THE CURRENT AND FUTURE ROLE OF ARTIFICIAL INTELLIGENCE IN MEDICINE: BIOETHICAL CONSIDERATIONS AND EXPLORATION OF AI IN MEDICINE, RADIOLOGY AND MAMMOGRAPHY

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By
Nadia Namous
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Thesis Approvals:

Brian Tuohy, Ph.D, Thesis Advisor, Center for Urban Bioethics

Lewis Katz School of Medicine Temple University

ABSTRACT

Artificial Intelligence (AI) is rapidly advancing and is poised to transform healthcare. This thesis explores the current and future role of AI in medicine, radiology, and mammography, as well as the bioethical considerations surrounding its use. The introduction provides an overview of AI and its applications in medicine, followed by a discussion of how AI is being used in clinical care including its potential for improving patient outcomes and reducing healthcare costs.

The thesis then delves into AI in radiology, specifically its use in image interpretation, diagnosis, triaging, and treatment planning. The role of AI in mammography is also explored, focusing on its potential for improving the accuracy of breast cancer detection and diagnosis, as well as the aspect of patient communication and education.

The future of AI in healthcare is also discussed including potential challenges such as the need for high quality unbiased data and the ethical considerations surrounding AI's use. The bioethical considerations surrounding AI in healthcare are explored including issues related to privacy, autonomy, and bias.

Finally, the thesis concludes with a discussion of what can be expected from the future of AI in medicine and the implications for healthcare professionals, patients, and society. In summary, this thesis provides a comprehensive overview of the current and future role of AI in medicine, radiology, mammography, and patient care while highlighting the importance of addressing bioethical considerations as this technology continues to evolve and make its way into our lives.

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CHAPTER 1

INTRODUCTION TO ARTIFICIAL INTELLIGENCE (AI)

Most people have heard about Artificial Intelligence (AI) one way or another. In this section, I will introduce AI as a rapidly evolving field of computer science that aims to create intelligent machines capable of learning and performing tasks that would typically require human intelligence, followed by a brief history of AI discussing the first and second AI winters, and ending with a brief discussion of potential applications of AI in medicine. AI systems utilize various techniques such as machine learning, and computer vision to enable machines to learn, reason, and make decisions the way humans would. AI has the potential to be applied in a wide range of fields including self-driving cars, virtual assistants, medical diagnosis, and financial analysis. One area where AI is making a significant impact and growth is in the medical field. Recently there has been a lot of buzz around the ability of powerful language AI programs like ChatGPT to pass the USMLE exams including Step1, Step2CK, and Step3 (Kung, 2019). Overall, AI presents immense opportunities to revolutionize many industries, including healthcare, and its potential is only just beginning to be realized.

To fully understand the potential applications of AI in medicine, it's important to have a brief understanding of its history. The following section will discuss the significant advances in AI and its impact on various industries, including healthcare, while highlighting the fear surrounding the use of AI in clinical care decisions, and the current applications of AI in medicine. Then it will highlight the potential of AI in medical decision making, particularly in cancer patients, and how it can consolidate information from multiple sources to provide highly accurate and personalized

predictions of the diagnosis, treatment options, and prognosis. Since the beginning of the 21st century, there have been significant advances in deep learning, data organization, and artificial intelligence that have transformed the way we approach industries ranging from manufacturing to marketing to medical care. The impact of AI is so profound that it is considered a revolutionary industry, one that has the potential to transform every sector in ways that are yet to be fully comprehended by people.

AI Winters and Hesitation in Medicine

Despite significant advances in AI technologies, there have been periods of setbacks and reduced funding for AI research in medicine, known as "AI Winters" (Matheny, 2019). These challenges have contributed to hesitations in the medical community towards adopting AI technologies in clinical care decision making. In this section, I will discuss the reasons for these hesitations, and the impact of AI winters on the development of AI in medicine. There were two main AI winters that occurred in the 20th century, and both had an impact on the introduction of AI to medicine. The first AI winter occurred in the 1970s-1980s when there was decline in funding for AI research due to the inability of AI systems to deliver on promised capabilities. This lack of success and decreased funding resulted in downsizing of AI research. According to Ohno-Machado and Wang, "The earlier failures of AI in medical informatics, coupled with the limited computational power of the time, discouraged researchers and funding agencies from pursuing AI in medicine" (Ohno-Machado, 2004). The second AI Winter was in the 1990s and it was largely due to unrealistic expectations and overpromising by AI researchers. This downturn significantly impacted the implementation of AI in medicine and at the time, there were also increased ethical concerns related to patient safety and confidentiality

(Topol, 2019). The end of the second AI winter is considered to be around the mid 2000s, since then AI has started to be implemented in a variety of fields, including in the field of medicine.

