AI; A New Horizon of Promises & Challenges: 'Exploring the Impact of Artificial Intelligence (AI) in Mental Health Care'.

S Manikandan [1]

[1] Assistant Professor, BGSB University, Rajouri, JK, IN.
Email: manilogankarunagapally@gmail.com
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ABSTRACT

Mental health is an important aspect of overall well-being and it has been widely recognized that Artificial intelligence (AI) technologies can play a significant role in improving mental health care. AI has made a significant impact on the healthcare industry, changing the perspectives of identifying, treating and monitoring patients. By enabling more individualized therapies and delivering more precise diagnoses, AI is significantly enhancing healthcare research and outcomes. The ability of AI in healthcare to quickly examine enormous amounts of clinical documentation aids in the identification of illness signs and trends that would otherwise go unnoticed by medical professionals. AI in the mental health field is an emerging field that uses AI techniques like machine learning, natural language processing, and other AI technologies to analyze large amounts of data in order to identify patterns, predict outcomes, and enhance the delivery of mental health care. Healthcare systems can become smarter, quicker, and more effective in providing treatment to millions of people worldwide by utilizing artificial intelligence in hospital and clinical settings. **Materials and Methods:** Several electronic databases, including PubMed, Wiley, APA Psych Info, Springer, Google Scholar, Web of Science, WHO, Academic Psychiatry, Wikipedia, Research Gate, Forbes, Medline, Healthline were searched for this article.

Keywords: Artificial Intelligence (AI), Promises, Challenges, Impact, Mental health, Healthcare.

INTRODUCTION

"Artificial intelligence will have a more profound impact on humanity than fire, electricity and the internet." – 'Sundar Pichai', CEO, 'Google'.

Mental health is a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well and contribute to their community. It is an integral component of health and well-being that underpins our individual and collective abilities to make decisions, build relationships and shape the world we live in. Mental health is a basic human right and it is crucial to personal, community and socio-economic development. Mental health is more than the absence of mental disorders. It exists on a complex continuum, which is experienced differently from one person to the next, with varying degrees of difficulty and distress and potentially very different social and clinical outcomes.[1] Healthcare and artificial intelligence (AI) have a wide range of possible uses from analyzing radiological images for early detection to forecasting outcomes from electronic health information. AI in the mental health field is an emerging field that uses AI techniques such as machine learning, natural language processing, and other AI technologies to analyze large amounts of data to identify patterns, predict outcomes, and improve the delivery of mental health care.[2] In 2021, over 150 million people in the WHO European Region were living with a mental health condition. Over the last few years, the COVID-19 pandemic has made matters worse. People have been less able to access services, increases in stress, adverse economic conditions, conflict and violence have shown how vulnerable mental health can be. WHO/Europe's "Regional digital health action plan for the WHO European Region 2023–2030", launched in September 2022, also recognizes the importance and need for innovation in predictive analytics for better health through big data and AI. [3]

METHODOLOGY

The following article is based on data searched/collected from a wide source of books, National & International journals, Internet sources (Including WHO, Wikipedia, Biomed Central, Healthline) and various databases including PubMed, APA Psych Info, Google Scholar, Wiley, Embase Psych, Research Gate, Springer Academic psychiatry etc. Also, more than 50 research articles including case reports and research reviews are explored and utilised in the present article.

