ARAIC RESEARCH

Applied Research in Artificial Intelligence and Cloud Computing

Applications of Artificial Intelligence in the Treatment of Behavioral and Mental Health Conditions

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INTRODUCTION

Artificial intelligence (AI) is the branch of science that studies and designs intelligent devices. For individuals unfamiliar with artificial intelligence, the concept of intelligent machines may bring up visions of attractive human-like computers or robots, like those described in science fiction. Others may consider AI technology to be mysterious machines limited to research facilities or a technical triumph that will come in the far future. Popular media accounts on the deployment of aerial drones, autonomous autos, or the potential dangers of developing super-intelligent technologies may have raised some broad awareness of the subject.

AI technology and approaches are already in use all around us, albeit frequently in the background. Many uses of AI technology and techniques have grown so widespread that they may no longer be considered AI-related. For example, AI technology is used to anticipate weather patterns, logistical planning, manufacturing, and financial activities AI technology is also used in autos, airplane guiding systems, smart mobile devices (such as Apple's Siri), Internet web browsers, and a variety of other practical everyday applications. AI technologies and approaches enable us to solve issues and complete activities in more dependable, efficient, and effective methods than were before feasible.

AI breakthroughs are also aiding the mental and behavioral healthcare industries. Computing tools for learning, comprehension, and reasoning, for example, can help healthcare workers with medical decision, testing, diagnosis, and care management. AI technologies and approaches, like interactive apps for mobile health (apps) that learn user habits and preferences, can develop self-care tools that enhance people's lives. AI is helping to improve public health by detecting health hazards and guiding actions. Another example is the employment of artificially intelligent virtual individuals that may engage with patients and propose treatments. As demonstrated in each chapter of this book, there are several opportunities to apply AI technology and methodologies to mental and behavioral healthcare activities.

The goal of this introduction chapter is to offer fundamental background and context for the book's succeeding chapters. I begin by providing an introduction of key AI principles and technology, with a focus on their use in behavioral and mental health care. Although not thorough, the review will offer users who are new to AI with fundamental core facts. I also present current technology advances to demonstrate developing capabilities and give a peek of future innovations. I next go over the several practical advantages that AI provides to behavioral and mental health treatment, as well as some extra issues. At the end of the chapter, a list of fundamental works is provided as a source for readers wanting more in-depth knowledge on any particular topic.

PRINCIPLES AND TECHNOLOGIES

The objective of AI is to create computers capable of doing activities that require intelligence, like thinking, understanding, thinking, problem-solving, and perceiving. The topic was named after computer scientist John McCarty, who convened The Dartmouth Conference in 1956 alongside Marvin Minsky, Nathan Rochester, and Claude Shannon. The conference's purpose was to bring together renowned specialists in order to advance a new discipline of research encompassing the analysis of intelligent machines. The conference's core assumption was that "any facet of learning or any other attribute of intelligence may be so thoroughly characterized that a computer can be built to replicate it". During the conference, Allen Newell, J.C. Shaw, and Herbert Simon showed the Logic Theorist (LT), the first computer software purposefully designed to mimic human problem-solving abilities. [1], [2]

AI has evolved over the previous 60 years into a diverse area encompassing computer science, engineering, psychology, philosophy, and other disciplines. AI's aims include designing technology to do highly specialized activities like computer vision, voice processing, and data analysis and prediction. Weak AI (also known as Applied AI or Narrow AI) refers to this concentrate on specialized intelligent activities . IBM's Deep Blue chess-playing system, which defeated world chess champion Garry Kasparov in 1997, is an example of a Weak AI computer. Deep Blue employed brute force approaches to evaluate probability to decide its attacking and defensive plays, rather than mimicking how a person would play chess. The phrase "Strong AI," coined in 1980 by philosopher John Searle, refers to the objective of creating robots with Artificial General Intelligence. The objective of Strong AI is thus to create computers with cognitive abilities that are indistinguishable from those of humans. The main goal of AI is not necessary to create robots that mirror human intelligence; rather, intelligent machines are frequently built to greatly exceed human intelligence's capabilities. These talents are typically limited to narrow and particular activities, such as performing mathematical procedures. [3], [4]

