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Supplemental Information

An interpretable deep-learning model for early prediction of sepsis in the emergency department

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1. Supplemental Figures

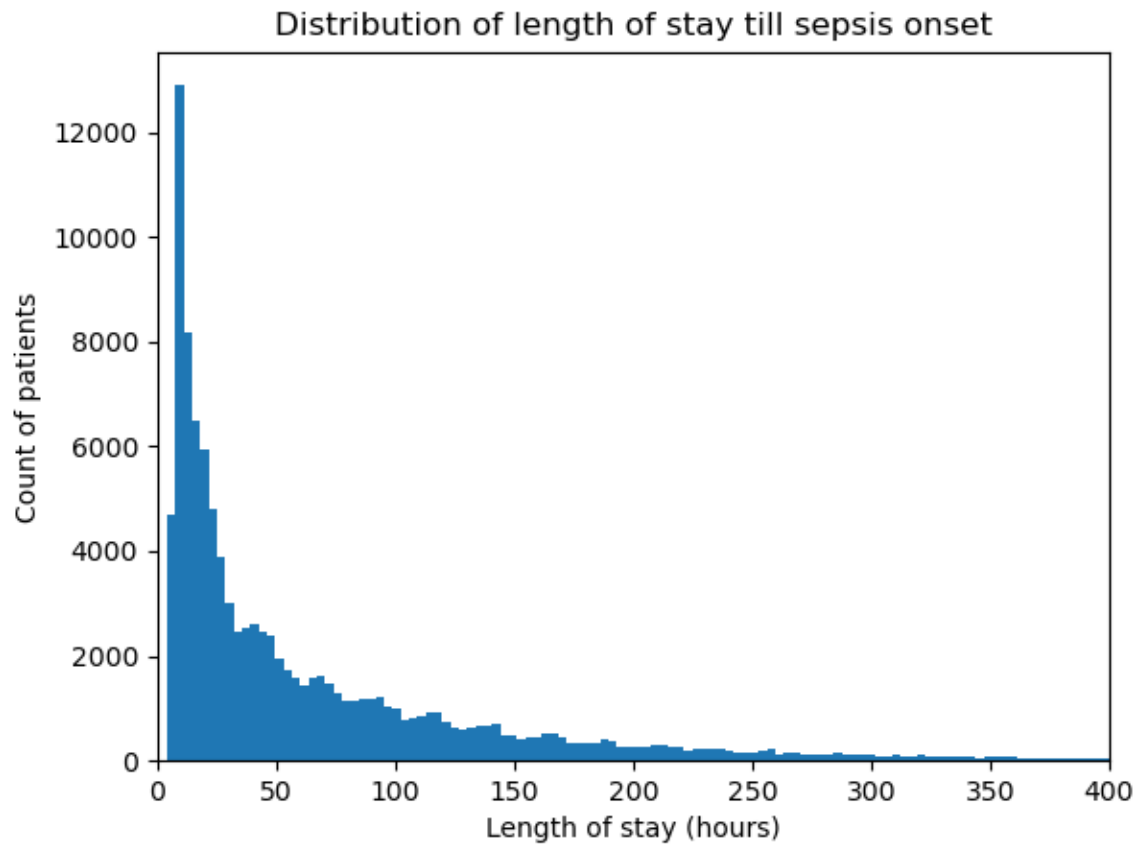


Figure S1. Distribution of length of stay from admission to sepsis onset on the dataset.

2. Supplemental Tables

Table S1. Feature summarization and description of 2019 DII challenge dataset.

