Improving AI in the Medical Field:

Elevating Diagnostics, Health Monitoring, & Drug Development

INNOVATE 1Z03 – Artificial Intelligence

Group 28

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Executive Summary

Artificial intelligence systems are best at recognizing patterns and extrapolating information from there. Within the medical field, professionals are utilizing this ability to detect cancerous lesions from medical imaging. AI has been found to be effective for the diagnosis of a variety of cancers. For example, AI use on mammograms has been found to detect breast cancer. This would reduce the load on radiologists in hospitals. In some instances, AI has been found to be more effective than professional radiologists in the detection of tumours. AI has also been found to determine if brain tumours are methylated or not, which is a vital step to find a treatment plan for brain cancer patients.

Despite the successes found in the use of AI in medical imaging and diagnosis, it is still important to consider the ethical implications of this. It must be ensured that patient's personal information is always protected and only used with their informed consent. When the AI systems are being developed it is also important to reduce the bias within the system and be careful to make the program effective for all different types of people.

Outside of medical imaging analysis, AI also shows promising outcomes in the field of precision medicine. Using genomic analysis, AI can interpret an individual's unique genome and determine the most effective treatment plan based on their precise genetics (Johnson et al., 2021). AI can further improve personalized medicine through tele-health monitoring. Advanced deep-learning software is being developed that can analyze an individual's speech and behaviour to predict cognitive decline and make medical diagnoses (Gold et al., 2018). Remotely monitoring a patient's health and well-being will greatly reduce the high volume of patients in hospitals and other care facilities.

Beyond diagnoses, AI is also entering the pharmaceutical industry. Using its predictive power to hallucinate folded protein shapes from a give sequence of amino acids, AI is speeding up

the pre-clinical testing phase of drug and medicinal development (Callaway, 2022). AI is also able to assist in the drug screening process with its ability to predict the toxicity, bioactivity, and other physical characteristics of a given substance (Paul, 2021). Using AI in this field will improve and increase treatment opportunities available for sick patients.

In addition to AI's ability to diagnose individual patients, it also has the incredible ability to predict emergency healthcare situations such as disease outbreaks, diagnosing larger groups of patients before issues are entirely realized. This is possible through data collection from many sources, a large source being social media, and AI's ability to sort through said data, searching for common sentiments and actions coming from the same locations as well as visual symptoms of disease through photos and images.

These AI models were put into effect during the COVID-19 pandemic, which led to earlier recognition of outbreaks and subsequently earlier access to healthcare for those in need. This outbreak tracking data could then be used for purposes including contact tracing and presenting society with dangerous locations to avoid. AI's application to large scale diagnostics can be viewed as quite a success when it comes to aiding society's battles against disease.

Despite AI's remarkable ability to improve the efficacy of treatment and support the healthcare system, its implementation faces key challenges. Main issues arise surrounding data privacy, biased data training sets, reliability, and accessibility to less-developed regions. Combatting these issues will be key to furthering the implementation of AI in the healthcare sector.

The future direction of Artificial Intelligence in medical diagnosis and personalized medicine holds immense potential for the healthcare industry. Medical imaging industry and AI continues to evolve into a useful piece of technology that provides greater efficiency and accuracy in diagnosis from X-Rays, MRI and CT scans, with algorithms to detect abnormalities the human eye can miss. With the more precise diagnosis AI can generate the results back to the patient quicker while also providing them with a personized treatment plan which can be more effective the earlier the diagnosis is caught.

The future of AI emerging with telehealth brings more potential to help patients and provide them with a faster diagnosis that can be made remotely. Bringing advancements to virtual medical help is a great way to help people gain healthcare that can be brough to their doorstep. AI emerging with telehealth brings more accessibility and is more efficient for patients and their needs by providing more options regarding their health.

The increasing trend of AI usage in healthcare promises advancements beyond diagnosis, which includes treatment plans, drug discovery, patient monitoring, and more. These methods are crucial in medicine, such as in oncology. However, challenges may persist as there is a lack of diverse data, hindering the efficacy of AI, for minorities. The future outlook is to address this gap in an ethical manner, enhancing treatment outcomes for all people and fostering societal well-being across various domains which impact the efficacy of AI in medicine further.

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Introduction

The COVID-19 pandemic revealed and worsened many of the cracks in the structure of the healthcare system. Hospitals, as well as long-term and intensive care units are under extensive stress, there are high turnover rates for healthcare workers due to burnout, and there are life-threatening delays in disease diagnosis and treatment (Glazier, 2023). Furthermore, half of the world cannot access essential healthcare services, with close to 100 million people facing high medical expenses that push them into extreme poverty (World Health Organization, 2017). There are not enough physicians, hospital beds, or resources for medical imaging tests to satisfy the public demand for healthcare (Glazier, 2023). With the world's population expected to increase by 2 billion in the next 30 years (United Nations, n.d.), if improvements are not made, the healthcare system is destined to face more stressors and medical care will become more inaccessible.

With the strain the healthcare industry is under, it prompts the search for solutions. Applications of Artificial Intelligence pose a promising outlook for the future of the healthcare system. With its pattern recognition and situational analysis capabilities (Kaul et al. 2020), AI has the potential to augment medical care and reduce the stress on the healthcare system. Its applications expand far across the medical industry, with AI being able to aid medical imaging diagnostics, precision medicine, tele-health monitoring, and hotspot tracking. This report will explore the current state of knowledge of the use of AI in these circumstances, as well as what the future of the healthcare industry could look like with the assistance of AI. Through this analysis, a framework can be developed to repair and reduce the pressure on the healthcare system to better support the growing population.

