

Battling severe mental illnesses with smartphones: how patients' smartphone data can help improve clinical care

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Received: 15 July 2016; Accepted: 03 August 2016; Published: 09 August 2016.

doi: 10.21037/mhealth.2016.08.03

View this article at: <http://dx.doi.org/10.21037/mhealth.2016.08.03>

The inability to reliably monitor disease progression is one of psychiatry's most glaring weaknesses. Unlike our colleagues in other fields, who can, for example, monitor diabetes via patients' hemoglobin A1c, psychiatrists do not have reliable biomarkers. Furthermore, the ways in which mental illnesses manifest are heterogeneous, the vast majority of the patient data in psychiatry is based on subjective patient self-reporting, and practice variation is significant. The inability to monitor disease progression and detect clinical decompensation is a particularly vexing problem for patients suffering from severe mental illnesses (SMI), who die on average 25 years earlier than the general population (1). Clearly we need a more reliable way to track patients' clinical progress, which is why there is increasing interest in augmenting care with insights derived from smartphone data.

Patient behavior is the currency of psychiatry, and smartphones are repositories of patient information that may serve as proxies for behavior. These devices automatically collect passive data, which includes the number of steps patients take in a day, the number of phone calls made and text messages sent in a week, the amount of broadband data used, the number of times the phone was unlocked, etc. Additionally, via smartphone apps, care providers can send patients surveys and communicate via texting or video chat. By tracking smartphone activity, clinicians are equipped with longitudinal behavioral data that can improve clinical decision-making.

Multiple National Health Service sites in England have implemented a smartphone app that notifies clinicians in real time when patients report alarming changes in their symptoms of psychosis (2). Another group designed an app

that walks patients through self-guided interventions such as brief breathing exercises, which has resulted in a reduction in psychotic symptoms after use (3). For patients battling alcoholism, the A-CHESS app features a panic button that would notify a patient's self-designated contacts should they feel the urge to drink. Additionally, warning notifications pop up when the phone's GPS detects that users are nearing areas where they used to procure alcohol. This intervention resulted in the reduction of risky drinking days by almost half when compared to controls (4).

In addition to augmenting clinical decision-making, the insights derived from smartphone data can also help further educate and involve patients and their family members in the care process.

Why now, and why the severely mentally ill?

Technology has become more ubiquitous, user-friendly, and reliable than ever before. With better security standards in place, apps can allow patients to securely text and video-chat with their care providers. Studies have demonstrated that SMI patients are willing and able to interact with providers via their smartphones (5). While technology improves, another revolution is underway in the behavioral health reimbursement ecosystem. As national healthcare reform is shifting the ethos of medicine from fee-for-service models ("the more you do, the more you get paid"), to accountable care organizations ("the better the care you provide, the more you get paid"), both healthcare providers and payers are working to better coordinate behavioral health services for their patients.

The SMI population have higher than average incidences

of hospitalizations, ED visits, and urgent care visits, which leads to worse suffering as well as higher healthcare costs. There is a real need in this population for better monitoring, which may allow for interventions before a hospitalization becomes necessary. Furthermore, by first targeting the population with the highest healthcare utilization, it will be easier to reliably evaluate the efficacy of smartphone interventions by assessing services used. By working with the SMI, we will be able to develop standards that one day may be more broadly applicable to less severely ill patients.

Multifaceted challenges

Ushering in the successful use of smartphone technology into the clinical care of the SMI population will not be without certain challenges. First and foremost, a standalone smartphone app is unlikely to lead to any meaningful change by itself. The technology must be seamlessly embedded within the workflow of clinical care. If a patient reports alarming symptoms or repeatedly fails to respond to text messages or notifications, his care team needs to be able to easily establish direct contact with the patient. Integration with EMR systems will also be important to allow for implementation of the new smartphone data into more traditional medical documentation.

Secondly, data analysis needs to be rigorous in order to produce information that changes clinical decision-making. To date, little is known about how smartphone activity actually correlates with clinical symptoms. Though it may be tempting for researchers and companies alike to jump to intuitive conclusions, it will be important to rigorously establish which variables are most predictive and how clinical decision-making should be changed.

Some features of smartphone usage data can make these necessary analyses challenging. Patients use their phones in highly variable ways, so it may be difficult to establish a true absolute baseline of 'normal' usage. Instead, what could be more useful is an algorithm that detects when a specific patient's usage patterns are deviating from her average numbers. Also, many patients may balk at responding to survey questions on a regular basis. Most studies that produce high response rates are short and last only weeks. Outside the controlled setting of a short trial, attrition is likely much higher. Determining the optimal ratio of passive *vs.* active data will be critical. Lastly, different diagnoses will likely produce different data signatures, and different age groups may exhibit different behavioral changes in response

to the same diagnosis. Analyzing data along appropriate demarcations will be challenging but important.

Collectively, the expertise required for success spans multiple domains: smartphone app development, data analysis, clinical care, process improvement, and care integration. Any attempt to solve this problem will require a team that commands expertise in all these varied disciplines.

The next steps

Smartphone data has great potential to provide new types of patient information that will allow care providers to make better-informed decisions. The reimbursement environment encourages behavioral health integration. Technology has matured, and preliminary studies suggest that patients with SMI are ready to engage with this type of technology. However, rigor and safety must not be sacrificed as these novel interventions are evaluated, and careful thought needs to be given to how the data is analyzed.

On a broader scale, bringing in smartphone data is in line with psychiatry's increasing focus on data-driven decision making. The Research Domain Criteria (RDoC), a new way of categorizing mental disorders based on biological research, is increasingly gaining prominence as researchers worry that the Diagnostic and Statistical Manual of Mental Disorders may lack validity. Researchers are increasingly focused on measuring outcomes of novel treatment interventions for the SMI population. Correctly used, smartphone data can serve as a powerful tool to further refine the rigor of our clinical decision-making algorithms.

Acknowledgements

None.

Footnote

Conflicts of Interest: D Mou is a co-founder of Valera Health, and receives consultation payments from Valera.

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doi: 10.21037/mhealth.2016.08.03

Cite this article as: Mou D. Battling severe mental illnesses with smartphones: how patients' smartphone data can help improve clinical care. *mHealth* 2016;2:32.