Fairness in Sepsis Diagnosis: Analyzing Racial and Socioeconomic Disparities in ICU Decision-Making Using MIMIC-III

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Abstract. Sepsis is a life-threatening condition requiring rapid diagnosis and treatment. However, prior research suggests that racial and socioeconomic disparities impact healthcare outcomes, potentially leading to delayed sepsis diagnoses for certain patient groups. This project aims to investigate whether such disparities exist in ICU settings by analyzing the MIMIC-III dataset. Specifically, we will examine time-to-diagnosis and treatment initiation differences across racial and socioeconomic groups. We hypothesize that minority and lower-income patients experience longer delays in sepsis recognition and antibiotic administration, leading to increased mortality and ICU stay durations. Our study will use statistical analyses, survival modeling, and fairness metrics to quantify bias in clinical decision-making. The findings will contribute to ongoing discussions about healthcare fairness and AI-driven clinical decision support systems.

Keywords: Fairness, Healthcare Bias, Machine Learning, Sepsis, MIMIC-III

1 Introduction

Sepsis is a critical condition requiring immediate intervention, yet research suggests that diagnosis delays disproportionately affect minority and lower-income patients. Our study investigates whether systemic biases exist in ICU sepsis care.

2 Research Question & Hypotheses

1. **Research Question**
   (a) Do racial and socioeconomic disparities impact the time-to-diagnosis and treatment of sepsis patients in ICU settings?

2. **Hypotheses**
   (a) Minority and Medicaid patients experience longer delays in sepsis diagnosis.
   (b) These delays correlate with worse health outcomes (higher mortality, longer ICU stays).

3 Methodology

1. **Dataset**
   (a) We will use the MIMIC-III database, which contains real ICU patient records.

2. **Analysis Plan**
   (a) Extract sepsis patients using ICD-9 codes from `DIAGNOSES_ICD`.
   (b) Measure time from symptom onset (e.g., fever, tachycardia) to official sepsis diagnosis.
   (c) Compare treatment initiation times (e.g., antibiotic administration).
   (d) Conduct fairness analysis using survival modeling and statistical tests.

3. **Fairness Analysis**
   – **Time-to-Treatment Parity** Measures whether different demographic groups (e.g., race, insurance type) experience similar wait times from symptom onset to sepsis diagnosis and treatment (e.g., antibiotic administration). Significant differences in average delays would indicate potential disparities in care.
   – **Equalized Odds:** Evaluates whether sepsis is diagnosed with the same accuracy across racial groups. We compare true positive and false negative rates, as a higher false-negative rate for a group suggests under diagnosis, leading to delayed treatment.
   – **Outcome Parity:** Assesses whether disparities in diagnosis delay lead to worse patient outcomes, including higher ICU mortality rates, prolonged stays, or readmissions. If certain groups experience longer delays and worse outcomes, it suggests structural biases in ICU decision-making.

References

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