Sepsis Insight and Management Platform (SIMPL): Utilizing Comorbidity Subgroups For Enhanced ICU Patient Care

Oakkar Aung oaaung@ucsd.edu
Rihana Mohamed rmohamed@ucsd.edu
Vibha Sastry vsastry@ucsd.edu
Jiyeon Song jis036@ucsd.edu
Mentor: Kyle Shannon kshannon@ucsd.edu

UC San Diego
HALICIOĞLU DATA SCIENCE INSTITUTE

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1. Medical Dashboard
2. About the group
3. GitHub Repository

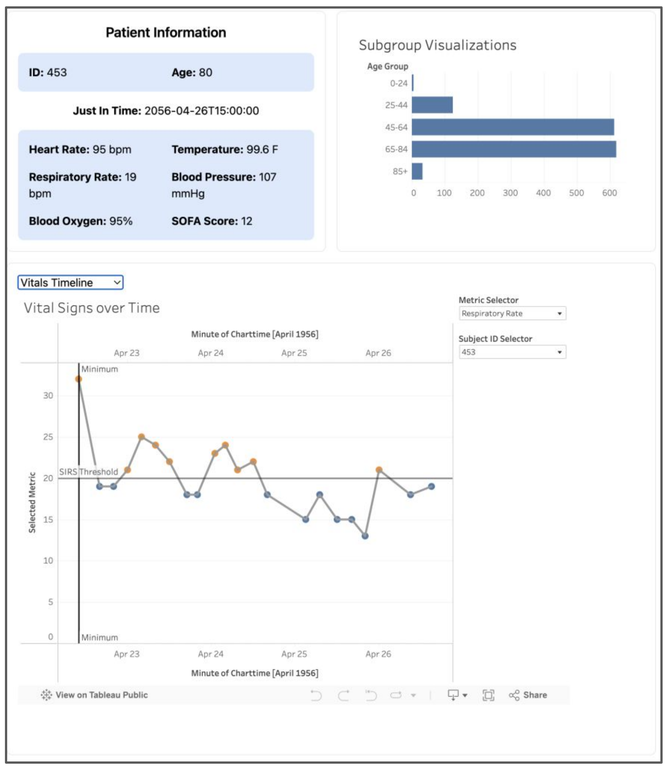
ABSTRACT

Sepsis is the leading cause of deaths in the ICU, highlighting a significant deficiency in the incorporation of medical history in current sepsis care protocols. Working with stakeholders, along with building upon the insights from *Zador et al.* (2019), which challenges the current diagnostic system, we decided to create a comprehensive sepsis risk assessment dashboard that capitalizes on our new insights relating to comorbidity, or disease composition.

DASHBOARD INFO

The dashboard incorporates HTML, Tailwind CSS, JavaScript, and Tableau.
- Simple and quick view of important Just In Time information
- Dynamic visualization of relevant vitals and subgroup data

VISUALIZATIONS



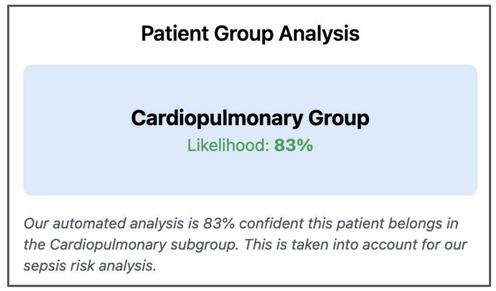
Selected Vitals Signs (based on UCSD Health):
- Blood Pressure
- Temperature (°F)
- Heart Rate
- White Blood Cell Count
- Respiratory Rate
- Oxygen saturation

Sepsis is diagnosed when the presence of two or more positive Systemic Inflammatory Response Syndrome (SIRS) criteria, which are as follows:

- Temperature > 100.9°F or 96.8°F
- Heart Rate > 90 bpm
- Respiratory Rate > 20 bpm
- White Blood Cell Count > 12,000 or < 4,000 or 10% bands

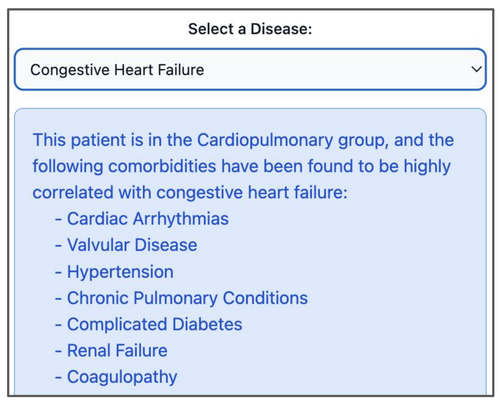
+ With suspected Source of Infections.