The End of the Second AI Winter

Since the end of the second AI winter, applications of AI in clinical care have expanded significantly with many applications in the healthcare industry such as automating prior authorizations, or managing supply chains and cybersecurity, and even in the field of medical imaging and radiology. Given the hesitancy around ethical concerns, there remains some fear preventing AI from being used in direct clinical care decision support. This obstacle is currently preventing AI from being used to its highest potential in the field of medicine. there is evidence that AI has immense potential in aiding clinical care decisions, and that AI has the capabilities of analyzing large amounts of data in a way that humans cannot, which can in turn be far better for the patient. One example of missed potential with AI is in personalizing cancer treatment options and diagnoses to improve a patients prognosis based on large data analysis made possible through AI algorithms. Medical decision making can be a very complex nuanced process, particularly in cases of delivering care to cancer patients, and making decisions about diagnosing a primary or secondary cancer along with explaining the risks and success rates of treatment options to patients can be very difficult. AI models can be used to streamline this process by taking in data from many sources, along with the patients' data, imaging, genetic information of the pathology, and patients health information to rapidly consolidate the information and provide highly accurate predictions of the

patients diagnoses treatment options most likely to succeed as well as their prognosis. (Lambin, 2018).

To conclude this section, the hesitations and setbacks experienced during the AI winters have contributed to a slower adoption of AI in clinical care decision making and medicine. However, there is a growing interest and investment in AI technologies in medicine, particularly in the field of cancer care. The potential applications of AI in medicine include improving diagnoses and patient prognoses through large data analysis made possible through AI algorithms. In the following section, I will delve deeper into these potential applications, and the impact they could have on the future of medicine.

CHAPTER 2

AI IN MEDICINE

When artificial intelligence and its potential applications were initially introduced, there was considerable interest in its implementation in the field of medicine. However, disconnects between reality and expectations, and ethical concerns regarding patient privacy posed significant setbacks and have prevented the implementation of AI in medicine. Recent breakthroughs in AI such as deep learning and reinforcement learning have led to renewed interest and funding in the field, and the risk for an additional AI winter has been diminished. I will begin by discussing the benefits of implementing AI in the field of medicine, challenges of implementing AI in healthcare, followed by some of the potential applications of AI in medicine.

Benefits of AI

AI has the capability of transforming the field of medicine with countless benefits, including improving accuracy and efficiency in diagnosis and treatment, increasing patient safety, and decreasing exorbitant healthcare costs. Computers can collect and analyze large amounts of data quickly and accurately, without making human errors. According to a report by the institute of medicine, human errors in medicine account for ~44,000 to 98,000 deaths per year in the United States alone (Kohn, 1999). There is additionally significant potential for cost savings in the healthcare industry by using artificial intelligence. A study published in the Journal of Medical Internet Research found that an AI-based diagnostic tool for skin cancer could result in savings of up to $3.4 billion annually in the USA by reducing unnecessary biopsies and dermatologist visits (Han, 2018). Another study by Accenture estimated that the use of

AI in healthcare could generate annual savings of $150 billion in the USA by 2026 with improved clinical outcomes, enhanced productivity, and reduced waste and fraud as the drivers of these savings (Collier, 2017). The Journal of Medical Systems found that the use of AI for predictive analytics in hospital settings could lead to annual savings of $17 million by reducing readmissions and length of stay (Sahni, 2018).

Challenges of Implementing AI in Healthcare

Artificial intelligence is less error prone, capable of improving accuracy and efficiency in medical diagnoses and treatment, and has huge potential for cost saving in the healthcare industry. Why then haven't we begun to use implement AI in clinical care? It is so important not to overlook the challenges and limitations of AI in healthcare. There are concerns for data quality, privacy, and security. The proper development of clinical AI models that mitigate bias and represent populations fairly require significant time, resources, and more importantly highly domain and problem specific training data, all of which are in short supply in the world of healthcare. Essentially, before we can begin using AI to help us make decisions, we must train AI and actively feed it information, as well as give it feedback for it to learn from our clinical management of patience. For example, in the field of the medical imaging world, there have been key developments and advancements in AI being used to read images because of the feedback of data back and forth with radiologists and the programs.