State of Knowledge

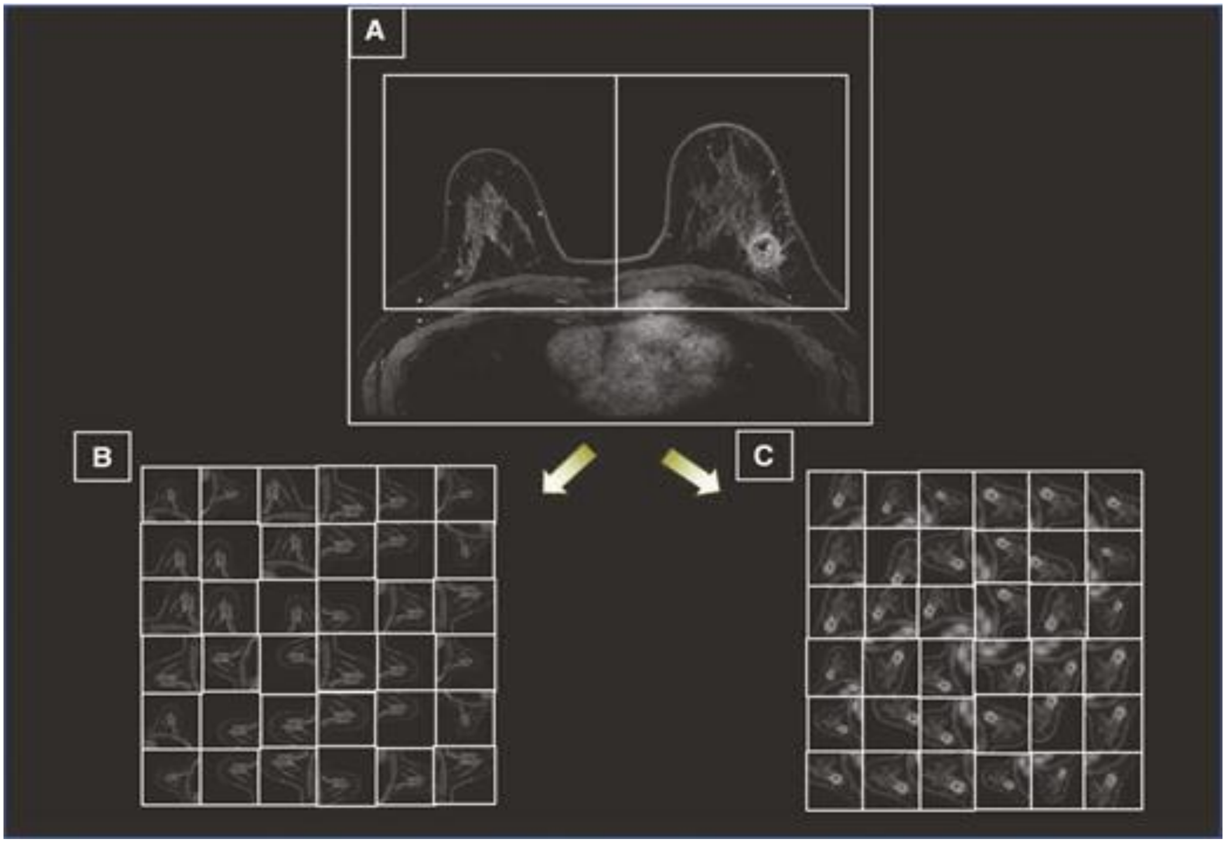
AI in Medical Imaging Diagnostics

Artificial intelligence, particularly machine learning algorithms have been found to be incredibly accurate in the diagnosis of cancerous lesions. Worldwide, cancer is an extremely significant public health concern. In this field, early detection and speed of diagnosis is incredibly important to a patient's prognosis. Hence, machine learning algorithms are being created that use data from medical imaging, a patient's medical history, genetic information and more. This algorithm finds patterns characteristic to cancerous growths, sometimes with more accuracy than radiologists themselves. In a 2023 paper, the National Center for Biotechnology Information found that "AI and ML have demonstrated greater accuracy in predicting cancer than clinicians" (Zhang et al., 2023, sec. Abstract). This application of AI means that cancer could be detected earlier, and patients could have a better quality of life.

In radiology, artificial intelligence image analysis systems have been found to detect cancerous growths based on large datasets of x-rays, MRI scans and CT scans. For example, deep learning algorithms have been used for breast cancer diagnosis. This process first requires a large data set of breast examination images such as mammograms. Then, an imaging expert along with the deep learning algorithm itself, must annotate these images by outlining the cancerous lesion. These systems are being found most effective for diagnosis of breast cancer in MRI scans, rather than ultrasounds that depend on the sonographer. Contrast-enhanced MRI's can provide "tumour morphology, texture, hemodynamic, and pharmacokinetics" (Zheng et al., 2023). Another article suggests that deep learning should be used by radiologists to look at the flagged axial slices of breast MRI images, which would speed up the diagnosis process greatly since they would not have to go through all the stacked images (Eskreis-Winkler et al., 2021). The use of artificial intelligence systems for breast cancer diagnoses can increase early detection of breast cancer and potentially become even more effective as identifying cancers than even expert radiologists.

Figure 1

Axial images of breast MRI images being divided into tumour-containing breast and tumour-free breast from a deep learning software.

