Data, technology drive new approaches to Parkinson's care

October 23 2017, by Mark Michaud

Credit: University of Rochester

Complex, multi-system diseases like Parkinson's have long posed challenges to both scientists and physicians. University of Rochester Medical Center (URMC) researchers are now reaching for new tools, such as algorithms, machine learning, computer simulations, and mobile technologies, to both improve care and identify new therapies.

Parkinson's disease is a progressive neurological disorder that erodes an individual's control over their movements and speech. While many of the recent advances in treatment have transformed Parkinson's into a manageable chronic illness, the individual patient experience can vary widely in both the onset and progression of the symptoms of the disease. This creates problems for clinicians who must constantly tweak the

combination and doses of medications to effectively manage symptoms and researchers who are often confronted with a range of responses to experimental treatments.

The advent and spread of new technologies – such as to broadband internet, smartphones, and remote monitoring and wearable sensors – coupled with growing investments in computational resources and expertise in fields such as bioinformatics and data science have the potential to provide researchers with unprecedented insight into the complex variations of diseases like Parkinson's.

An example of this approach is new research out in the journal *The Lancet Neurology*. The study sought to identify genetic markers that may explain why motor symptoms –stiffness or rigidity of the arms and legs, slowness or lack of movement, tremors, and walking difficulties – come on more rapidly for some patients with the disease.

The research involved Charles Venuto, Pharm.D., an assistant professor in the URMC Department of Neurology and the Center for Health + Technology (CHeT), and GNS Healthcare, and was funded by the Michael J. Fox Foundation for Parkinson's Research and the National Institute of Neurological Disorders and Stroke.

The researchers tapped into huge data sets compiled by the Parkinson's Progression Markers Initiative (PPMI) which has collected biological samples and clinical data from hundreds of individuals with the disease.

"We have access to more information about diseases like Parkinson's than ever before," said Venuto. "But all of that data has created a scientific conundrum akin to losing sight of the forest for the trees. In order to unlock the potential of this information we need to harness more sophisticated ways to understand what we are seeing."

In a departure from traditional research approaches, the team turned over the vast quantities of genetic, clinical, and imaging profiles compiled by the PPMI study to a machine learning and simulation program. As the computer program analyzed the data, it was also "learning" by constantly refining and modifying its criteria and algorithms as it sifted through the information looking for patterns and associations.

The study identified a mutation in the LINGO2 gene that, together with a second gene and demographic factors, could identify patients with faster motor progression of Parkinson's. The finding, if confirmed, could ultimately help clinicians refine care and help researchers more precisely understand how individual patients may respond to experimental therapies.

The application of data-driven technologies to biomedical research has exploded in the last several years. URMC neurologist Ray Dorsey, M.D., M.B.A., who is also the director of CHeT, has been at the forefront of this transformation. Dorsey has long been a pioneer in expanding access to Parkinson's care via telemedicine. In 2015, Dorsey – in collaboration with Sage Bionetworks – helped develop an iPhone app which allows patients with Parkinson's disease to track their symptoms in real time and share this information with researchers. Dorsey has become a national figure in this field and has organized an annual conference – the dhealth Summit – that brings together thought leaders from industry, academia, health care, and government to discuss the application of technology to improve the delivery and access to care.

Several additional research programs at the intersection of technology and disease have emerged in Rochester in recent years. Gaurav Sharma, Ph.D., a professor in the University of Rochester Department of Electrical and Computer Engineering, is working with wearable sensors to track the progression of Parkinson's and Huntington's diseases. M.

Eshan Hoque, Ph.D., an assistant professor in the Department of Computer Science, is developing analytical tools that scan videos of patients to help diagnose early stage Parkinson's.

"The volume of data we are now generating is astronomical," said Dorsey. "In the past we would collect data from a patient once every six months, now we have sensors that are sampling data 10 times per second. So as opposed to spending a lot of effort to gather a small amount of data, now with very little effort we are generating huge amounts of data."

The challenge for researchers is to both transform the vast amount of data that is being collected into a usable format – a process referred to as data wrangling – and then ultimately extract valuable scientific and clinical conclusions. To accomplish this, new tools and methods to collect, store, organize, and analyze data are being developed. In recent years, the Medical Center and the University have made significant new investments in state-of-the-art computational resources, recruited new faculty, and started new degree programs in the fields of bioinformatics, computer science, and data science.

The data revolution in medicine has created a wave of new scholarship. Dorsey also serves as editor-in-chief of Digital Biomarkers, a new journal that launched this month in recognition that emerging technologies hold the potential to transform research and the delivery of care.

"Just as imaging and genetics have revolutionized our understanding of health, altered our definition of disease, revealed our ignorance, and changed therapeutic development, new digital biomarkers can do the same," said Dorsey. "Digital Biomarkers was created to foster this emerging field by disseminating the best ideas and supporting the international community of scientists working on novel ways to advance

research."

More information: Jeanne C Latourelle et al. Large-scale identification of clinical and genetic predictors of motor progression in patients with newly diagnosed Parkinson's disease: a longitudinal cohort study and validation, *The Lancet Neurology* (2017). DOI: 10.1016/S1474-4422(17)30328-9

Provided by University of Rochester