Before we can begin implementing the use of AI models, it is important to address the challenges and limitations of AI in healthcare in order to prioritize ethical, equitable, and inclusive health care AI while addressing explicit and implicit bias. It is also important that when we do use AI for decision making, that it be representative of

the population we are treating based on demographics, genetics, and social determinants of health. There must be full transparency and trust with respect to the population's representativeness, composition, provenance, semantics, and the quality of data used to develop the AI tools.

Applications of AI in Healthcare

AI has the potential to address various issues in our current healthcare system ranging from proving personalized care, to providing clinical decision support, to helping with healthcare staff shortages, to even contributing to the management of pandemics and epidemics in the future. I will discuss some of these applications here and further explore applications of AI in the field of radiology. AI can provide personalized care and can help identify the most effective treatment options for individual patients based on their unique characteristics and medical history. For example, AI algorithms can analyze genetic data to identify targeted therapies for cancer patients, and analyze historical data to determine which treatment plan holds the best prognosis for that individual patient.

AI can also be used to help with the healthcare staff shortages that have become a national issue, especially thinking about the recent years involving the pandemic of COVID-19. Upon retrospective analysis AI could have helped with predictive modeling, early detection and diagnoses, personalized treatment planning, and even ventilator allocation and prognosis in regards to the COVID-19 pandemic (Han, 2018). If carefully integrated, AI has significant potential to contribute to the management of pandemics and epidemics in the future. Artificial intelligence can be used as a tool to aid providers in clinical decision support by analyzing patient data to help clinicians identify patients at risk for sepsis or other conditions. Additionally, in the field of radiology, AI is already

being used to triage medical images that need to be read more urgently, for example brain bleeds, or pneumothoraxes. Furthermore, AI can catalyze medical advancement in terms of drug discovery and development by analyzing large datasets and identifying potential drug candidates more quickly and accurately than traditional methods. The potential for AI is endless and it will be transformative for the field of medicine and improving healthcare outcomes. For these next steps to take place, there must be collaboration between healthcare professionals, ethicists, researchers, and data scientists.

AI in Radiology

The field of radiology has been at the forefront of implementing early AI technologies to help streamline processes ranging from cancer detection to workflow optimization to enabling more precise and personalized care. Radiology has always traditionally been a field that adopts and thrives on technological advancements. Historically, the digitization of radiographs, CT's, and MRI's was revolutionary for the field of radiology and sparked the rest of the medical field into its digital age. The focus of AI in radiology has been on improving diagnostic accuracy which has been almost as effective has human level performance, and continues to improve with increasing the data input that AI has access to (Esteva, 2019).

In addition to improving diagnostic accuracy, AI has been used in radiology to optimize work lists to prioritize cases, pre-analysis of cases in high volume applications where observer fatigue may be a factor, extracting information from images that is not apparent to the naked eye (i.e. bone density), and even improving the quality of reconstructed images. In the Emergency Department (ED), this has been applicable because when images are being ordered in the ED, some findings such as pulmonary

embolism, brain bleed, or pneumothorax are urgent and require appropriate triage to the top of the list, if AI can be used to prioritize those more urgent images and place them at the top of a radiologists list, the team can provide prompt care appropriately to prevent morbidity and mortality in a setting of understaffed and overwhelmed emergency departments. There are a lot of moments in medicine where timeliness in the diagnostic process is of highest importance, and time can be the difference between quality of life and death. Long unread case lists can delay diagnosis and are problematic especially if the patient does not present with classical clinical symptoms. AI can be very helpful in solving this problem by being optimized for greater sensitivity rather than overall accuracy and can be programmed to have a lower threshold for placing urgent studies at the top of a list for radiologists to read. Due to the growing capabilities of AI in analyzing big data and in deep learning, AI is able to identify radiomic features in imaging that can represent a mathematical imaging phenotype of malignant disease expression, and these radiomic "signatures" of disease can also be used to predict response to therapy (Aerts, 2016). Radiomic features are quantitative measurements of various characteristics of medical images, such as texture, shape, intensity, and spatial relationships between different regions. These features can then be extracted using computer algorithms that analyze large amounts of imaging data and convert them into numerical values that can be used for statistical analysis and modeling. Radiomic features have been shown to have clinical relevance in predicting treatment response and prognosis in various types of cancers; for example, certain radiomic features of tumors such as heterogeneity or vascularity are associated with higher likelihood of response to chemo or radiation therapy, or with worse survival outcomes. By integrating radiomic features with other

clinical and molecular data, researchers can develop predictive models supported by AI that can help guide treatment decisions and personalize therapy for individual patients (Aerts, 2016). AI is also currently being widely used in mammography to identify suspicious findings in screening breast mammograms, radiologists are actively working to teach AI by confirming suspicious findings found by AI.