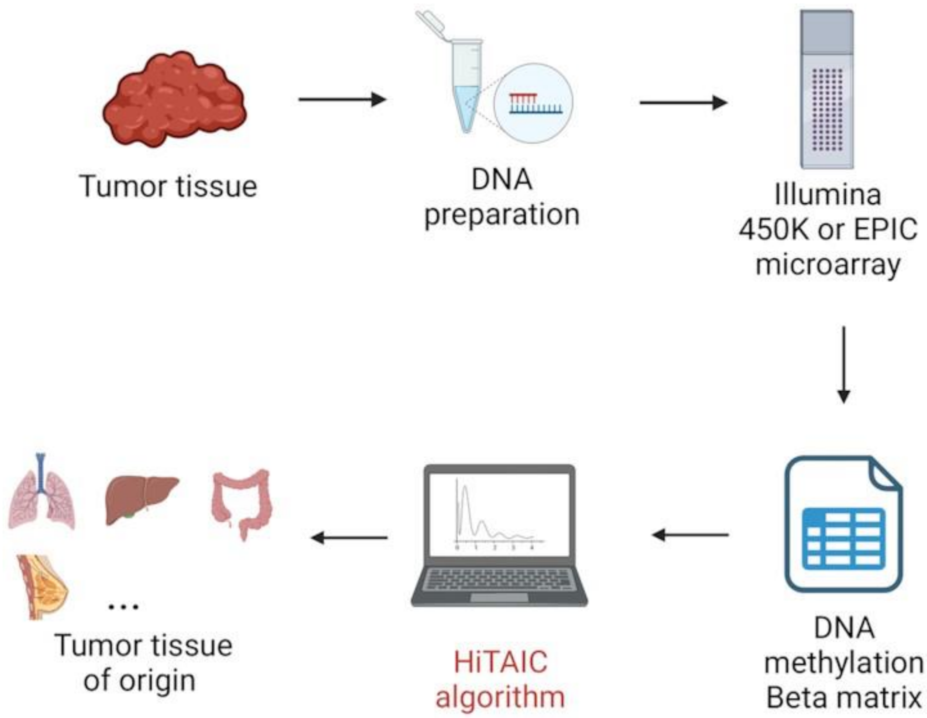


Note. Image from Eskreis-Winkler, S., Onishi, N., Pinker, K., Reiner, J. S., Kaplan, J. B., Morris, E. A., & Sutton, E. (2021). Using Deep Learning to Improve Nonsystematic Viewing of Breast Cancer on MRI. *Journal of Breast Imaging*, *3*(2), 201–207. https://doi.org/10.1093/jbi/wbaa102

Another diagnostic technique being aided by deep learning algorithms are brain tumours. Brain tumours are categorized as methylated or unmethylated which can help oncologists determine the proper treatment plan for patients and the prognosis of the patients' condition. (*Glioblastoma Multiforme (GBM)*, n.d.). The systems that are allowing this to be possible is machine-determined DNA methylation which "authors reported the highest accuracy even greater than pathologists" (Zhang et al., 2023, sec. Abstract). Because of the poor prognosis of brain cancers and tumours, this technology could make a big difference for many patients with this disease.

Figure 2

HiTAIC is an algorithm that traces the tissue of origin and tumour type in metastatic tumours.



Note. Zhang, Z., Lu, Y., Soroush Vosoughi, Levy, J., Christensen, B., & Salas, L. (2023). HiTAIC: hierarchical tumor artificial intelligence classifier traces tissue of origin and tumor type in primary and metastasized tumors using DNA methylation. *NAR Cancer*, *5*(2). https://doi.org/10.1093/narcan/zcad017

Despite the advantages of artificial intelligence used in medical image diagnosis, many people are reluctant to embrace the involvement of artificial intelligence in the healthcare system due to patient privacy and the security of their personal information. Due to the black box nature of many of these artificial intelligence systems being used in healthcare, there are major concerns with ensuring patients privacy and confidentiality. These models need to be easier to interpret by developers to ensure that if something goes astray, it can be promptly fixed. The development of these systems is also slowed due to patient privacy.

As in any artificial intelligence system, there is also always biases and prejudice to overcome. For example, the systems used to help flag breast cancer was found to be much less effective in Asian women since it has been shown that their breasts are composed of more fibrous tissues than other groups worldwide (Lim et al., 2022). As such, these systems should be trained to take the patients ethnicity into account and perhaps more closely analyze images of patients of Asian descent or flag them for a radiologist to look at further.

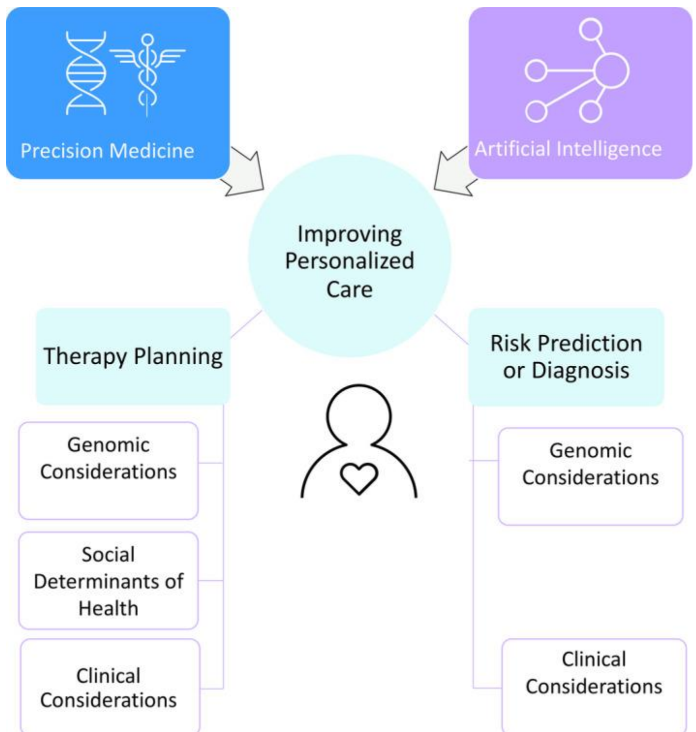
To conclude, artificial intelligence is a valuable resource in the diagnoses of many types of cancer, such as breast and brain cancers that has ethical implications that must be considered when such systems are being developed and used by physicians. Artificial intelligence has the potential to improve patients' quality of life and diagnosis deadly cancers earlier.

AI in Precision Medicine and Health Monitoring

Outside of medical imaging diagnostics, AI also has the potential to revolutionize healthcare with precision medicine through personalized diagnoses and treatment plans. As of now, AI has not yet been incorporated in precision medicine, however, this potential application is becoming widely researched. There are many ways AI can be implemented to augment and improve personalized patient care, as depicted in Figure X.

Figure 3

Potential ways patient care can be improved by combining precision medicine and artificial intelligence.



Note. Image from Johnson, K. B., Wei, W., Weeraratne, D., Frisse, M. E., Misulis, K., Rhee, K., Zhao, J., & Snowdon, J. L. (2020). Precision Medicine, AI, and the Future of Personalized Health Care. *Clinical and Translational Science*, *14*(1), 86–93. https://doi.org/10.1111/cts.12884

One area of interest for AI-supported healthcare is genomic patient profiling. AI has notably been able to interpret human genes thoroughly and efficiently. It can predict gene expression from genotype data, as well as identify protein configurations and transcription sites, all of which are integral to identifying variations and disease presentation in genomes (Johnson et al., 2021). Disease can present differently in varying populations based on their genetics, for example, typical medulloblastoma treatment plans are generic, involving chemotherapy, surgery, and brain radiation (Johnson et al., 2021). In specific subgroups of this disease however, which is identifiable by analyzing the patient's genomes, only chemotherapy treatment is required which imposes far fewer future complications on patients. Using AI to assist in patient genomic analysis would personalize the treatment process to an individual's specific needs, preventing unnecessary damage or costly procedures.

