ACR AI-LAB - Lahey/MGH COVID CXR Research Project

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ACR AI-LAB @Lahey

- Lahey Hospital and Medical Center (LHMC) was one of the 7 sites participating in the pilot phase
- Successfully implemented by December 2019

MGH Model

- AI model to predict the severity of lung disease based on lung opacities
- Developed by MGH and validated in Newton-Wellesley
- Convolutional Siamese neural networks[1] application for continuous disease severity evaluation and change detection
- Able to predict the risk of intubation and death within 3 days with reasonable accuracy
- Offered in the AI-LAB platform for validation by other sites

1. https://www.nature.com/articles/s41746-020-0255-1

Ground Truth

- Radiographic Assessment of Lung Edema (RALE) score was initially devised to assess lung edema based on degree and extent of lung opacity
- A modified version of score (mRALE) was adopted for this project
- 3 radiologists were trained to assess the 141 patients' admission chest X-rays and assign mRALE score

Ground Truth

- In late April, 161 patient with positive COVID PCR test who had a chest X-ray were identified
- 20 transfer patients were excluded, since we didn’t have access to the admission chest X-ray
- Admission, intubation and death dates was also recorded for each patient

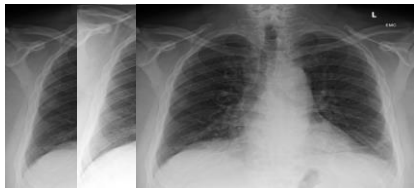
Patient Cohort

- 141 Lahey Clinic COVID-19 RT-PCR positive patients with chest x-rays
  - 120 admitted and 21 not-admitted
  - 14 intubated and 127 not intubated within 3 days of CXR
  - 135 alive and 6 dead with 3 days of CXR
  - 81 males, 60 females
  - Median age = 73 years

Data Processing

Ground Truth

(mRALE score)



