

The Potential Effects of Artificial Intelligence in Healthcare within the United States

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Artificial Intelligence and Healthcare

Artificial intelligence (AI) has the potential to transform healthcare. In 2021, AI systems in healthcare accounted for \$6.7 billion of the market (Kwo, 2021). AI systems can make fast, accurate, and informed decisions by analyzing patterns from datasets and have vast applications in the early detection of diseases, medical imaging, personalized patient care, drug development and delivery, clinical research, and administration (Davenport & Kalakota, 2019). AI systems can improve patient outcomes by supporting physicians with data-driven decisions, reducing medical errors, and automating laborious administrative tasks such as record keeping. However, integrating AI into healthcare has complex implications for the affordability and accessibility of healthcare, the quality of care provided, racial and socioeconomic disparities, patient privacy, and physician autonomy (Rajkomar, 2019).

This paper will explore the potential effects of integrating AI in healthcare within the United States through an Actor-Network Theory framework. Specifically, the paper will identify the actors of the network, how they interact to enable and contribute to the social and technical effects of integrating AI in medicine, and how the differences in desired outcomes for each actor create conflict. The paper will end with a discussion of actionable steps for integrating AI in healthcare that can maximize outcomes for patient and physician benefit and minimize risk and concerns.

Introduction to Actor-Network Theory (ANT)

Actor-Network Theory (ANT) is a theoretical framework that describes the social construction of technology and the role of actors in shaping technological development. According to ANT, the social and technical are not distinct categories, but rather intertwined and co-constructed. The

world is a network of actors, which can be both human and nonhuman such as computers, machines, infrastructure, and concepts. The interaction between the actors results in societal and technical change (Law, 1992).

Compared to other social theories and frameworks, ANT is distinguished from other approaches by recognizing both human and nonhuman agents as actors in shaping social processes. ANT moves away from technological determinism, the idea that technology impacts humans as an external force, to the view that human actors have the agency to influence technology. It differs from social construction of technology, which only recognizes human actors, by recognizing the influence of nonhuman actors. (Brett Ideas, 2017)

ANT is not without fault or criticism. Its uniqueness in assigning agency to nonhuman actors is a point of weakness since ANT does not make a distinction between human and nonhuman agents. Every actor in the network is treated as equally important which may not be truly representative when comparing the agency of a human versus a nonhuman object such as a calculator. However, the strengths of ANT are that it enables analysis of the complex interactions that have built up social activity and forces. ANT focuses on how networks are formed and how they change over time, rather than simply analyzing static structures that exist at one given moment (Cresswell et al., 2010).

ANT is a fitting choice to analyze the complex topic of AI in healthcare since it recognizes AI, a non-human entity, as a critical part of the network. By identifying the actors involved in AI healthcare and their interactions, we can investigate how each actor influences the development and implementation of AI systems in different ways, and how their interactions shape the complex social effects of utilizing AI in healthcare.

Stakeholders, Actors, and Desired Outcomes

The stakeholders of AI in healthcare include patients, physicians, healthcare insurance companies, and AI developers/AI developing organizations. However, not all stakeholders have the same priorities or values. Therefore, there is a conflict of desired outcomes when it comes to integrating AI into healthcare. Patients value privacy, affordability, accessibility, and improvement of healthcare services. Physicians value autonomy and desire improvement of healthcare and advancement of the medical field in research and services. They hope that AI will assist doctors in diagnosis and free up time by handling the administrative side of healthcare. However, AI companies and healthcare insurance companies value the welfare of their organization and may prioritize profit, revenue, company brand/public image, and competitive advantage more than advancing the healthcare field.

Actors include stakeholders along with other relevant human and non-human entities such as the AI system itself; people/groups such as patients, physicians, and AI developers; infrastructure and systems such as laws and regulations regarding AI; other social phenomena and concepts such as public perception of AI. Table I below lists actors in the network by the different categories.

Table I: Actors in the Network In Regard to AI in Healthcare

AI System	People/Groups	Organizations	Social phenomena
<ul style="list-style-type: none">- Data collection- Data preprocessing (Biased data)- Model selection (oversimplification)- Feature variables- Training data/testing data	<ul style="list-style-type: none">- Patients- Physicians and Healthcare Providers- AI developers	<ul style="list-style-type: none">- U.S. government and regulatory bodies- Health Insurance companies- Institutions that develop AI systems- Hospital/healthcare administration	<ul style="list-style-type: none">- The Public perception of technology and social attitudes- Pre-existing racial and socioeconomic disparity in healthcare

Analysis of Potential Effects of AI in Medicine through ANT

The integration of AI in medicine has the potential to influence many social factors related to the healthcare industry. AI in medicine is neither guaranteed to improve nor worsen the healthcare industry and the existing social conditions and barriers. Whether or not the influence increases the presence of the social factor or decreases it depends on the interaction between the actors in the network, and the conflict between their desired outcomes. The following section will investigate the interaction between the actors and the effect on the affordability and accessibility of healthcare, the quality of care provided, racial and socioeconomic disparities, patient privacy, and physician autonomy.