HISTORY OF AI: THE TURING TEST & TURING'S ERROR

"AI development is typically portrayed as the development of ever-smarter machines. The human element of the narrative, which explains how our minds and bodies are employed to build, train, and power clever machines, has been lost". 'Alan Turing', widely considered as the 'father of artificial intelligence' during the dawn of digital age in 1950s, published a well-known article; "Computing Machinery and Intelligence," in which he poses the question, "Can machines think?" Turing outlined a different method for answering the question derived from a Victorian parlour amusement called the imitation game. The rules of the game stipulated that a man and a woman, in different rooms, would communicate with a judge via handwritten notes. The judge had to guess who was who, but their task was complicated by the fact that the man was trying to imitate a woman. Inspired by this game, Turing devised a thought experiment in which one contestant was replaced by a computer. If this computer could be programmed to play the imitation game so well that the judge couldn't tell if he was talking to a machine or a human, then it would be reasonable to conclude. The enduring appeal of the test is that it promises a non-ambiguous answer to the philosophically fraught question: "Can machines think?" If the computer passes the test, then the answer is yes Turing argued, that the machine was intelligent. This thought experiment became known as the Turing test and to this day, remains one of the founding ideas behind AI. In a section of "Computing Machinery and Intelligence," Turing simulated what the test might look like with an imagined intelligent computer of the future. (The human is asking questions, the computer responding.) Question: Add 34957 to 70764. Answer: (Pause about 30 seconds and then give as answer) 105621. In this exchange, the computer has actually made a mistake with the arithmetic. The real sum of the numbers is 105721 and not 105621. It's unlikely that Turing, a brilliant mathematician, left this mistake there by accident. The miscalculation was indeed a programming trick, a sleight of hand to fool a judge. Turing understood that if careful readers of the computer's response picked up the mistake, they would believe that they were corresponding with a human, assuming that a machine would not make such a basic arithmetic error. A machine could be programmed to "deliberately introduce mistakes in a manner calculated to confuse the interrogator," Turing observed. [2] The academic discipline of artificial intelligence was established in 1956. The field saw periods of optimism and disappointment followed by a loss of funding; however, in 2012, when deep learning outperformed all prior AI techniques, there was a significant surge in funding and interest. [4]

WHAT IS AI?

Artificial Intelligence (AI) is the is the intelligence of machines or software, as opposed to the intelligence of human beings or animals. As 'Turing' observed, "systems that act like humans." At its simplest form, artificial intelligence is a field, which combines computer science and robust datasets, to enable problem-solving. It also encompasses sub-fields of machine learning and deep learning, which are frequently mentioned in conjunction with artificial intelligence. These disciplines are comprised of AI algorithms which seek to create expert systems which make predictions or classifications based on input data. AI applications include advanced web search engines (e.g., Google Search), recommendation systems (used by YouTube, Amazon, and Netflix), understanding human speech (such as Siri and Alexa), self-driving cars (e.g., Waymo), generative or creative tools (Chat GPT and AI art), and competing at the highest level in strategic games (such as Chess and Go). [5, 6]

AI TYPES:

+ **Weak AI:** Also known as narrow AI, is designed and trained to complete a specific task. Industrial robots and virtual personal assistants, such as Apple's Siri, use weak AI. [7]

+ **Strong AI:** Also known as artificial general intelligence (AGI), describes programming that can replicate the cognitive abilities of the human brain. When presented with an unfamiliar task, a strong AI system can use fuzzy logic to apply knowledge from one domain to another and find a solution autonomously. In theory, a strong AI program should be able to pass both a Turing test and the Chinese Room argument. [7]

+ **Type 1: Reactive machines:** These AI systems have no memory and are task-specific. An example is Deep Blue, the IBM chess program that beat Garry Kasparov in the 1990s. Deep Blue can identify pieces on a chessboard and make predictions, but because it has no memory, it cannot use past experiences to inform future ones. [7]

+ **Type 2: Limited memory:** These AI systems have memory, so they can use past experiences to inform future decisions. Some of the decision-making functions in self-driving cars are designed this way. [6]

+ **Type 3: Theory of mind:** Theory of mind is a psychology term. When applied to AI, it means the system would have the social intelligence to understand emotions. This type of AI will be able to infer human intentions and predict behaviour, a necessary skill for AI systems to become integral members of human teams. [7]

+ **Type 4: Self-awareness:** In this category, AI systems have a sense of self, which gives them consciousness. Machines with self-awareness understand their own current state. This type of AI will exist in near future. [7]

'AI' SCOPE

+ **Learning.:** This aspect of AI programming focuses on acquiring data and creating rules for how to turn it into actionable information. The rules, which are called algorithms, provide computing devices with step-by-step instructions for how to complete a specific task. [6, 7]