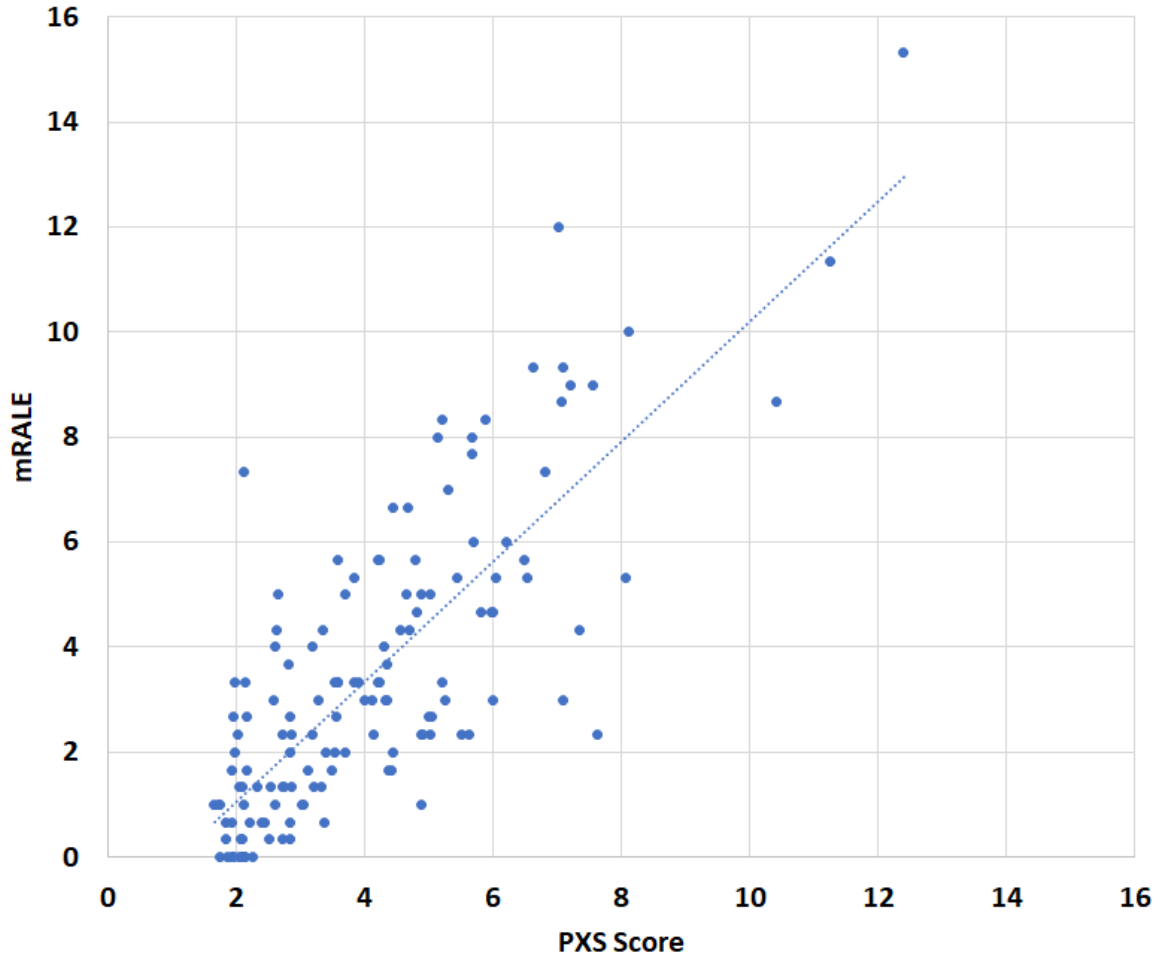
Dockerfile from MGH

On premise ACR AI-LAB platform

PXS score

Data optimization

Model Outcome