The word "AI" is also used to denote the intelligent behavior of machines, therefore a machine may be called to have "AI" when it performs activities that we deem intelligent. AI can take the form of standalone hardware or software, spread over computer networks, or embodied in a robot. AI can also take the form of autonomous intelligent agents that interact with their surroundings and make their own decisions. AI technology may also be linked to biological systems, constructed of biological materials (biological AI), or as tiny as molecular structures (nanotechnology). For the purposes of this chapter, I refer to AI as a scientific area and AI technologies or intelligent machines as technologies that execute intelligent activities. [5]–[7]

Artificial Neural Networks and Machine Learning

Machine learning (ML) is a subfield of artificial intelligence that tries to give computers the capacity to learn without being expressly programmed. Numerical learning strategies, neural networks, instance-based learning, genetic programming, data analysis, facial recognition, natural language processing (NLP), computational learning theory, and reinforcement learning are all subfields and applications of machine learning [8], [9].

ML is essentially the capacity of software or a machine to increase job performance through data exposure and experience. A typical ML model initially learns from the data it is exposed to, and then utilizes that knowledge to forecast emerging (future) data. The software is "trained" on a pre-defined collection of "training examples" or "training sets" in supervised ML. Unsupervised ML is when a software is given data but is required to uncover patterns and relationships in that data [10]–[12]

The capacity of ML techniques to search for and find patterns in enormous amounts of data and in certain applications without previous knowledge is a unique advantage. ML software, for example, may be used to uncover patterns in big electronic health record datasets by recognizing subsets of data records and attributes that are out of the ordinary (e.g., signal dangers) or that disclose parameters related with patient outcomes. ML approaches may also be used to forecast future trends in data (e.g., predictive analytics or predictive modeling) or to aid in decision-making under ambiguity. Internet websites are also using ML algorithms to understand the patterns of care seekers, adapt to their preferences, and tailor the information and material that is offered. ML is also the foundational technology that enables robots to learn new abilities and adapt to their surroundings. [13]–[17]

ANNs are a sort of machine learning (ML) approach that models the structure and operation of neuronal networks in the brain. The computational stages in classical digital computing are sequential and use linear modeling approaches. Modern neural networks, on the other hand, employ nonlinear statistical data modeling approaches to respond in parallel to the pattern of inputs supplied to them. Connections are formed and reinforced by regular usage, much as they are in real neurons. Handwriting recognition, computer vision, and speech recognition are recent examples of ANN applications. In theoretical and computational neuroscience, ANNs are used to develop models of biological brain systems in order to explore neural processing and learning mechanisms. ANNs have also been investigated as a statistical tool for forecasting the durations of psychiatric hospital stays calculating the expenses of psychiatric medicine and predicting obsessive compulsive disorder (OCD) treatment response.

Modern expert systems can benefit from ML techniques and neural networks as well. Expert systems are a type of AI computer that duplicates human experts' knowledge and analytical skills. Clinical decision support systems (CDSSs) are a kind of expert system that is especially developed to assist in the clinical decision-making process. Traditional CDSSs give decision possibilities based on preprogrammed data and regulations. Incorporating contemporary ML and ANN approaches, on the other hand, enables CDSSs to deliver suggestions without preprogrammed information. Fuzzy modeling and fuzzy-genetic algorithms are auxiliary approaches used to aid in rule optimization and membership categorization. These strategies are based on the notion of fuzzy logic which is a type of reasoning that uses approximate values (e.g., some degree of "true") rather than fixed and exact values (e.g., "true" or "false"). These approaches give a valuable qualitative computational strategy for dealing with uncertainty, which can assist mental healthcare providers in making more optimum judgments that enhance patient outcomes. [18]–[23]

