Supplementary Data

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STROBE Checklist	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	7
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*8*
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	8

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for nonparticipation at each stage	Figure1
		(c) Consider use of a flow diagram	Figure1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	Figure1
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	9
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	*10*
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11
		(*b*) Report category boundaries when continuous variables were categorized	10
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	10
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Supplementary Table

Table S1. Participating institutions and enrollment of patients in the RESCUE registry

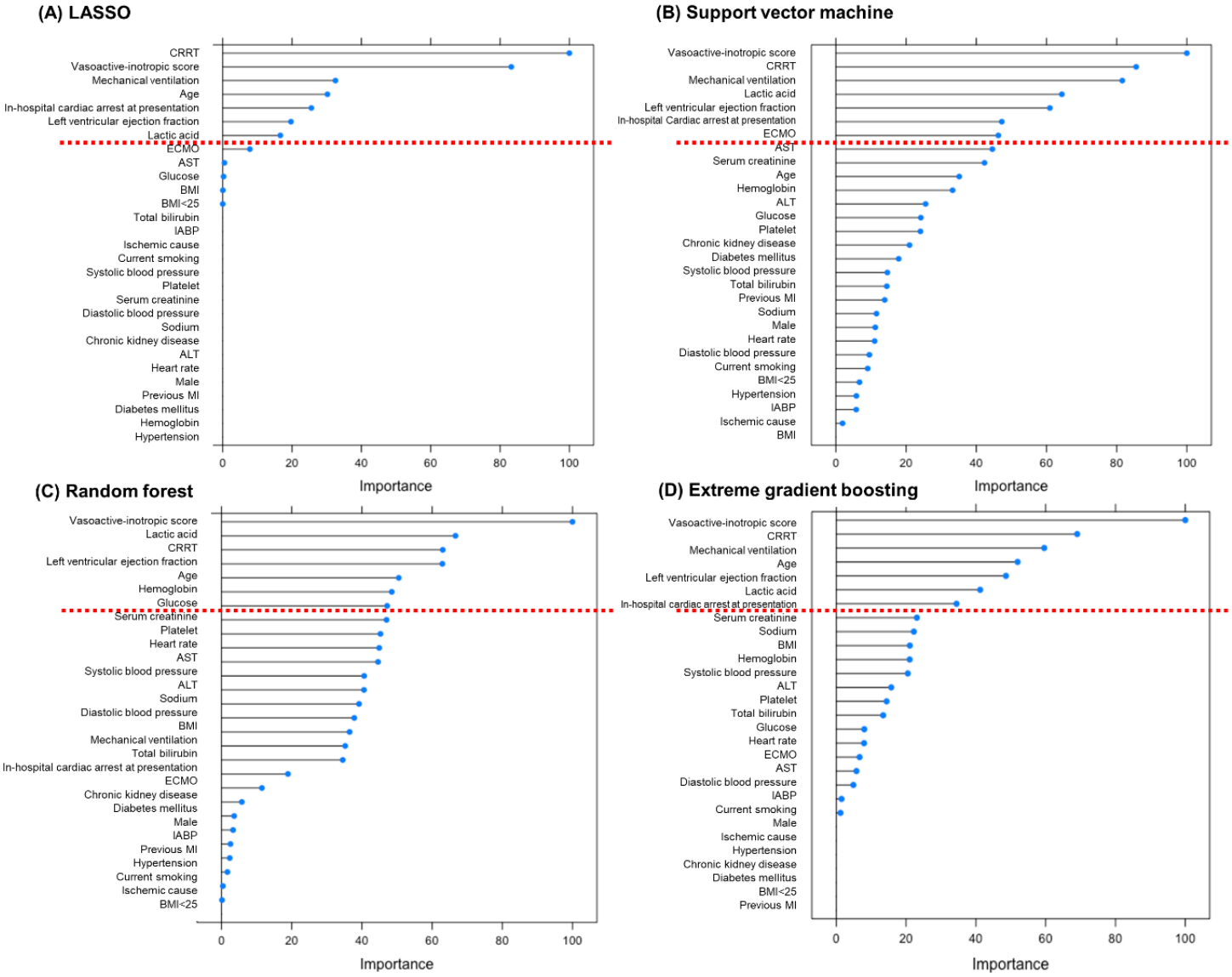
Institutions	Total (N = 1247)	Prospective (n = 293)	Retrospective (n = 954)
Samsung Medical Center	249	105	144
Severance Cardiovascular Hospital	181	34	147
Korea University Anam Hospital	134	4	130
Samsung Changwon Hospital	122	76	46
Konkuk University Hospital	112	23	89
Chungbuk National University Hospital	91	1	90
Inje University Ilsan Paik Hospital	78	14	64
Sejong General Hospital	66	6	60
Chung-Ang University Hospital	67	4	63
Chungnam National University Hospital	57	0	57
Inha University Hospital	52	20	32
Dankook University Hospital	38	6	32