Other than personalized genome analysis, AI sensors and remote monitoring applications are becoming more heavily researched and tested. A platform called EmPowerYu uses sensors to detect an individual's actions such as opening and closing doors, turning on and off appliances, and their movements through an area. The program uses a machine-learning algorithm to assess if the individual is pacing, night wandering, conducting repetitive activities and monitors other behaviours (Gold et al., 2018). Researchers believe these monitoring devices could be used to assess behaviours and measure cognition levels or cognitive decline. Furthermore, software is being researched that can analyze semantic coherence in an individual's speech, a key marker for cognitive disorders like Parkinson's disease or other neurodegenerative disorders (Gold et al., 2018); this software was able to discriminate test patients with 75% accuracy.

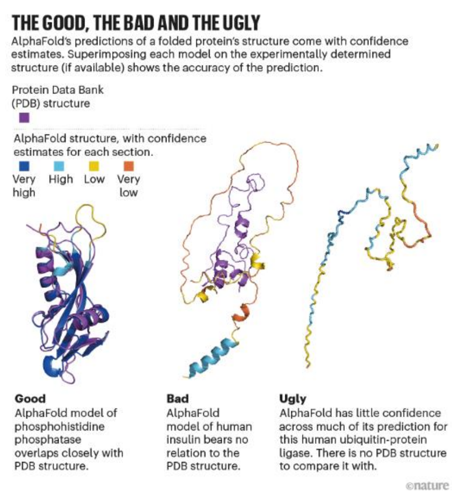
Overall, coupled with AI's remarkable ability to read and produce diagnoses from medical imaging tests, implementing AI into precision medicine and personalized care is becoming an increasingly researched concept. With its ability to quickly diagnose and categorize individual patients based on their unique genomic sequence and behaviours, quicker and more accurate care can be provided on a case-by-case basis rather than following general procedures. Though, there are vital ethical concerns that must be addressed before further implementing this application of AI into the healthcare system. These concerns include the bias in health data sets with a lack of diverse sampling, of which an AI model could amplify (Ferryman et al., 2018). Other key concerns include global efficacy of AI implementation. In Thailand clinics, the low-quality images provided were not compatible with the AI algorithm's high standards and poor internet connection reduced the processing speeds of AI models, increasing waiting times rather than decreasing them (Beede et al., 2020).

AI in Pharmaceutical Development

The pharmaceutical industry is another large sector of healthcare where applications of Artificial Intelligence are emerging. Applications range from aiding drug discovery and development to automated manufacturing and product management (Paul, 2021). In 2020, one of the first drastic leaps of AI into the pharmaceutical industry was DeepMind's AlphaFold, a deep-learning neural network that can predict a protein's folded shape solely from its amino acid sequence (Callaway, 2022). This software was trained with a vast array of protein structures in protein databases, allowing it to take a new amino acid sequence input, match it to related sequences and use the related sequences to output an estimated shape for new 3D proteins (Callaway, 2022). As of 2021, AlphaFold was able to predict structures for 330 000 proteins (Chun, 2023), and was projected to predict about 130 million structures by the year's end (Callaway, 2021). Figure X depicts predicted protein structures produced by AlphaFold with varying accuracy estimates.

Figure 4

Protein structures predicted by AlphaFold and their associated accuracy estimates.

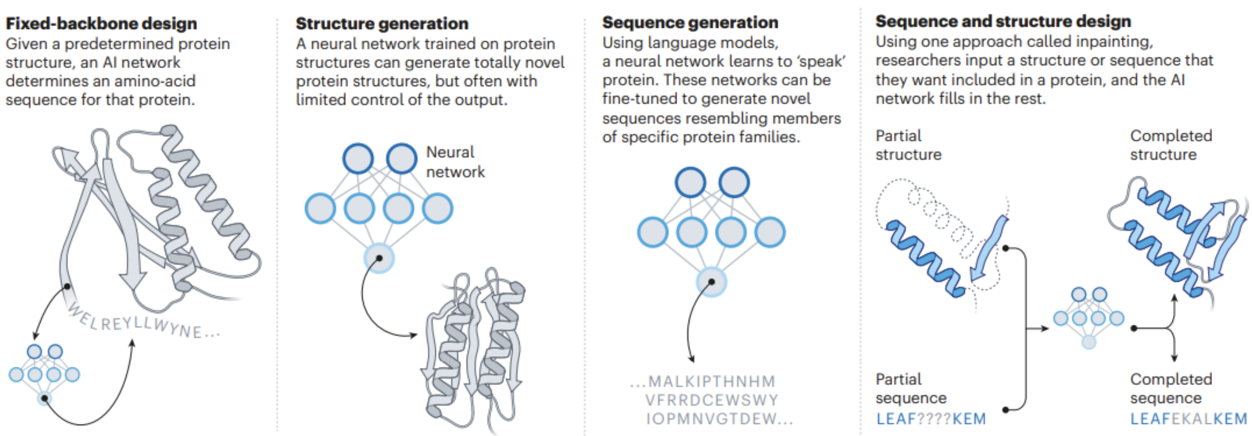


Note. Image from Callaway, E. (2022). What's next for AlphaFold and the AI protein-folding revolution. *Nature, 604*, 234-238. https://doi.org/10.1038/d41586-022-00997-5

Further developments of AI neural networks have been made that can hallucinate protein structure predictions from amino acid sequences, then optimize the structure design, all while maintaining the original shape required (Callaway, 2022). The use of AI for generating protein structure, protein sequences and structure design as depicted in Figure X has sped up time-consuming experimental processes from months to seconds, while also requiring less computing power (Callaway, 2022).

Figure 5

AI-powered protein design process.



Note. Adapted from N. Ferruz et al. Preprint at bioRxiv https://doi.org/10.1101/2022.08.31.505981 (2022); and J. Wang et al. *Science 377*, 387–394 (2022).