Natural Language Processing

NLP refers to machines' capacity to interpret and analyze human (natural) language. NLP is an AI subfield that merges computer science and linguistics. "Computer linguistics" or "statistical text classification" refers to the application of computational approaches to precisely evaluate and categorize language. The ELIZA software, developed by MIT computer scientist Joseph Weizenbaum in 1966, was one of the first instances of an NLP user interface. ELIZA was built with a basic programming language called SLIP (Symmetric LIst Processor) and used language syntax to deliver defined replies based on a programmed model to resemble psychologist Carl Rogers' empathetic communication style. Users would input a question or statement on a keyboard, and the program would rephrase the remarks into new questions or statements, mimicking human dialogue exclusively. In the early 1970s, Stanford University psychiatrist Kenneth M. Colby created PARRY, a software that emulated paranoid schizophrenia. The computer, like ELIZA, could speak with people via a text interface, and studies of PARRY revealed that skilled psychiatrists were unable to discriminate between PARRY and genuine patients with paranoid schizophrenia. The natural language processing techniques utilized in these systems were eventually repurposed for use in the rudimentary forerunners of today's virtual agents, known as "chatbots" or "chatterbots." [24], [25]

The system, named after IBM founder Thomas J. Watson, employs advanced natural language processing (NLP), sentiment analysis, retrieval of information, data analysis, automated reasoning, and machine learning (ML). During a televised demonstration match in 2011, Watson memorably defeated the winners of the American TV quiz program Jeopardy!, Brad Rutter and Ken Jennings.

Watson employs a technique known as DeepQA (QA stands for question and answering). It works by evaluating data, creating a wide variety of options, assessing evidence for each possibility based on available facts, and developing a confidence level for each possible answer. The system will then provide a ranked list of replies as well as a description of the supporting evidence, which will be weighted using DeepQA algorithms. IBM has now created a more comprehensive, commercially available version of Watson that has learned medical literature. Watson can also evaluate data from patient-reported genetic history, electronic medical records, prescription use, and test findings to assist healthcare practitioners in making best diagnosis and treatment decisions.

NLP has several applications in behavioral and mental health treatment. For example, NLP paired with ML can enable virtual persons to communicate with humans via text or voice communication. NLP is also utilized for text and speech (audio data) scanning and semantic analysis, and it may be used for predictive analytics in health surveillance. NLP paired with machine learning approaches may also be used to scan therapy sessions for trends or content of interest. Many used similar algorithms to identify significant semantic information in psychotherapy transcripts in order to recognize semantically unique content from various therapeutic interventions and interventions. This technology, according to the researchers, might be beneficial in training and fidelity monitoring in clinical trials or naturalistic settings to automatically detect outlier periods or therapist interventions that are inconsistent with the prescribed treatment plan. [26], [27]

Perception and Sensing in Machines

Machine perception is a branch of AI that tries to equip computer systems with the required hardware and software to identify sights, sounds, feel, or even scent (i.e., machine olfaction) in a way that improves human-machine interaction. Visual sensing in autos (e.g., Google Car, Honda's Lane Assist) and video camera system capable of recognizing human faces are two examples. Sensors can be integrated in the environment or included into mobile devices like smartphones. Motion sensors, digital compasses, accelerometers, GPS, mics, and cameras are examples of these sorts of sensors. Other biosensor technologies and approaches enable physiological features like blood pressure and respiration to be measured, as well as brain and heart activity to be assessed.

Affective Computing

Emotional computing is a branch of computer science that focuses on emotion recognition by computers, emotion modeling, affective user modeling, and emotion expression by robots and virtual agents. Affective human computer interaction (affective HCI) seeks to create machines that can detect, classify, and respond to the user's emotions and other stimuli. Affective computing employs a variety of technologies, including multimodal sensors, ML, and NLP.

