# Predicting deterioration in Covid-19 patients

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## Background

The COVID-19 pandemic has been spreading worldwide since December 2019, presenting an urgent threat to global health. To date, there is no reliable predictor of disease deterioration. It is currently a clinical challenge to predict which hospitalized patients will deteriorate. Early prediction can allow physicians to take measures that prevent or lessen condition worsening.

**Our goal** is to develop a predictive model for early identification of patients at risk for clinical deterioration by analyzing Electronic Medical Records (EMR) data of COVID-19 inpatients and by conducting a meta-analysis of existing studies.

## Dataset

The Tel-Aviv Sourasky Medical Center (TASMC) EMR data contains medical records of 760 inpatients that were diagnosed with COVID-19, including

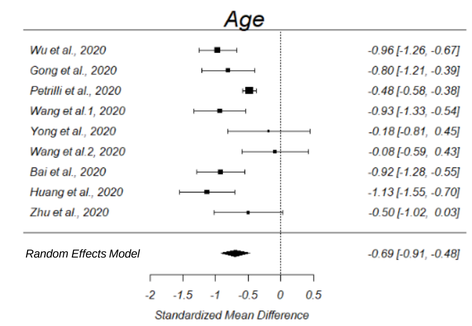
**58 ventilated patients**

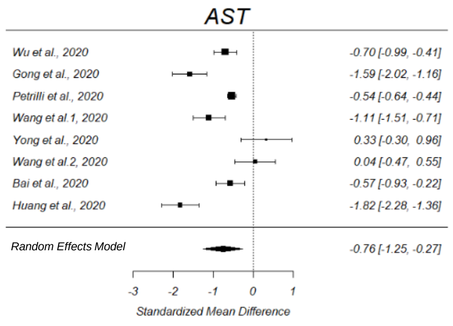
**239 patients with severe disease**

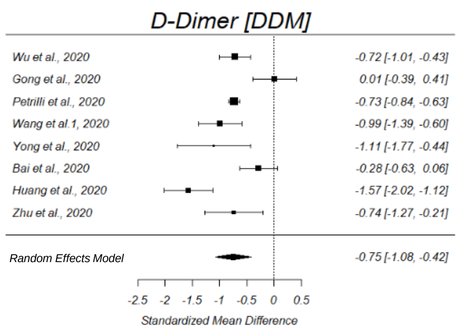
The features are derived automatically from the EMR of the entire hospitalization period. A total of ~150 features were collected per patient, including demographics, background diseases, laboratory tests, vital signs, symptoms and habits.

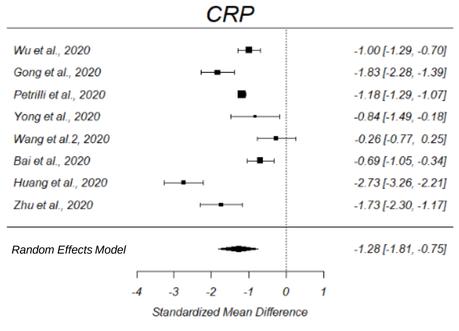
## Meta-Analysis

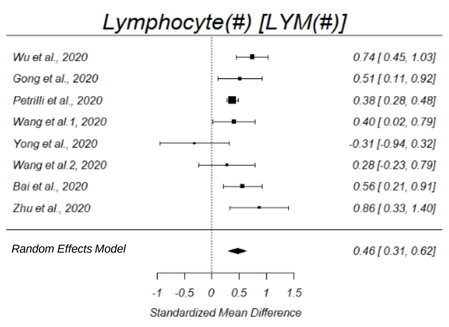
We analyzed 14 published studies comparing the laboratory test results in severe vs. non-severe COVID-19 patients. For detection of significant risk factors, the Standard Mean Difference was calculated.



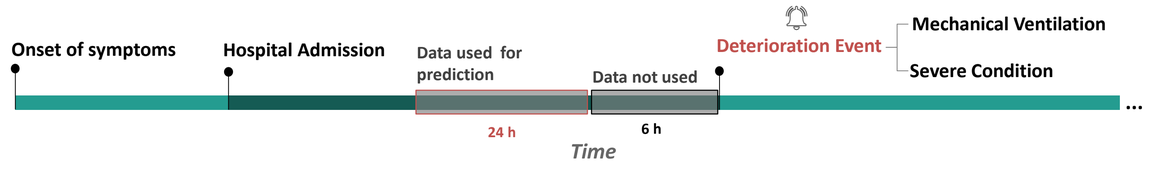




Five top significant parameters that were observed in more than six studies

## Our Approach

We developed models for predicting patients at risk for clinical deterioration in the next 30 hours, without using the data in 6 hours prior to the event.
We used two different criteria of deterioration:

- Mechanical ventilation.
- A high COVID-19 Modified Early Warning Score (COVID-19 MEWS ≥ 7).

