LEVERAGING ARTIFICIAL INTELLIGENCE/MACHINE LEARNING TO ADDRESS MENTAL HEALTH ISSUES AFFECTING SOCIETY TODAY

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TABLE OF CONTENTS

INTRODUCTION

Predicting mental health early and precisely has major implications for clinical management and practice, and ultimately life expectancy. This paper discusses the use of Artificial Intelligence/Machine Learning techniques to produce robust modeling tools that aim to improve the precision of clinical practice in mental health. Additionally, this paper aims to find out how AI/ML can aid in making a safe space for people in need of a secure and understanding community, and provide mental health guidance and professional help.

Artificial Intelligence/Machine learning will be used to predict and classify disease risk at an individual level (for dementia, anxiety, depression, and others) and to determine the interactive factors that influence mental health across people's lifespans (for example, genetics, cognition, demographics), within their societies they live in as well, to capture their emotional and behavioral problems.

Keywords: mental health; social and emotional learning; resilience; social, emotional, and behavioral problems, Machine Learning, Artificial Intelligence.

RESEARCH PROBLEM

The increased rate of mental health issues in today's society has proved to be a burden to healthcare systems all around the world, with limited professional resources, some of which are expensive to the local individuals.

The existence of Artificial Intelligence/Machine Learning, and its help in controlling the rising cases of mental health through predictive analytics, and other techniques is the new way to prevent this fate – "Mental Health Disorders" in our society.

Many people, especially youths in these stressful days experience a lot of stressful conditions that cause them to have mental depletion/retardation, resulting in mental health issues/disorders.

Health Care Systems are interested in improving their mental health, despite the stigma, especially in these stressful times. They face a problem in that they don't know where to start learning about improving their mental health and seeking professional, incorporated with Artificial Intelligence (AI) help is also difficult for being expensive and inaccessible due to family views as well.

BACKGROUND AND RELATED WORK

Increasing prevalent mental problems including depressive disorders, anxiety, and related disorders are affecting the population's health conditions negatively. The frequency of mental health and Artificial Intelligence (AI) publications has expanded dramatically over the past few years. Machine learning (ML) methods would be important to handle complicated medical data sets and build vigorous data sets to share between institutions.

Recent studies suggest a promising direction for employing technology including deep learning to improve our understanding of mental health diagnosis and treatment. Robotic interactions assist in providing the availability of information regarding individual emotional changes and keep daily records of cognitive changes.

Technology such as Machine Learning has been implemented to solve mental health problems; emerging data in this field have provided insights into the application of AI technologies in psychological treatments. Research regarding deep learning and its application in the medical ground is clinically increasingly relevant to therapeutic applications in treating mental disorders.

Several studies of Artificial Intelligence and mental health have been carried out that used Electronic Health Records (EHRs), mood rating scales, brain imaging data, novel monitoring systems (e.g., smartphone, video), and social media platforms to predict, classify, or subgroup mental health illnesses including depression, schizophrenia or other psychiatric illnesses, plus suicide ideation and attempts. Collectively, these studies revealed high accuracies and provided excellent examples of Artificial Intelligence's potential in mental healthcare, but most should be considered early proof-of-concept works demonstrating the potential of using machine learning (ML) algorithms to address mental health questions, and which types of algorithms yield the best performance.

The implementation of AI in mental healthcare offers a potential solution to some of the problems associated with the availability, attractiveness, and accessibility of mental healthcare services. However, there are many knowledge gaps regarding how to implement and best use AI to add value to mental healthcare services, providers, and consumers.

SIGNIFICANCE OF AI/ML ADOPTION IN ADDRESSING MENTAL HEALTH

Artificial intelligence (AI) holds both great promises to transform mental healthcare and potential pitfalls. This article provides an overview of AI and current applications in healthcare, a review of recent original research on AI specific to mental health, and a discussion of how AI can supplement clinical practice while considering its current limitations, areas needing additional research, and ethical implications regarding AI technologies.