Feature	Unit	Missing rate	Contribution rate	Description
A/G Ratio	NULL	0.995	0	Albumin / Globulin Ratio
Albumin Quant	g/dL	0.983	0.001	Albumin Quantitative, Serum
Alk Phos, Serum	U/L	0.985	0.001	Alkaline Phosphatase, Serum
ALT/SGPT	U/L	0.984	0.001	Alanine Aminotransferase / SGPT
Amylase, Serum	U/L	0.969	0.002	Amylase, Serum Enzymatic Activity/Volume
Anion Gap	mmol/L	0.969	0.001	Anion Gap
AST/SGOT	U/L	0.983	0.001	Aspartate Aminotransferase / SGOT
Base Excess	mmol/L	0.98	0.001	Base Excess
Baso %	%	0.97	0.001	Basophils Percent
Baso Abs	10*3/uL	0.987	0.002	Basophils Absolute Count
Baso Abs Cnt Bld	10*3/uL	0.989	0.001	Basophils Absolute Count Blood
Bilirubin Direct, Serum	mg/dL	0.997	0.002	Bilirubin Direct Quantitative, Serum
Bilirubin Serum Quant	mg/dL	0.997	0.001	Bilirubin Total Quantitative, Serum
Bilirubin Total Bld mCnc	mg/dL	0.988	0.001	Bilirubin Total Serum or Plasma Mass/Volume
Blood Urea Nitrogen	mg/dL	0.958	0.001	Blood Urea Nitrogen
BMI	NULL	0.978	0.002	BMI, Body Mass Index
BNP-B Type Natriuretic Peptide	pg/mL	0.999	0.002	BNP-B Type Natriuretic Peptide
Body Surface Area	m2	0.988	0.004	Body Surface Area
Braden Scale	NULL	0.917	0.024	Braden Q Scale
BUN/Creat Ratio	NULL	0.99	0.002	Blood Urea Nitrogen Creatinine Ratio
Calcium Ionized	mmol/L	0.993	0.001	Calcium Ionized
Calcium Quant	mg/dL	0.959	0.001	Calcium Quantitative, Blood
Chol HDL	mg/dL	0.999	0.001	HDL Cholesterol
Chol Total, Serum	mg/dL	0.999	0.002	Cholesterol Total, Serum
CK/CPK, Total, Serum	U/L	0.997	0.005	CK/CPK, Total, Serum
CKMB	ng/mL	0.998	0.001	Creatine Kinase-MB
Cl, Serum	mmol/L	0.959	0.002	Chloride, Serum
CO2	mmol/L	0.912	0.011	Carbon dioxide
Creatinine, Serum Quant	mg/dL	0.958	0.002	Creatinine, Serum Quantitative
DBP	mm[Hg]	0.278	0.164	Blood Pressure Diastolic
Diff Bands	%	0.996	0.001	Differential Bands
Diff Bands, Abs	/uL	0.999	0	Diff Bands, Abs
Diff Blast	K/mm3	0.999	0	Differential Blast
Diff, Eosinophil %	%	0.98	0.001	Eosinophil Percent
Diff, Eosinophil Abs Quant Bld	10*3/uL	0.987	0.001	Eosinophil Absolute Count Blood
Diff, Eosinophil Count %	%	0.989	0.007	Diff, Eosinophil Count %
Diff, Eosinophil Count, Abs	K/mm3	0.988	0.006	Diff, Eosinophil Count, Abs
Diff, Granulocyte %	%	0.994	0.004	Granulocyte Percent
Diff Nucleated RBC	%	0.994	0	Differential Nucleated Red Blood Cell (RBC)
ETCO2	mm[Hg]	0.963	0.004	ETCO2 (End Tidal CO2)