- **Reasoning, problem-solving:** Early researchers developed algorithms that imitated step-by-step reasoning that humans use when they solve puzzles or make logical deductions. By the late 1980s and 1990s, methods were developed for dealing with uncertain or incomplete information, employing concepts from probability and economics. They solve most of their problems using fast, intuitive judgments. [6, 7]

- **Self-correction.** This aspect of AI programming is designed to continually fine-tune algorithms and ensure they provide the most accurate results possible. [7]

- **Automation.** When paired with AI technologies, automation tools can expand the volume and types of tasks performed. An example is robotic process automation (RPA), a type of software that automates repetitive, rules-based data processing tasks traditionally done by humans. [6, 7]

- **Perception:** Machine perception is the ability to use input from sensors (such as cameras, microphones, wireless signals, active lidar, sonar, radar, and tactile sensors) to deduce aspects of the world social awareness. [6, 7]

- **Social Intelligence:** Robot Kismet has some basic social skills. Systems that perceive, interpret, process, or replicate human feeling, emotion, and mood fall under the interdisciplinary umbrella of affective computing. To look more receptive to the emotional dynamics of human connection, for instance, or to simply enhance human-computer interaction, some virtual assistants are programmed to speak informally or even joke around. [6, 7]

- **Intelligence in general:** Artificial general intelligence should enable machines to tackle a wide range of issues with the breadth and adaptability of human intelligence. [6]

IMPACT OF 'AI' IN MENTAL HEALTH CARE

Artificial intelligence in healthcare refers to the use of machine-learning algorithms and software to mimic human cognition in the analysis, presentation, and comprehension of complex medical and health care data or to exceed human capabilities by providing new ways to diagnose, treat or prevent disease. The primary aim of health-related AI applications is to analyze relationships between clinical data and patient outcomes. AI programs are applied to practices such as diagnostics, treatment protocol development, drug development, personalized medicine and patient monitoring & care. Major public health concerns affecting a significant section of the population include mental health conditions such depression, anxiety, and post-traumatic stress disorder (PTSD). Although traditional approaches have been proven to be successful to mental health care, there can be some drawbacks often associated with psychotherapy and medication. For instance, it may be difficult to effectively identify and treat mental health disorders and access to mental health care may be restricted in some locations. By offering fresh perspectives and spotting trends that human experts might not be able to see, artificial intelligence (AI) technologies have the potential to enhance the diagnosis and treatment of such mental health issues. [2] Chatbots are increasingly being used to offer advice and a line of communication for mental health patients during their treatment. They can assist in coping with symptoms, as well as look out for keywords that could trigger a referral and direct contact with a human mental healthcare professional. Woebot, a chatbot that learns to adapt to its user's personalities and is capable of talking them through a number of therapies and talking exercises commonly used to help patients learn to cope with a variety of mental health conditions. Another chatbot, Tess, offers free 24/7 on-demand emotional support and can be used to help cope with anxiety and panic attacks whenever they occur. Some AI mental health solutions function as wearables that can interpret bodily signals using sensors and step in to offer help when it's needed. Biobeat collects information on sleeping patterns, physical activity and variations in heart rate and rhythm that are used to assess the user's mood and cognitive state. This data is compared with aggregated and anonymized data from other users to provide predictive warnings when intervention may be necessary. Also, users can make adjustments to their behaviour or seek assistance from healthcare services when they feel it's necessary. [8]

'AI' IN MENTAL HEALTH CARE: TECHNIQUES & APPLICATIONS

- **Natural Language Processing (NLP):** NLP is being used to analyze large amounts of data from electronic health records (EHRs) and social media to identify patterns in mental health conditions and predict outcomes. [6, 7]

- **Machine learning:** Machine learning algorithms are being used to analyze data from EHRs, brain imaging and genetic tests to identify biomarkers of mental health conditions and to predict which treatments will be most effective for specific individuals. [6, 7]

