Big Data, Health, Covid-19 and Longevity

On January 19th, 2022, Kitalys Institute held the webinar Knowledge is Power: Realizing Disease Prevention and Individualized Disease Management, in which Stanford's Michael P. Snyder, Ph.D., discussed advances in harnessing Big Data to transform healthcare from population-based medicine to personalized medicine. This webinar was truly fascinating as it examined the huge improvements possible within healthcare that could occur simply from switching from our current model to one in which relevant wellness parameters and values are monitored by wearables and sensors 24/7 in real time

The current healthcare system focuses on treating people after they become sick instead of focusing on intervening earlier to maintain healthy living. Additionally, population measurements determine health decisions rather than individualized data. Dr. Snyder and his lab hope their current research utilizing "-omics" technologies for early disease detection will solve these current healthcare challenges.

Dr. Snyder noted that each person's baseline oral temperature varies slightly, but a few degrees determines whether or not an individual is sick. Thus, if a person feels sick and goes to a doctor's office, the doctor may tell them they are healthy because the doctor compares the patient's current temperature to the population normal spread, and the patient is within these values. However, this person could actually be quite sick because they are much higher than their baseline temperature. While population measurements provide parameters, more personalized measurements assist in providing better treatment.

Dr. Snyder and his lab thus have set up a personal -omics profiling system that follows an individual's epigenome, microbiome, physiology, etc. using various technologies. For the last nine years, they have been running a study collecting data on 110 originally healthy participants, including Dr. Snyder himself. Through collecting multiple data measurements longitudinally, they better track and analyze each participant's health status. The lab takes data when people get sick, go on trips, etc. to see how measurements alter in order to determine what it means to be healthy, how health changes over time, how it differs between people, and what happens when individuals get sick. The goal is to diagnose diseases pre-symptomatically in order to intervene early and maintain health. Individuals are also genome sequenced to see if they possess a potential risk for Mendelian diseases, such as BRCA mutations that indicate a high risk for breast and ovarian cancer in women. By discovering these genomic sequences, individuals are able to better customize medications and take preventative measures.

The Snyder Lab additionally developed a new way of analyzing genomes that is more inclusive than the current Polygenic Risk Score method. For instance, they studied Abdominal Aortic Aneurysm (AAA), a genetically heritable disease, using their analysis method. AAA accounts for 10% of deaths in people who are 60 years or older and diagnosis usually only occurs with the growing and eventual bursting of the aorta. Using whole genome sequencing, machine learning and electronic health record information, they identified 60 genes involved in AAA and a risk score system with 0.8 risk prediction. This approach can apply to other diseases, such as ALS and severe COVID.

The Lab discovered that an individual's personal health profile remains relatively stable throughout life, and a larger difference exists between people than between when the same person is healthy or has an infection, thereby further demonstrating the importance of personalized (over population-based) medicine. Combining different techniques—genome sequencing, imaging, biochemical measurements, biomarkers, metabolites, transcripts, mRNA, clinical labs, cytokines—allows for the detection of a wide array of pre-disease states. The more data collected on a person, the more Dr. Snyder's lab knows what health measures are best for them. Since individuals respond differently to various types of treatments, obtaining these measurements helps a person better take care of themselves and prevent the onset of diseases.

Dr. Snyder explained that most molecules are relatively stable, but some change seasonally (in winter and late spring) and some change through aging. His lab decided to specifically focus on how people's molecules change over time by grouping 43 people into ageotypes (i.e., aging patterns) by kidney, liver, metabolic, and immune agers. Through looking at clinical markers associated with ageotypes, they

discovered not all individuals aged in every category at the same rate. The goal of ageotype research is healthspan extension and morbidity compression. With this mission in mind, Dr. Snyder formed the company, QBio, which conducts deep data profiles, MRIs, and other tests to track people longitudinally and therefore pre-symptomatically catch diseases and cancers, such as ovarian, prostate, and pancreatic.

Given the spread and growing accessibility to wearable digital sensors, Dr. Snyder touched upon his work with wearables, which started eight and half years ago. Wearables serve as a powerful form of technology because 50 million people wear smart watches and these devices can take hundreds of thousands of measurements every day. People track heart rate, heart rate variability, respiration, etc. and can detect material, as well as immaterial, shifts from baseline rates.

In March 2020, when Covid-19 started to lock down normal social activities, the Snyder Lab was working on improving wearable detection algorithms. Pivoting attention to the pandemic, they partnered with wearable technology companies and launched an IRB approved study which immediately enrolled 5,300 people to test a Covid alert system. Comparing trends in the days preceding positive diagnosis with Covid-19, the algorithm predicted Covid in 26 of 32 positive diagnoses a median of four days prior to symptoms and seven days prior to diagnosis based on elevated resting heart rate. They noted however that the alert is not specific for COVID, so other illnesses are picked up as well. Dr. Snyder's lab is working on determining the optimal resolution for different kinds of conditions (i.e., infectious disease, mental stress, etc.). To join a wearables study, see here. The ultimate goal is to make this health detection system available to everyone.

Dr. Synder also discussed his research with continuous glucose monitors on normal and prediabetic individuals. The lab found that not only do prediabetics and diabetics undergo moderate to severe spikes in glucose, but also normal people do too. Therefore, they wrote an algorithm classifying individuals into glucotypes—severe, moderate, and low—based on elevated sugar levels. The results demonstrated people spiking to different foods. With this data, Dr. Snyder started another company, January AI, that shows users their wearable, clinical, and other data on various timescales. Users can then monitor themselves and share data with physicians to improve health diagnosis. This platform builds personalized health profiles using machine learning to determine correlates to beneficial health outcomes for the specific individual. January AI also builds personalized metabolic control systems.

All of these research efforts into harnessing -omics data support Dr. Snyder's ideal world consisting of people getting their genome sequenced before they are born, and then obtaining physiological measurements along with deep biochemical and wearable measurements throughout their lifetimes for more accurate disease risk prediction and early disease detection.

For more information, please check out the webinar here!
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