Artificial Intelligence in Healthcare: What to Consider

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Introduction:

> The integration of Artificial Intelligence (AI) in healthcare is transforming the way healthcare is delivered, with the potential to improve patient outcomes, reduce costs, and enhance the overall quality of care. AI technologies, such as machine learning and natural language processing, are being used to develop predictive models, assist in diagnoses, and personalize treatment plans. However, as AI becomes more prevalent in healthcare, its ethical implications are increasingly important. Ethical considerations related to AI in healthcare involve the appropriate use, deployment, and regulation of these technologies. This thesis paper aims to explore the ethical dimensions of AI in healthcare.[1]

The previous paragraph was written by ChatGPT, an artificial intelligence chatbot. With a simple prompt, the AI scanned its vast resources to produce an introductory paragraph to a thesis paper on the ethics of AI in healthcare. This example of AI demonstrates that the technology is available, and accessible. Almost anyone can use certain forms of AI, and more research is being done to adapt and improve the technology. As more uses for AI emerge, it is essential to reflect on the ethical dilemmas that may arise with its uses.

The field of artificial intelligence was first theorized by Alan Turing, who now is considered the founder of AI. He posed the famous question “Can machines think?” in 1950 which sparked the development of artificial intelligence technology.[2] Artificial intelligence refers to the practice of attempting to make intelligent machines.[3] Simply put, this involves using computers to try to simulate some form of intelligence. This means that computers can perform certain processes that previously were thought to be possible only for humans to achieve.

Already, AI has changed many parts of society. Voice recognition such as Siri or Alexa, self-driving cars, plagiarism checkers, and chatBots, like the one demonstrated previously, are all forms of AI that have become commonplace. And the uses for AI are only increasing. In healthcare specifically, many new uses are being adopted, and even more are being proposed. As the world of artificial intelligence in healthcare rapidly expands, it is important to evaluate the decisions being made for their ethical validity and ensure the right decisions are being made. AI has the potential to revolutionize healthcare as it is known currently, but there are also risks that need to be considered.

Literature Review:

The use of artificial intelligence (AI) in healthcare has recently become a more heavily debated topic as more progress is made in the field of its development. With the recent discussion of artificial intelligence increasing, one may think this is a new introduction to healthcare. But the use of artificial intelligence dates back to the 1950s.[4] AI has the potential to impact every facet of healthcare. In some cases, AI has been shown to be as effective, or more effective than human healthcare providers in diagnosing various conditions.[5] AI also has been shown to aid in the treatment of certain conditions. AI also has been used to streamline some of the tedious tasks of healthcare, such as paperwork, to make the healthcare experience more efficient.[6]

Artificial intelligence in healthcare can be broken into two broad areas of study: physical and virtual.[7] The physical branch refers to any physical AI objects that take part in the delivery of healthcare. For example, a robot that assists in surgery, or a medical device that delivers drugs.[8-9] The virtual branch refers to nonphysical algorithms that can improve different aspects of healthcare.[7] The most prominent area of virtual AI is machine learning. Sometimes, the terms

artificial intelligence and machine learning are used interchangeably, but this is not technically accurate.[10] Machine learning is a subfield in the larger area of study of AI. Broadly speaking, machine learning refers to the ability to program computers to learn without having to be explicitly programmed.[10] Generally, machine learning uses data to "train" the algorithm written by a programmer. Given the data, the computer will train itself to become better at whatever it has been programmed to do. Machine learning can further be broken down into three categories: supervised, unsupervised, and reinforcement. First, in supervised machine learning, the input data is labeled explicitly by humans before being input into the algorithm. In unsupervised machine learning, the data is unlabeled and the algorithm searches for patterns in the data. And lastly, in reinforcement machine learning, the machine is trained through trial and error using some sort of reward system.

One form of machine learning is artificial neural networks. Artificial neural networks (ANNs) were formed in an attempt to mimic the process by which the human brain learns information. To achieve this, there are a series of "neurons" that are arranged in layers.[11] Each neuron is connected to other neurons by weighted connections. As the weights increase, the connection between the neurons strengthen. This mimics the idea that in the human brain, the more frequently used neural connections are stronger. There are at least three layers in ANNs: an input layer, one or more hidden layers, and an output layer.