Financial Affordability of Healthcare

The actors that influence the financial affordability of healthcare through integrating AI in medicine are primarily:

- US Health insurance companies
- Organizations developing AI systems - private businesses, academic institutions
- United States Laws about fair pricing
- Patients and Physicians

AI technology has the potential to reduce the innate cost of healthcare services by decreasing labor and time needed. However, the battle between profit versus delivery of health is a long-existing conflict in the United States. Even if the innate cost of healthcare is lowered, the interaction between different actors could keep the market price of healthcare the same or even increase it.

The U.S. health system is a mix of public and private, for-profit and nonprofit insurers and healthcare providers. Within federal and state regulations, public and private insurers can set their own benefit packages (Tikkanen et al., 2020). However, private insurance is the dominant form of coverage for a majority (66%) of Americans (Keisler-Starkey and Bunch, 2022). American health insurance companies are for-profit entities notorious for opaque and inequitable pricing (Rosenthal, 2017). Many private companies are developing AI systems for healthcare applications, much like pharmaceutical companies or companies manufacturing medical devices. In the U.S., the companies that develop healthcare products solely control the prices (Hawley, 2022). This means even if the innate costs of AI technology are low, the companies developing the technology have the power to sell their product for a higher price due to high demand from patients or physicians and “new technology hype.” AI in healthcare, very much like a lab test, drug, or service, could be overcharged or not covered by insurance companies. Even if AI reduces the innate cost of healthcare, in reality, the interaction between health insurers and AI-developing companies can lead to no improvement or even an increase in the cost for patients.

The medical laws and precedents of the U.S. government are another actor that influences financial affordability. Laws exist to protect patients from overcharges such as the No Surprises Act (Hoadley et al., 2022) However, AI in healthcare due to its novelty poses some uncertainties. The existing laws may be inadequate in covering the new technology. There are very few legal precedents for AI in the healthcare space and AI in general. Current U.S. regulations and legal systems may be unprepared to protect citizens against the abuse of AI in healthcare and may have to be updated.

Quality of Healthcare

The actors that influence whether or not the quality of healthcare is improved by AI in medicine are primarily:

- Patients
- Physicians
- System of medical education
- Medical community - research, trials, established use/common practice
- Laws and regulations - FDA

Patient engagement and adherence are integral parts of the effective delivery of health. The more patients proactively participate in their well-being and care, the better the outcome. If the patient's engagement and attitude are low, it could lead to noncompliance such as not scheduling a follow-up visit, refusing prescribed medicine and lifestyle changes, or not even seeking medical care in the first place. Then, even the highest quality of medical technology will be ineffective. (Davenport and Kalakota, 2019) Therefore, whether or not AI in healthcare will improve the quality of care for patients depends not only on the AI technology itself but the patient's perception of AI technology. Patient distrust toward AI could lead to noncompliance with treatment plans or rejection of the diagnosis that the physician provides with the support AI.

There is a mix of positive and negative public attitudes toward AI in medicine among Americans. As of December 2022, 60% of Americans would feel uncomfortable if their healthcare provider relied on AI, with a significantly smaller percentage (39%) feeling comfortable. In addition, 60% of Americans think that AI in medicine would worsen or cause no improvement in health outcomes for patients. However, a larger portion of Americans thinks the use of AI would reduce rather than increase the number of mistakes (40% versus 27%) made by

healthcare providers. And there is more openness to the use of AI among younger adults with higher levels of education who had previously heard about AI. Specifically, 42% and 47% of people who received a college or post-grad education would be comfortable versus 37% and 36% of people who received some college or high school education. In terms of previous exposure, 50% and 37% of people who heard a lot or a little about AI would be comfortable versus 28% of those who heard nothing. (Tyson et al., 2023) Even though there is a feeling of uneasiness surrounding AI by the American public, there is potential for a shift in public attitude that could be influenced by exposure and education.

In addition to patient perception, physicians influence the effective use of AI to improve the quality of care. AI can help providers make fewer mistakes, inform them with data-driven decisions, and help providers focus more on providing care by taking care of the administrative or logistical clinical load. (Basu, 2022) However, the challenge of AI in healthcare is not whether the technology will be capable enough to be useful, but rather ensuring their adoption in daily clinical practice (Davenport and Kalakota, 2019). AI is a technology that is not an area of expertise for most physicians. Physicians need to understand the capabilities of the AI systems they are using, the right inputs to provide, and how to interpret the results and use them to supplement their decision-making. One actor that influences physician capability and trust in AI is the medical school curriculum. The education received in medical school influences physician capability as well as attitudes toward certain technology, practices, and tools. Research studies, clinical trials, and well-established use and common practice of the technology in the medical community also act to build physician trust toward new practices and tools.

