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A New Era in Psychiatry: Influence of Technology and Artificial Intelligence

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Technology is transforming our lives. With the progression of inventions of alphabet, printing press, phone, computers and the internet, our ability to store and share vast quantities of information and interact with one another across the globe at the speed of light with rich media content has increased drastically. Progress in information technologies has changed every facet of our lives, from our homes to our workplaces, by automating mundane tasks and improving productivity. Smartphones and social media have intruded into our everyday life, taking over much of our personal interactions. Only specialty fields such as art and psychiatry that require a special, "human" touch appeared somewhat immune to this transformation, but that is no longer the case, due to advances in artificial intelligence.

Here is a brief historical context to progress: Electronics enabled us to process signals from industrial sensors (temperature, pressure, voltage, torque, etc.) and input devices (microphone, camera, keyboard, etc.), transmit these signals reliably across long distances, and control switches, electric motors, robot arms, and TV screens. However, each new function required designing, manufacturing, and deploying new electronic devices, a time-consuming, costly undertaking. There comes the computer, a universal device that can mimic any such function by merely changing its memory content. It only requires implementing the software and downloading it. Software requires an expert team to devise an algorithmic solution, and a programming team to codify the solution, and this is still a significant undertaking. Furthermore, there are many functions that humans can perform with ease without explicitly knowing how to do them. Recognizing faces, transcribing spoken speech, or buttoning a shirt has evaded automation, until another artificial intelligence approach, "machine learning" made it possible.

Machine learning strives to discover the pattern underlying a data set, assuming such a pattern exists. It draws from our body of knowledge in numeric computation, optimization, and statistics. It requires large amount of input data in order to produce reliable results, as well as vast computational resources to process the data in a timely fashion. While it is not a new discipline, only recently the volume of available data and computational resources have reached a level to render it practical. Another way to look at machine learning is learning by examples: For instance, a machine learning system can be trained using a set of images that is obtained via functional imaging techniques, already labeled with their respective diagnoses (1). The outcome of training would be a mathematical model that correlates image data with the diagnosis labels, so that it can be used on new images to predict a diagnosis. The prediction accuracy of such models can be evaluated using statistical techniques. Some machine learning models can be far too complex for human analysis, but others can be more interpretable and offer insights into which input variables impact the outcome and also by how much.

In today's practice, psychiatrists face the burden of shorter patient interviews, and shorter inpatient stays. On the other hand, mental status examination which is substantially based on observation, is the key point for accurate psychiatric diagnosis. Until now, the tools of observation have been largely limited to our senses. New technologies are providing opportunities to supplement them. Firstly, technology may assist psychiatrists in observing behaviors inside their offices, and might augment the capabilities of a psychiatrist. For example, a computer might detect facial emotional expressions of a patient and then supply a continuous emotional read out during a session. Secondly, technology may be used to track behavior outside office visits. For example, sleep, eating, exercise, social activities, obsessive compulsive behaviors etc. can be measured and recorded by smartphones (2). Augmenting psychiatrists' observations in this manner will require machine learning tools to process this detailed high amount of data. Above all, datasets now not only involve behavioral data but also many heterogeneous variables, including clinical, neuroimaging, genomic, proteomic, transcriptomic and other

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measures. The interpretation of all this data could be made possible by machine learning algorithms, which may find patterns too complex for humans to catch (3).

Psychiatry can especially benefit from machine learning in several areas. For example, machine learning can assist psychiatry researchers in discovering computational models of various factors (behavioral data, clinical findings, neuroimages, etc.). Predictions from such models can assist psychiatrists with patient diagnosis and treatment plans. Tools can be built to facilitate everyday cognitive tasks such as emotion recognition that improve patients' quality of life. There might even be a role for chatbots for assisting patients when a mental health professional is not available, or preferable (4).

Note that machine learning has significant limitations. Machine learning results are inherently biased by the volume, quality and locality of training data, and they may not transfer well across cultural boundaries. Moreover, differentiation of normality and pathology is much more complex than recognition of patterns. Technology alone, is not enough to replace social feedback, cultural perception of symptoms, and psychiatrists' opinions based on observations and examinations. To prevent the neglect of such essential information due to growing fascination with technology must be one of the major responsibilities of psychiatrists.

In conclusion, psychiatrists may soon begin to have access to information about their patients on a whole new level through wearable technologies and they may start to diagnose in more sophisticated ways by the help of artificial intelligence. Psychiatrists will need to partner with machine learning practitioners to develop these technologies, assess their limitations and applicability, and devise improvement methods. Future psychiatrists will require training on these technologies just as they learn other interventions, such as mental state examination and medications (5). Machine learning has the potential to augment the way we study behaviors, and it may enhance our understanding of the human mind, but realizing this potential will require close collaboration between psychiatrists and engineers.

We wish, this paper is going to provide a good example of such a collaboration between psychiatry and engineering.

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