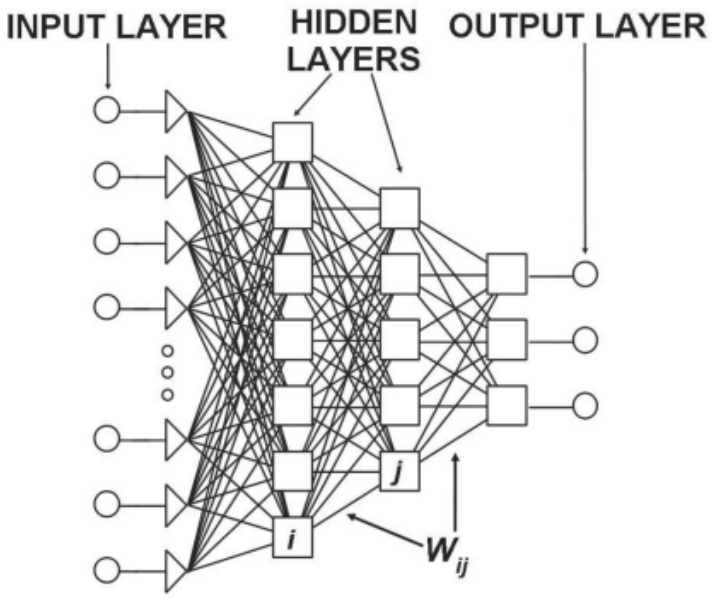

Figure 1: Diagram illustrating the layout of an artificial neural network.[12]

ANNs have the potential to optimize healthcare decisions.[12] Using this system, the ANN could take healthcare data (symptoms, age, history, etc.) as input, go through a series of hidden layers, and produce an output of a diagnosis. ANNs are a potentially powerful tool that has the ability to consider a much larger amount of input data than a human physician can. Theoretically, the more data that can be considered, the better chance a correct diagnosis is made.

Because an algorithm set to mimic the human brain may sound slightly alarming to some, it is important to clarify the meaning of an algorithm. All artificial intelligence is made up of a set of algorithms. Today, some may think of the word algorithm as threatening, but this is not the case. By definition, an algorithm is a series of decisions or a set of instructions.[13] Algorithms themselves have been used in medicine to represent the science behind diagnosis-making and for guiding patient care since the 1980s.[14] When discussing AI in medicine, it can be useful to

remember that it is a series of algorithms put together. Although the technology is new and advancing, the terminology should not be a cause of nervousness.

As technology rapidly advances, there are many current and proposed uses for AI. One of the most useful aspects of AI is its ability to detect patterns in a way that sometimes humans cannot.[5] Radiology and pathology are two medical specialties in which learning to detect patterns is an important part of the job. For this reason, many implementations of AI to date have been in these two fields. Pathology is the field of medicine that analyzes specimens to provide diagnosis information to other branches of medicine.[14] Radiology refers to diagnosing and treating patients based on medical imaging.[15] Both of these fields require the physician to interpret data and use their training of detecting certain patterns, evaluate the given data and determine the next step. Naturally, this is an instance in which AI can aid healthcare workers. For example, one of the job duties of a radiologist is reading mammograms for the detection of breast cancer. When evaluating a scan, the interpretation of a mammogram by two readers instead of one increases the rate of cancer detection by around 10%.[16] In a 2008 study, evaluation by the second radiologist was replaced by a computer-aided detection system. The proportion of cancers detected by double readers was 87.7%, and the proportion of cancers detected by a single reader with computer-aided detection was 87.2%.[16] So, this study proved that in this instance, AI was able to take the role of the second physician reader with almost the same accuracy.

But the implementations of machine learning reach far beyond these two fields of medicine. In the field of dermatology, researchers trained a computer using a supervised machine learning approach to diagnose skin cancer. After training, the algorithm was able to classify skin cancer at the competence level of human dermatologists.[17] The uses of AI even can be seen in the field of psychiatry. Researchers at Vanderbilt University created algorithms to detect suicide

attempts. The algorithm accurately predicted whether a patient would suffer a suicide attempt in the next two years with 80-90% accuracy. When predicting if a suicide attempt would happen within a week, the AI predicted with 92% accuracy. This research produced more accurate predictions than traditional methods of suicide prevention.[18]

Currently, most applications of artificial intelligence are still under the control of physicians. But there is research being conducted to create autonomous AI tools that potentially could operate independently of human guidance. In 2016, a surgical robot was developed that stitched a pig's small intestine autonomously, i.e. without a human surgeon's direction.[9] In fact, the researchers found the robot's surgery to be more successful than the human counterparts. As more advancements are made, technology will allow autonomous physical AI to become a common part of the healthcare system.

The possibilities for the implementation of artificial intelligence in healthcare are numerous. But there are many concerns with certain aspects of artificial intelligence. One of the main concerns with artificial intelligence is not exclusive to healthcare: the black-box nature of artificial intelligence.[19] Although there is debate surrounding the specific meaning of "black box", in general, this issue is defined as not being able to explain a system's behavior. In the case of AI, many times researchers and programmers will understand the inputs and outputs of machine learning algorithms, but how the input reaches those outputs is not always clearly understood. For example, researchers can observe the inputs to artificial neural networks and can observe the outputs, but the hidden layers are not completely understood. This is a cause for hesitation in implementing artificial intelligence.

