Predicting Imminent Mortality in a Cardiovascular Intensive Care Unit Using Artificial Intelligence

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INTRODUCTION

This study developed and evaluated an AI model for predicting imminent mortality in a Cardiovascular Intensive Care Unit (CVICU).

Currently, care team members monitor patient lab data and physiological sensor measurements as part of care delivery.

Our AI model uses these same data streams to reliable detect patients in danger of mortality, with an AUC of .975.

AI shows promise in automating the detection of imminent mortality in CVICUs using available laboratory and sensor data.

METHODS

Continuous data were collected from 1,472 patients at a single-center CVICU between 2021 and 2022. The primary outcome was mortality, utilizing lab data and sensor streaming data from the preceding 6 hours via Etiometry (with 15 minutes pre-death excluded).

The AI pipeline is as follows:
(1) mean, median, and quantile statistics are calculated for each sensor stream for each patient
(2) the stream statistics are concatenated with lab data far each patient
(3) missing values are median imputed with train set medians
(4) the data is scaled to z-scores with train set mean and variances
(5) a linear SVC predicts mortality vs control

393 laboratory features and 42 physiological sensors were employed.

The train, validation, and holdout sets were stratified with set divisions of 72.25%, 12.75%, and 15%, respectively.

RESULTS

A total of 1,472 patients (144 with CVICU mortality) were included. Holdout AUCs across 50 iterations were as follows: physiologic sensors only, 0.952 (IQR: 0.936, 0.967); laboratory parameters only, 0.867 (IQR: 0.842, 0.896); both, 0.977 (IQR: 0.970, 0.986).

Table 1. Feature Importance Scores

Feature	Importance Score
Lactate (POC)	0.320
Heart Rate (EKG, q05)	0.276
Arterial Blood Pressure (q25)	0.252
pH (UA1)	0.210
Anion Gap (CMP)	0.189
Arterial Blood Pressure (q05)	0.165
Protein Total (Liver)	0.165
Mean Corpuscular Hemoglobin (CBC)	0.158
White Blood Cell Count (CBC)	0.158
Respiratory Rate (q25)	0.157

Figure 1. Feature Importance Scores

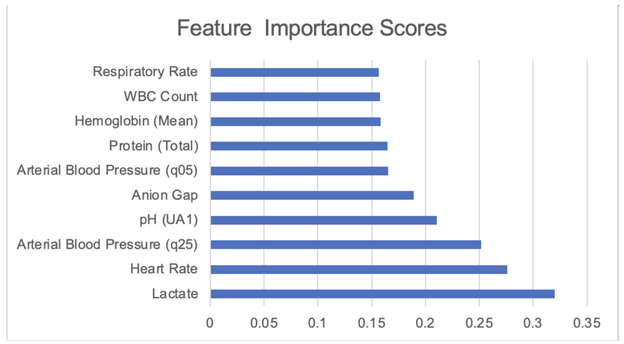
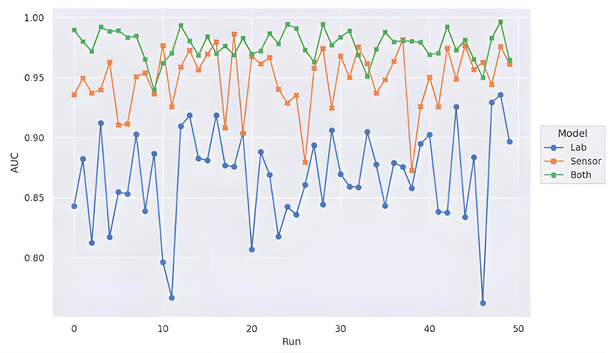


Figure 2. AUC Comparisons Across Models



CONCLUSIONS

AI can be employed for automated detection of imminent mortality using 6 hours of CVICU sensor data. Excellent performing models were attained in using labs alone and sensors alone, but the combine model shows superior performance.

SUMMARY

Our results demonstrate that AI can effectively detect imminent mortality with high accuracy. AUCs ranged from 0.867 (labs only) and .952 (sensors only) to 0.977 (labs + sensors) across 50 iterations.

X-AI (eXploratory-AI) reveals predictive features that align with clinical expertise.

These findings suggest the potential of AI to automate the detection of imminent mortality in critically ill patients.

REFERENCES

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