

Lilly, Evidation, Apple report data on digital biomarkers to detect cognitive impairment

By Stacy Lawrence, Staff Writer

Screening for early signs of cognitive impairment and dementia amongst the elderly is a task that's often unevenly attended to by primary care physicians. But the routine personal consumer devices that we use every day might offer a clearer and more consistent window into early declines in cognitive and memory function, according to data from a feasibility study that were reported this week at the Association for Computing Machinery's Knowledge, Discovery and Data Mining conference in Anchorage, Alaska.

The feasibility study was conducted by [Eli Lilly and Co.](#), [Evidation Health Inc.](#) and [Apple Inc.](#) It monitored 113 people aged 60 to 75 during their everyday activities in their normal environment for 12 weeks using various Apple devices including an iPhone, Apple Watch, iPad and the Beddit sleep monitoring device in conjunction with various apps. Of those studied, seven patients had been diagnosed with mild dementia, 24 with mild cognitive impairment (MCI) and 82 who did not have any impairment.

Elements defined

"We collected data that spanned many different domains, from physical activity to sleep to device interaction patterns. Many of the data streams that were collected contributed to the performance of the models," Nikki Marinsek, a data scientist at San Mateo, Calif.-based Evidation and a first author on the study, explained to *BioWorld MedTech*. "Some of the most important features captured keyboard usage, patterns in when steps were taken, phone usage, text message usage (which only consisted of the time that messages were sent and received, never any content), and patterns in responding to the daily one-question surveys."

The study was set up as a machine learning regression task to sort through the 16 terabytes of data gathered; it was designed to identify the most useful behavioral aspects to monitor to distinguish early cognitive impairment and dementia patients from healthy people.

The most useful five evaluations involved monitoring typing keystrokes per minute with no pauses; median time first active as measured by the phone pedometer; fraction of days with no response to an energy survey; median time of day responding

“*These results are a starting point, and more accurate analyses may be possible with longer longitudinal data, larger cohort sizes and other advances in unobtrusive data collection.*”

Nikki Marinsek
Data scientist, Evidation Health Inc.

to an energy survey; and total number of text messages received. Healthy people overall had faster typing speeds, arose earlier, responded to survey questions more frequently and earlier in the day and received more text messages.

"We know that insights from smart devices and digital applications can lead to improved health outcomes, but we don't yet know how those resources can be used to identify and accelerate diagnoses," said Marinsek. "The results of the trial set the groundwork for future research that may be able to help identify people with neurodegenerative conditions earlier than ever before."

This study was exploratory, and the technology involved isn't intended for clinical use, rather the data will be used to inform subsequent follow-up studies. These analytics of everyday interaction with personal devices, alongside unobtrusive survey questions on them, could one day enable capabilities that include screening for mild cognitive impairment or early dementia, monitoring the symptoms of patients diagnosed with those indications, as well as clinical trial monitoring to better understand the impact of investigational treatments or therapies.

The data in this study were sourced from passive sensors on smart devices, mood and energy questionnaires, and activities on a digital assessment app that included psychomotor tasks, reading tasks and a typing task.

The area under the curve for distinguishing cognitive symptomatic patients from healthy people using demographics

Continues on next page

Continued from previous page

combined with the collected data was 80.4% – and it was even higher specifically for mild dementia patients at 91.6%.

“While further research is needed, the study findings provide important insight into the potential benefits of wearable devices in identifying chronic health conditions such as MCI, Alzheimer’s disease, and dementia. These findings could inform subsequent research that may eventually lead to early screening or detection tools for neurodegenerative conditions,” said Divakar Ramakrishnan, Lilly’s chief digital officer.

Business necessity

Novel, patient-centered clinical trial endpoints are part of a future that both the FDA and biopharma companies are looking to enable. In addition, the regulatory agency has made it a priority to push earlier, even into presymptomatic people, when it comes to the diagnosis and potential treatment of dementia patients. An application of digital technology along the lines of that used in this study could prove crucial to making both these visions a reality.

Indianapolis-based Eli Lilly, like other pharmas, has seen repeated clinical trial failures in Alzheimer’s disease, even in large, costly late-stage trials. Last summer, it halted a phase III study of lanabecestat, an oral beta secretase cleaving enzyme (BACE) inhibitor intended to treat Alzheimer’s disease, due to lack of efficacy. Hope for eventual clinical success on this front likely lies with the convergence of all sorts of emerging technologies including better imaging, blood and behavioral

biomarkers for Alzheimer’s and dementia.

Evidation Health, like other digital health players, is seeking to prove its relevance in improving patient outcomes – particularly in the wake of recent data that suggest consumer wearable devices may not actually be particularly effective in improving exercise habits and boosting health.

For its part, Cupertino, Calif.-based Apple has long been pushing into digital health applications. It unveiled an Apple watch last year that included an FDA-cleared ECG monitor complete with atrial fibrillation detection. Its long-term ambitions in health care aren’t quite clear yet, but as its growth slows with advances in competitive consumer devices Apple will need to innovate in new areas.

The next steps for researchers include longer, longitudinal studies with much larger cohorts, as well as including further advances in passive data collection. In addition, they aim to achieve a fuller understanding of some specific kinds of subject activity including accelerometer, audio and video data.

“These results are a starting point, and more accurate analyses may be possible with longer longitudinal data, larger cohort sizes and other advances in unobtrusive data collection,” concluded Marinsek. “Rich, longitudinal data enables people to be their own control, and measure change with respect to their own personalized baseline. This is very important in a condition that displays a high degree of heterogeneity such as dementia. We are evaluating the best path forward to advance our understanding of this research.” ♦