Supplement 1. Model Architecture

COVID - Selected Architecture

For testing purposes the mean output of five 2-second windows was used

Adapted from [3]
Supplement 2. Invitation Letter

March 24, 2020

ECG Screening to Identify Subjects at Risk for Coronavirus Infection – Study Invitation

Dear Colleague:

This note is to invite you to participate in a global research study. As you know, currently the world is suffering from a pandemic caused by a coronavirus infection resulting in COVID-19 disease. Animal data from rabbits as well as human clinical reports indicate that coronavirus frequently enters myocardium causes a myocarditic picture that includes elevated troponins as well as electrocardiographic and heart rhythm changes.\(^1\) The known nonspecific electrocardiographic changes appear to arise early in a COVID infection. With the use of machine learning these may permit screening for infection and/or prediction of its severity.

We have previously demonstrated that a neural network can be trained to identify subtle or nonspecific patterns in an electrocardiogram to identify the presence of occult cardiovascular disease and disorders including left ventricular dysfunction, intermittent atrial fibrillation, hypertrophic cardiomyopathy, as well as other conditions.\(^2\)–\(^4\) In this context, we hypothesize that a neural network can be trained to identify the presence of the coronavirus infection. Given the shortage of reagents with current coronavirus genetic screening tests, and in many geographies delays in obtaining results, a rapid, noninvasive, potentially self-administered and massively scalable via mobile phone test utilizing the electrocardiogram may identify individuals who should preferentially undergo the currently available standard genetic screening test. Moreover, in addition to screening for disease, this test may potentially serve to predict who will suffer from severe disease, to warrant closer observation or admission.

In this study, we propose to acquire ECGs from patients and controls from around the world. ECG digital data will be obtained as well as COVID status (positive outpatient, positive inpatient, and COVID positive critical care, known COVID negative or presumed COVID negative, etc, with dates of each COVID test and each ECG recorded). Minimal clinical data, when available, will also be collected. Data will be received by Mayo Clinic in Rochester and analyzed using our existing ECG AI engine to see whether a neural network can be created to differentiate patients who are infected from those who are not, and the ultimate severity of infection in positive patients.
A few basic principles:

1. If a test is successfully developed it will be made available globally at no charge
2. None of the contributors will receive any reimbursement for participation
3. All contributors will be acknowledged.

If you choose to participate, we will need to know your hospital affiliation, the type of ECG equipment used at your hospital, the name/contact information of an engineer at your hospital or ECG manufacturer so we can arrange for standard digital transfer of ECGs. All material will be treated as confidential. We will send you a simple case report form and details regarding the standard ECG format to be used (FDA XML), and work with your ECG manufacturer to facilitate exporting digital ECGs in that format. We have established a dedicated email account: covidECG@mayo.edu. And phone number 1-xxx-xxx-xxxx to facilitate communication.

Thank you for considering participating in this study. Working together, globally, we can hopefully limit human suffering from this scourge.

Respectfully,

Paul A. Friedman, MD, FHRS
Paul A. Friedman, M.D.
Consultant, Department of Cardiovascular Medicine
Professor of Medicine
Norman Blane & Billie Jean Harty Chair, Mayo Clinic Department of Cardiovascular Medicine Honoring Robert L. Frye, M.D.

PAF/brs
References:


Supplement 3. ECG Examples. (Example ECGs, in sequence: true positive, false positive, true negative, false negative, and artifact)

**True positive:**
False positive
True negative
False negative

Artifact