The key benefit of using AI for developing proteins is its ability to speed up experimental production trials; this increases the speed at which proteins can be developed for preclinical vaccine testing. The reduced time and computing power of AI models compared to older protein fabrication software also reduces the cost involved in the process, increasing the viability of early-stage vaccine development, and allowing us to combat disease at a faster pace.

Outside of protein folding prediction, AI is also being used in drug screening. Deep-learning AI algorithms have been developed that can quickly predict toxicity, bioactivity, and interactions with other molecules, as well as other physiochemical properties of drugs (Paul, 2021). These systems work by taking inputs from databases; these inputs include known features of a drug, and molecules it will be targeting. Then, they analyze and forecast the strength and effectiveness of their interaction (Paul, 2021). This application of AI in drug screening provides a quick analysis of a drug's potential effect on cells in the human body, creating a starting point for further trials and experimentation. The quick nature of these systems allows for faster drug production and increases the speed a candidate drug can reach the clinical-trial stage, also increasing the speed at which we can tackle disease.

Despite the increased speed that AI brings to drug development and testing, it also faces notable setbacks, a large one being a lack of data to further train AI systems. For a deep-learning models to be accurate, reliable, and effective, it must be trained on a vast array of data (Mock et al., 2023). As seen in Figure X, when software like AlphaFold lacks reference data, its protein prediction is considered "ugly", and the software has little confidence in its prediction. Furthermore, when using AI to screen pharmaceuticals, complex drugs with multiple target cells have unpredictable behaviour in the human body and there is limited data available that can train AI models on their potential interactions (Mock et al., 2023). For these AI models to be an effective tool for drug development, more data must be collected from and shared between biopharmaceutical companies. Though, sharing this data may enable competing developers to produce a drug more quickly than the company the data originated from, reducing a corporation's desire to share this necessary information.

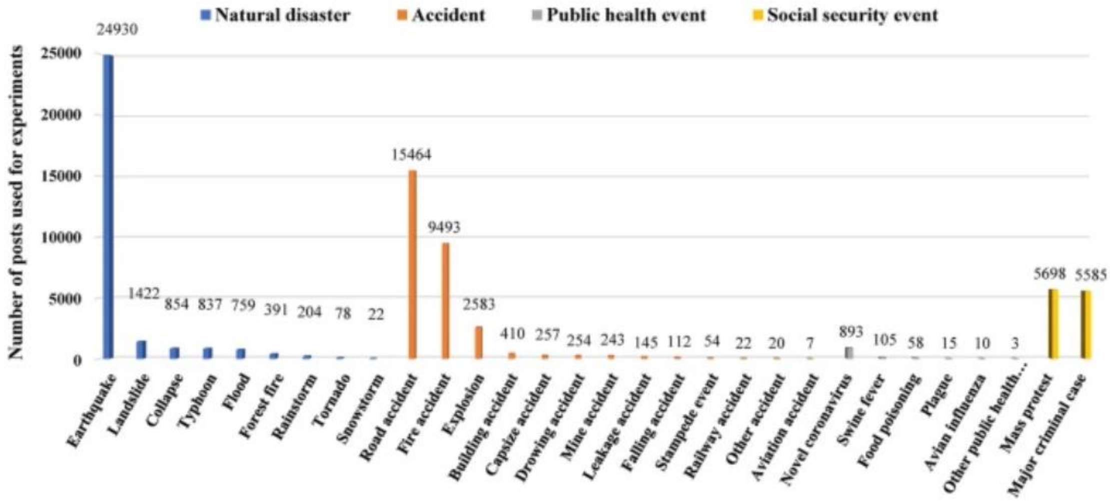
AI in Hotspot Tracking

In the discussion of using Artificial Intelligence for the purpose of healthcare diagnostics, the context is usually taken to be the diagnosis of individual people. The reality of AI's capabilities in this field however goes far beyond this individual case-by-case basis, in that AI can diagnose larger areas by recognizing clusters or "hot spots" of certain diseases through its collection of data. It can then be successful in contact tracing, monitoring the individuals who are at risk, and tracking the overall spread of diseases. In a similar vein, AI can determine which areas are most vulnerable by considering the number of cases, rate of spreading, and rate of mortality. AI can complete these tasks more efficiently than humans are able to due to its quantity of data collected from healthcare experts and the media, specifically social media, as well as its ability to monitor all locations using visual symptoms of diseases. It can then create automatic platforms to track and predict the disease, which of course presents impacted people and healthcare professionals with a head start on the battles against disease (Vaishya et al., 2020).

Although the topic of AI social media surveillance is controversial, the use of social media to obtain data relating to healthcare emergencies has been vital for the development of these AI models. Social media such as Facebook, Twitter, WeChat, and Sina Weibo are extremely popular throughout society and many people use these as platforms to discuss their concerns and perceptions of what goes on around them. The model sorts through the data obtained from social media, separating the informative data from the irrelevant data using natural language processing and semantic web technology. It looks for various keywords that have different weights based on their relevance to the emergencies being looked for. The data that is classified as emergency information is compared with other emergency data to determine if the two are similar enough, then they are clustered together which further determines the severity of the emergency at hand. A study collected 890,938 Weibo posts using certain keywords, among which 70,927 posts were emergency-related and 820,011 were unrelated. The clusters created by the AI model are presented in the following graph (Huang et al., 2022).

Figure 6

Clusters of emergency data found by AI models.