The Defense Advanced Research Projects Agency's (DARPA) Detection and Computational Analysis of Psychological Signals (DCAPS) system is an example of an emotional detection system. This system analyzes language, physical gestures, and social signals using ML techniques, NLP, and computer vision to identify psychological distress indications in humans . The system's goal is to improve the psychological health of military personnel while also developing and testing algorithms for detecting distress markers in humans from other data inputs such as sleeping habits, voice and information connectivity, social activities, Internet use behaviors, and nonverbal cues Other emotional detection systems have been created for commercial objectives, such as studying people's reactions to television advertising or political candidates . [28], [29] Emotion-sensing technology is becoming more commercially available and is now available on gaming systems such as Microsoft's Xbox One Kinect.

Augmented and virtual reality

Virtual reality is a human-computer interface that allows users to immerse themselves in and connect with computer-generated virtual surroundings. Clinical virtual reality is the application of this technology for clinical evaluation and therapy , and it has been used to treat a variety of psychiatric illnesses. Virtual reality is a technology that allows people to interact with virtual humans or other simulated life forms in virtual environments or on mobile devices or personal computers. Virtual human systems to help improve medication adherence among patients with schizophrenia to provide patients with hospital discharge planning to provide skills training for people with autism spectrum disorder and to provide training and treatments in therapeutic computer games. AI tools such as machine learning, natural language processing, and affective computing make these artificial creatures more lifelike, interactive, and engaging.

Augmented reality (AR), sometimes known as mixed reality, mixes virtual reality and the real world by superimposing computer-generated images over live camera imagery. This technology makes information about the user's surroundings available for interaction and digital modification. The technology may potentially be combined with GPS capabilities to give the user with real-time position data. AR may be used on mobile devices like smartphones, tablet computers, and other wearable devices. Google Glass for example, gives users Internet connectivity for real-time data access and sharing, as well as AR experiences. AR systems that can project images and data into contact lenses and directly onto the retina 8 Artificial Intelligence in Behavioral and Mental Health Care of the human eye have been tried in cutting-edge research. The user may view what appears to be a traditional video display floating in space in front of them. [30], [31]

Wireless and Cloud Computing Technologies

Cloud computing is another relatively recent innovation in which computation and data storage are available via a network such as the Internet rather than a single local device. Cloud computing is an outgrowth of the concepts of J.C.R. Licklider, an experimental psychologist and MIT professor who helped establish the ARPANET, the Internet's forerunner. Cloud computing is vital for the research and implementation of AI because it takes use of the benefits of distributed processing and storage, allowing access to massive quantities of processing power and data. Wi-Fi, Bluetooth, and cellular (4G, LTE, etc.) technologies enable different types of hardware devices, to connect to and interact with other devices and data "in The Cloud." [32]

Robotics

Robotics is gaining popularity in a variety of healthcare settings, including surgery, diagnostics, prosthetics, physiotherapy, monitoring, and mental health assistance . In terms of conduct and Artificial Intelligence in Behavioral and Mental Health Care: An Overview 9 In the field of mental health care, robots offers immense potential to change how treatment is delivered. Robot therapy, for example, substitutes animals used in animal-assisted treatments and activities with robots. For usage in robot treatment, many types of robots have been designed and utilized. Paro, for example, is a robotic baby seal created to give rehabilitation to dementia sufferers. Furthermore, the FDA has approved for use in hospitals a robot named RP-VITA, which can go from room to room and link healthcare practitioners to patients or other healthcare providers through wireless video teleconferencing. Given the rate of technological advancement, it is feasible that one day people may be able to seek mental healthcare counseling and therapies directly from AI embodied in robots in hospital settings or at home.

While all-in-one central processing units may be used in robots to execute intelligent duties, the integration of cloud computing and wireless technology opens up new opportunities for robot learning and navigation.

