

# COMPARATIVE STUDY ON AI in Mental Health and Wellbeing – Current Applications and Trends

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**Abstract** - We are living in such a situation where the mental health disorder rate is as high as it could be at any time in the near future. Digital technologies such as AI, Machine learning, and the Internet of Things (IOT) will play an important role in detecting and treating the patient of mental disorder.

With the emerging improvement of digital approaches to identify the psychological state based on some patterns, in particular with trendy ML and artificial intelligence(AI), are getting used the development of diagnosis, monitoring, detection, and treatment for mental health care. In terms of treatment, AI is being incorporated into digital interventions, notably internet and smartphone apps, to boost user experience and optimize personalized psychological state care. In terms of prediction and detection, data-driven technologies like AI ways are utilized to develop prediction/detection models for psychological state conditions.

In this research, we reviewed AI-based solutions and current applications in health care that would be effective in the monitoring of electronic health records (EHRs), mood rating scales, brain imaging data, novel monitoring systems to detect, predict, classify mental health illnesses, Treating and identification of a person's pulse, happiness rate, mental condition, suicide ideation attempts to identify a (suspected) person with mental disorder, it is a review and discussion of how AI can supplement clinical practice while considering its current limitations. The Research is designed to help public health officials, researchers, and clinicians control and manage this disorder through the smart edge.

**Key Words:** Mental Health, AI, Machine Learning, CBT, DBT, Deep learning, Depression, Natural language processing, Suicide

## 1.INTRODUCTION

we are presently living in the age of the internet conjointly referred to as the “digital Revolution” which consists of a fusion of technologies and types. A well-known example can be in form of technology which is originally recognized in 1956 referred to as artificial intelligence (AI), the Neuropsychopharmacology conference in 2019. It provides an outline of AI approaches in mental healthcare, seeking to assist with clinical diagnosis, prognosis, and treatment, furthermore clinical and technological challenges, focusing on multiple illustrative publications.

AI applications in medicine are day by day increasing as there is continuous development happening in this field. As AI in mental health researchers, we need to make our self-familiarize with AI, find its current and future uses, and be prepared and ready to work with AI because it is entering the medical stream. This article provides an overview of AI in healthcare, a review of original, recent literature on AI and applications, methods utilized in mental healthcare, and a discussion of how AI can replace the mental health clinical practice while considering its current limitation, identification of area where we need improvement in research and way forward for of AI.

### 1.1 Artificial Intelligence in our daily lives

Artificial Intelligence” is the term coined in a document which is co-authored by John McCarthy. He defined AI as “Is the science and engineering of making intelligent machines”. Alan Turing is another “Father of AI” He published an article in 1950 by the name, “Computing Machinery and Intelligence” which tells about conditions where we can consider a machine to be intelligent. Intelligence is the human ability, but this form of intelligence is a computational part of the ability to achieve goals in the world. At present, scientists have made huge research and finding in AI. It is the technology that is improving day by day and allows us to achieve more in less time.

Today, AI plays a role in many aspects of our daily life, from shopping to browsing the web. AI technology is improving all the time and in software development this technology is having huge market. examples where AI impacts our Daily life social media, digital assistants, web search, e-commerce, music recommendations.

### 1.2 Machine learning for big data analysis

Machine learning(ML) is an AI approach consist of various types of the algorithm to learn. The most common algorithms to be used for healthcare purposes are supervised unsupervised and deep learning. to deal with Task such as pattern recognition, speech recognition, text analytics, image processing It is widely used with and has a strong link with mathematical optimization and statistics.

### 1.2.1 Supervised learning

Supervised learning refers to a type of problem where there is an input data defined as a matrix  $X$  and we are interested in predicting a response  $y$ . Where  $X = \{x_1, x_2, \dots, x_n\}$  has  $n$  predictors and has two values  $y = \{c_1, c_2\}$ .

### 1.2.2 Unsupervised Learning

Unsupervised learning deals with the Matter of finding teams that are similar inside one another without having a class to learn from. There are many approaches to the task of learning a mapping from predictors to finding teams that share similar instances in every cluster and are completely different from one another.

### 1.2.3 Deep learning

Deep learning permits machines to solve complicated issues even when using a data set that is very large, unstructured, and inter-connected. The more dl and artificial intelligence algorithms we learn and merge with the application, the better they perform. Examples where DL is widely used Virtual assistants, Translations, Vision for driverless delivery trucks, drones, and autonomous cars, Chatbots and service bots, Image colorization

### 1.3 Analytic approaches of traditional statistical programming versus ML

ML techniques and approaches heavily depend on computing power whereas traditional statistical techniques were developed when computing power was not an option. As a result, traditional statistical heavily depends on small samples and heavy assumption about data and its distribution. Modern ML approaches have benefits over traditional statistical approaches because they can detect complex (non-linear), high-dimensional interactions that may inform predictions [3]. Table 1 summarizes the comparison of primary goals between ML and TS.