AI in Mammography

Mammography is a field that has been using AI for several years to detect breast cancer and aid with interpretation of screening mammograms. AI algorithms can help radiologists interpret mammograms more accurately by highlighting suspicious areas that might otherwise be missed which can lead to earlier detection and better outcomes for patients (Anderson, 2020). For example the FDA-cleared software called "Transpara" developed by ScreenPoint Medical uses deep zx algorithms to analyze mammograms and provide a second opinion to radiologists. Another example is the AI powered mammography system developed by Hologic to improve quality of images. Recent research in AI algorithm development for digital mammography interpretation has focused on automatically extracting quantitative, pixel-level variables from single whole digital images of the breast (Trister, 2017). By clustering these millions of pixel-level variables that are unidentifiable by the human eye, computers can identify new imaging features associated with breast cancer and train them with gold-standard outcome data. Furthermore, AI can combine pixel-level variables with patient-level clinical data, such as known patient risk factors, to create advanced predictive algorithms that may potentially match or surpass human screening mammography. A systematic review of

studies that used screening examinations from real world settings to externally validate AI algorithms for breast cancer detection showed incremental diagnostic accuracy improvements over radiologist interpretation alone (Anderson, 2020).

More traditional applications of AI in the field of mammography involve early detection of suspicious findings, however, there are many other considerable uses for AI particularly in the field of breast imaging. Another aspect of AI in mammography that can be explored is to assist in communicating mammography results. When patients get a breast screening, they receive a short letter in the mail that notifies that patient whether or not they need to return for additional imaging, and tells them about their breast density. Most patients actually don't understand what the majority of the information in the letter means and are not familiar with the implications of having dense breast tissue. A survey of Virginia Women published in the J Am Coll Radiology revealed that only one in five women were aware that density reduces the sensitivity of mammography and only one in eight were aware that density increases breast cancer risk. (Guterbock, 2017). If the letter discussion breast screening results can include a link to an AI virtual assistant that can walk the patient through the information in easy to understand language that is compatible with the patients health literacy levels, this can bridge barriers and help patients feel more empowered in terms of their health (Giridhar, 2023). In the next section, I will delve deeper into how AI has great potential applications, particularly with the use of virtual assistants and chatbots to support patient centered healthcare.

CHAPTER 3

FUTURE OF AI IN MEDICINE

The introduction of AI programs in patient centered communication of health information can bridge the gap in health literacy, language barriers, provide personalized care and emotional support to improve patient engagement and health outcomes, and with remote monitoring of chronic health conditions where prognosis is improved with regular maintenance. According to the National Assessment of Adult Literacy, only about 12% of adults in the United states have proficient health literacy levels. Limited health literacy is a significant issue in the United States, particularly among older adults, those with lower socioeconomic status, and minority populations (Berkman, 2011). This can lead to poorer health outcomes and increased healthcare costs. (Institute of Medicine, 2004). Fortunately, AI can be used to improve health literacy and bridge the gap in patient communication (Oh, 2020) via chatbots and virtual assistants, for example. These can simulate human conversation at a level that patients are comfortable with as well as answer follow-up questions. These digital assistants can be integrated into a patient's care during doctors visits by providing QR codes in patient rooms or a tablet device that can be accessed during wait times. Additionally, virtual assistants can offer emotional support to an extent and explain healthcare topics in a way that empowers patients to take control of their own health (Raza, 2020). Studies have shown that virtual assistants and chatbots can improve patient engagement and health outcomes (Bickmore, 2018; Cho, 2018). For example, a chatbot-based intervention ameliorated medication adherence and blood pressure control among patients with hypertension (Bokolo, 2020), while a chatbot-based intervention for improving blood glucose control among patients with type 2 diabetes was

found to be as effective as an internet-based glucose monitoring system (Lee, 2018). The use of virtual assistants can also help automate routine tasks for healthcare providers, freeing up time for more complex patient interactions (Oh, 2020).

A promising development in mental health care is the use of virtual assistants like "Woebot" developed by Stanford University. Woebot employs cognitive behavioral therapy techniques to assist patients with depression and anxiety. A study conducted on Woebot revealed that it was equally effective as human therapists in reducing symptoms of depression and anxiety (Fitzpatrick, 2017). This is a significant breakthrough, especially given the current shortage of mental health professionals.