FiO2	%	0.917	0.054	FiO2 (Fraction of Inspired Oxygen)
FLACC Pain Scale	NULL	0.99	0.013	FLACC Pain Scale (Face Legs Arms Cry Consolability Scale)
GFR/BSA Pred Black SerPl MDRD ArVRat	mL/min/1.73m ²	0.992	0.002	Glomerular Filtration Rate/1.73 sq M Predicted Among Blacks Creatinine Based Formula (MDRD)
GFR/BSA Pred non black SerPl MDRD ArVRat	mL/min	0.994	0.002	Glomerular Filtration Rate/1.73 sq M Predicted Among non-blacks Creatinine Based Formula (MDRD)
Glasgow Coma Score	NULL	0.728	0.086	Glasgow Coma Score
Globulin, Serum	g/dL	0.996	0	Globulin, Serum
Glomerular Filtration Rate	mL/min/1.73m ²	0.972	0.004	Glomerular Filtration Rate
Glucose, Serum Quant	mg/dL	0.95	0.014	Glucose, Serum/Plasma Quantitative
Glucose Stick/Meter WBlood POC	mg/dL	0.944	0.13	Glucose Stick/Meter Whole Blood POC
HCO3	mmol/L	0.97	0.002	HCO3
Hct	%	0.956	0.002	Hematocrit
Height	cm	0.973	0.001	Height
Hgb	g/dL	0.954	0.003	Hemoglobin
Hgb A1C	%	0.999	0.003	Hemoglobin A1C (Glycosylated Hemoglobin)
HR	bpm	0.288	0.206	Heart Rate
Imm Granulocytes Cnt Bld Auto, %	%	0.998	0.004	Imm Granulocytes Cnt Bld Auto, %
Imm Granulocytes Cnt Bld Auto, Abs	10 ³ /uL	0.998	0.001	Imm Granulocytes Cnt Bld Auto, Abs
INR Platelet Poor Plasma	NULL	0.997	0.001	INR Platelet Poor Plasma
International Normalized Ratio	NULL	0.988	0.004	International Normalized Ratio
Iron, Serum	ug/dL	0.999	0.004	Iron, Serum
Lactic Acid Blood	mmol/L	0.994	0.002	Blood Gas Lactic Acid Blood
Lactic Dehydrogenase	U/L	0.999	0.008	Lactic Dehydrogenase
Lipase, Serum	U/L	0.998	0.001	Lipase, Serum
Lymph %	%	0.968	0.002	Lymphocyte Percent
Lymph Abs Cnt	10 ³ /uL	0.969	0.002	Lymphocyte Absolute Count
Magnesium, Serum/Plasma	mg/dL	0.977	0.002	Magnesium, Serum/Plasma
MAP	mm[Hg]	0.511	0.135	Mean airway pressure (MAP)
MCH Concentration	g/dL	0.96	0.002	MCH Concentration
Mean Corpuscular Hemoglobin	pg	0.96	0.001	Mean Corpuscular Hemoglobin
Mean Corpuscular Volume	fL	0.96	0.002	Mean Corpuscular Volume
Mean Platelet Volume	fL	0.964	0.002	Mean Platelet Volume
Mono %	%	0.966	0.003	Monocyte Percent
Mono Abs Cnt Bld	10 ³ /uL	0.97	0.001	Monocyte Absolute Count Blood
Neutrophil %	%	0.974	0.001	Neutrophil Percent
Neutrophil Abs Bld Cnt	10 ³ /uL	0.974	0	Neutrophil Absolute Count Blood
Pain Score	NULL	0.841	0.133	Pain Scale Score
PCO2	mm[Hg]	0.964	0.006	Partial Pressure Carbon Dioxide (PCO2)
Peak inspiratory pressure	cmH20	0.959	0.002	Peak inspiratory pressure
Peep	cmH20	0.939	0.002	Peep (Positive End Expiratory Pressure)

