Title: Applications of artificial intelligence technologies on mental health research during COVID-19

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Applications of artificial intelligence technologies on mental health research during COVID-19

The coronavirus disease (COVID-19) pandemic has impacted both physical and mental health globally (Kang et al., 2020; Rajkumar, 2020; Thombs et al., 2020). A growing body of literature reports a continued burden of mental health problems emerging from persistent psychosocial stressors, including unemployment, fear of getting infected, a lack of hope, helplessness, social isolation, lockdown, loneliness, and inadequate psychosocial support during this pandemic (Kang et al., 2020; Mazza et al., 2020). Moreover, as most nations are struggling to address new infections and provide critical care to severely affected patients, mental health services remain suboptimal across those contexts despite an emerging need for such services. It is essential to deploy advanced research methodologies that may use complex data to draw meaningful inferences facilitating mental health research and policymaking during this pandemic.

Artificial intelligence (AI) technologies offer a wide range of opportunities to leverage advancements in data sciences in analyzing health records, behavioral data, social media contents, and outcomes data on mental health (Mak et al., 2019; Su et al., 2020). A scoping review of machine learning methods identified 300 articles reporting the use of several AI technologies such as vector machines, neural networks, latent Dirichlet allocation, decision trees, and clustering (Shatte et al., 2019). Such methods are widely used to detect and treat depression, schizophrenia, Alzheimer's disease, and other mental health problems. Another systematic review found 17 studies that deployed supervised and unsupervised learning methods in mental health research on substance use disorders with varying accuracy across models and study samples (Mak et al., 2019). For example, a study evaluated the pattern of alcohol abuse in Canada (3826 subjects) and Australia (2190 subjects) and found the corresponding area under the curve (AUC), F1 prediction scores, and accuracy levels were 0.869, 0.885, and 0.852 for the Canadian sample; and 0.855, 0.876, and 0.847 for the Australian sample (Afzali et al., 2019). Moreover, AI is increasingly used in neuropsychiatric diagnostics. For example, a systematic review found 35 studies that used AI technologies to identify altered brain functions in schizophrenia, such as default mood network, visual network, sensorimotor network, salience, and frontoparietal network (Filippis et al., 2019). In addition, AI can facilitate decision-making

in providing treatment and predict the outcomes across the continuum of mental health care. For example, a meta-analysis of 20 studies reported that classification algorithms were able to predict therapeutic outcomes in depression with an overall accuracy of 0.82 (95% confidence interval [CI] of [0.77, 0.87]) (Lee et al., 2018). Furthermore, the pooled estimates of classification accuracy were significantly greater ($p < 0.01$) in models that used multiple data types (e.g., combination of phenomenological patient data and neuroimaging; pooled proportion [95% CI] = 0.93 [0.86, 0.97]) when compared to models with lower-dimension data types (pooled proportion 0.68 [0.62, 0.74] to 0.85 [0.81, 0.88]). This suggests that AI can be leveraged with higher accuracy using multiple data sources, which may help the mental health researchers and practitioners to investigate complex mental health problems and inform decision-making while providing care.

Despite recent advancements in using AI and big data analytics in mental health studies, the applications of such technologies in the context of COVID-19 is still under development (Hossain et al., 2020a). A recent study used an AI-based approach to evaluate the mental health impacts of COVID-19 among the affected individuals. This study analyzed social media data (Weibo posts) from 17,865 users using the approach of Online Ecological Recognition (OER) based on several machine-learning predictive models to assess scores of several mental health indicators such as anxiety, depression, indignation, happiness, and cognitive functions (Li et al., 2020). While the findings of such studies offer critical insights regarding mental health outcomes during this pandemic, they also enable the decision-makers to understand the etiology of such psychosocial challenges that are challenging to evaluate in clinical interactions, especially during this pandemic where face-to-face mental health care is markedly disrupted. Nonetheless, the availability of diverse sources of data may bridge the informatic gaps that exist between clinical analytics and social sciences, which may complement each other in understanding the psychopathological processes among the affected individuals. Moreover, the use of big data analytics through AI may help in understanding the unique pattern of mental health problems for individual cases resulting in a more accurate diagnosis and treatment, which are the fundamental goals of precision psychiatry (Hossain et al., 2020b). These opportunities call for further deployment of AI technologies in mental health research in this pandemic, as electronic health records and social media data can be used effectively. This may also address the limitations of

traditional formats of research, such as the in-person data collection that are less feasible due to social distancing, lockdown, and other contextual challenges amid COVID-19.

As more studies are emerging on the psychological impacts of COVID-19, scholars and practitioners should consider several potential strategies to leverage AI technologies wherever appropriate. First, electronic patient data can be assessed to identify patterns of mental health problems among hospitalized individuals with COVID-19, whereas community-based estimates can be linked-to predict how similar psychological issues are prevalent across populations (Shatte et al., 2019; Su et al., 2020). Such insights may facilitate the development and implementation of psychosocial interventions for people affected by COVID-19. Second, the successful adoption of AI and big data analytics in mental health would necessitate scholarly and technological collaborations between researchers from mental health sciences, social sciences, public health, and data sciences. The concurrent and forthcoming psychological challenges due to COVID-19 should be prioritized to foster such collaborations. Third, AI technologies may not be readily available in resource-constrained contexts (Hossain et al., 2019), which would necessitate technological partnerships among organizations and countries to share their collective resources for mental health research in this pandemic. Fourth, the available mental health literature and datasets related to COVID-19 should be synthesized and made suitable for AI training models and use the same for cross-sectional and longitudinal analyses during this pandemic. Fifth, prevalent mental health conditions and associated factors identified through AI models should be readily made available for the practitioners and policymakers to ensure the rapid dissemination of evidence and the adoption of multipronged mental health intervention. Lastly, the applications of AI in mental health may need policy-level commitment and deployment of resources. Such efforts may enable different stakeholders to address the current barriers and facilitate the use of robust AI technologies for assessing and addressing mental health problems during the COVID-19 pandemic.

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