Some argue that the black box issue is not a cause for worry. Opaque decisions may be more common in medicine than opponents of AI realize. Even with the advancements in

medicine seen today, for many diseases the pathophysiology is unknown.[20] Additionally, the mechanisms of the treatments may not be known exactly either. For example, lithium has been a widespread treatment for bipolar disorder for more than 60 years, and the reason as to why the treatment works still is not known.[21] So, it may be important to consider the progress AI can provide despite its opaque nature, similar to other tools with black-box nature already being used in healthcare.

The opaque aspect of artificial intelligence is not the only worrisome aspect of implementing artificial intelligence in healthcare. The nature of AI is based on pattern recognition. While this can be useful in many instances, it may be harmful in some. The AI used in medicine does not understand the pathophysiology behind the decision it makes, it just knows the patterns it recognizes. In some cases, this can cause a system to draw incorrect conclusions from erroneous patterns. For example, researchers developed AI systems that were purported to accurately detect COVID-19 in radiographs.[22] But, after studying the systems, it was found that the artificial neural networks relied on unintended shortcuts instead of the true pathophysiology the developers intended. So, the AI relied on confounding factors that may affect its implementation in real performance. This example highlights the importance of detecting the correct patterns in data sets and not random correlations.

Along with the importance of establishing intended patterns, the training input selected for AI is an important decision for many reasons. The input selected to train an AI system essentially determines the direction the algorithms will train themselves. If an AI system is trained using biased input, this can become a major issue in the outcome and validity of the system. Some claim there is an inherent bias associated with AI.[5] Depending on the data selected to train the algorithm, there could be bias inadvertently trained into the AI. But also, humans are

responsible for selecting data and training AI. Unfortunately, bias is inherent in humans. So, either on purpose or by accident, the humans creating AI still can pass bias through a system that has been praised for being more unbiased than humans.[23]

While there are negative issues that must be considered with AI, to examine fully the ethical situations of implementing AI in healthcare it is important to assess the positives as well. Using AI in medicine has the ability to reduce human error. AI already has been proven to reduce misdiagnosis rates in multiple fields.[10] In a field like healthcare, reducing human error may be worth some of the associated risks. Avoiding human error has the potential to save lives in the medical field.

Now, much of a physician's day is spent doing tedious tasks such as paperwork, insurance claims, charting, and more. It has been shown that physicians and healthcare staff spend an average of 16.4 hours per week working on insurance approvals alone.[24] This is just one aspect of office work that occurs in a medical setting. One worthwhile implementation of AI would be to use AI algorithms to do these tedious tasks, freeing healthcare providers' time for more important tasks.[12] This would mean the physician could focus on more important matters, and potentially would reduce the cost of healthcare. The use of AI for office tasks in hospitals could lead to improved patient experience, reduced waste, and improved efficiency.[25] This is an important value of AI because saving these resources means they could be applied to more important patient-focused costs.

Already, ChatGPT, the AI chatbot mentioned previously, has been used to automate daily tasks. Recently, ChatGPT has become a widespread example of AI. ChatGPT is an AI-powered chatbot that is capable of mimicking human conversation.[6] A physician simply can ask ChatGPT to write a patient chart for them and, with the correct inputs, what would have taken a physician

a large chunk of time takes the chatbot only milliseconds. ChatGPT also is predicted someday to assist in the diagnosis and treatment aspects of healthcare.[6] ChatGPT is an important example to consider because this is not a theoretical idea; ChatGPT already has become commonplace in many fields and will only increase in prevalence moving forward.

Discussion:

When one considers the ethics behind implementing AI in healthcare, it is essential to look at how the insertion of the technology into the patient-provider relationship affects the trust built in the healthcare system. The foundation of the patient-healthcare provider relationship lies on trust. ""Trust" is relational, highly complex and involves at least two actors: one actor trusts the other to do, or not do an activity."[26]

One aspect that strengthens the trust between a patient and healthcare provider is the responsibility for decisions. One of the core responsibilities of clinicians is to provide clear reasoning behind their decisions.[27] Thus, the responsibility for the clinical decisions naturally falls on the provider. But when considering the implementation of AI, there is a possibility to shift some of this responsibility. In some cases of artificial intelligence use, there has been a dismissal of the values of evidence-based medicine.[27] Instead of relying on the evidence that is demanded of healthcare providers, certain AI was not held to the same standard. As AI becomes more commonplace in the healthcare field, it is essential to maintain the responsibility for clinical decisions in the hands of the providers and view artificial intelligence as a tool to help reach these decisions instead of a replacement for the human healthcare provider.