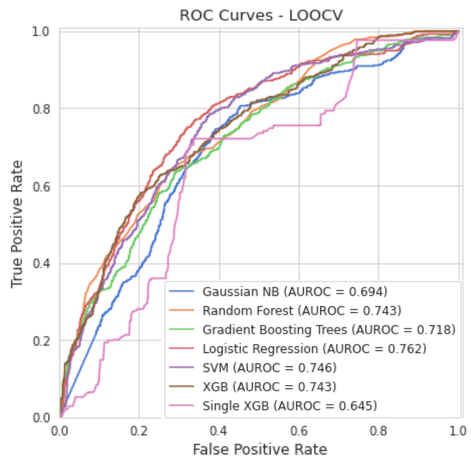


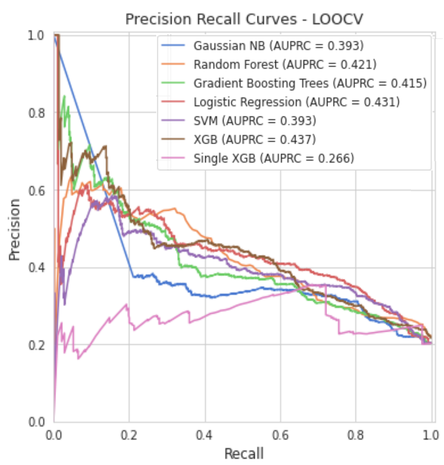

## Model Development Overview

1. Cohort Selection
2. Time Discritization
3. Feature Extraction
4. Data Imputation
5. Feature Selection
6. Model Selection
7. Evaluation

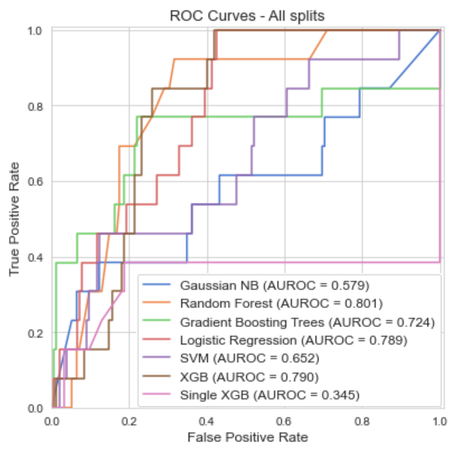
## Results

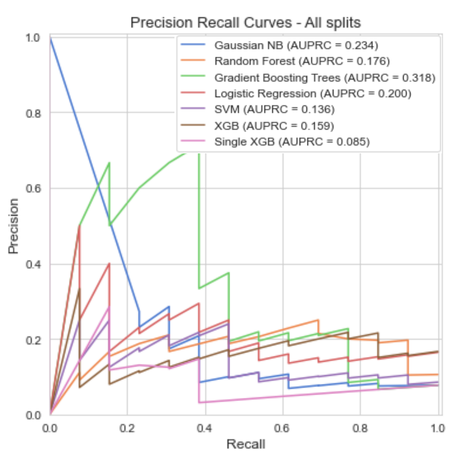
### Predicting high Covid-19 MEWS




### Predicting mechanical ventilation




## Conclusions and Future Plans

We developed two machine learning models for predicting deterioration events within the next 7-30 hours in COVID-19 inpatients. On TASMC EMR data, the models achieved AUROC=0.76 and AUPR=0.43 in predicting severe condition, and AUROC=0.78 and AUPR=0.2 in predicting mechanical ventilation.

These results are still preliminary. We aim to achieve higher performance by improving data pre-processing, imputation and feature engineering, and by developing of survival-based methods.

Our study is limited at this point to data from a single center. We aim to validate our models on data from other hospitals. This will increase model generalizability and lower the risk of overfitting.

***Study supported in part by the Israel Science Foundation (grant 1339/18 and grant 3165/19 within the Israel Precision Medicine Partnership program) and German-Israeli Project DFG RE 4193/1-1.***
***DC and ON were supported in part by fellowships from the Edmond J. Safra Center for Bioinformatics at Tel Aviv University.***