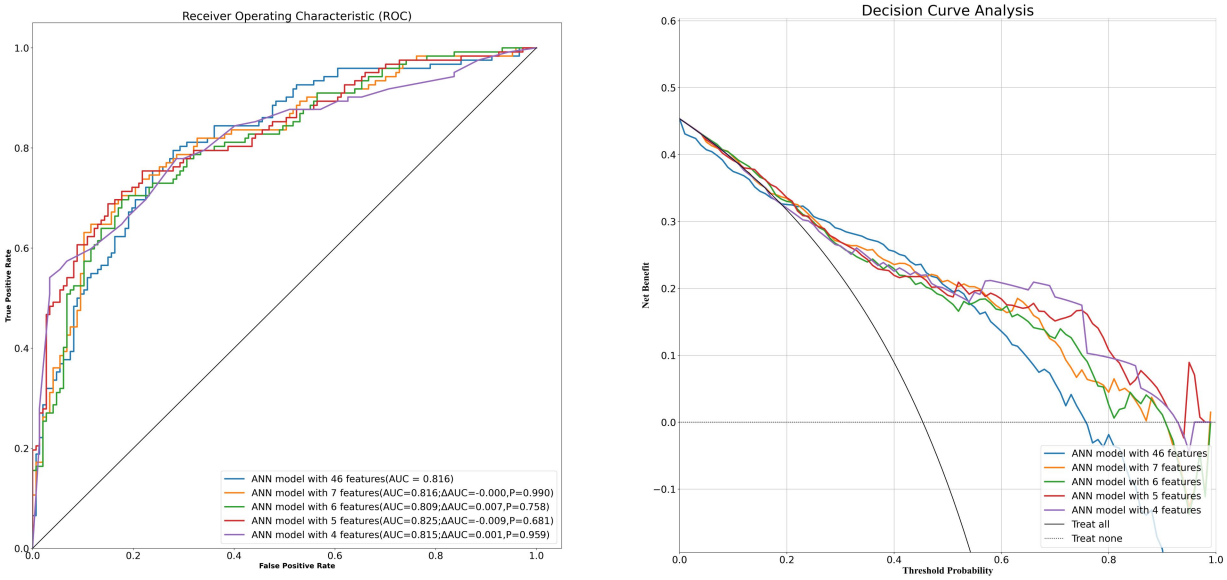
(J) (K)

Figure S2. SHAP summary point plot of the top 20 characteristics of all the machine learning models. (A) AdaBoost, (B) ANN, (C) DT, (D) ET, (E) GBM, (F) KNN, (G) LightGBM, (H) LR, (I) RF, (J) SVM, (K) XGBoost. These graphs show the characteristic importance ranking of the machine learning model in the internal validation dataset. The probability of in-hospital death increased with increasing SHAP value. Each patient's contribution to each characteristic in the model is represented by a point, so each patient has a point on each characteristic line. The actual value of the characteristic is shown by the color of the points: red indicates a higher actual value, and blue indicates a lower actual value. Points are stacked vertically to show density. ACEI/ARB: angiotensin-converting enzyme inhibitors/angiotensin receptor blockers; AdaBoost: adaptive boosting; AKI: acute kidney injury; ANN: artificial neural network; BUN: blood urea nitrogen; CABG: coronary artery bypass grafting; CKD: chronic kidney disease; DT: decision tree; ET:extra trees (extremely randomized trees); GBM: gradient boosting machine; KNN: k-nearest neighbors; LightGBM:light gradient boosting machine; LR: logistic regression; KRT: blood oxygen partial pressure; MCHC: mean erythrocyte hemoglobin concentration; MCV: mean red blood cell volume; Mechvent: mechanical ventilation; RF: random forest; RR: respiratory rate; SBP: systolic blood pressure; SHAP: SHapley Additive explanation; SVM:support vector machine; WBC: white blood cell count; XGBoost: eXtreme gradient boosting; β-blockers: β-adrenergic receptor blockers.