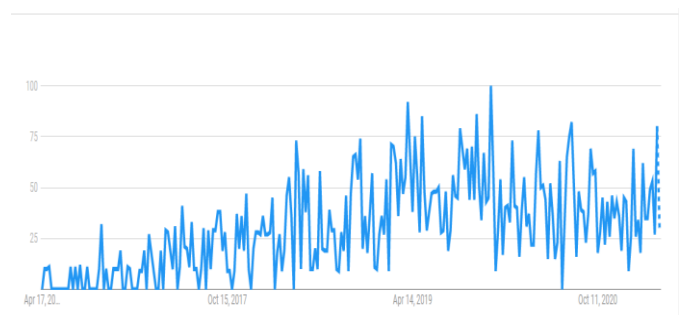
**Table -1:** Key comparisons between machine learning and traditional statistics in healthcare research

	Machine Learning (ML)	Traditional statistics (TS)
Goal	"learning" from data of all sorts No rigid pre-assumptions about the problem and data distributions in general	Analyzing and summarizing data Tight assumptions about the problem and data distributions
Year envision	1959	17 <sup>th</sup> century
Data size	Very large and can be the size of an entire population of interest	Small to moderate and samples of a population of interest only for statistical inference
Number of features	Large and unspecified	Small and explicitly specified for statistical inference
Rigor	Minimal model assumptions	Strict model assumptions for statistical inference
Methods for assessing performance	Often empirically using cross-validation, ROC AUC, % accuracy, sensitivity, and specificity	Statistical and practical significance (e.g., $p$ values, effect sizes)

AUC=area under the curve; DL=deep learning; ROC=Receiver Operating Characteristic; UML=unsupervised machine learning

## 2. Artificial Intelligence in health care

AI is currently being used to enable early disease detection, and allow us to understand better disease progression. The major strength of AI is rapid pattern analysis of large datasets. AI is most successful in finding pattern recognition include ophthalmology, cancer. From chronic diseases, like cancer, AI is being efficient, effective and accurate inventions that will help to find cure from and take care of patients suffering from these diseases. Also, it is unlikely that intelligent machines would ever completely replace medical staff. AI-based systems are widely used in the medical field to support clinical decision-making. Examples, where AI is efficiently working, are accurate cancer diagnosis, Early diagnosis of fatal blood diseases, customer service chatbots, virtual health assistants. etc. AI in the medical field depends on interpretation of huge amounts of data sets and analysis to help doctors make better decisions, manage patient data information effectively.



**Graph -1:** Investment of AI in health care

## 3. Artificial Intelligence in mental health care

AI is been slower to adopt in the mental health discipline as compared to other fields of medicines, While AI technology is becoming widely used in the medical field for physical health applications as compare to mental health. This is because mental health practitioners spend most time on documentation and they are more patient-centric than

nonpsychiatric practitioners. They try to develop a bond with patients and their more focus is on directly observing patient's behaviors and emotions. Mental health clinical data is often in the form of subjective and quantitative patient statements and written notes. AI technology can provide desirable results to practitioners but still, the mental health field has much to benefit from AI. AI has great potential to redefine our diagnosis and help us to understand more clearly about mental illnesses. An individual's unique bio-psycho-social profile is best suited to fully explain to us about his/her mental health. However, we have a relatively narrow understanding of these biological, psychological, and social systems. AI technologies and methods offer the ability to develop better analysis tools, screening tools and form a model that can determine the individual's risk for developing mental illness. To make advancement in mental health care as a long-term goal then we have to make use of computational approach like AI.

#### 4. AI used in:

##### 1). Diagnostic tools:

One challenge for clinicians while making a diagnosis because patient interaction only gives a little snapshot of a patient's mental state, yet mood disorders are dynamic in nature and fluctuate over time. At present, psychiatric assessment of a patient is the first step of the treatment process. The assessment includes social and biological information, direct observation of their mental state, data from specific psychological tests, and subjective self-report questionnaires, such as the GAD-7 for anxiety and PHQ-9 for depression. These methods are time-consuming and difficult to repeat. AI can provide additional methods that can help practitioners to diagnose a patient based on audio and video analysis, additional questionnaires such as a diagnostic tool may help to monitor the progress of patients. Some of the examples where AI is currently is being used,

1. IBM researchers developed a speech classifier with 80% of accuracy to detect mental illness.
2. Based on video analysis of a person's behavior computer vision can detect ADHD and ASD with 96% accuracy
3. The quartet is one of the automated tools that help to diagnose patients, screening them for common conditions like depression, anxiety, and spectrum disorders based on questionnaires.

##### 2). Monitoring:

Monitoring and evaluation are the key processes used for determining the severity of mental illness. Most of the practitioner follows to tell the patient to keep a record of their mental health, such as mood diaries at an outpatient setting. This type of data is used to identify the type of

mental disease, its severity and help to define the plan and make decisions that can be made on the basis of monitoring and evaluations. So we can apps which actively ask users to answer questions on their mood, sleeping patterns, and other relevant areas. AI should be combined with a smartphone application to allow more detailed monitoring of the mood, so the following are some examples that are based on AI which take care of the Monitoring part,

1. "Companion" is an app developed by cogito, a Boston-based AI company, This app is used to record the behavioral patterns of the user based on smartphones. They have studied more than 80 people that are affected with either PTSD or depression, they found the outgoing call and count of unique number texted, distance traveled, variation in voice, speaking rate, and voice quality this is all good predictor of symptoms of depression.