Brain Simulation and Supercomputing

Computer processing power remains a primary driving element behind AI developments. Computers with faster and bigger memory capacity, along with enhanced design and software techniques, enable computer systems to do more tasks in less time and with more efficiency. IBM's neuromorphic (brain-like) computer chip TrueNorth, which contains 5.4 billion transistors, is one of the largest and most sophisticated computer chips ever manufactured . Stanford University researchers have also recently developed a new circuit board dubbed Neurogrid that replicates 1 million neurons and 6 billion synapses.

Several research and development efforts are now ongoing to map and simulate the human brain using supercomputing advances. Some of these initiatives aim to construct software representations of the individual neurons and neural circuits that comprise the human brain. The Blue Brain Project, for example, was launched in May 2005 by the Brain and Mind Institute of the E' coll Polytechnique Fe'de'rale de Lausanne (EPFL) in Switzerland to research and develop a software brain by simulating the mammalian brain down to the molecular level. The study takes use of the Blue Gene supercomputer and the NEURON software, which allows for the modeling of a physiologically accurate model of neurons. The research team stated in 2009 that they had successfully created a model of the rat cortical column.

The Human Brain Project (HBP) was founded in 2013 as a continuation of the Blue Brain Project. The HBP's mission is to build technologies that will allow for full human brain modeling. In the United States, the Obama administration announced a billion-dollar investment in a coalition of private (e.g., Howard Hughes Medical Institute, Allen Institute for Brain Science) and governmental institutions to do brain mapping . This initiative, like the HBP, intends to develop a functional map of neuronal networks in the human brain.

Brain mapping at the neuron level offers the potential to improve understanding of complex neurocognitive processes as memory, perception, learning, and decision-making. Computer systems that replicate human brain activity may thereby advance understanding of both normal and dysfunctional human brain functioning. One potential prospect is that they will allow us to model psychiatric disorders and evaluate models of their genesis, courses, and consequences at a significantly more complex level than earlier computer models. Simulated brains may also be "implanted" into virtual bodies, allowing researchers to alter simulated environmental changes and evaluate how the simulated brain would interact, learn, and adapt in a particular context. This might open the door to more complicated assessments of diathesis stress models in psychopathology. For example, researchers might simulate environmental stresses that may induce the onset of depression by modeling a brain with genetic or other predispositional characteristics associated with depression. In the laboratory, these simulations might be time-accelerated to swiftly simulate results. [33], [34]

Mapping the human brain may potentially hasten AI development and bring the science closer to replicating human general intelligence. Some believe that this research will eventually lead to machines with intellect far beyond that of humans. Ray Kurzweil, a futurist, inventor, and Google Director of Engineering since 2012, forecasts that by 2045, AI technology will have advanced rapidly to a point known as the technological singularity. The uncertainty of what happens when robots gain superintelligence is referred to as the si ngularity. Several books and media articles have been written in recent years about whether or not machine superintelligence poses an existential danger to humans . Nonetheless, the effort to create robots with human-level general intelligence has the potential to help us discover more about AI's "mind" and even the nature of consciousness itself, a question that has confounded mystics, philosophers, and scientists for centuries. It would be fascinating to see if an artificial human brain develops a subconscious mind, unpleasant ideas, or repressed memories.

Turing's Test

Any AI overview would be incomplete without including Alan Turing and the Turing Test. Alan Turing was a great British mathematician who some regard as the founder of computer technology. Turing presented the issue "Can a Machine Think?" in his 1950 paper, Computing Machinery and Intelligence, published in the philosophy magazine Mind, and developed what is now known as the Turing Test. This test, dubbed "the imitation game" by Turing, is a method for determining computer intelligence and, more specifically, whether machines are capable of "thinking." To pass the exam, a computer program must imitate a human enough in a textual dialogue with a human judge in real-time that the human judge cannot reliably discern between the program and a genuine human. According to the test, if a computer can answer any question provided to it in the same language as an average person, we may assume that the machine is capable of intelligent thought.