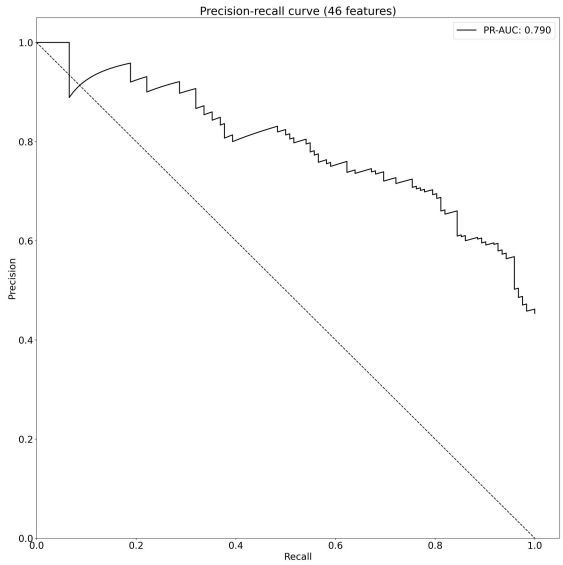


(A) (B)

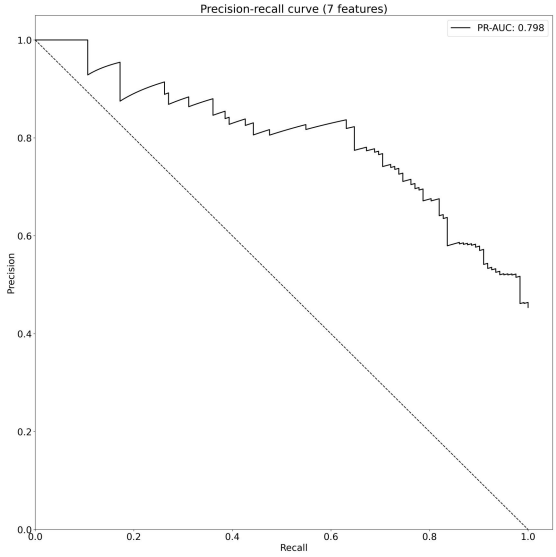
Figure S3. (A) Comparison of AUC values of the GBM model with 6 characteristics and the ANN model with 6 characteristics; (B) Comparison of AUC values of the ANN model with 5 characteristics and the ANN model with 6 characteristics. AUC: area under the ROC curve; ANN:artificial neural network; ROC: receiver-operating-characteristic; GBM: gradient boosting machine.



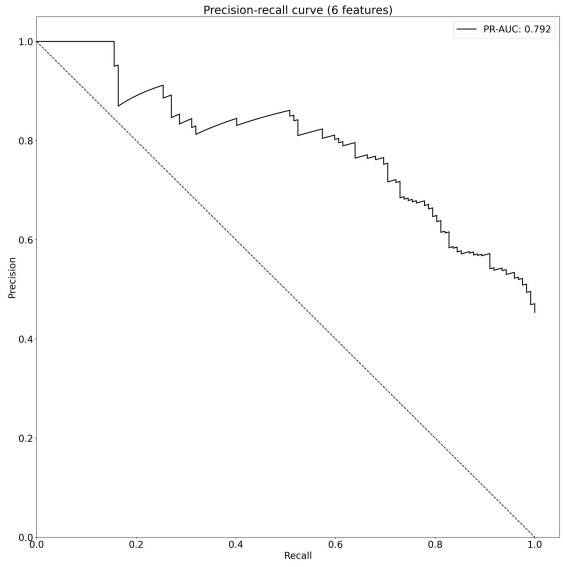
(A) (B)



