

Personalized Machine Learning for Improving Mental Health

I. Mental Health Care Industry Overview

The disease of Major Depression Disorder (MDD) is the second largest contributor to death in the younger generation. Because of the pandemic, the global need for mental health care delivery has ballooned, and institutes have predicted a more significant rise in patient volumes both in the short term and long term. Nonetheless, the shortage of mental health specialists, limited resources, and inaccurate assessment done by traditional interview approach all prevent patients from receiving adequate treatment (MIT Media Lab).

II. Emerging Algorithm for Improving Mental Health

In order to make mental health care more attainable for patients, Professor Rosalind W. Picard from MIT and Dr. Paola Pedrelli from Massachusetts General Hospital (MGH) started a 5-year pilot study on using machine learning to conduct the passive recording of behavioral data and detect mental health changes of patients. This is significant as it can help physicians to better monitor depression symptoms and enable early intervention and personalized treatment (Picard).

In the pilot study, the research team gathered 48 patients, who suffered from depression and just started their treatments, and monitored them through the biometric data sent from the wristbands they wore for 12 weeks (Gold and Gross). Along with the use of an app designed by the team, researchers were also able to collect information such as location, app usage, and the number of text messages. By putting all data into their machine learning program and training the dataset, the team successfully came up with an algorithm that can identify the factors associated with depression symptoms, including electrodermal activity, sleep

behaviors, motion, location changes, and phone usage and patterns. By comparing the test result with the Hamilton Depression Rating Scale Score provided by doctors, it is found that the algorithm can predict the severity of symptoms with only a 6% error rate (MIT Media Lab). Now the team is just about to finish the 5th year of the study and is actively looking for the best way to present it to the users without causing harm.

III. Future Predictions & Risks

Before implementation, the team has to remove some of the key barriers to success first. In the near term, as briefly mentioned in the last section, machine learning scientists will have to work with mental care physicians to figure out the best way of putting the algorithm into practical use. According to MIT News, if it is implemented improperly, the technology may bring patients harm instead of help. For example, if it is designed in a way to notify a patient that his condition is worsening, it can aggravate the depression symptoms by causing more negative emotions. Professor Picard suggests that the most effective tool should tell patients the specific factor that leads to depression symptoms and suggest some ways to improve it (Williams).

As the machine learning algorithm has been optimized for 5 years, the most probable next step for the team is to focus on performing more pilot experiments on patients with different severity or those in different stages of depression. In this way, they can make sure they minimize the side effects and the potential harm of this technology before bringing it to the public. Plus, it is an opportunity for the team to increase the sample size with more patient data, which is critical to further improving the accuracy of the algorithm.

Additionally, considering the short time span and the high costs of development, the main

devices used to monitor patients within this timeframe are still likely to be the wristbands and the app, maybe with a more sophisticated system and easily accessible interface. Though funded by the National Institutes of Health (NIH) and supported by MGH, the test phase is admittedly costly and unpredictable, meaning the lack of funding or research resources may hinder the progress of building and utilizing this technology.

In the medium term, within the next 5 to 10 years, it is more likely that the technology will penetrate more of the care receiver side than the care provider side. In a recent global physician survey report conducted by the National Library of Medicine, it is suggested that 70% of the patients in the U.S. expressed an interest in using mobile technologies to monitor their mental health status. Given this trend, it seems like once the algorithm and the devices are ready to be used, many patients are willing to embrace the technology for monitoring and help-seeking purpose. However, the professionals also suggest that the high level of interest may not be translated into actual usage, as some patients are concerned about the data privacy issue. On the other hand, physicians are often hesitant to employ the artificial intelligence product primarily because of “the result of the lack of knowledge about these new technologies rather than a strong rejection”. Therefore, the data privacy concern and the lack of knowledge are plausibly the main barriers that give patients and physicians second thoughts before using this new tech.

Looking from a long-term perspective, machine learning scientists should be confident that their findings will be employed by most psychiatry clinics and patients. To preserve privacy for patients, the research team is actually inventing a technique based on autoencoders and adversarial training which can retain the information required to predict depressive symptoms but mask sensitive personal data (Jameel Clinic). It is almost certain

that they will be able to provide that level of security for patients by the next ten years, thus maximizing the acceptance rate of the algorithm on the care receiver side. Also, throughout the long span of time, it is possible that the team will develop a new device that combines the features of the current devices and present it in a more intuitive way to use. Regarding the lack of knowledge of physicians on this new technology, one solution is to utilize the network with MGH to raise physicians' awareness and socialize the benefits of using the new algorithm. As MGH has a highly reputable psychiatry department in the U.S. ranking system, its words can be convincing for most hospitals and private psychiatry clinics, potentially contributing to higher acceptability of machine learning usage.

IV. Implications for Stakeholders

Two major stakeholders that are directly related to this technological advancement are patients and healthcare providers. The use of machine learning can benefit patients by visualizing the undetectable changes in their bodies and providing them with another layer of protection when intervention is needed. By simply putting on those wearables, patients can gain more support from their families and physicians in a more transparent and accessible way. Even though, the invention is still risky to patients if it is not implemented correctly.

For mental health care providers, such as hospitals or private clinics, it has a more complex implication. The use of this disruptive technology is likely to change the overall treatment method and competitive landscape. On one hand, existing psychiatrists can take advantage of the technology to have better control and judgment on patients' mental health conditions. As the passive recording data is proven to be more transparent and comprehensive, it would be easier and more efficient for psychiatrists to detect worsening

conditions and personalize treatment for patients. On the other hand, embracing technology means healthcare providers have to spend money to invest in both software and hardware, which can be burdensome and unprofitable in the short run. Also, there will likely be a shift in the curing method from the traditional self-administered and interview-based assessment to the hybrid model of using both techniques. Unfortunately, care providers may still need to spend some efforts to find the balance point between the two approaches.

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