The legal availability of AI technology for physicians to use is important for AI to impact the quality of care. Actors that impact the availability of AI include U.S. laws and regulations of

healthcare and medicine set by organizations such as the FDA. The FDA considered software that is intended to treat, diagnose, cure, mitigate, or prevent disease as a medical device. Most medical AI is categorized as Software as a Medical Device and Software in the Medical Device and has different standards based on risk classification. (Pew, 2023) The standards set by the FDA, and the speed at which regulations are updated according to new advances, will affect the AI technologies that are accepted and available for physician use.

Accessibility, Bias, and Socioeconomic Disparities

The actors that influence whether or not accessibility, bias, and socioeconomic disparities are improved or worsened by AI in medicine are primarily:

- Method of developing AI technology
 - Data selection, Feature selection, Training, Testing
- Pre-existing bias
 - Data collection and previously collected data
 - Previous clinical studies
 - healthcare providers
- Patients (minorities)
- Organizations developing AI systems - private businesses, academic institutions

One major hope for AI in medicine is that it will reduce racial biases and socioeconomic disparities pre-existing in the healthcare space. Data-driven decisions can help mitigate bias since an AI wouldn't make assumptions about a person's health only on the trained inputs and not based on their appearance. For instance, one algorithm to read knee X-rays for patients with arthritis found that the AI program more accurately diagnosed Black patients' reported pain than

human radiologists (Asar, 2021). In addition, AI can make medicine accessible by removing blockers, stigmas, and mental/cultural obstacles. This can help certain ethical and racial groups and demographics who are more opposed to certain treatments. One study found that people suffering from post-traumatic stress and other forms of mental anguish are more open to discussing their concerns with virtual humans than actual humans for fear of judgment (Basu et al., 2022). This shows promise for the role of virtual assistants to help groups opposed to mental health treatment such as people of color, men, and older generations.

On the other hand, there is a major fear that AI in healthcare will exacerbate biases and disparities. For instance, one model was used by a health insurance company to predict future healthcare costs and recommend patients for more care. The algorithm ended up reducing the number of Black patients referred for extra care from 50% to 20% (Asar, 2021).

Major factors that influence the bias of AI models are the design choices of the model and the data used to train the model. If the model type, feature variable selection, the training dataset, and the endpoint are not carefully selected, or a biased training dataset is used, that is reflected in a biased model. Accounting for biases in the world that are innately reflected in healthcare data is one of the biggest challenges in developing AI. Clinical trials primarily enroll white male patients and consistently underrepresented women, the elderly, and people of color. While people of color make up about 39% of the US population, these groups represent 2% to 16% of patients in trials (Giusti et al., 2021). This underrepresentation leads to data collection from a limited sample group. In addition, pre-existing social inequalities tend to be reflected in datasets. In the case of the health insurance company algorithm, developers selected cost as the endpoint. Black patients tended to have lower incomes and less robust insurance, so ended up with lower lifetime healthcare costs—not because they didn't need as much care but because

they did not receive it. The algorithm, designed to be theoretically race-blind, ended up reinforcing the pre-existing disparities reflected in the data. When the developers switched from cost to the number of comorbid conditions, the bias was erased using the same model (Asar, 2021).

In addition, all humans have some form of implicit bias. Many providers have some form of implicit bias and negative attitudes toward people of color. Even if the AI technology is trained properly so that there are no learned biases, human physicians are the ones utilizing the technology, interpreting results, and maybe even prescribing treatment. If physicians are the mediators between AI technology and patients, then the provider's biases may still affect patient outcomes.

Patient Privacy

The actors that influence whether or not patient privacy is improved or worsened by AI in medicine are primarily:

- Data collection and pre-processing methods used by developers
- Privacy laws (HIPAA)
- Method and Infrastructure of storing big data
- Cloud service companies
- Patients

Since AI relies on large quantities of data for training, there are concerns about how this data is collected, stored, and used. One major actor that protects patient privacy is the Health Insurance Portability and Accountability Act of 1996. Known as HIPAA, it is a federal law that protects sensitive patient health information from being disclosed without the patient's consent for

knowledge. Specifically, the HIPAA Security Rule protects patients' identifiable health information in electronic form (CDC, 2022). Due to HIPAA, the kind of data available can be limited and datasets must be de-identified to protect patient privacy. The restricted availability of data can limit model training and poses challenges to developing a comprehensive AI system.