Table S2. Institutional review boards of participating institutions in the RESCUE registry

Name of Institutional review board	No.	Approval date
Samsung Medical Center, institutional review board	2016-03-130	2016-04-06
Severance Cardiovascular Hospital, institutional review board	4-2017-0880	2017-11-06
Korea University Anam Hospital, institutional review board	2016AN0297	2016-11-07
Samsung Changwon Hospital, institutional review board	2016-SCMC-041	2016-08-17
Konkuk University Hospital, institutional review board	KUH1010790	2016-09-01
Chungbuk National University Hospital, institutional review board	CBNUH2017-01-008	2017-02-09
Inje University Ilsan Paik Hospital, institutional review board	2016-07-008	2016-08-30
Sejong General Hospital, institutional review board	1620	2016-08-03
Chung-Ang University Hospital, institutional review board	C2016168(1911)	2016-11-01
Chungnam National University Hospital, institutional review board	2018-02-050	2018-03-22
Inha University Hospital, institutional review board	INHAUH2016-08-006	2016-10-18
Dankook University Hospital, institutional review board	DKUH2016-06-002	2016-06-20

Supplementary Figures

Figure S1. Variable selection from 4 machine learning models



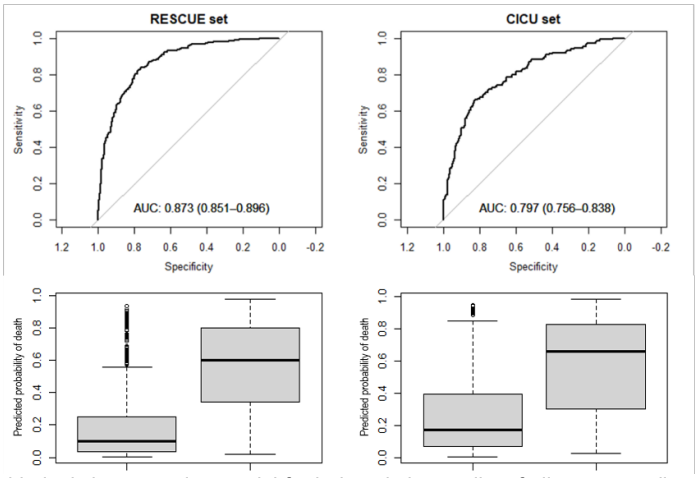
Feature importance plot of (A) LASSO (least absolute shrinkage and selection operator analysis), (B) support vector machine, (C) random forest, (D) extreme gradient boosting. Each plot displays the variables in order of importance. ALT, alanine transaminase; AST, aspartate transaminase; BMI, body mass index; CRRT, continuous renal replacement therapy; ECMO, extracorporeal membrane oxygenation; IABP, intra-aortic balloon pump; MI, myocardial infarction.

