Case Study

MACHINE LEARNING FOR DISEASE EVENT DETECTION

Viral respiratory illnesses can be particularly challenging for people with asthma. A cold or flu can lead to acute respiratory complications or even death in asthmatics. Elder Research developed a predictive algorithm to define asthma, and identify asthma sufferers who are ill and at risk for major respiratory complications, allowing for intervention prior to onset of acute asthma symptoms, thereby potentially preventing hospital stays and even loss of life.

INDUSTRY

» Biotechnology & Healthcare

BUSINESS NEED

» Find a biomarker signature for subjects at risk for suffering acute respiratory events

» Develop a predictive algorithm that can become an app in a wearable device

SOLUTION

» Built a predictive model – using target shuffling and cross validation – to robustly identify four predictive biomarkers

BENEFIT

» Identified a molecular signature for asthma that could be developed as a diagnostic tool

» Created a predictive algorithm for acute asthma events that can be incorporated into a wearable device app

The Challenge

Recent estimates made by the Global Asthma Network indicate that as many as 334 million people worldwide may be suffering from asthma, and that number is rising. Approximately one in 12 people in the UK and the US have asthma and the Asthma and Allergy Foundation of America reports that, on average, 10 people in the US die per day due to the ailment. For people with asthma, developing a viral respiratory tract infection, such as from the common cold or flu, can have a profound effect on the expression of disease resulting in the need for acute care and possibly, death.

One of the challenges in asthma research and treatment is that there is no standard definition or test to diagnose asthma or acute asthma events. Rather, combinations of lung function tests, medical history, physical exam, and response to medication may all be used towards the final diagnosis.

The Solution

Patients do not usually present themselves to the hospital just prior to experiencing a severe event (i.e acute asthma attack), which limits the collection of data that could potentially lead to a predictive algorithm or signature. Our client has developed a controlled environment to collect clinical samples and data from volunteers in-oculated with a virus or placebo. Data collection covers the course of the disease, from stages prior to infection through recovery.

Elder Research was hired to:

1. Find a molecular signature that could be developed as a diagnostic tool
2. Develop a predictive model that could be turned into an app and incorporated into a wearable device.

Up until now, there has been no standard definition to characterize people infected with a virus or who have asthma. To accomplish our goals, our Data Scientists worked in collaboration with client doctors and staff to develop indexes that identified volunteers who were sick and volunteers who experienced an acute asthma attack during the course of the study. Data from analytes (see Figure 1) extracted from daily blood and from nasal wick samples collected from the volunteers were investigated.

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Additional data that was analyzed included:

- Clinical measurements
- Biological samples
- Volunteer self-evaluations of viral-induced and asthmatic symptoms

Not all volunteers experienced their first acute asthma episode in the same timeframe after inoculation (and in real-life, the time of viral exposure is rarely known). Therefore, the data was analyzed using the first acute asthma episode as a reference point so that potential predictive factors could be assessed in a defined period of time prior to the event as opposed to time since the inoculation.

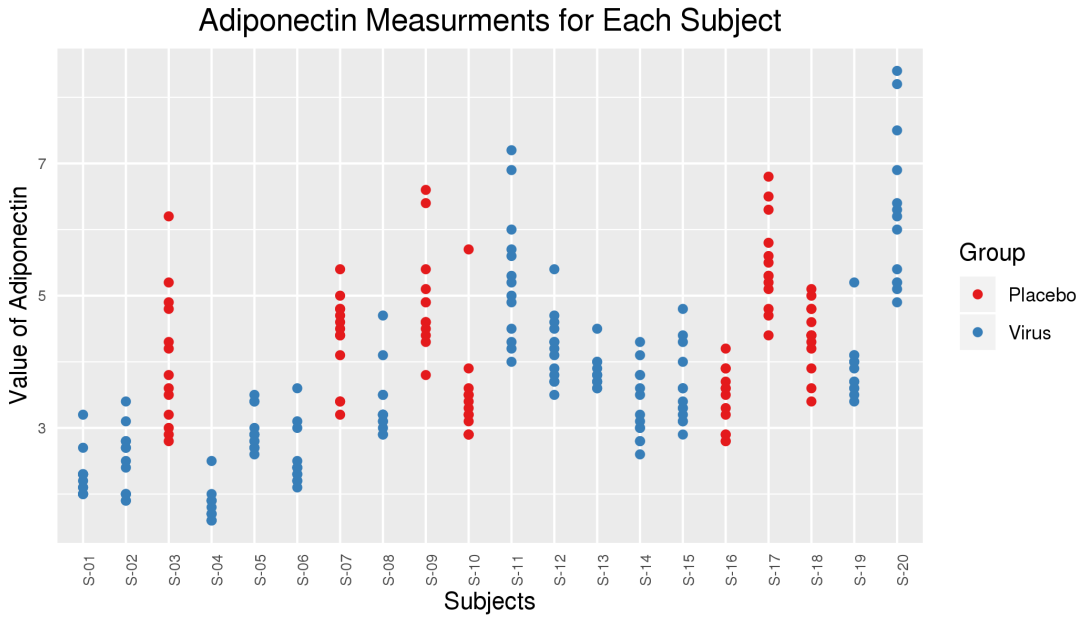

Figure 1. All values of the analyte Adiponectin recorded for each subject between the days -5 and 5. As can be seen from the plot the value of this analyte can vary widely between subjects. Taking the difference of values in relation to an asthma worsening event day standardizes this measurement.

Results

In two months Elder Research developed two indexes and applied them as a standard definition to characterize volunteers who fell ill and those who experienced acute asthma worsening. Using clinical and biological data from volunteers, those who were ill AND experienced acute asthma worsening were used as positive targets in a predictive modeling approach. The methodology included target shuffling and cross validation to robustly identify four predictive biomarkers (three analytes and one clinical measurement). We also developed an algorithm that can be incorporated into an application. Since delivery of our model and results, the client has continued to research the discovered biomarkers, filed a patent application, and is planning to test our algorithm in further studies.

Customer Information

Our client is a pioneer of human disease models and indus-try-leading clinical development services business focused on airways diseases. Leveraging human disease models in flu, RSV, and asthma exacerbation, the platform captures a 'disease in motion', illuminating the entire disease life cycle from healthy to sick and back to health.

Via this insight, the platform enables the rational selection of drug targets and biomarkers while simultaneously providing a revolutionary methodology for testing product safety and efficacy.

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