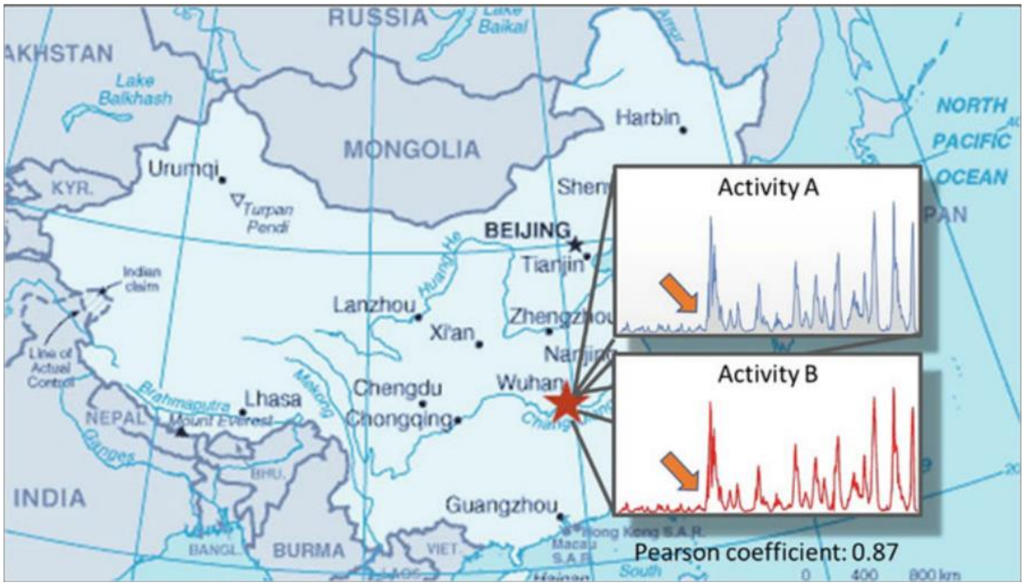


Note. Image from Huang, L., Shi, P., Zhu, H., & Chen, T. (2022). Early detection of emergency events from social media: a new text clustering approach. *Natural Hazards*, *111*(1), 851–875. https://doi.org/10.1007/s11069-021-05081-1

An example of AI being used for this purpose is arguably the most notable healthcare disaster in recent history, the COVID-19 pandemic. The models took in information such as flights to and from certain cities, direction and intensity of traffic, purchase rate of medical supplies, movements, or relocations of medical and emergency personnel, and of course, sentiments and certain topics presented on social media. Using this data, it can pinpoint locations with unusual activity. This data can be conveyed on a map that medical professionals can use to visualize clusters of threats.

Figure 7

Demonstration of map displaying a cluster of emergency data.

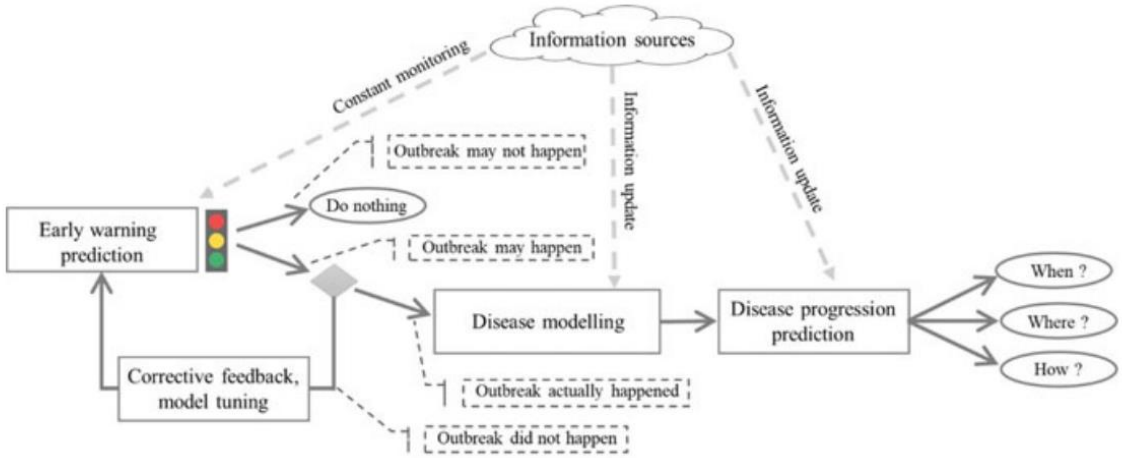


Note: Image from Fong, S. J., Dey, N., & Chaki, J. (2021). Artificial Intelligence for Coronavirus Outbreak. In *SpringerBriefs in Applied Sciences and Technology*. Springer Singapore. https://doi.org/10.1007/978-981-15-5936-5

Of course, it is unable to be classified as an outbreak right away; however, during the latency period between the model's first notice and an outbreak, the model works tirelessly, focussing specifically on this location to determine if there is an outbreak that will require additional support. This both allows people who have the virus to get the help that they need and stops further spreading of the virus. For instance, if someone tweets a complaint about an illness they have developed, the model will catch it and search for similar complaints within the area, if enough data is discovered to suggest that this abnormality correlates to a pandemic or illness seen before, then the AI model will report it, hence diagnosing society before anyone realizes that there is an issue. The following figure presents the process that these models take, from obtaining data, to deciding whether to act, to creating a prediction for the disease (Fong et al., 2020).

Figure 8

Flow chart of the general process of disease prediction models.



Note. Image from Fong, S. J., Li, G., Dey, N., Gonzalez-Crespo, R., & Herrera-Viedma, E. (2020). Finding an Accurate Early Forecasting Model from Small Dataset: A Case of 2019-nCoV Novel Coronavirus Outbreak. *International Journal of Interactive Multimedia and Artificial Intelligence*, *6*(1), 132. https://doi.org/10.9781/ijimai.2020.02.002

Using these artificially intelligent models, COVID-19 related data can be obtained, clustered, and analyzed for further prediction and action from medical professionals. This is a large asset for healthcare professionals as AI can be used to both give them warnings of outbreaks and mitigate the resulting impacts.