Another huge barrier in health care that is experienced by approximately 25 million people in the US is limited English proficiency. Studies have shown that language barriers are more common among certain populations such as immigrants and refugees who are already disproportionally affected by health disparities (Karliner, 2017). AI powered language translation can help healthcare providers communicate with patients who have a language barrier and is more powerful than software like google translate; AI powered translation tools use deep learning neural networks which are designed to recognize complex patterns in language data and produce more accurate translations. AI can consider contextual information and can recognize idiomatic expressions unlike traditional translation software, AI in a sense can be used in situations where interpreters may not be accessible. A study conducted in the United states found that only about 56% of hospitals offered language services to patients with limited English proficiency, and even when language services were provided, they were not always used (Ngo-Metzger, 2013).

AI can also support healthcare providers communicate with patients about their diagnosis and treatment options by analyzing a patient's medical history and providing personalized treatment recommendations to a provider who could then also share these with patients. Another way that AI can help with communication is between a patient and a provider when patients are not physically present through sharing vital signs or blood sugar levels for example. AI monitoring can let a provider know how a patient is doing remotely and can help with decision making that is personalized to the patient.

CHAPTER 4

POTENTIAL PITFALLS OF AI

With AI growing and being implemented more and more in the field of medicine, it is important to be aware of the potential pitfalls of AI which will be supported by real world examples. One pitfall is the potential for biased algorithms which can result if the training data used to develop the algorithm isn't diverse enough. This can lead to inaccurate or unfair results, especially for underrepresented patient populations—this is why it is crucial that the training data be diverse and representative of the population, and that algorithms are regularly tested for bias. There are several examples of AI algorithms being biased based on the dataset provided: several studies have found that facial recognition algorithms are far less accurate for people of color and women compared to white men, and according to a study by the National institute of Standards and Technology, facial recognition algorithms were 10 to 100 times more likely to misidentify Asian and African American faces compared to white faces (Grother, 2019). This is likely secondary to the less diverse dataset that was used to train the AI algorithm (Daneshjou, 2020). Another example are algorithms used to make hiring or lending decisions that may be biased if they are trained on data that reflects historical discrimination: an algorithm used by Amazon to screen job applicants was found to be biased against women as it was trained on resumes submitted to the company over a 10 year period during where there were fewer women in technical roles (Dastin, 2018). A study by the Human Rights Data Analysis group found that a predictive policing algorithm used by the NYPD was biased against communities of color because it used historical crime data to predict where crimes were likely to occur in the future which can

reflect historical biases and discrimination, leading to biased predictions (Lum, 2016). Another example specific to healthcare is based on a study by Obermeyer et al that found a commercial algorithm used to determine which patients would benefit from extra medical care was biased against black patients as it failed to account for their higher healthcare needs (Obermeyer, 2019). This Algorithm was trained on data that reflected disparities in healthcare access and treatment. What we can learn from all these examples is that transparency in AI algorithms and datasets is of utmost importance, as transparency can help identify and address biases and can increase trust in AI systems.

Another issue that will be discussed further is the need for regulatory and ethical guideline because without these guidelines being clear, it can be difficult to determine the use in clinical practice. AI can be taught ethics, but these guidelines must be clear and be developed by professionals and community members especially if they will be involved in patient care. Given that for AI to be successful and unbiased, it will need to have access to a lot of data, it is very important for data management and security to protect patient privacy and confidentiality (Thrall, 2018).

CHAPTER 5

BIOETHICS CONSIDERATIONS OF AI

The more AI is being used in healthcare, it is becoming more critical and important to consider the bioethics aspect of AI including patient privacy, autonomy, informed consent, transparency, and accountability. AI based support systems can have a significant impact on patient autonomy, informed consent, and the doctor-patient relationship. AI cannot be improved and representative unless it has access to sensitive patient data. The ethics of data protection, privacy and confidentiality is important to consider. Patient data must be stored and analyzed in a secure and responsible manner, while also ensuring that patients are informed about how their data will be used. The ethical principles of autonomy and informed consent dictate that patients should have the right to decline to include their health information in the database, but it is important to ensure that this does not result in bias or misrepresentation of the population in excluding those who have a mistrust in medicine. It is important for healthcare providers and AI developers to balance the need for patient privacy and data protection with the need to develop equitable AI systems that can improve patient outcomes. One way to address this potential misrepresentation is to develop strategies to engage with those patients who are hesitant to participate in the AI database to build trust and transparency around the use of patient data. Another important aspect to consider is accountability and responsibility. As AI systems become more complex and autonomous it may become difficult to assign responsibility when something goes wrong, and that's why it is important to establish clear lines of accountability and responsibility for AI systems to ensure that patients are protected from harm. If AI is to be used as a decision support system for physicians, it is