Figure S2. Receiver operating characteristic curves and box plots of risk prediction models using 4 machine learning algorithms

(A) LASSO (least absolute shrinkage and selection operator analysis), (B) support vector machine, (C) random forest, (D) extreme gradient boosting

Figure S3. Conventional multivariable stepwise logistic regression for in-hospital mortality

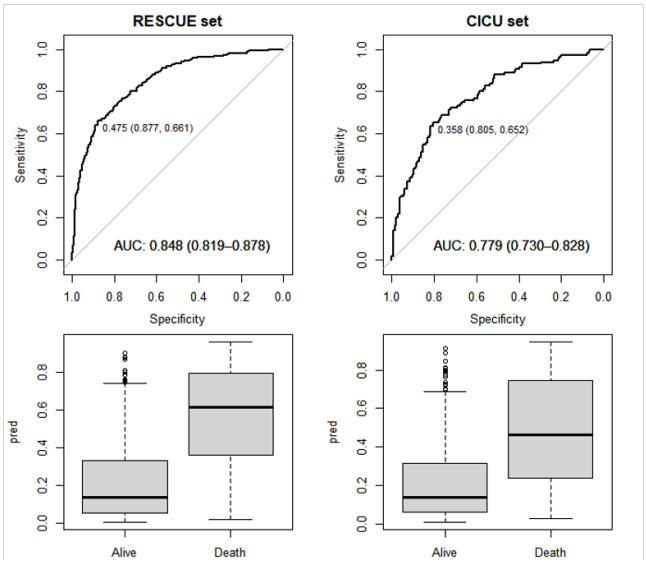
Variables	β-coefficient	Crude OR	Adjusted OR	95% CI	P-value
Male	-0.304	0.76	0.74	0.51-1.07	0.105
Diabetes mellitus	0.320	1.45	1.38	0.96-1.98	0.084
In-hospital cardiac arrest at presentation	0.916	3.38	2.50	1.65-3.80	<0.001
Requiring continuous renal replacement therapy	1.653	7.30	5.22	3.53-7.74	<0.001
Requiring mechanical ventilation	1.233	8.80	3.43	2.22-5.30	<0.001
Age, years	0.048	1.03	1.05	1.03-1.06	<0.001
Left ventricular ejection fraction, %	-0.030	0.96	0.97	0.96-0.98	<0.001
Platelet, x10^3/μL	-0.002	1.00	1.00	0.99-1.00	0.031
Aspartate transaminase, U/L	0.201	1.36	1.22	1.07-1.40	0.004
Vasoactive-inotropic score	0.247	1.62	1.28	1.15-1.43	<0.001



The conventional multivariable logistic regression model for in-hospital mortality of all-cause cardiogenic shock patients derived from the RESCUE registry. The area under the receiver operating characteristic curves and the box plots of the conventional logistic regression model in the RESCUE registry (left) and the Samsung Medical Center CICU registry (right). OR, odds ratio; CI, confidential interval.

Figure S4. Conventional multivariable stepwise logistic regression using 7 variables for in-hospital mortality

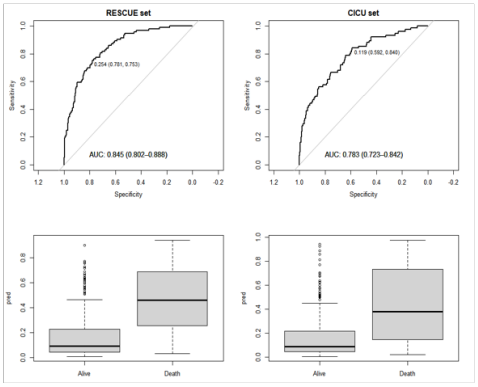
Variables	β-coefficient	Crude OR	Adjusted OR	95% CI	P-value
ECMO	0.551	3.91	1.74	1.12-2.69	0.014
Lactic acid, mmol/L	0.338	2.42	1.40	1.06-1.86	0.019
Vasoactive-inotropic score	0.327	1.62	1.39	1.21-1.59	<0.001
Requiring continuous renal replacement therapy	1.685	7.30	5.39	3.52-8.25	<0.001
Requiring mechanical ventilation	0.925	8.80	2.52	1.52-4.18	<0.001
Age, years	0.041	1.03	1.04	1.03-1.06	<0.001
Left ventricular ejection fraction, %	-0.026	0.96	0.97	0.96-0.99	<0.001