Correlation: r = 0.79

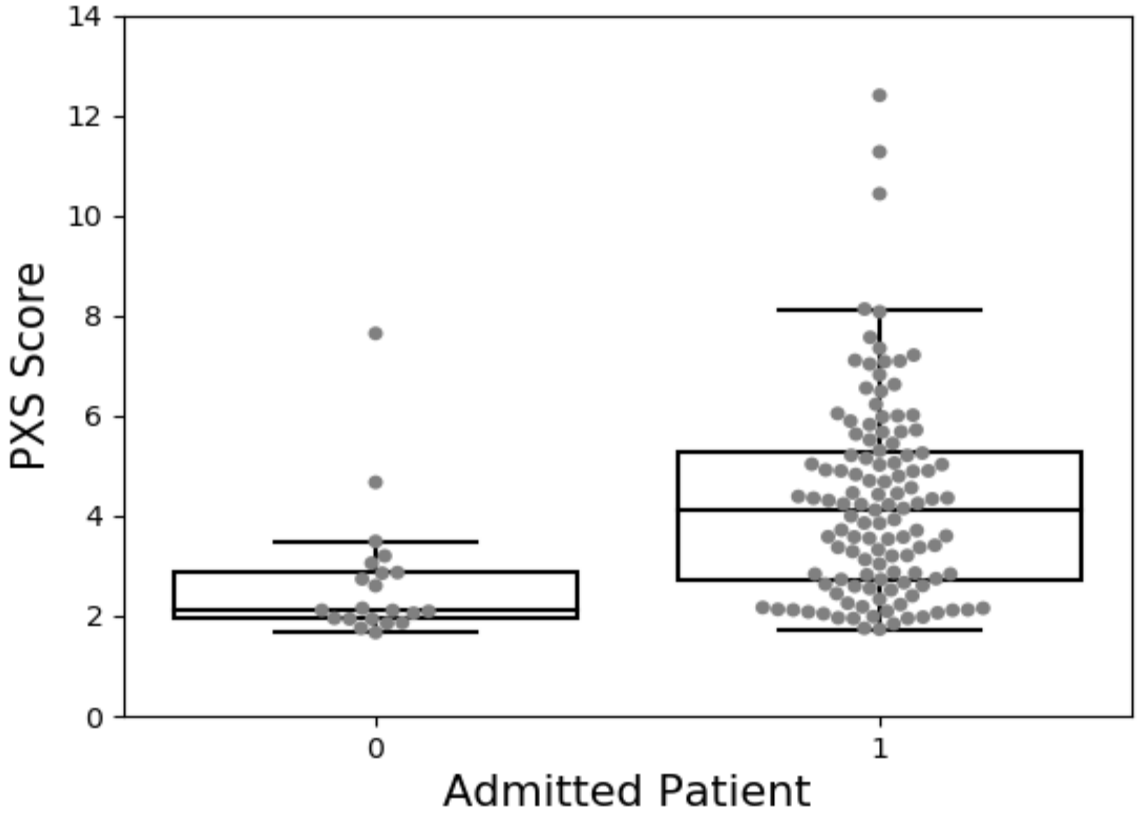
Results - Admission

PXS score is significantly higher in admitted patients

Median PXS score:

- Not admitted (0): 2.1
- Admitted (1): 4.1

Mann-Whitney U test, $p < 0.001$



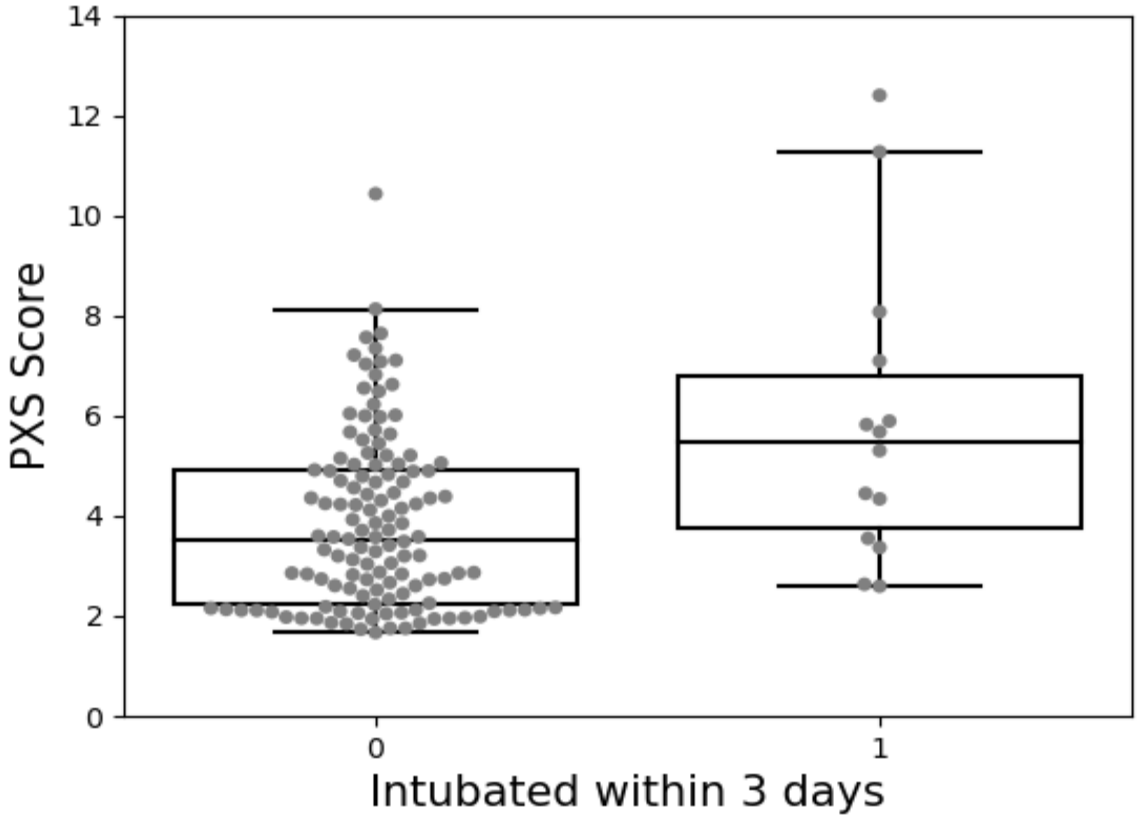
Results - Intubation

PXS score is significantly higher in intubated patients

Median PXS score

- Not intubated (0): 3.5
- Intubated (1): 5.5

Mann-Whitney U test, p = 0.005

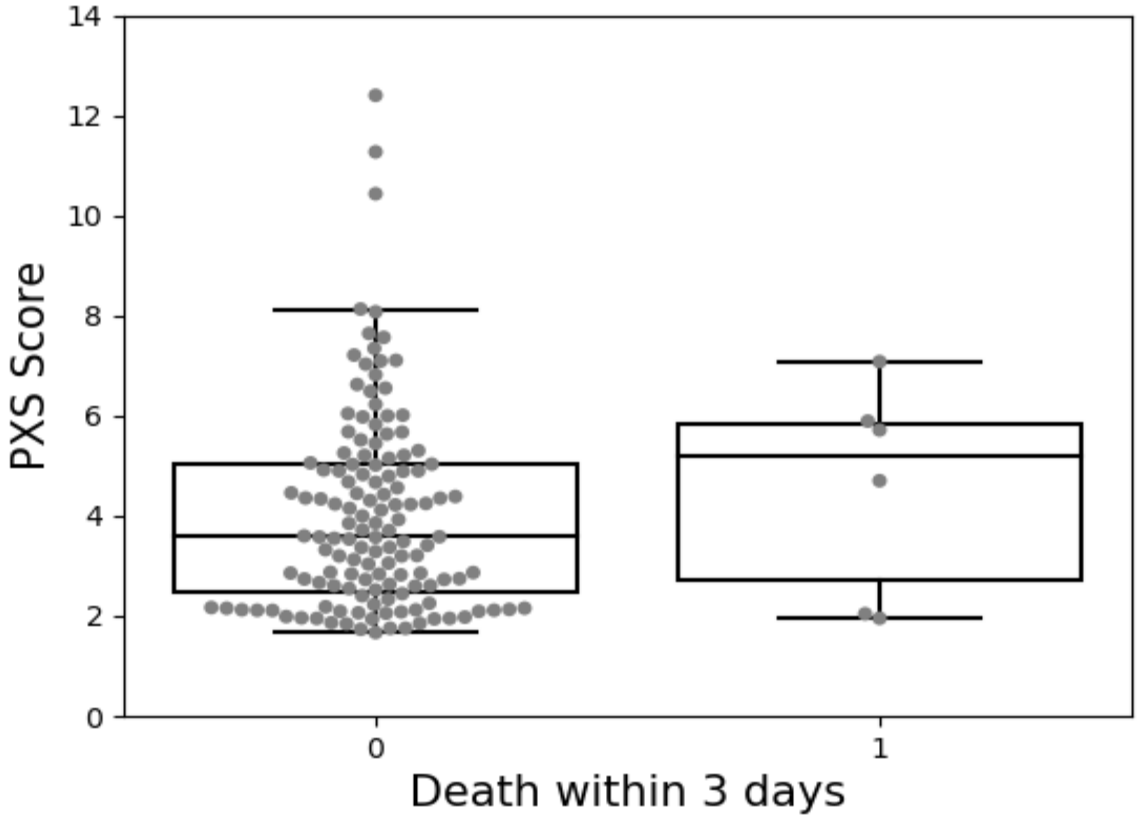


Results - Mortality

Mortality assessment was limited by small number of deaths in cohort
Median PXS score