Patients are actors in this network, but even if their consent to disclose sensitive information is protected by law, data breaches happen and they often lose autonomy over their data once it is released. An important actor that has raised the risk of data leakage is the method and infrastructure of storing big data. (Davenport and Kalakota, 2019) Recent advances in cloud services like Amazon AWS have allowed more convenient storage of bigger datasets. However, these services are provided by big corporations, and hosting a database on a server that is owned by another company means relying on the corporation's security and privacy policy. This poses more privacy risks than storing data on local servers.

Physician Autonomy

The actors that influence whether or not physician autonomy is improved or worsened by AI in medicine are primarily:

- US Healthcare system/insurance coverage
- Hospital/healthcare administrators
- Physicians

While physicians are excited that AI could revolutionize healthcare, they are also wary that the increased role of AI in healthcare could result in a loss of physician autonomy. One actor that influences physician autonomy is the U.S. health insurance infrastructure. Even if physicians may retain the discretion to deviate from AI recommendations, the insurer could only reimburse

or cover treatment that AI recommends. This would discourage patients from following physician recommendations due to the extra cost and lead to a loss of physician autonomy (Ward, 2019).

Another related actor is hospital or healthcare administration. There is a likely scenario where AI systems move into a role of controlling clinicians' decisions and workflow, as assistants that handle logistical and record-keeping work. This can lead to a positive outcome for physicians when the assistants are used for error-checking and increasing the efficiency of workflow. However, hospital administration could raise AI technology further up in the chain of command and set its chief utility to improve profit or fineness evaluation. This would result in a loss of physician autonomy.

Increasing Positive Outcomes for Patients and Physicians

AI in healthcare has many different potential effects depending on the interaction between the actors. The priorities and desired outcomes of some actors conflict (i.e. healthcare receivers/providers versus corporations such as insurers and tech companies) which makes it possible for AI technology in medicine to be abused for profit and corporate gain. For AI in healthcare to lead to positive outcomes for physicians and patients, proactive steps can be taken on an individual and infrastructural level to protect against abuse and encourage advancement.

First, AI should be used to augment and complement, rather than replace, human decision-making (Verghese et al., 2018). While AI can process and analyze large amounts of data quickly and accurately, it lacks the empathy, intuition, and clinical judgment of the human physician. Physicians can build trust with their patients through clear communication which is critical for good patient outcomes. The human physician can also take into account personal

factors about their patient that the AI could overlook. In addition, protecting physician autonomy leads to improved public perception of AI in healthcare which will help patients reap the full benefits of AI. General public openness to AI increases when AI is used as a support tool rather than in place of the physician (Tyson et al., 2023). To protect physician autonomy, healthcare administrations, and the government have the responsibility to guarantee that the physician has the final say through regulations and laws.

Second, engineers of AI technology have an ethical responsibility to improve patient and physician outcomes, whether that be individual workers or organizations that develop these technologies. Individual developers, managers, and testers are responsible for accounting for biases in the dataset, fully testing their models, and keeping the benefit of patients as the end goal in design. Companies and research organizations have the responsibility to form teams with diverse perspectives and steer company direction toward a commitment to good patient and physician outcomes, and ethical pricing.

Third, one of the biggest barriers to fully realizing the potential of AI is data. The best training algorithms and model types are ineffective without sufficient and well-represented data. Representative data stored securely will mitigate bias learned during training and protect patient confidentiality. Currently, there is no standard patient record-keeping method across the United States. Creating a more centralized, standardized, and well-secured healthcare data infrastructure will provide representative data and protect patient privacy.

Last, the issue of AI in healthcare doesn't exist in a bubble. It lives in the bigger U.S. healthcare system and within the overall political and social infrastructure of the country. Therefore, AI in healthcare has its own complications but also inherits the complexities and issues of the general U.S. healthcare system. It is important that healthcare institutions, as well as

governmental and regulatory bodies, establish structures to monitor key issues, react responsibly and establish governance mechanisms to limit negative implications not only for specific issues of AI in healthcare but for the overall United States healthcare system.

Conclusion

This paper provided an analysis of the potential effects of integrating AI in medicine within the United States through an Actor-Network Theory framework. There are many different actors in the network such as patients, physicians, health insurance companies, organizations that develop AI systems, hospital administration, U.S. governmental and regulatory bodies, and the AI systems themselves. The interaction between these actors not only results in technical advances in medicine and AI systems, but results in social changes that can affect the affordability and accessibility of healthcare, the quality of care provided, racial and socioeconomic disparities, patient privacy, and physician autonomy. The issue of AI in healthcare is a powerful and consequential technology. Therefore, it is critical for individuals, organizations, and infrastructures to make intentional choices and thoughtful policies to maximize good outcomes.

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