Future Outlook

Medical Imaging Diagnostics with AI in the Next 5 Years

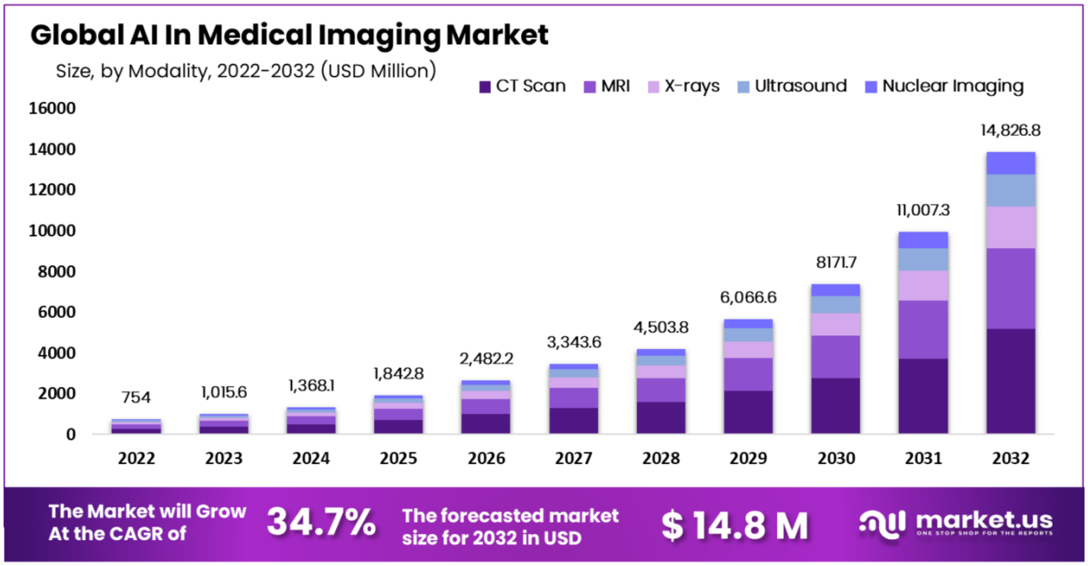
In the future direction of Artificial Intelligence applications in medical diagnostic and personalized medicine, there are great beliefs that AI holds immense potential for expansion within the healthcare industry. In the future AI is said to greatly evolve and help in the medical field especially by being used for diagnosis from medical imaging. Since AI can incorporating machine learning, more specifically supervised learning methods like classification, it continues to offer significant promise.

Some notable recent research that are prime examples of this future development would be its application within radiation oncology. These innovations have not only increased the efficiency of treatments but have also allowed for more personalized care strategies that are closely tailored to the individual needs of patients (Weidlich & Weidlich, 2018). The implementation of AI systems continues to offer us a more accurate and precise method for diagnosing and creating effective treatment plans, paving a path where technology and human expertise will converge to improve health and outcomes significantly (Bicer et al., 2023).

Over the years AI in the medical imaging industry have grown an improved immensely and it continues to do so each year. AI has evolved as a useful tool to provide greater efficiency in clinical care. AI diagnostics with skilled learning advancements provide faster and more precise diagnoses from X-Rays, MRI, and CT scans (Samson, 2023). With AI using algorithms that easily analyze medical images with impeccable accuracy, there algorithms easily detect subtle abnormalities and patterns that would regularly pass the human eye. Especially with AI's ability to adapt and grown with its machine learning to continuously grown on its medical image knowledge, AI is making tremendous progress in the medical field (Najjar, 2023).

Figure 9

Graphical Display of AI use in the Medical Imaging Market



Note. Image from Najjar, R. (2023). Redefining Radiology: A Review of Artificial Intelligence Integration in Medical Imaging. *Diagnostics*, *13*(17), 2760. https://doi.org/10.3390/diagnostics13172760

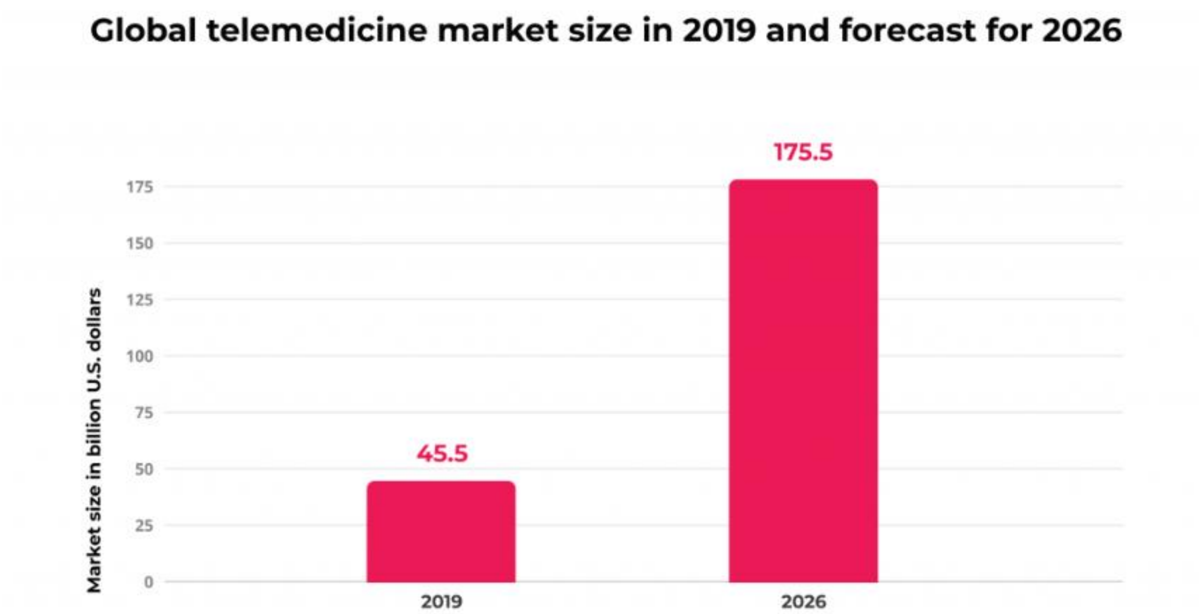
Therefore, with AI continuously being more precise in its ability to diagnosis, the market of AI has increased immensely since 2022 and is predicted to increase over the years (shown in picture).

With is ability to produce more precise diagnostics, in 2025 it is very likely that AI can generate an earlier detection of diseases that humans would not be able to catch while also being more accurate on what that disease is. AIs algorithms can also provide results back to the patients and doctors quicker than it would take a regular doctor to look at (Miller, 2024). Therefore, leading to a possible earlier detection which is very important since a treatment plan could be implemented quicker. With the treatment plan implemented faster to a patient, it could lead to being more effective while also preventing the persons disease from growing bigger and worse at the same time.

