Patient Data Generation and Machine-Learning Utilizing clinical data to predict the severity of presentation of chronic lung diseases

Description:

The Covid-19 pandemic heavily accelerated deployment of telemedicine and remote care services to reduce infection spread and protect essential workers. This has created opportunities to tackle long-standing public health problems endemic to respiratory illness. Heart failure (HF) is a chronic, progressive condition in which the heart muscle is unable to pump sufficient blood to meet the body's circulatory and oxygenation needs. At present, the global prevalence of HF is estimated to include 38 million people with an associated direct and indirect cost burden of $108 billion. Hospitalizations from HF exacerbations account for 6.5 million hospital days, the leading cause of hospitalization in the USA and Europe. Inadequate at-home management and self-awareness of heart failure (HF) exacerbations are known to be leading causes of the greater than 1 million estimated HF-related hospitalizations in The USA alone. Most current at-home HF management protocols include paper guidelines or exploratory health applications that lack rigor and validation at the level of the individual patient. The lack of accurate, automated, and personalized approaches for self-identification and early care of these illnesses has led to unnecessary healthcare utilization, preventable death, increased morbidity, and missed opportunities for timely therapeutic intervention.

Vironix (vironix.ai) specializes in developing consumer validated, cloud-enabled application-programming interface software that – when invoked under smartphones, tablets, computers, monitoring devices, and a variety of institutional HR/Payroll software – delivers on-demand detection and triage of health deterioration. One major challenge in developing these algorithms, however, is access to relevant data. Electronic medical records are proprietary, often inaccessible, and generally contain hoards of incomplete, dirty, and irrelevant data. Public databases that hold genetic, blood, and biomarker type data sources include some explanatory information, but as this data is generally not available to consumers at-home, it can't be used to guide software-based diagnostics in a reasonable consumer setting.

Some datasets that are available (in the literature and in public databases) include clinical characteristic databases which catalog the features of those presenting with severe and non-severe illness flare-ups in both inpatient and outpatient settings (i.e.: percentage of severe cases in which patients had specific symptoms, vital signs, baseline lung function, height, weight, etc).

We propose a project to identify and leverage clinical characteristic data in the literature to classify severe and non-severe exacerbations of congestive Heart Faillure. Vironix has successfully implemented one approach in which it has converted marginally distributed clinical characteristic data on severe/non-severe Covid-19 patient cases into hypothetical patient scenarios for training ML-classification models. This conversion process used a mix of Bayesian inference and Monte Carlo simulation. During the MPI 20212workshop, we wish to explore the following:

Specific questions/aims:

1) Identify – in scientific literature and/or public databases – a representative set of data that catalogs the clinical characteristics of patients presenting with both severe and non-severe flare-ups of

Congestive Heart Failure. Vironix has made some progress on this already, but we'd like more research done.

2) Identify a methodology for utilizing that data to predict severe/non-severe presentations of Heat Failure. Vironix has some approaches for an alternate disease, but we'd be looking to explore others.

3) Develop and validate a prediction model and show reasonable accuracy, sensitivity, and specificity in detecting adverse health episodes.

4) describe and detail the most important clinical features relevant to predicting mild, moderate, and severe exacerbations.

Some useful literature and links:

Company website: vironix.ai

A Machine Learning Methodology for Identification and Triage of Heart Failure Exacerbations
https://link.springer.com/article/10.1007/s12265-021-10151-7

CovidX: Remote Screening, Surveillance, Triage, and Management of Novel Coronavirus
https://vironix.ai/wp-content/uploads/2021/02/CovidX_CoronaVirus_WhitePaper.pdf

Machine Learning Based Triage Models for Remote Detection and Care of Influenza
https://vironix.ai/wp-content/uploads/2021/02/Vironix_MP2_Influenza_Tech_report_2020-1.pdf

A machine learning approach to triaging patients with chronic obstructive pulmonary disease
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0188532

Economic Burden of Chronic Obstructive Pulmonary Disease (COPD): A Systematic Literature Review
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7049777/

Taylor RA Hong WS, Haimovich AD. Predicting hospital admission at emergency department triage using machine learning. PLoS ONE, 13(7):e0201016, 2018.