Predicting National Acute Myeloid Leukemia Mortality Trends by Age, Race, and Region Using Long Short-Term Memory Networks

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Introduction

- Acute Myeloid Leukemia is a **devastating malignancy** with high short-term mortality and variability in outcomes.
- Prognostic models often **underperform** due to disease complexity and underrepresentation of certain demographics.
- We present a **Long Short-Term Memory deep learning model** trained on United States epidemiologic data to capture **dynamic mortality patterns** and provide **actionable insights**.

Methods

- Mortality data for Acute Myeloid Leukemia were obtained from the **Centers for Disease Control and Prevention WONDER Database (1999–2021)**.
- Data was **normalized and numerically encoded** for age, sex, race, and state.
- A **Long Short-Term Memory deep learning model** was developed in RStudio and trained on 20-year temporal sequences.
- Model accuracy was evaluated using **mean absolute error, root mean square error, and mean absolute percentage error**.
- Performance was further assessed across **demographic subgroups** to ensure broad applicability.

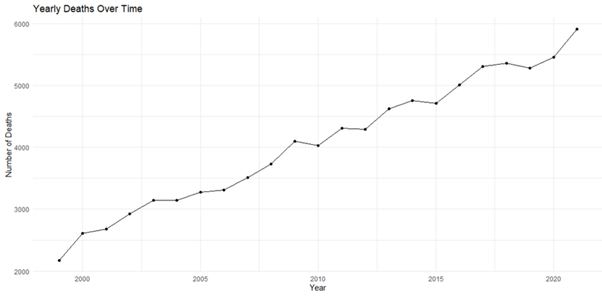


Figure 1 :Overview of the dataset, yearly deaths over time

Results

- The Long Short-Term Memory model revealed **age-related disparities**: adults ≥65 years accounted for 89.2% of Acute Myeloid Leukemia deaths, with the highest fatality in **ages 75–79**.
- **Racial and geographic trends** in mortality were also evident.
- Model performance: **mean absolute error = 142.47 deaths**, **root mean square error = 175.15**, and **mean absolute percentage error = 3.21%**.
- **Accuracy was highest** among older adults and states with robust historical data.

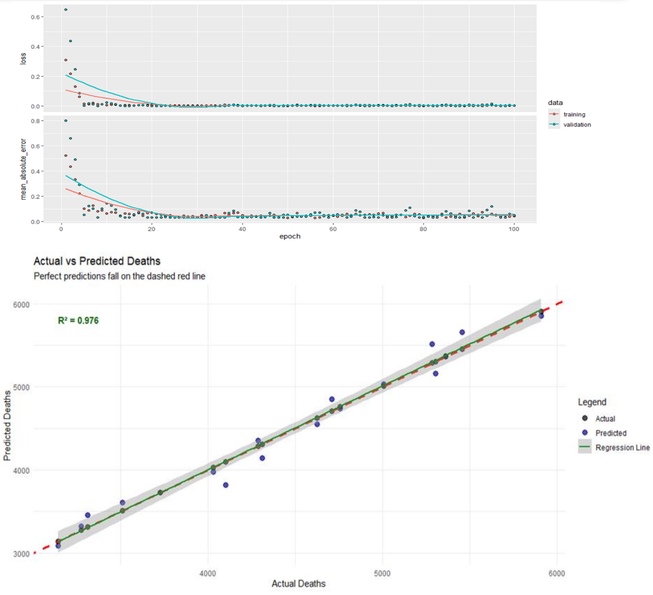


Figure 2 : Actual Deaths and LSTM Predictions

The model identified **subtle mortality trends** often missed by traditional approaches, but was **less responsive to abrupt shifts** such as those seen during the COVID-19 pandemic.

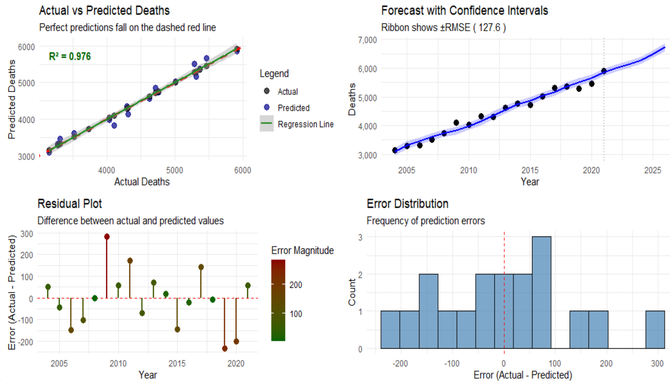


Figure 3: LSTM Prediction Results

Conclusion

- This Long Short-Term Memory model is among the **first tailored for Acute Myeloid Leukemia** mortality forecasting at a national level, **filling a key gap** where Acute Myeloid Leukemia patients are often overlooked in machine learning research.
- By distilling complex demographic and temporal trends, our model enables **earlier and smarter risk identification**, critical for timely intervention in Acute Myeloid Leukemia.
- Future work should focus on developing hybrid models that integrate clinical, treatment, and genetic data, with the aim of supporting real-time decisions regarding therapy intensity and transplant eligibility in Acute Myeloid Leukemia.
- This approach offers a **practical blueprint** for integrating machine learning into individualized Acute Myeloid Leukemia care

Acknowledgements and Author Information

No Acknowledgements

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