RNN based model to predict COVID-19 patients outcomes on admission

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Introduction

- There is an increased need for tools to help identify COVID-19 patients who are at high risk of clinical deterioration.
- Deep learning based models proved to better predict patients' health outcomes using their previous clinical information available in EHRs
- We developed a predictive model that can predict different health outcomes on admission including mortality risk, intubation, and long length of stay

Significance

- High accuracy predicting patient outcomes on admission, using historical patient information
- Minimum need for data curation
  - Embeddings use for better feature representations
- Temporal patient information
  - Time aware RNNs

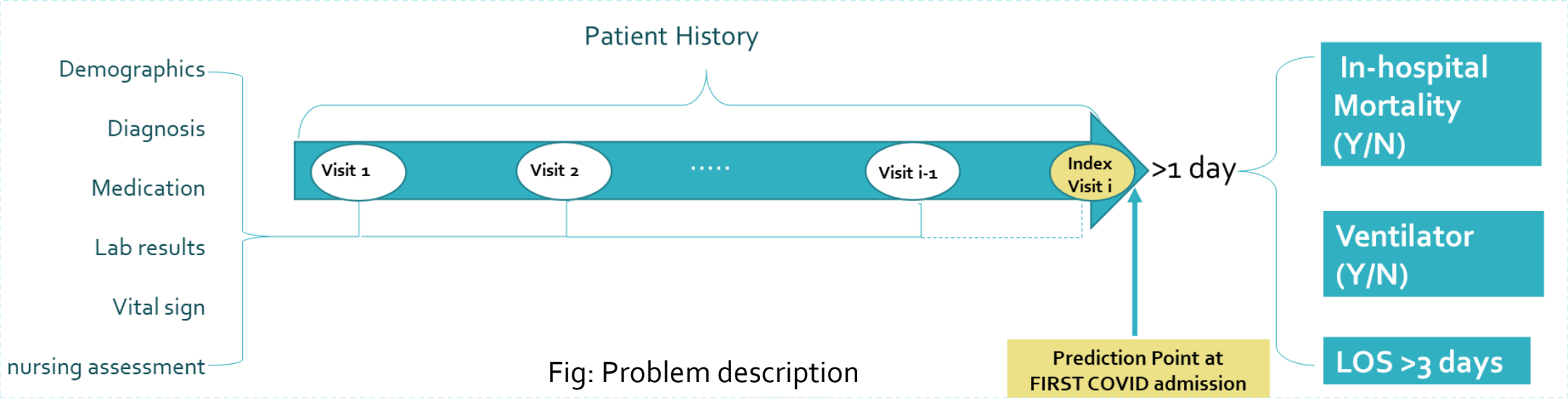


Fig: Problem description

Methods

Cerner *Real World* COVID-19 Data

- 117,496 COVID patients from 62 health systems.

  patients had at least one emergency or inpatient encounter with a COVID diagnosis or a positive laboratory result.
- We excluded all patients who have < 1 day of information after their index date

  Index date is the first COVID encounter admission/service start date
- We included all diagnoses, medication, laboratory results, and other clinical events values available before/on the index date

