Lung Ultrasound-Based Artificial Intelligence Prediction of Congestive Heart Failure Readmission

Jacob Duplantis[1], Gautam Gare[2], Jana Armouti[2], Malini Shivaram[2], Laura Hutchins, M.D. [1], Thomas Deiss, D.O. [1], Tom Fox, M.D. [1], Amita Krishnan, M.D. [1], Ricardo Rodriguez, M.D. [3,4], James Emilian Uvan Joseph Antony[2], John Galeotti, Ph.D. [2,4], Bennett deBoisblanc, M.D., FACP, FCCP, FCCM[1]

1. LSUHSC Section of Pulmonary/Critical Care Medicine, 2. Carnegie Mellon University Robotics Institute, 3. Cosmetic Surgery Facility LLC 4. Elio AI

Introduction

- 1 in 4 Americans will develop congestive heart failure (CHF).[1]
- Annual hospitalizations increasing
- Projected health care cost ~70 billion by 2030.[2,3]
- 59% discharged still volume overloaded.[4]
- Previous studies show artificial intelligence (AI) can detect LUS edema but has not been used to track improvement in CHF over time.

Hypothesis

AI interpretation of serial LUS will predict 30-day CHF readmission.

Methods

- Patients prospectively enrolled from convenience sample of adults admitted to a single center with a clinical diagnosis of congestive heart failure and volume overload
- LUS videos collected at 6 pre-specified anatomic locations on the thorax[6] at times 0 - 24, 48, and 72 hours after admission depending on length of hospital stay.
- Clinicians annotated videos for artifacts
- Clinical data and readmission within 30 days captured from EHR.
- Segmentation labelling performed on subset of videos.
- AI trained on data from random sample of 2/3 of patients and validated on 1/3.