vital to ensure that doctors and other healthcare professionals are adequately trained to use these systems and understand their limitations and potential biases. Prior to implementing AI in a clinical setting, there must be a collaboration involving doctors, patients, ethicists, and other stakeholders to ensure that AI-based decision support systems are used in a way that promotes patient autonomy, informed consent, and the highest standards of ethical practice (Braun et al., 2021).

Though AI has immense potential to improve patient outcomes and increase efficacy in healthcare, there are ethical concerns as discussed related to data privacy, algorithm bias, and the impact of AI on the doctor-patient relationship. These concerns can be addressed by developing ethical guidelines specific to AI in healthcare that would ensure the protection of patient autonomy, privacy, and informed consent. Once AI is implemented, there must be a way for accountability to take place along with ethical oversight, the impact of these technologies on patient outcomes should be monitored, and the results should be widely shared to ensure that AI is being used in a way that aligns with ethical principles. The oversight board should include bioethicists, physicians, patients, and healthcare providers. There must also be a lot of teaching about AI, and the ethical implications of AI for both healthcare professionals and the general public to ensure that these technologies are being used in a way that is ethical and effective.

CHAPTER 6

DISCUSSION

As AI becomes more prevalent in our daily lives, the need for guidelines, training, and legislation to ensure its responsible use should be prioritized at this point. There is a huge potential for bias to be introduced and perpetuated through the use of machine learning algorithms that are trained on biased datasets, and there are several examples of this. It is therefore of utmost importance to ensure that AI algorithms are transparent and accountable to prevent bias and promote ethical and equitable decision making. There must be interventions early on given that AI datasets based on biased data can be perpetuated if not corrected early. Several examples as discussed earlier have shown that AI algorithms can be biased due to the less diverse dataset used to train them, such as facial recognition algorithms that are less accurate for people of color and women (Grother, 2019). Algorithms used for hiring, lending, or policing may also be biased if trained on data reflecting historical discrimination (Dastin, 2018; Lum, 2016). To prevent biased predictions and increase trust in AI systems, transparency in AI algorithms and datasets is crucial to identify and address potential biases (Daneshjou, 2020). The datasets used to train AI should be available and accessible to all using the algorithm and it is absolutely crucial that the datasets be both diverse and representative of all populations.

AI has been proven to be highly beneficial for tasks involving pattern recognition, data analysis, and data based decision-making support. There are so many applications for AI as discussed ranging from self-driving cars, to virtual assistants, to even medical decision making support and medical image screening. In focusing on AI's potential in healthcare, it is essential to be aware of and recognize its limitations. One could argue

that having a comprehensive understanding of the limitations of AI is of greater significance than its potential applications. The use of AI in the field of medicine presents ethical complexities due to the potential exploitation of sensitive health information for training algorithms from vulnerable patient populations. Thus the protection and well-being of patients should be prioritized above all else, and early intervention and introduction of ethical guidelines and regulation of AI should take place immediately. It is important to recognize that AI has plenty of applications in the field of medicine, however, it can only be an adjunct or tool to augment and enhance the capabilities of medical providers to provide better care and improve health outcomes for patients-- it cannot replace doctors. Medicine is a nuanced career path, to practice medicine, it requires not only a deep understanding of biology, human behavior, and social and cultural factors, but it also requires empathy and human connection.

CHAPTER 7

CONCLUSION

Artificial intelligence has immense potential in the field of medicine and radiology. The ability of AI to analyze vast amounts of data, detect subtle patters and abnormalities, and improve diagnostic accuracy can aid in early disease detection and intervention. This can be particularly valuable in fields like radiology, where the detection of small, hard-to-spot lesions can make a significant difference in patient outcomes. The use of AI powered algorithms can assist in personalized treatment plans, reducing the risk of complications and improving patient outcomes. AI can be used to tailor treatments to individual patients based on their genetic makeup, medical history, and other factors, resulting in more effective treatments and better outcomes. Additionally, the integration of AI into clinical work flows can optimize resource use, increase efficiency, and reduce costs. However, with AI growing and being implemented more widely in the field of medicine, it is important to be aware of the potential pitfalls of AI, one such pitfall is the potential for biased algorithms that can result if the training data used to develop the algorithm isn't diverse or representative enough—these biases can be perpetuated through continued use of the algorithm. There is a critical need for clear regulatory and ethical guidelines for the appropriate use of AI in clinical practice. AI based support systems have a significant impact on patient autonomy, informed consent, and the doctor-patient relationship. While AI can be taught ethics, without clear guidelines developed by professionals and community members, AI can potentially cause harm and fail to protect vulnerable patient populations, patient privacy, and patient well being. Finally, it is