RNN based Model

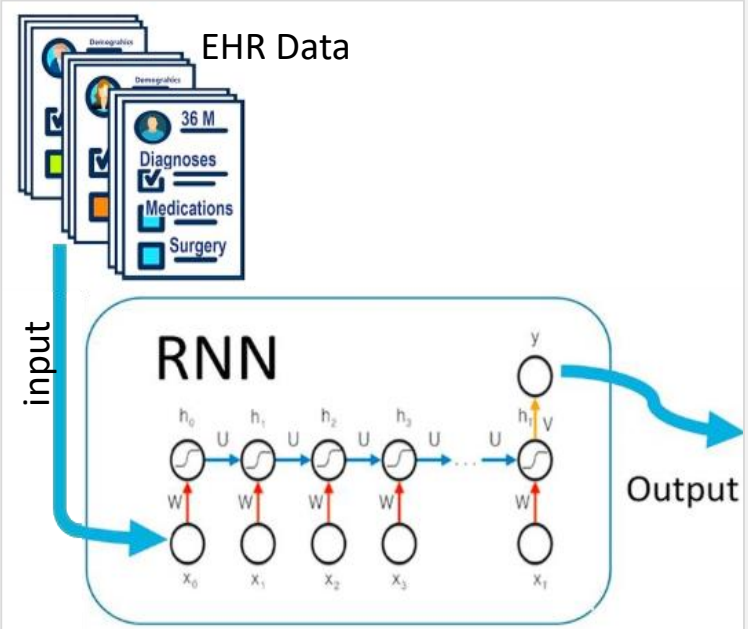


Fig: RNN model trained on EHR data

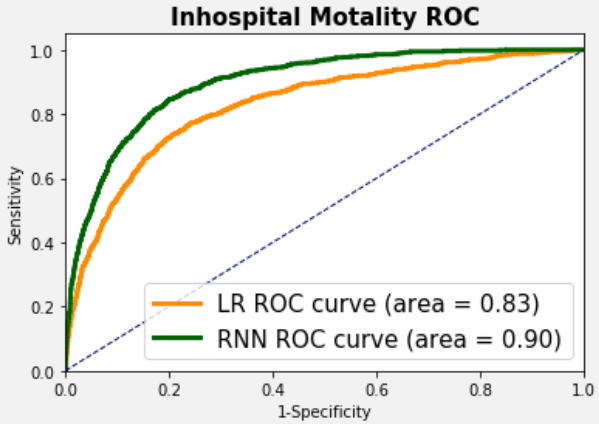
https://github.com/ZhiGroup/pytorch_ehr

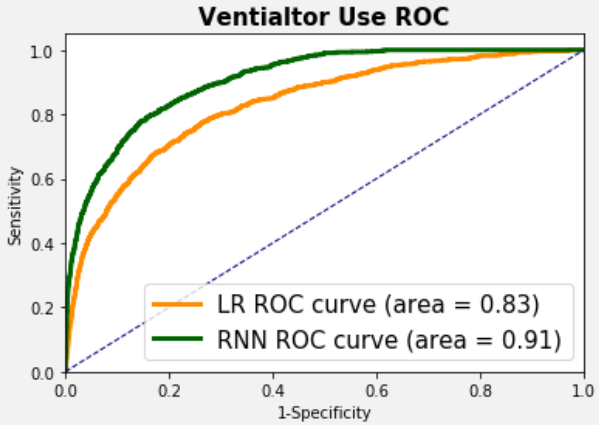
Evaluation

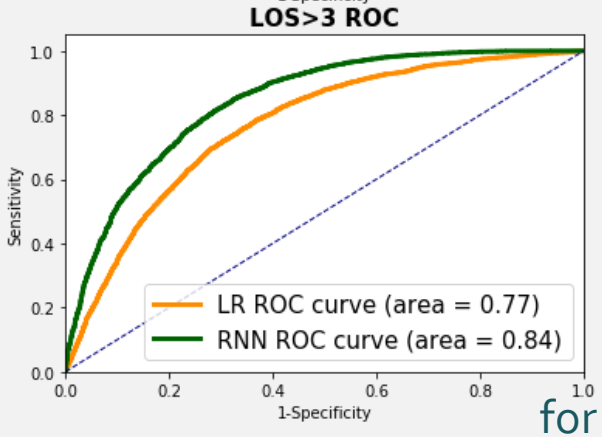
- Compare RNN based model results against a logistic Regression (LR) based model trained on same data.
- Metrics Reported:
  - ✓ AUROC

Results

Characteristics	n= 55,068
Age median *(IQR)*	57 *(37-72)*
Gender	
Female	28,356 *(51.5%)*
Race / Ethnicity	
White	32,675 *(59.3%)*
African American	10,321 *(18.7%)*
Hispanic or Latino	15,589 *(28.3%)*
Outcomes	
Mortality	4,593 *(8.3%)*
Intubation	4,907 *(8.9%)*
Length of Stay median (IQR)	3 *(1 - 7)*







Discussion & Conclusion

- Our RNN models showed high prediction accuracy
- Our RNN model had a 69% sensitivity with a PPV of 38% while LR showed a sensitivity of 47% with a similar PPV.
- Limitations:
  - We build different model for each outcome
- Future Work:
  - Survival Prediction
  - Adding explainability layers to facilitate clinical judgment
  - A single model – multiple outcome predictions

Thank you !

for Questions please email: Laila.rasmy.gindybekhet@uth.tmc.edu