The Turing Test has served as an inspiration throughout the development of artificial intelligence, and it has also sparked major philosophical controversy. Much of the discussion has focused on whether the Turing Test is a sufficient or required criterion for measuring intelligence. Other philosophical debates have centered on the notion of intelligence (and awareness), as well as what intelligent computers might be expected to perform . The Loebner Prize, for example, is an annual AI challenge based on the Turing Test . There are now computers that have passed the Turing Test using only the test's fundamental rules.

The application of Turing Test principles to analyze the appropriate ethical of intelligent care-providing computers is of special interest to us. Moral Turing Tests (MTTs), for example, have been proposed as a method of assessing autonomous intelligent beings' ability to engage in ethical behavior. This subject is covered in Chapter 11 in relation to intelligent care-giving devices.

AI'S BENEFITS FOR BEHAVIORAL AND MENTAL HEALTH CARE

Intelligent Machines are superior in several areas. Intelligent machines have a number of benefits over human healthcare providers. Modern systems and other intelligent computers may assist with very complicated jobs with higher efficiency, precision, and dependability than people. Machines that give care are immune to tiredness, boredom, burnout, or amnesia. Intelligent computers may potentially be seen as impervious to human therapists' personal prejudices. For this reason, some patients may prefer contacts with intelligent devices, such as virtual people, to human therapists, and care seekers may feel less anxious when discussing intimate, private matters with a machine than with another person. Initial data indicates that some people may feel more comfortable providing information to virtual humans during clinical interviews and prefer to communicate with virtual humans rather than medical professionals where, one explanation for this choice is that virtual persons may spend more time with patients, are always courteous, and do not rush or condemn users [35] [36] [37]

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Improved Self-Care and Access to Care.

AI technology can also significantly increase self-care alternatives for anyone looking for self-treatment or health-related information. The majority of adults and children in the United States with behavioral health concerns who may benefit from care do not receive any assistance. Furthermore, almost 80 million

Americans live in places where there are insufficient mental health practitioners to address the requirements of their communities. This resource disparity An Introduction to Artificial Intelligence in Behavioral and Mental Health Care 15 could be addressed by interactive virtual human care providers who are available anywhere and at any time on mobile devices to provide health information, perform question-and-answer assessments, provide self-care counseling, and deliver therapeutic interventions. [38]

This AI application can deliver a more dynamic experience than a static website or scripted movie. The usage of intelligent care-giving equipment further expands the benefits of telehealth services by offering services to patients in remote geographic locations and providing access to speciality care services that may not be accessible in the patient's area. Furthermore, sophisticated mobile and wearable devices can expand the quantity of data available to consumers and offer them with additional information to assess health and track progress toward personalized health objectives [39] [40] [41], [42] [43]

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Care Integration and Personalization

Intelligent care delivering technologies have the ability to dramatically enhance health outcomes among care seekers by tailoring their care. These systems might be programmed with knowledge and skills from several evidence-based treatments and then offer or combine multiple approaches based on a patient's diagnostic profile, preferences, or treatment progress. Intelligent care-giving devices may also be capable of cultural sensitivity and adaptability. For example, a virtual human psychotherapist might adjust its mannerisms, spoken accent, usage of colloquialisms, and other traits to fit a certain cultural group and therefore create and increase rapport with a patient and achieve better communication. By incorporating data from additional intelligent devices like as sensing devices, wearables, and biofeedback devices, expert systems may further adapt services to the therapeutic needs of patients. These skills will only increase as technology continues to shrink in size, become more integrated with other technologies, and become more prevalent in everyday life.