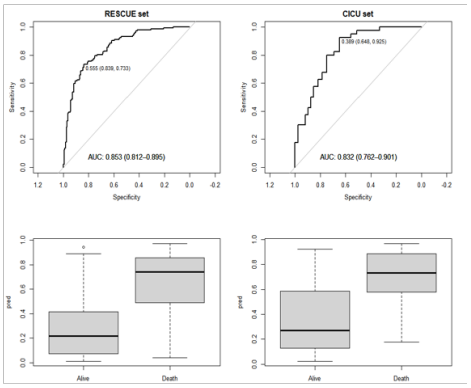
The conventional multivariable logistic regression model for in-hospital mortality of all-cause cardiogenic shock patients using 7 variables derived from the RESCUE registry. The area under the receiver operating characteristic curves and the box plots of the conventional logistic regression model in the RESCUE registry (left) and the Samsung Medical Center CICU registry (right). OR, odds ratio; CI, confidential interval; ECMO, extracorporeal membrane oxygenation.

Figure S5. Predictive performance of the RESCUE score in subgroup analyses

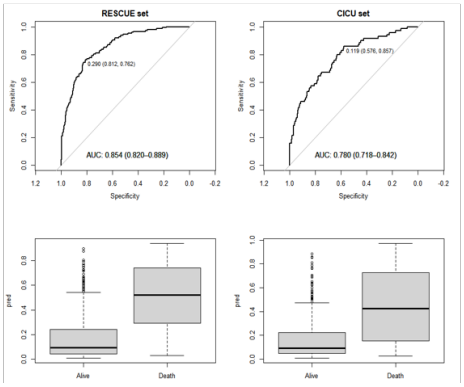
(A-1) No ECMO



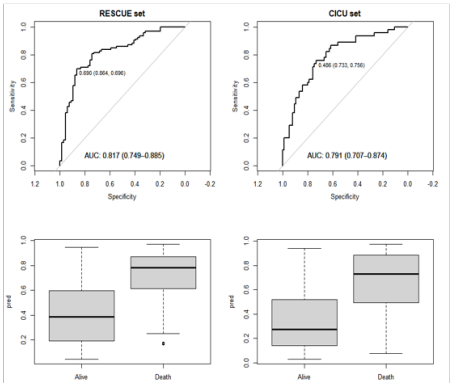
(A-2) ECMO



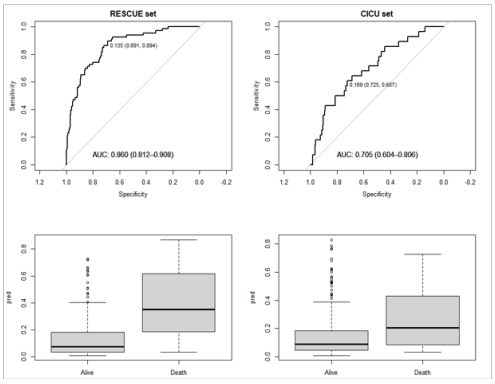
(B-1) No Cardiac arrest



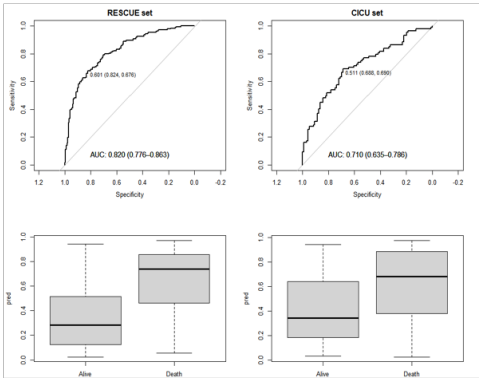
(B-2) Cardiac arrest



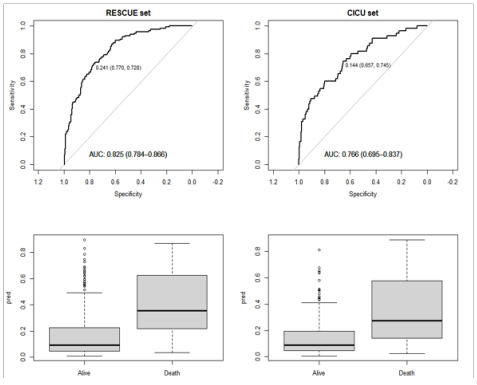