Figure 1. Expert annotation interface

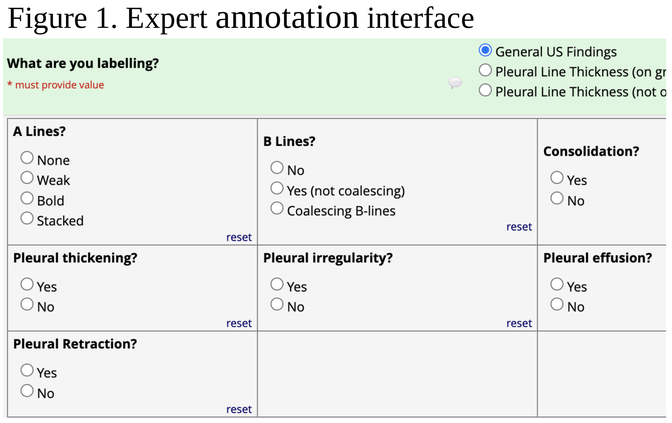


Figure 2. AI accuracy and recall of 30-day readmission

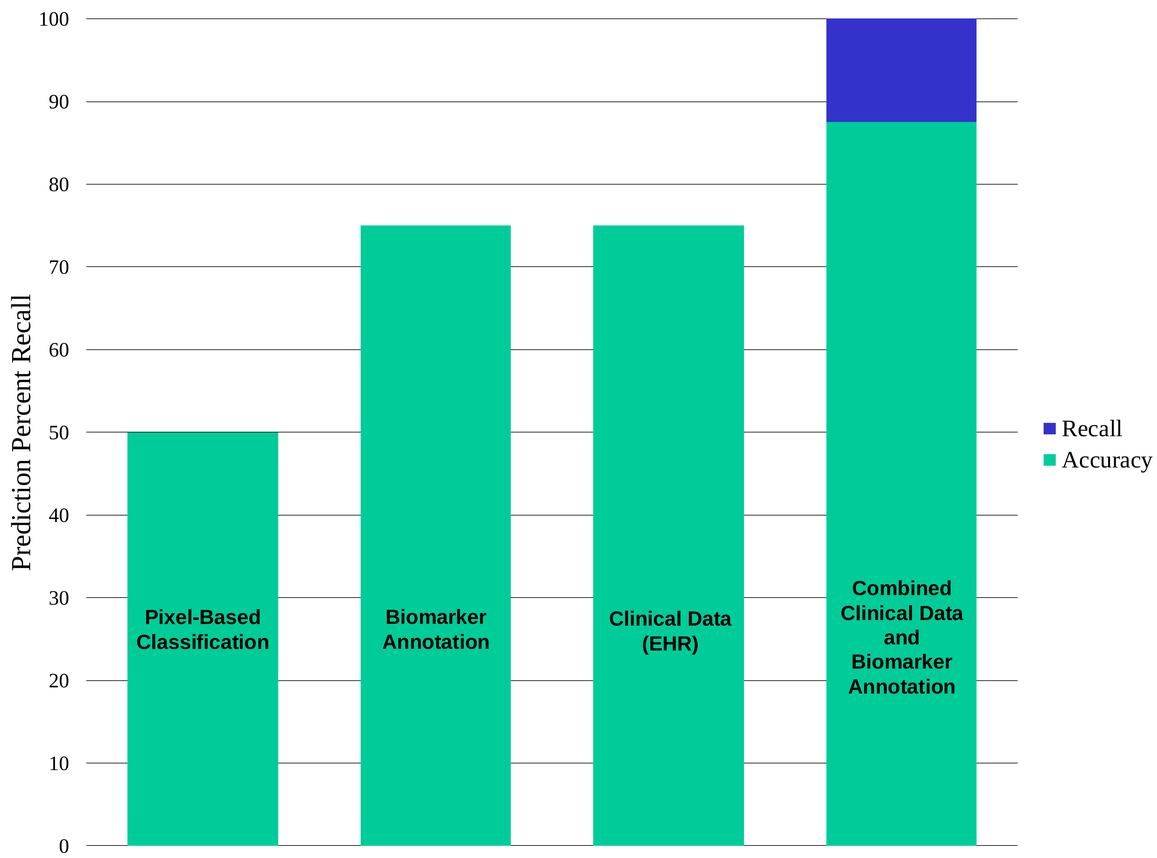
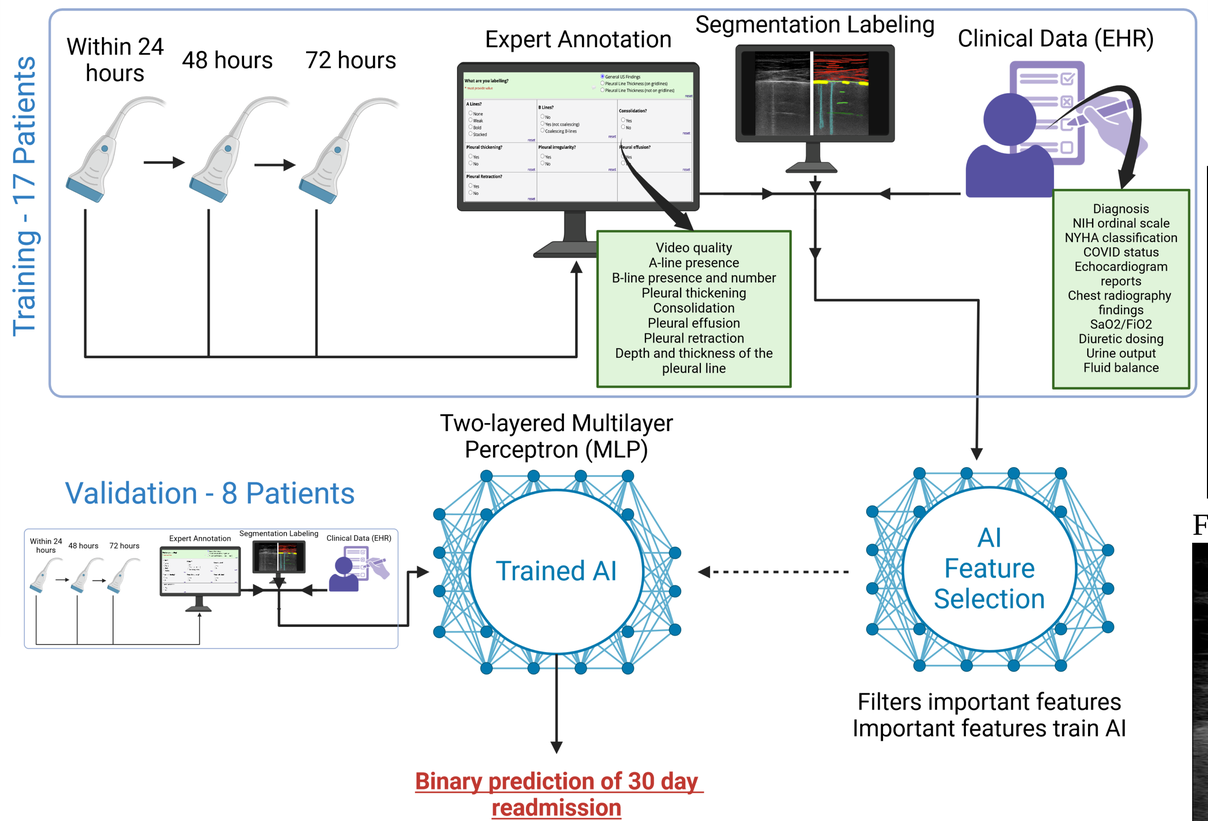


Figure 3. Summary of methods



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Additional Ultrasound Annotators
Luke Yesbeck, D.O.
Michael Olejniak, M.D.
Keyur Patel, M.D.
Sepehr Sadeghi, D.O.
Cyrus Sandrina, D.O.
Amber Hart, M.B.B.C.H
Daniel Cho, M.D.
Amanda Ritchie, M.D.
Thales N. Gomes, M.D.

Results

- Using either clinical data or an annotation-based multi-layer perceptron (MLP) AI model during training yielded 75% accuracy in predicting 30-day re-admission.
- Combining methods increased accuracy to 87.5%.
- Combined feature model achieved 100% recall, implying that it detected all readmission cases, though with false positives.
- In preliminary analysis, AI visual labeling of pixels from single BluePoint had validation accuracy of 50%.

Conclusion

- AI can identify with high accuracy those CHF patients who are at risk for early readmission.

Future Work

- This approach may allow for targeted treatment of selected patients with the hope of reducing recidivism.
- Additional studies in larger sample sizes are needed to confirm these results.
- AI understanding of individual pixels, not just annotated biomarkers

Figure 4. Expert segmentation labeling