Economic Benefits

Intelligent machines in healthcare have the potential to bring large economic benefits to both healthcare providers and users of mental health services. By accelerating decision-making processes, CDSSs can minimize demands on clinical staff time and, as a result, enhance the overall efficiency of medical treatment. Computational modeling and simulation approaches can aid in the efficiency of complicated healthcare systems. Through the stepped-care method, AI systems can also assist to cut total healthcare expenses. Stepped care is the process of providing the least resource-intensive treatment to the most people initially, followed by more intense care to those who require it the most. Care seekers, for example, can do self-assessments with a virtual care provider and, if required, be moved to full therapy with a human care provider. This would increase efficiency and, in the end, lessen the financial strain on healthcare systems. Furthermore, because intelligent machine care providers are easily copied, they will provide scalability to care delivery. Increased accessibility and cheaper prices of intelligent devices that offer care may open the door to longer-term treatments that are now limited by managed-care expenses. As a result, patients will be able to engage in longer-term therapy as well as undergo frequent check-ups at significantly lower costs to healthcare providers.[44]–[47]

On a societal level, the use of AI technology in the delivery of treatment might result in large cost savings from untreated behavioral and mental health disorders, as well as increased productivity from a healthier population. According to a World Economic Forum research, the worldwide cost of mental illness was estimated to be approximately $2.5 trillion dollars (US) in 2010 (two-thirds in indirect expenses) and is expected to surpass $6 trillion dollars by the next decade. According to the same analysis, mental health expenses are the greatest single source of health-related worldwide economic burden, surpassing cancer, cardiovascular disease, chronic respiratory illness, and diabetes. Furthermore, according to the World Health Organization (WHO), mental disorders are the main causes of disability-adjusted life years globally, accounting for 37% of healthy years lost due to noncommunicable diseases. It is envisaged that AI technology and approaches can assist to reduce the growing costs of health care by delivering evidence-based and effective alternatives that solve modern health care's present constraints.

CONCLUSION

The practical application of artificial intelligence technology and techniques in behavioral and mental health care is a fast evolving field that offers several interesting potential and benefits. Intelligent machines can assist to address many of the global health care concerns by offering valuable tools that increase health care efficiency and quality. AI advancements also assist humanity in raising the bar for its potential for innovation and function. That is, technology advancements can help us improve our cognitive and physical capacities while also increasing our total productivity. Artificial Intelligence in Behavioral and Mental Health Care: An Overview 19 Individual practitioners, small group practices, major hospitals, and whole healthcare systems, as well as consumers seeking methods to enhance their health and wellbeing, stand to profit from these technologies.

To realize the full potential of what AI and other technologies may offer to behavioral and mental health care, mental healthcare experts, ethicists, technologists, engineers, healthcare administrators, entrepreneurs, and others must collaborate. Psychologists and other mental health experts may help system developers by contributing theoretical and practical knowledge about incorporating evidence-based treatments and therapeutic methods to these technologies. Ethicists may help design these systems so that they can function ethically, and ethicists and mental healthcare practitioners can collaborate to meet practical mental healthcare ethics needs. When planning the design and deployment of these technologies, it is also critical to include the end user (i.e., patients).

There is a lot of research to be done. It is necessary to do research on human computer and human robot interaction in the context of health care in order to optimize intelligent machine systems for interaction with care seekers. More study is needed, in particular, to understand people's attitudes and preferences toward employing intelligent devices for health care. This should also involve a look at demographic and cultural disparities in how people choose to use these systems. Randomized controlled trials are especially important for comparing the efficacy of new intelligent machine-delivered therapies to traditional treatments.

AI is ushering in a new era of behavioral and mental health treatment. Knowledge and skills of medical professionals will no longer be restricted to the physician, psychologist, counselor, social worker, or other professions; knowledge and skills will be embedded into intelligent devices with which we will communicate [48]–[50]. The employment of these technologies also necessitates a reconsideration of the therapeutic relationship, as it now includes the patient's interaction with technology. Emerging ethical considerations, such as new threats to patient privacy, must also be carefully evaluated. We must not lose sight of the importance of the relationship between care providers and care seekers, as well as the duties we have to each other and the communities in which we live, while we develop and implement new technologies. We must design these robots to constantly serve people's well-being, to alleviate as much pain as possible, and to do it in a fair and ethical manner.

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