pH, Arterial	pH units	0.971	0.001	pH, Arterial
Phosphorus, Serum	mg/dL	0.982	0.002	Phosphorus, Serum
pH, Urine	pH units	0.998	0.003	pH, Urine
Platelet Count	10 ³ /uL	0.961	0	Platelet Count
PO2	mm[Hg]	0.968	0.002	Partial Pressure of Oxygen (PO2)
Potassium, Serum	mmol/L	0.955	0.002	Potassium, Serum
Protein Total, Serum	g/dL	0.985	0.001	Protein Total, Serum
PT	s	0.985	0.002	Prothrombin Time
PTT	s	0.99	0.008	Partial Thromboplastin Time
PTT/APTT PPP	s	0.997	0.004	PTT/APTT, Platelet Poor Coagulation Assay
Pulse	bpm	0.796	0.084	Pulse
Pulse Oximetry	%	0.982	0.011	Pulse Oximetry
QRS Duration	s	0.984	0.013	QRS Duration
QT Interval	s	0.982	0.038	QT Interval
RBC	10 ⁶ /uL	0.961	0.001	Red Blood Cell Count
Red Blood Cell Distribution Width	%	0.966	0.001	Red Blood Cell Distribution Width
Resp Rt	Br/min	0.22	0.158	Respiratory Rate
SBP	mm[Hg]	0.335	0.117	Blood Pressure Systolic
SO2	%	0.58	0.07	O2 Saturation (SO2)
Sodium, Serum	mmol/L	0.958	0.001	Sodium, Serum
Specific Gravity Urine	NULL	0.998	0.002	Specific Gravity, Urine
TCO2	mmol/L	0.991	0.015	Carbon dioxide Total (TCO2)
Temp	Cel	0.668	0.143	Temperature (Route Not Specified)
Thyroid Stimulating Hormone	u[iU]/mL	0.998	0.003	Thyroid Stimulating Hormone
Tidal Volume	mL	0.956	0.004	Tidal Volume
Triglyceride, Serum	mg/dL	0.998	0.001	Triglyceride, Serum
Troponin I	ng/mL	0.997	0.002	Troponin I
Troponin T S/Pl	ng/mL	0.999	0.001	Troponin T, Serum/Plasma
UA Red Blood Cell	[HPF]	0.999	0.005	UA Red Blood Cell
UA Urobilinogen	mg/dL	0.999	0.003	UA Urobilinogen
UA WBC	[HPF]	0.998	0.002	UA White Blood Cell
Vitamin B12, Serum	pg/mL	0.999	0.003	Vitamin B12, Serum Quantitative (Cobalamin)
WBC	10 ³ /uL	0.96	0.001	White Blood Cell Count
Weight	kg	0.964	0.008	Weight

Table S2. P-value matrix of model performance (AUC) across various subpopulations on Case1 sepsis prediction.

		Gender		Race				Age group							
		Female	Male	African American	Asian	Caucasian	Others/ unknown	20~30	30~40	40~50	50~60	60~70	70~80	<20	>=80
Gender	Female	1	0.025	0.33	0.22	0.02	0.012	0.046	0.007	0.64	0.123	0.323	0.011	0.013	0.856
	Male	0.025	1	0.01	0.478	0.747	0.165	0.314	0.081	0.005	0.582	0.624	0.112	0.002	0.075
Race	African American	0.33	0.01	1	0.138	0.008	0.005	0.019	0.004	0.501	0.037	0.118	0.005	0.046	0.299
	Asian	0.22	0.478	0.138	1	0.504	0.724	0.775	0.831	0.182	0.417	0.405	0.849	0.027	0.244
	Caucasian	0.02	0.747	0.008	0.504	1	0.221	0.366	0.109	0.004	0.464	0.546	0.143	0.002	0.06
	Others/ unknown	0.012	0.165	0.005	0.724	0.221	1	0.902	0.67	0.004	0.135	0.217	0.657	0.001	0.026
Age group	20~30	0.046	0.314	0.019	0.775	0.366	0.902	1	0.85	0.025	0.24	0.274	0.824	0.003	0.068
	30~40	0.007	0.081	0.004	0.831	0.109	0.67	0.85	1	0.003	0.074	0.137	0.956	0.001	0.016
	40~50	0.64	0.005	0.501	0.182	0.004	0.004	0.025	0.003	1	0.044	0.192	0.005	0.017	0.552
	50~60	0.123	0.582	0.037	0.417	0.464	0.135	0.24	0.074	0.044	1	0.885	0.093	0.003	0.221
	60~70	0.323	0.624	0.118	0.405	0.546	0.217	0.274	0.137	0.192	0.885	1	0.148	0.008	0.423
	70~80	0.011	0.112	0.005	0.849	0.143	0.657	0.824	0.956	0.005	0.093	0.148	1	0.001	0.022
	<20	0.013	0.002	0.046	0.027	0.002	0.001	0.003	0.001	0.017	0.003	0.008	0.001	1	0.014
	>=80	0.856	0.075	0.299	0.244	0.06	0.026	0.068	0.016	0.552	0.221	0.423	0.022	0.014	1