- **Virtual reality and Chat bots:** These technologies are being used to deliver mental health interventions such as Cognitive behavioural therapy (CBT) in virtual environments. They also can provide mental health support to users through chatbots with natural language abilities. [6, 7]

- **Mental health diagnosis and assessment:** AI-based systems can analyze data from various sources such as brain imaging and genetic tests to identify biomarkers of mental health conditions and improve the accuracy of diagnosis. This can help to improve the early detection of mental health conditions and reduce the risk of wrong diagnosis. [2, 6]

- **Electronic health records/Personalized treatment:** AI-based systems can analyze data from electronic health records (EHRs), brain imaging and genetic tests to identify the most effective treatment for specific individuals. This can help to improve the effectiveness of treatment by matching patients with the treatment that is most likely to be effective for them. [2, 6]

- **Mental Health Monitoring and Tracking:** AI-based systems can be used to monitor and track the mental health status of patients over time. This can help to detect changes in mental health status early and provide timely interventions. [2, 6]

- **Research and Development:** AI can be used in research and development to analyze big data and identify patterns that would be difficult for humans to see. This can help to identify new biomarkers for mental health conditions and develop new treatments. [2, 6]

- **AI and elder care:** In relation to geriatric care, AI bots have been helpful in guiding older residents in assisted living with entertainment and company. These bots are allowing staff in the home to have more one-on-one time with each resident but the bots are also programmed with more ability in what they are able to do; such as knowing different languages and different types of care depending on the patient's conditions. [2, 6] The implementation of AI enormously helps physicians and doctors to formulate early diagnosis of Alzheimer's and dementia and the best suited treatment modalities with the help of AI tools including decision making algorithms. [9]

- **Telemedicine:** With the increase of telemedicine, the treatment of patients remotely has shown the rise of possible AI applications. AI can assist in caring for patients remotely by monitoring their information through sensors. A wearable device like a pulse oximeter may allow for constant monitoring of vitals with the ability to notice changes in parameters. The Physician can then interpret the data and offer services through telephone/Internet. [10] Another application of artificial intelligence intertwined with telemedicine is chat-bot therapy. Anxiety reduction, stress management and even suicide prevention services are being offered with the help of a chat bot made by Haptik, an artificial intelligence company. These chatbots can augment the work of psychologists, psychotherapists and health care professionals and assist with efficient diagnosis and e-triaging. [11]

AI IN MENTAL HEALTH CARE: CHALLENGES

In psychiatry, AI applications are still in a budding phase of proof-of-concept. Areas where the evidence is widening quickly include: predictive modelling of diagnosis and treatment outcomes, chatbots, conversational agents that imitate human behaviour and which have been studied for anxiety and depression. [12, 13, 14] Challenges include the fact that many applications in the field are developed and proposed by private corporations, such as the screening for suicidal ideation implemented by Facebook in 2017. [15] Such applications outside the healthcare system raise various professional, ethical and regulatory questions. Another issue is often with the validity and interpretability of the models. Small training datasets contain bias that is inherited by the models, and compromises the generalizability and stability of these models. Such models may also have the potential to be discriminatory against minority groups that are underrepresented in samples. [16, 17] It is widely believed that AI has the potential to be highly beneficial when it comes to predicting mental health issues, creating personalized treatment plans, and ensuring compliance. However, it also brings specific challenges that require cooperation between AI researchers and healthcare workers. A research project carried out at the University of California, Davis, focused on creating personalized treatment plans for children suffering from schizophrenia based on computer vision analysis of brain images. An important challenge of the research is the focus on "explainable AI" – the algorithms need to be understandable by doctors who are not AI professionals. [3, 8]

ADVANTAGES

- **Improving the accuracy of diagnosis:** AI-based systems can analyze data from various sources such as brain imaging and genetic tests, to identify biomarkers of mental health conditions and improve the accuracy of diagnosis. [2, 12]

- **Personalized treatment:** AI-based systems can analyze data from EHRs, brain imaging and genetic tests to identify the most effective treatment for specific individuals. [2, 18]