AI/ML will be able to reliably diagnose mental disorders at early disease stages, reducing false positives due to comorbidities (e.g. mood-related disorders).

AI/ML will be able to also identify individual prognostic trajectories that are critical for patient stratification (e.g. individuals with dementia vs. mood-related disorders) and guide clinical decisions about personalized diagnostic and treatment pathways.

AI/ML will also be able to give clinically/medically guided decisions, (if provided with necessary data for training) based on the data provided and be able to determine whether an individual is actually in a state of being under mental issue attack or he/she is in already (and provide support on what to do, based on the data again).

AI/ML will analyze patient data to assess the probability of developing mental health conditions, classify disorders, and suggest optimum treatment plans.

RESEARCH SCOPE

Mental health concerns are a large burden for individuals, healthcare systems, and the economy.

Although mental health concerns affect a lot of people, many find it difficult to access appropriate support. Software systems are one potential way to address long wait times and a lack of mental health resources.

With this project review, we want to address most of the mental health issues that are becoming or have already become a huge problem to society, burdening the health system and all other systems involved in curbing it.

The scope of this research is to cover mostly affected areas that have the least or no appropriate access to mental health care and are in much need of it, through the making of systems (softwares) that can be accessible to them all.

The scope also introduces the increase in the use of mobile phones which are now common, (thanks to technological innovations) and can be used, together with the AI systems built, and embedded into them, so that people, even in remote areas can easily get basic access to such service (mental health care) and even educated about it through such systems.

RESEARCH QUESTIONS

1. What are the benefits and risks of delivering mental health care through technology instead of face-to-face and what impact does the removal of face-to-face human interaction have?
2. How do certain mental health conditions (e.g. depression) affect how people engage with technology?
3. How can treatment outcomes be maximized by combining existing treatment options (medication, psychological therapies, and others) with digital (Artificial Intelligence) mental health interventions?
4. At what point in the care pathway (e.g. crisis intervention, prevention, engagement, treatment, maintenance, and recovery) are digital (Artificial Intelligence) interventions most safe and effective?
5. How should software systems for mental health be evaluated and endorsed?
6. What impacts will the adoption of digital (Artificial Intelligence) technology in mental health services have on capacity, access to services, waiting times, and preferred appointment times?
7. Are therapies (for example, cognitive behavioral therapy) delivered via digital (Artificial Intelligence) technology as effective as those delivered face-to-face?
8. Can the common elements of therapy (for example, empathy, gestures, non-verbal cues) that come from person-to-person interactions be maintained with digital (Artificial Intelligence) technology interventions?
9. Do digital (Artificial Intelligence) health interventions increase reach and access to groups and people less well served by traditional mental health services (e.g. black and ethnic minorities, men with depression, people in rural areas, and many more)?
10. How can social media be used more effectively to bring people with mental health problems together and help them connect (e.g. in their communities), rather than isolating them in their homes?

HYPOTHESIS

Mental health disorders are prevalent in society and are a serious public health problem. In 2001, the World Health Organization estimated that 450 million people worldwide had such problems (World Health Organization, 2001). Approximately 75% of mental disorders emerge before the age of 25 years and it is expected that 29% of people will experience a mental disorder at least once in their lifetime. Mental illness restricts individuals' abilities to function, engage in daily activities, and maintain social relationships, causing significant suffering to individuals and their families.

Despite the prevalence and severity of mental illness, there are many barriers to achieving optimal detection, prevention, treatment, and monitoring of mental health disorders. Availability of mental healthcare remains limited. Many people with mental illnesses receive no mental healthcare, and even those who do rarely receive evidence-based mental healthcare. There is a shortage of psychiatrists, psychologists, nurses, and social workers; almost half of the world's population live in countries where there is less than one psychiatrist per 100,000 people (World Health Organization, 2017). This shortage of mental healthcare professionals restricts care opportunities, resulting in long waiting lists, delays, and multiple, diverse contacts before appropriate care is obtained.