- Alive (0): 3.6
- Dead (1): 5.2

Mann-Whitney U test, p = 0.5



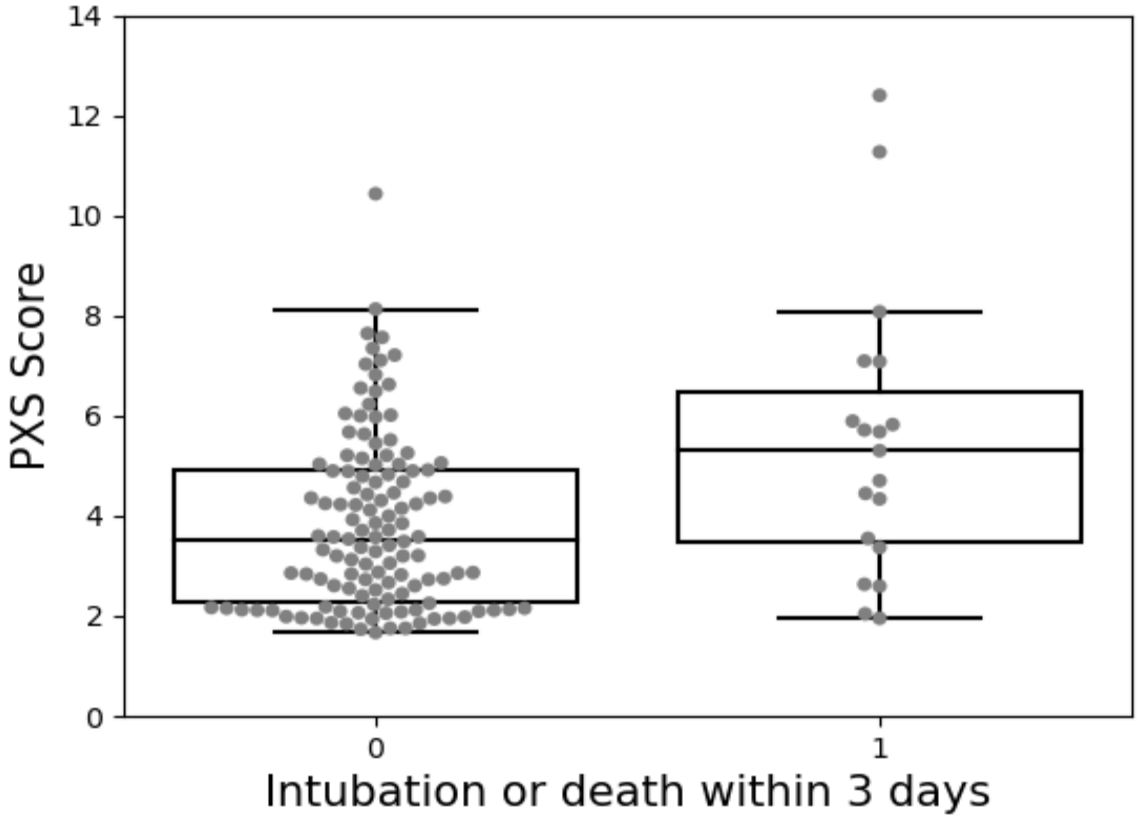
Results - Combination Intubation or Dead