- **Improving access to mental health care:** AI-based systems can be used to deliver mental health interventions such as cognitive behavioural therapy in virtual environments, which can improve access to mental health care in areas where access is limited. [2, 19]

ETHICAL ISSUES

Personalities such as 'Stephen Hawking', 'Bill Gates' & 'Elon Musk' have expressed concern about existential risk from AI. It has also been argued that AI will become so powerful that humanity may irreversibly lose control of it. As the physicist Stephen Hawking puts it, "spell the end of the human race". [20]

- **Privacy:** The use of AI in mental health raises concerns about privacy as large amounts of personal data are collected and analyzed and thus proliferating increased cases of data breaches. [2, 22]

- **Bias:** AI systems can be biased if the data used to train them is biased. This can lead to inaccurate predictions and unfair treatment of certain groups of people. [2]

- **Automation:** According to a 2019 study, AI can replace up to 35% of jobs in the UK within the next 10 to 20 years. If AI were to automate healthcare-related jobs, the jobs most susceptible to automation would be those health care workers dealing with digital information, radiology and pathology as opposed to those dealing with doctor-to-patient interaction. [21, 23]

- **Lack of data:** There is a lack of data available to train AI systems which limits their ability to identify patterns in mental health conditions and predict outcomes. [2, 24]

+ **Expensive & Limited labour force:** As it's quite expensive and requires deep technical expertise, there is limited supply of qualified workers to build AI tools. Also, AI eliminates human jobs thus creating increased unemployment rates. [25]

AI & OTHER HEALTHCARE DISCPLINES

With the potential to be used as an initial triage tool, artificial intelligence algorithms have demonstrated encouraging results in accurately diagnosing and risk stratifying individuals with concerns for coronary artery disease. In order to forecast patient mortality, pharmaceutical side effects, and adverse events after acute coronary syndrome treatment, AI tools are employed. [23, 25] The ability to monitor patients' cardiac data has also been demonstrated by wearables, cell phones, and internet-based devices, extending the amount of data and the range of settings AI models can use and potentially enabling early diagnosis of cardiac events occurring outside the hospital. Deep learning has been closely related to image processing since its inception. Processing dermatological photos with deep learning demonstrated significant advancement. Han et al. showed how to detect keratinolytic skin cancer from photos of the face. [26] The area of gastroenterology can benefit from the use of AI in a number of ways. Rapid identification of aberrant tissue is crucial to the success of endoscopic examinations like esophagogastroduodenoscopies (EGD) and colonoscopies. Clinical professionals can more quickly diagnose diseases, assess their severity and see blind spots by augmenting these endoscopic procedures.[27] AI tools are used in cancer diagnosis, risk assessment, molecular tumor characterisation, and cancer drug discovery depending on each patient's unique genetic, molecular, and tumor-related factors. AI has been applied to support decision-making, predictive modelling, and business analytics in primary care. [23] In 2018, the U.S. Food and Drug Administration approved the sale of the first medical device that uses an artificial intelligence algorithm to identify diabetic retinopathy. [28]

AI IN POPULAR CULTURE/FILMS

Though there are many works of fiction available about artificial intelligence, few notable ones are discussed here. Beginning with Mary Shelley's Frankenstein, a recurring theme in these works depicts a human creation that poses threat to its creators. The legendary, Arnold Schwarzenegger starrer, The Terminator (1984) and sequels shows how AI controlled robots and Cybernetic systems will wage warfare on humanity and destroy the human civilization in near future. Keanu Reeves starrer, The Matrix (1999), Will smith's I Robot (2004) are few other movies worth mentioning. [29]