Even when providers exist, studies have documented accessibility barriers, including concerns about the cost, transportation or inconvenience, problems recognizing mental illness symptoms (for example, poor mental health literacy), and lack of awareness of care options. Attitudinal barriers also prevent people from seeking mental healthcare, including the belief that it will not help and a preference for self-reliance. Public stigma against mental health disorders and those who receive care is a common concern that also functions as a barrier. As such, even where care is hypothetically available, few in need of such care actually receive it.

The implementation of artificial intelligence (AI) in mental healthcare offers a potential solution to some of the problems with the availability, attractiveness, and accessibility of mental healthcare services. Artificial Intelligence (AI) generally refers to a computerized system (hardware or software) that is able to perform tasks or reasoning processes that we usually associate with intelligence in a human being.

AI applied to mental healthcare includes techniques to improve the ability to detect and predict various conditions, with implications for screening, assessment, and clinical decision-making. AI can also be used to improve treatments by identifying treatments or treatment

elements most likely to provide benefit, thus promoting personalized mental healthcare, or can be incorporated into digital interventions, such as smartphone apps, to create novel interventions, thus reducing reliance on professionals and increasing scalability.

RESEARCH OBJECTIVES

1. To implement and validate machine learning models, capitalizing on existing datasets, that can identify individualized profiles of cognitive health. These models should be biologically interpretable to determine the key factors that best determine mental health, and how they interplay.
2. To extend these predictive models to compare metrics of interacting predictors across repeated measurements on the same individuals over time. Further to this, multi-modal deep learning architectures will be implemented that allow for cross-modal dataflow between feature extractors, extracting more interpretable features than uni-modal learning for the same amount of training data. In particular, Graph Attention Networks will be tested which can allow for very significant improvements on potentially sparse and small datasets from repeated measurements.
3. To test the validity of this approach by training the algorithms produced with 'privileged' information from highly diagnostic data (for example, brain imaging data) from a small sample, and predict mental health (for example, high versus low risk) on an independent sample using only routine clinical data. Enhanced model predictions with privileged data will validate the proposed models as powerful diagnostic tools with potential applications in clinical practice.

PROPOSED METHODOLOGY

The proposed Artificial Intelligence Technique (methodology) that can be used is Machine Learning. Machine Learning is one of the applications of AI where machines are not explicitly programmed to perform certain tasks; rather, they learn and improve from experience automatically.

Deep Learning is a subset of machine learning based on artificial neural networks for predictive analysis. There are various machine learning algorithms, such as Unsupervised Learning, Supervised Learning, and Reinforcement Learning. In Unsupervised Learning, the algorithm does not use classified information to act on it without any guidance. Supervised Learning, deduces a function from the training data, which consists of a set of an input object and the desired output. Reinforcement learning is used by machines to take suitable actions to increase the reward to find the best possibility which should be taken in to account.

In general, an ML model has to obtain predictions and use those predictions and eventual insights to solve a range of problems. Model Interpretation redirects your focus from 'What was the conclusion?' to 'Why was this conclusion reached?'. You can get an understanding of the model's decision-making process, i.e. what exactly drives the model to classify a data point correctly or incorrectly.

Machine Learning models vary in degrees of complexity and performance. One size doesn't fit them all. As a result, there are different ways to interpret them. Primarily, these methods can be categorized as:

Intrinsic or post hoc. Intrinsic interpretability refers to models that are considered interpretable due to their simple structure, such as linear models or trees. Post hoc interpretability refers to interpreting a black box model like a neural network or ensemble model by applying model interpretability methods like feature importance, partial dependence, or LIME after training the model.

Model-specific or model-agnostic. Model-specific interpretation tools are specific to a single model or group of models. These tools depend heavily on the working and capabilities of a specific model. In contrast, model-agnostic tools can be used on any machine learning model, no matter how complicated. These agnostic methods usually work by analyzing feature input and output pairs.

Local / Global scope. The local scope covers only an individual prediction, capturing the reasons behind only the specified prediction. The global scope extends beyond an individual data point and covers the model's general behavior.

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