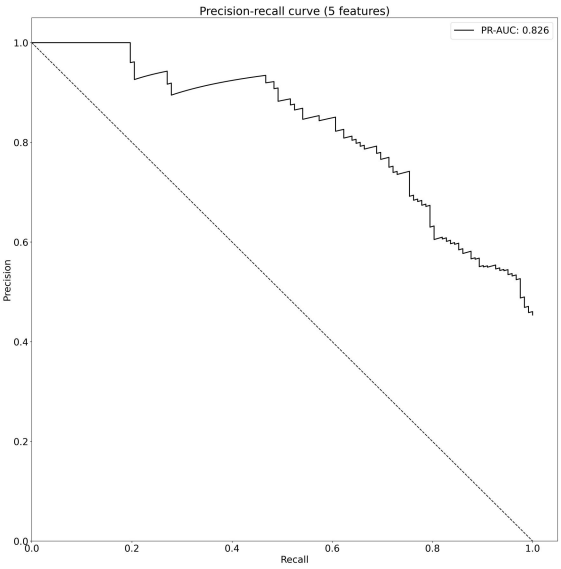
(C)



(D)

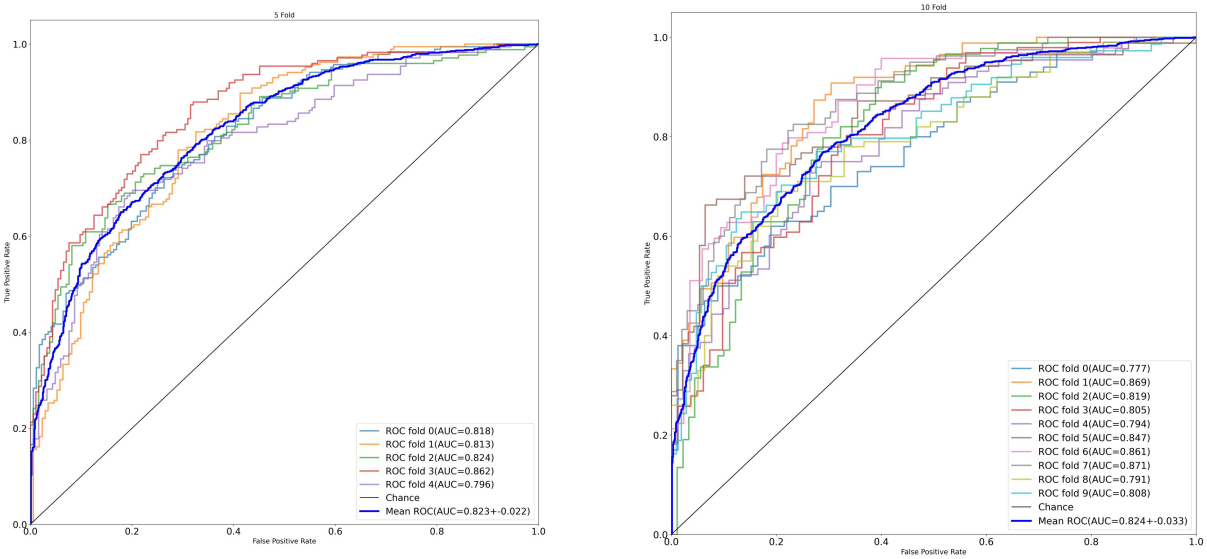


(E)



(F)

Figure S4. Performance of the ANN model with reduced characteristics. **(B)** ROC curve (A) and DCA curve (B) of the ANN model under different characteristics. The ΔAUC and P values represent a comparison to an ANN model with 46 characteristics. **(C-F)** P-R curves of the ANN model with 46 characteristics (C), 7 characteristics (D), 6 characteristics (E), and 5 characteristics (F). These graphs show the predictive performance of the model in the internal validation cohort. AUC: area under the ROC curve; DCA: decision curve analysis; P-R: precision-recall; ANN: artificial neural network; ROC: receiver-operating-characteristic.



(A) (B)

Figure S5. Predictive performance of the final ANN model in cross-validation. (**B)** 5-fold cross-validation (A) and 10-fold cross-validation (B) of the final ANN model in the case of 6 characteristics. These graphs show the predictive performance of the model cross-validated on the MIMIC-IV dataset. AUC: area under the ROC curve; ANN:artificial neural network; ROC: receiver-operating-characteristic.