

Bern, 15.04.2021

Bern Data Science Day 2021 - April 23

AI-multi-omics-based Prognostic Stratification of COVID-19 Patients in Acute and Chronic State

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Abstract

COVID-19 is a pandemic disease with tremendous consequences spreading at fast pace. Key measures to control and manage this currently untreatable disease, and to provide adequate patient care are rapid and reliable diagnosis as well as severity assessment. While most patients develop only mild symptoms or are asymptomatic altogether, others exhibit severe courses that are associated with a high mortality rate. Of the initially moderate to severe cases, some recover completely while others deteriorate with the need of being put on invasive ventilation support or even extracorporeal membrane oxygenation. The long term effects on the lung in severe cases are largely unknown to date.

In this project we develop and test an AI-based multi-omics system that combines and uses information from chest CT, laboratory parameters, and clinical data to a) assess the current state of a patient in the acute phase and to forecast seven-day progression and b) to predict chronicity (chronic lung damage). To date, we have access to more than 2'000 chest CTs of patients with laboratory-proven COVID-19 infection as well as their lab parameters, age, gender, and patient history. The majority of COVID-19 positive cases will be provided from centers in Northern Italy. As controls, we include 1'200 cases with similar symptoms who have had pathological CT findings (pneumonias of various causes) before 12/2019 to rule out that these symptoms could have been caused by COVID-19 and 1'000 negative controls with normal chest CT. We measure the performance of the AI-based computational engine, as well as the contribution of each individual variable to the classification and prediction performance of the proposed system. Quantitative metrics used to analyze the results include sensitivity, specificity, accuracy, positive predictive value and area under the curve (AUC) of the Receiver Operating Characteristic (ROC).