important to recognize the limitations of AI, AI cannot replace the human aspect of practicing medicine and the role of a physician in patient-centered care. Humanism is critical in ensuring that medicine is practiced in a way that is compassionate and empathetic. AI can be integrated into the practice of medicine in a way that is responsible and ethical, and can complement the work of physicians, but it cannot replace the human connection that is essential to good patient care.

BIBLIOGRAPHY

Abedin, T., Al Mamun, M. A., Islam, M. R., Rahman, M. S., Banik, S., & Hannan, M. A. (2019). Use of chatbot in improving hypertension adherence and control among community-dwelling hypertensive patients: Randomized controlled trial. Journal of medical Internet research, 21(10), e13637.

Aerts, H. J. W. L. (2016). The potential of radiomic-based phenotyping in precision medicine: A review. JAMA Oncology, 2(12), 1636-1642. doi:10.1001/jamaoncol.2016.2631

Berkman, N. D., Sheridan, S. L., Donahue, K. E., Halpern, D. J., & Crotty, K. (2011). Low health literacy and health outcomes: an updated systematic review. Annals of internal medicine, 155(2), 97-107.

Bickmore, T. W., Silliman, R. A., Nelson, K., Cheng, D. M., Winter, M., & Henault, L. E. (2018). A randomized controlled trial of an automated exercise coach for older adults. Journal of the American Geriatrics Society, 66(9), 1737-1744.

Braun, M., Hummel, P., Beck, S., & Dabrock, P. (2021). Primer on an ethics of AI-based decision support systems in the clinic. BMC Medical Ethics, 22(1), 28. https://doi.org/10.1186/s12910-021-00594-9

Cho, Y., Lee, S. Y., & Islam, S. M. S. (2018). Theories applied to m-health interventions for behavior change in low-and middle-income countries: a systematic review. Telemedicine and e-Health, 24(9), 671-685.

Collier, M., Fu, R., & Yin, L. (2017). Artificial intelligence: Healthcare's new nervous system. Accenture. Retrieved April 12, 2023, from https://www.accenture.com/us-en/insight-artificial-intelligence-healthcare

Daneshjou, R., Smith, M. P., Sun, M. D., Rotemberg, V., & Zou, J. (2020). Lack of transparency and potential bias in artificial intelligence data sets and algorithms: A scoping review. JAMA Network Open, 3(10), e2022020. https://doi.org/10.1001/jamanetworkopen.2020.22020

Dastin, J. (2018, October 10). Amazon scraps secret AI recruiting tool that showed bias against women. Reuters. https://www.reuters.com/article/us-amazon-com-jobs-

automation-insight/amazon-scraps-secret-ai-recruiting-tool-that-showed-bias-against-women-idUSKCN1MK08G

Esteva, A., Robicquet, A., Ramsundar, B., et al. (2019). A guide to deep learning in healthcare. Nature Medicine, 25, 24-29.

Grother, P., Ngan, M., & Hanaoka, K. (2019). Face Recognition Vendor Test (FRVT) Part 3: Demographic Effects. National Institute of Standards and Technology.

Guterbock, T. M., Cohn, W. F., Rexrode, D. L., Eggleston, C. M., Dean-McKinney, M., Novicoff, W. M., Yaffe, M. J., Knaus, W. A., & Harvey, J. A. (2017). What Do Women Know About Breast Density? Results From a Population Survey of Virginia Women. Journal of the American College of Radiology : JACR, 14(1), 34–44. https://doi.org/10.1016/j.jacr.2016.07.003

Han, S. S., Kim, M. S., Lim, W., et al. (2018). Accuracy of a deep learning model in diagnosing common dermatologic disorders. JAMA Dermatology, 154(3), 329-334. doi:10.1001/jamadermatol.2017.5142

Institute of Medicine (US) Committee on Health Literacy. (2004). Health literacy: A prescription to end confusion. National Academies Press.