DISCUSSION

One very exciting area of research involves leveraging AI to create personalized treatments for a number of mental health conditions. AI has been used to monitor symptoms and reactions to treatment to provide insights that can be used to adjust individual treatment plans. A systematic review of studies where AI was used to parse various data sources carried out by IBM and the University of California found that machine learning could predict and classify mental health problems including suicidal thoughts, depression and schizophrenia with high accuracy. Data sources used in the 28 studies that were reviewed included electronic health records, brain imaging data, data taken from smartphone and video monitoring systems, and social media data. Additionally, researchers at Vanderbilt University Medical Center found that hospital admission data, demographic data, and clinical data could be parsed with machine learning to predict whether a person will take their own life with 80% accuracy. [8] Another study focused on using AI to predict mental health issues is underway at the Alan Turing Institute. Here, researchers are looking into ways of using large-scale datasets from individuals who have not shown symptoms of mental health issues to predict which of them are likely to develop symptoms during their lifetimes. [8] AI has also been used to predict cases where patients are more likely to respond to cognitive behavioural therapy (CBT) and therefore be less likely to require medication. Research published in JAMA Psychology found that deep learning can be used to validate the effectiveness of CBT as a method of treatment, potentially reducing the need to prescribe medication to some patients. [30, 8] AI can be used to predict when a patient is likely to slip into non-compliance and either issue reminders or alert their healthcare providers to enable manual interventions and can be done via chatbots like those mentioned previously or via SMS, automated telephone calls and emails. Algorithms can also identify patterns of behaviour or occurrences in patients' lives that are likely to trigger non-compliance. This information can then be passed to healthcare workers who can work with the patient to develop methods of avoiding or countering these obstacles. [8] Though several studies appreciate the importance of AI in health care, one particular study points out the flaws in use of AI and questions it's use in mental health care. [3] "Methodological and quality flaws in the use of artificial intelligence in mental health research, a systematic review authored by experts from the Polytechnic University of Valencia, Spain and WHO/Europe looked at the use of AI for mental health disorder studies between 2016 and 2021 and found that AI application use in mental health research is unbalanced and is primarily limited to studying depressive disorders, schizophrenia and few other psychotic disorders. This indicates a significant gap in our understanding of how they can be used to study other mental health conditions. Even though, policy-makers may gain insight into more efficient strategies to promote health and the current state of mental disorders, however, AI often involves complex use of statistics, mathematical approaches and high-dimensional data that could lead to bias, inaccurate interpretation of results and over-optimism of AI performance if it is not adequately handled. The study found significant flaws in how the AI applications process statistics, infrequent data validation and poor evaluation of the risk of bias. In addition, several other areas cause concern, such as the lack of transparent reporting on AI models, which undermines their replicability. The study also found that data and models mostly remain private and there is little collaboration between researchers. The lack of transparency and methodological flaws are concerning as they delay AI's safe, practical implementation. Also, data engineering for AI models seems to be overlooked or misunderstood, and data is often not adequately managed. These significant shortcomings may indicate overly accelerated promotion of new AI models without pausing to assess their real-world viability. [3]

CONCLUSION

Artificial intelligence is the cornerstone of the modern digital revolution. It is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. AI is Often applied to the project of developing systems endowed with the intellectual processes characteristic of humans such as the ability to reason, discover meaning, generalize or learn from past experience. [31, 32] "Given the increasing use of AI in health care, it will play a crucial role in mental health care in the upcoming days. It is relevant to assess the current status of the application of AI for mental health research to inform about trends, gaps, opportunities and challenges as AI in the next few years will drive health-care systems to adapt their structures and procedures to advance in the provision of mental health services. [3] It is being estimated that, owing to an exponential increase in approvals from FDA(USA) for AI health products, AI had become an $8 billion industry by 2022. However, many health experts are encouraging to put a stop to the AI frenzy. "AI is still in its infancy and it needs to mature," observed, José Morey, MD, a physician, AI expert, and former associate chief health officer for IBM Watson. "Consumers should be wary of rushing to a new facility simply because they may be providing a new AI tool, especially if it is for diagnostics", he added. Also, there are really just a handful of physicians across the world who understand the strengths and benefits of AI tools, currently available.[33] In general, there are encouraging indications that AI has the ability to improve many facets of mental healthcare. At the same time, it is obvious that development must be done in a controlled manner and that models and approaches must be extensively examined for bias before being approved for use in circumstances, where impact on human lives matters. [8]

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