PXS score is significantly higher in patients intubated or dead within 3 days

Median PXS score

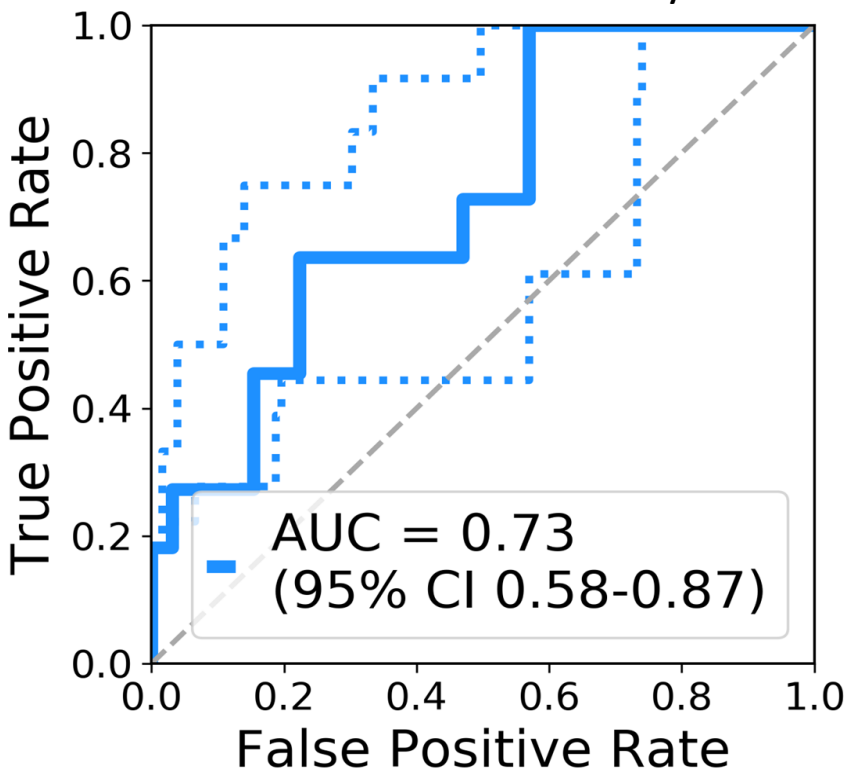
- Not intubated or dead (0): 3.5
- Intubated or dead (1): 5.3

Mann-Whitney U test, p = 0.01

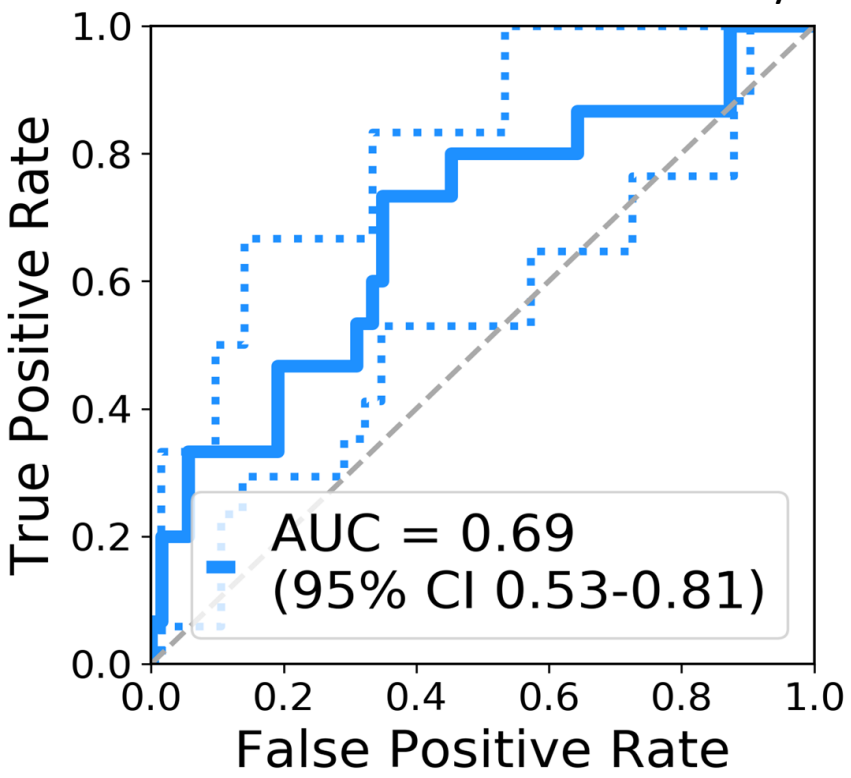


Results - ROC Curves

Intubation within 3 days



Intubation or death within 3 days



Compared to AUC≃0.8 for MGH cohort

Summary

- From conception to results in less than 4 weeks (including IRB)
- ACR AI-LAB platform a viable option for validation of AI algorithms developed in other sites even in the absence of on site data scientists
- Plan to reprocess the images with an updated algorithm
- Incorporating more clinical data (BMI, Vital signs, Labs,...) to strengthen the model

Thank You

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