STATISTICAL ANALYSIS



Latent Class Analysis (LCA): A clustering model for multivariate discrete data
- Age (16+)
- Admission Types (Elective, Emergency)
- 30 Elixhauser Comorbidity Index

By choosing the lowest AIC and BIC, 7 latent groups are identified.
- Cardiopulmonary
- Cardiac
- Young
- Complicated diabetics
- Uncomplicated diabetics
- Hepatic/addiction
- UNKNOWN



Logistic Regression: A statistical model for predicting categorical variables dependency on other variables

The statistical association ($P \leq 0.01$) between various diseases within specific groups, allowing us to efficiently inform healthcare professionals about potential comorbidities in patients based on their group classifications.

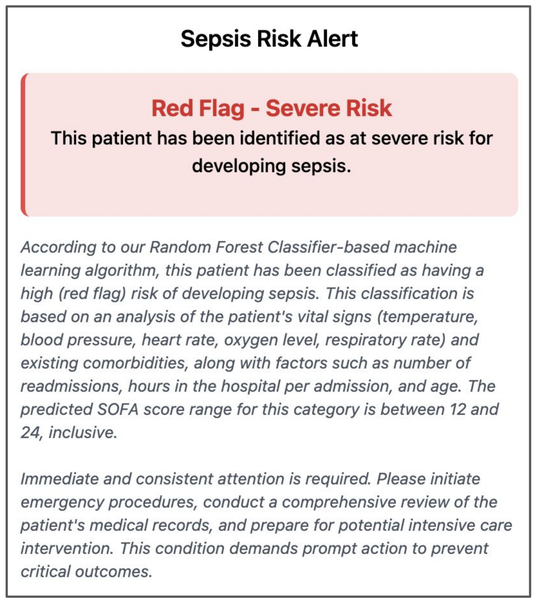
MACHINE LEARNING

Random Forest Classifier Features:
1. Vital signs: temperature, blood pressure, heart rate, oxygen level, respiratory rate
2. Comorbidity groups to which the patients belong
3. Number of readmissions, Hours in the Hospital per Admission, Age

The model predicts the sepsis risk score category for each patient and assigns a color-coded flag based on the predicted score range.

Color Flags Explanation:
- RED: *Severe Risk* indicates that patients need consistent and immediate attention. SOFA score between [12, 24] inclusive
- YELLOW: *Mid Risk* suggests that patients require regular monitoring and potential intervention. SOFA score between [5,11] inclusive
- GREEN: *Low Risk* signifies that patients are currently stable but should continue to be observed for any changes. SOFA score between [0, 4] inclusive

Our model, while not highly accurate at approximately 60 - 80% per subgroup, is designed to be explainable, allowing doctors to understand the basis for each prediction.



Organ System, Measurement	SOFA Score				
	0	1	2	3	4
Respiration PaO_2/FiO_2, mmHg	Normal	<400	<300	<200 (with respiratory support)	<100 (with respiratory support)
Coagulation Platelets $x10^3/mm^3$	Normal	<150	<100	<50	<20
Liver Bilirubin, mg/dL (µmol/l)	Normal	1.2-1.9 (20-32)	2.0-5.9 (33-101)	6.0-11.9 (102-204)	>12.0 (<204)
Cardiovascular Hypotension	Normal	MAP<70 mmHg	Dopamine ≤5 or dobutamine (any dose)**	Dopamine >5 or epinephrine ≤0.1 or norepinephrine ≤0.1	Dopamine >15 or epinephrine >0.1 or norepinephrine >0.1
Central Nervous System Glasgow Coma Score	Normal	13-14	10-12	6-9	<6
Renal Creatinine, mg/dL (µmol/l) or Urine output	Normal	1.2-1.9 (110-170)	2.0-3.4 (171-299)	3.5-4.9 (300-440) or <500 mL/day	>5.0 (>440) or <200 mL/day

RESULTS

With the model using the general UCSD Health Protocol using just vitals:
- Sepsis Model (All Patients): 50%

With the model using general UCSD Health Protocol using vitals + comorbidity:
- Subgroup Specific Model: 60- 80%