The addition of some sort of technology in this relationship between the patient and healthcare provider runs the risk of weakening this trust. But measuring this intangible variable is difficult, and thus it is hard to study the effect AI can have on this relationship. Some argue

that the lack of transparency present in implementations of artificial intelligence leads to an inability to fully trust the technology.[26] In some fields, this lack of transparency is not such a concern. The pros of utilizing these algorithms far outweigh the cons in many fields, such as some areas of engineering, business, and weather forecasting. But, in healthcare, the stakes often are extremely high.[28]

Some argue the opposite, that artificial intelligence has the ability to bring more trust into the patient-doctor dynamic. In the patient-doctor relationship, there is some innate trust that comes with the licensing and social expectations of physicians. Additionally, as a doctor successfully diagnoses and treats a patient repeatedly, this further builds trust into their relationship. Consider now if a physician utilizes an AI tool to assist in their diagnosis and treatment plan. Assuming that the algorithm is properly trained and implemented, this will increase the accuracy of the physician's work. Now, the doctor has a lower chance of misdiagnosis, which has the possibility to increase the trust in the patient-physician relationship.[29]

There is another part of relationship-building in healthcare that AI has the potential to improve. In a study aimed at exploring the effect computers have on patient willingness to share personal details in clinical interviews, the researchers found that participants were more likely to share sensitive information with virtual humans.[30] Providing more honest responses in a clinical interview leads to better healthcare outcomes. So, the addition of AI as a clinical interviewer has the potential to strengthen the trust between a patient and provider in multiple ways, as well as strengthen the trust between AI and the patient.

However, there are important qualities of human healthcare providers artificial intelligence cannot replicate. Algorithms, at this point, are not capable of duplicating the traits

associated with good human physicians such as empathy, compassion, and caring.[31] Empathy is often cited as one of the top qualities necessary to make a person a valuable physician.[32] Empathy can be further broken down into three definitions: emotional empathy, cognitive empathy, and motivational empathy.[33] Emotional and motivational empathy are associated with feeling emotions that are programmed through biology and society that then prompt people to help someone. Cognitive empathy is a different sort of empathy. Cognitive empathy comes from the recognition of someone else's mental state. There is risk associated with developing AI that is capable of cognitive empathy, i.e. it can recognize distress in a person but is unable to reproduce emotional and motivational empathy. Eventually, AI likely will be capable of simulating forms of emotional reasoning based on human models. But how much empathy is able to be reproduced? Although empathy can be demonstrated in a moment in time, the human brain has undergone years, sometimes decades, of experiences and emotions to produce the one moment of empathy. This is almost impossible to recreate in a simulation of the human brain using AI. Another key part of producing empathetic feelings is the ability to view the situation from another person's perspective. This can only be achieved through shared human experience. Even if someone has not lived the exact situation, human experience allows shared emotions that help relate situations to each other. For this reason, it is unethical and irresponsible to aim to replace healthcare workers with AI systems.

Additionally, it is almost impossible to construct an artificial intelligence that considers every single variable in a clinical decision. Chin-Yee and Upshur propose the example of asthma exacerbation.[27] There are rare reasons for this clinical presentation including thunderstorms and other environmental disturbances. Training an artificial intelligence to consider every possible variable would be almost inconceivable. Just as with any human healthcare provider, it is

important to not claim an algorithm to be correct 100% of the time, because this is simply unattainable.

Overall, there are too many opportunities for AI to improve healthcare to abandon its implementation. The possibilities are numerous for this technology; some even have compared artificial intelligence to electricity in its ability to revolutionize the world.[7] To ignore the benefits of this technology in medicine would be ethically wrong. Floridi proposes a "mindful" adoption of AI into the healthcare field.[34] Here, mindful means not being afraid of its usage, but also reflecting on the decisions being made about the technology. But it is important to not stray away from the potential impacts it could have because of the negatives.

It is important to establish the role of artificial intelligence in healthcare before blindly adopting every proposed use for it. In the healthcare field, AI should be viewed as a supplemental tool to healthcare providers. The aim should be to develop artificial intelligence to support these providers, not replace them. AI cannot replace the emotional attributes that dictate a good physician, and attempting to replicate these emotions would only produce faulty attempts at imitating empathy that could, in extreme cases, be dangerous.[33] But, artificial intelligence does have the potential to improve healthcare.

Conclusion:

AI already has changed and continues to change many fields. In healthcare specifically, artificial intelligence already is being implemented, and new uses are being proposed every day. The effects AI could have on medicine have the potential to be revolutionary. But as the technology progresses it is important to evaluate the decisions being made surrounding its implementation. The technology is powerful, and its uses should be deliberated as such.

Moving forward, it is important to be mindful of the uses of AI in medicine, with "mindful" meaning the potential is not squandered, but also not implemented blindly either. It also is important to determine a place for AI in the field of healthcare and base the implementations on this goal. The intention should be to support healthcare workers, not replace them with artificial intelligence. By aligning the decisions surrounding the use of AI in healthcare with this goal, it potentially could improve many aspects of healthcare as it currently is practiced.

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