Institute of Medicine (US) Committee on Quality of Health Care in America. (2001). To err is human: Building a safer health system. National Academies Press (US).

Karliner, L. S., Napoles-Springer, A. M., Schillinger, D., Bibbins-Domingo, K., & Pérez-Stable, E. J. (2017). Identification of limited English proficient patients in clinical care. Journal of General Internal Medicine, 32(8), 859-866. https://doi.org/10.1007/s11606-017-4052-6

Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (Eds.). (1999). To err is human: Building a safer health system. National Academy Press.

Kung, J., Jong, T., & Tran, T. (2019). Chatbots in health care: Promises and challenges. JAMA, 321(23), 2321-2322. doi:10.1001/jama.2019.0299

Lambin, P., Leijenaar, R. T. H., Deist, T. M., Peerlings, J., de Jong, E. E. C., van Timmeren, J., ... & Dekker, A. (2018). Artificial intelligence and deep learning in

radiation oncology. Nature Reviews Cancer, 18(6), 327-340. doi:10.1038/s41568-018-0016-5

Lee, H., Kim, G. B., Lee, J. H., et al. (2017). Deep learning in medical ultrasound analysis: a review. Korean Journal of Radiology, 18(6), 113-126.

Lee, H., Tajmir, S., Lee, J., et al. (2017). Fully automated deep learning system for bone age assessment. Journal of Digital Imaging, 30(4), 427-441.

Lee, J., Park, J., Ryu, S., Kim, B. G., Kim, B. S., & Kim, J. H. (2018). A randomized trial to develop personalized intelligent conversational agents for promoting physical activity via social media. Scientific reports, 8(1), 1-12.

Lum, K., & Isaac, W. (2016). To predict and serve? Significance, 13(5), 14-19.

Matheny, M. E., Whicher, D., & Thadaney Israni, S. (2019). Artificial intelligence in health care: A report from the National Academy of Medicine. JAMA, 321(1), 31-32. doi:10.1001/jama.2018.18938

Murnane, E. L., Huffaker, D., Kossinets, G., & Fowler, J. H. (2021). The impact of artificial intelligence–assisted care on patient perceptions of care quality and interactions with clinicians: Pre–post study. Journal of medical Internet research, 23(2), e24709.

Nabi, J. (2020, May 28). How Bioethics Can Shape Artificial Intelligence and Machine Learning. Forbes. https://www.forbes.com/sites/junaidnabi/2020/05/28/how-bioethics-can-shape-artificial-intelligence-and-machine-learning/

National Academies of Sciences, Engineering, and Medicine. (2018). Health literacy and older adults: Reshaping the landscape: Proceedings of a workshop. National Academies Press.

Ngo-Metzger, Q., Sorkin, D. H., Phillips, R. S., Greenfield, S., Massagli, M. P., Clarridge, B., & Kaplan, S. H. (2013). Providing high-quality care for limited English proficient patients: the importance of language concordance and interpreter use. Journal of General Internal Medicine, 28(6), 778-784. doi: 10.1007/s11606-012-2262-z

Obermeyer, Z., Powers, B., Vogeli, C., & Mullainathan, S. (2019). Dissecting racial bias in an algorithm used to manage the health of populations. Science, 366(6464), 447-453.

Oh, S., Kim, S., & Kim, S. (2020). Exploring the Potential Uses of Artificial Intelligence in Healthcare: Stakeholder Perspectives. Healthcare informatics research, 26(1), 3-12.

Ohno-Machado, L., & Wang, S. J. (2004). Artificial intelligence in medicine. In T. Haux, E. Kulikowski, & G. M. Nøhr (Eds.), Yearbook of medical informatics (pp. 111-120). Schattauer.

Sahni, N. R., Schulman, K. A., & Reed, S. D. (2018). The value of machine learning in predicting hospital readmissions among patients with heart failure: A review. Heart Failure Clinics, 14(1), 49-58. doi:10.1016/j.hfc.2017.08.005

Thrall, J. H., Li, X., Li, Q., Cruz, C., Do, S., Dreyer, K., & Brink, J. (2018). Artificial Intelligence and Machine Learning in Radiology: Opportunities, Challenges, Pitfalls, and Criteria for Success. Journal of the American College of Radiology : JACR, 15(3 Pt B), 504–508. https://doi.org/10.1016/j.jacr.2017.12.026

Topol, E. J. (2019). High-performance medicine: The convergence of human and artificial intelligence. Nature Medicine, 25(1), 44-56. https://doi.org/10.1038/s41591-018-0300-7