(C-1) Below median VIS



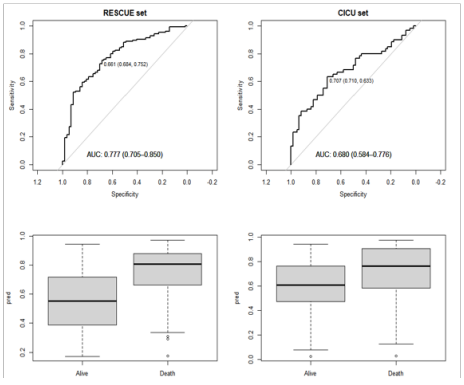
(C-2) Above median VIS



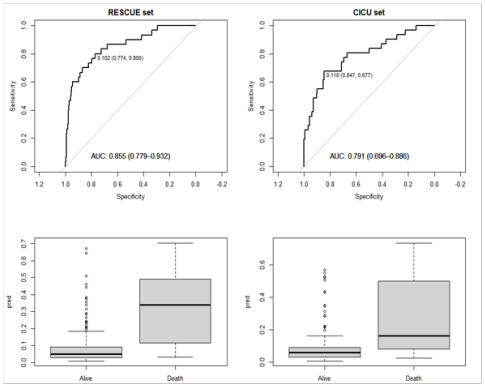
(D-1) No CRRT



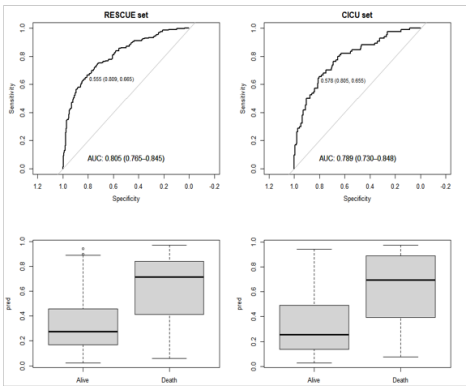
(D-2) CRRT



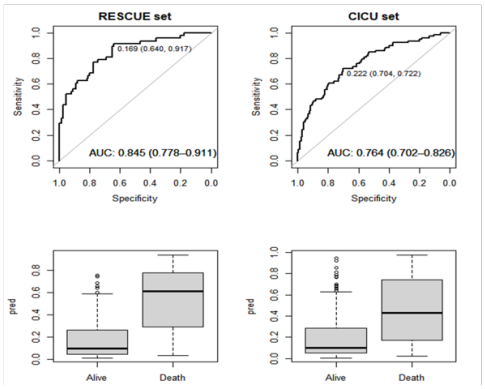
(E-1) No mechanical ventilation



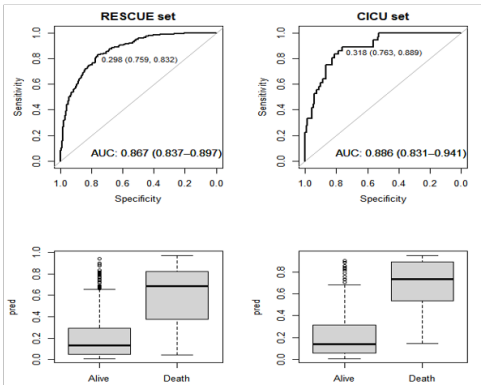
(E-2) Mechanical ventilation



(F-1) Non-ischemic heart disease



(F-2) Ischemic heart disease



The area under the receiver operating characteristic curves and the box plots of the RESCUE score in the RESCUE registry (left) and the Samsung Medical Center CICU registry (right), according to subgroups. (A) ECMO use, (B) Cardiac arrest at presentation, (C) VIS, (D) CRRT, (E) Mechanical ventilation, (F) Ischemic heart disease. CRRT, continuous renal replacement therapy; ECMO, extracorporeal membrane oxygenation; VIS, vasoactive-inotropic score