Several applications aim to improve effectiveness by giving reminders and helping patients to keep track of their medication. the use of AI may need continuous improvement in such applications which include tailoring to the individual to maximize their effect on the medication.

##### 3). Treatment:

The first phase of treatment is always to identify which mental illness patients have that can be done with the help of repetitive questionnaires or by observing patient's behavioral patterns. AI can enable effectiveness to the current traditional methods. As per global data, there is less than one Psychiatrist per 10000 but more than 50% of the world population is using smartphones. So by using AI-based apps can increase accessibility by reducing the costly and time-consuming travel to mental health clinics. Also, it can enable the reach of mental health professionals to provide their service. Below is a few examples of AI-based app that are available to help people to manage their depression. Although these apps cannot diagnose or treat the person's mental health condition, these apps can be used as complementary for people which are working with a doctor or mental health practitioner

## CBT Chatbots:

From the 1990s internet-based cognitive behavioral therapy has been used but not as popular. The chatbot has the ability to mimic normal conversational style to deliver CBT that can help to provide other advantages. In 2017 clinical psychologists from Stanford University developed an app called "woebot". This app helps to reduced depression and anxiety in college students within a 2-week course. This app is the digital version of 40 years old cognitive behavioral therapy. which is nothing but highly structured talk psychotherapy that helps to alter a negative thought pattern from a patient within the limited number of sessions. But the optimal use of such apps is still unclear.

## 4). Re-balancing clinician workload:

According to WHO, there are only 0,48 psychiatrists and psychologists per 100,000 people. More than 14% of the world population is suffering from various forms of mental illness. And world crime record bureau has revealed that each year 3% growth in suicide cases. The world's mental health workforce is not up to the mark. A massive shortage of mental health professionals creates workload, so AI may help to drastically re-balance a clinician's workload by giving them more time to interact with patients and help to increase the quality of care. In this field, text data is largely used. reading previous notes to build an accurate picture of a patient's history take most of the time of Psychiatrists which can be replaced by Natural Language Processing (NLP) which involves analyzing human language for meaningful information. NLP could be used to provide an exact summary at the beginning of consultation as it helps to summarize the important data from a patient's health records. For example, a timeline of the mental state of the patient can be drawn. Also if NLP can be combined with AI to the analysis of audio and video to provide useful information about the mental state of the patient.

## 5. Limitations of AI in mental health

There are several obstacles that may prevent people from seeking and receiving help for depression are at least minimized or reduced by AI-driven applications. It is also essential that clinicians must be educated on how to use AI technology on their patients. A global survey of more than 750 psychiatrists found that the majority of them believe that AI will become a regular part of their practice to perform documentation. While many are not convinced of the concept of benefits of AI in medical field. AI algorithms are only valid under certain situations or for a certain group of people. The performance accuracy of AI applications with clinical diagnostic accuracy is still unclear. While research and development of AI-based mental health resources continue to improve, these apps are not able to replace the clinical treatment of any mental health condition including anxiety or depression

## 6. Discussion: Future Research Directions and Recommendations

If we utilize today's available technologies, we can create unique bio-psycho-social profiles of individuals that impact their mental health from continuous, long-term monitoring. The result of this process will generate huge complex, multimodal data which is too much for a human to process to get a meaningful result, but AI is well suited for this task. As AI technology is continuously improving, it may be possible to define mental illness more objectively than the current DSM-5 classification, identify mental illnesses at an earlier stage when human interventions may be more effective, and tailor prescribed treatments based on the unique characteristics of an individual.

### 1). How AI can benefit current healthcare

The use of AI technology offers many benefits in addition to improving the detection and diagnosis of anxiety and depression. physician time is progressively limited and most of the time of clinicians time is waste in documentation due to insufficient technology, these problems arise with mental health practitioners who depend on their skills to create a therapeutic report of their patients and design personalized treatments. AI algorithms can interpret a large amount of varied data source with a better understanding of the level of mental illness, also it offers monitoring treatment progress and helps in to deliver remote therapy sessions,

## 7. CONCLUSIONS

Collectively these studies revealed high accuracies, efficiency and effectiveness of AI and ML algorithms and provided excellent examples of AI's potential in mental healthcare and the potential of using machine learning (ML) algorithms to address mental health questions, and which types of algorithms will give the best result. The successful integration of AI into healthcare can dramatically improve the quality of therapy. The new tools for diagnosis, monitoring, and treatment may improve patient outcomes and re-balance clinician workload. As there is great potential in AI technology but it also involves numerous risks and challenges. These challenges are carefully tackled to ensure the successful implementation of this new technology. Because of its positive and trustworthy outcome Ai is widely used in mental health care. Mental health researchers including scientists, clinicians, practitioner's patients are now realizing the potential of AI. The future of AI in mental healthcare is promising. To improve mental health practice and care of patients we have to take part to introduce AI in clinical care by taking help from computational scientists and expert to collaborative data.

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