AI emerging with telehealth in the future holds immense potential with healthcare delivery that be brought to a user's doorstep. Telehealth can provide a user greater potential to get help and a diagnosis quickly especially if they have poor access to a medical office. AI with telehealth can give patients faster results and diagnosis or even helpful advice if they are stuck on a urgent question and need general health information. Since the phone lines with registered nurses can be filled with patients needing live help, AI can handle the smaller and simpler cases so that there is a less workload for the nurses while also helping patients at the same time. In 2026 it is predicted that the global telemedicine market size will increase greatly compared to the previous years. AI emerging with telehealth brings people more accessibility with their health care needs and more options regarding their health.

Figure 10

Global Telemedicine Market Size in 2019 and Forecast for 2026



Note. Image from *The Key Issues and Challenges for AI-Based Telehealth*. (2023, January 24). Www.linkedin.com. https://www.linkedin.com/pulse/key-issues-challenges-ai-based-telehealth-spsoft-com/

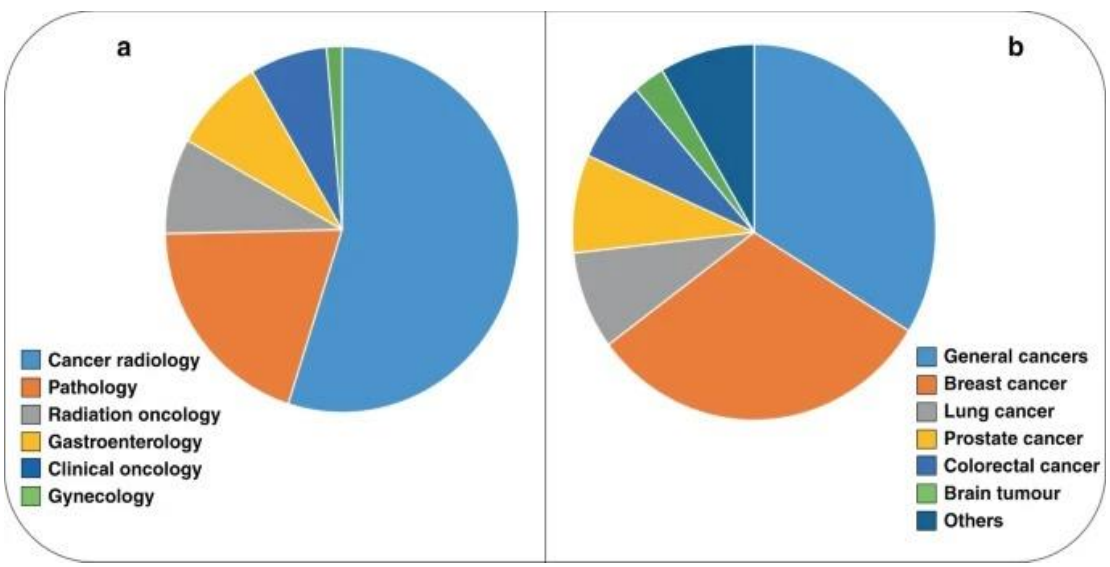
The Future of Application of AI in Medicine Beyond Diagnosis

Health care first adapted AI slowly, however now health care is adapting to AI at a much higher rate. This means that the problems and tasks that AI will accomplish and be assigned to in healthcare will only increase in the future. The health care industry has various amounts of data sets from its nature of treating and taking note of its patients, which provides AI more flexibility to help automate tasks (Ahmad et al., 2021).

As mentioned throughout the report, AI has already been used for diagnosis. For example, it has already been used to diagnose cancers such as breast, lung, and prostate cancer. However, in the future AI will help in medicine further. Such as in oncology, AI will likely be able to help find new drugs for treatments, plan treatments, and monitor patients. AI will aid through combining medical information such as RNA and DNA data. AI would be able to help in treatment for rare cancers as well, however this would be rather difficult, as there is not a great variety of data sets available for rare types of cancer (or any other rare type of a disease) compared to more common cancers such as breast, lung, and prostate cancer (Luchini et al., 2021). To get a clear idea of which AI devices are being applied currently in research using AI, acknowledge the chart below on the left. To get a clear picture of how AI use is distributed amongst certain research for different types of cancer, please acknowledge the chart below on the right.

Figure 11

Application and methods of AI in Cancer treatment



Note: Image from Luchini, C., Pea, A., & Scarpa, A. (2021, November 26). *Artificial Intelligence in oncology: Current applications and future perspectives*. Nature News. https://www.nature.com/articles/s41416-021-01633-1

In the case of AI helping find new drugs for treatment, this could be done through analyzing datasets of existing drugs and their properties, to find its potential applications for new diseases or infections. Through the data, AI would accelerate the virtual screening process of which drug is best for the application through datasets which include biological data like proteins and enzymes involved or targeted by the disease. AI would also be able to use generative models to design molecular structures which would be able to be used to create drugs to treat or cure certain diseases, which professionals would be able to use as a blueprint. This would mean that AI optimizes the formulation of the compound in a drug to enhance the efficiency of the drug, and it would be able to continuously monitor the data of existing drugs and updated scientific discoveries, to enhance and modify existing drugs. Similarly for planning treatments, it would be able to design a blueprint through the data and updated information of the patient's medical history and information, to optimize and create the treatment. In addition, through its access to the updated information, it would be able to flag any concerns, which it might pull from a combination of recent and past medical information (Romm & Tsigelny, 2020). Through AI's continuous help in various aspects of medicine, the treatment of patients will improve drastically, which would mean that the survival rates of diseases would increase as well. This mirrors a healthier population in the future, influencing their quality of life and happiness in a positive manner, compared to a future with no aid from AI.

The Improvement of Efficacy of AI in Medicine for Minorities

A current concern for AI in public services and public health, is the lack of data it has for minority groups. This translates to it not being able to help minorities and underrepresented groups to its full potential, as it would have less data to pull from, making its solutions and plans less efficient. This could lead to grave and serious concerns, and in the field of healthcare, even death, as a solution that may work for someone who is Caucasian may not work for someone who is a minority. However, in the future, it is expected that there would be more emphasis in seeking and acquiring more data to better serve all people from different backgrounds. However, this may raise ethical concerns as there would be a more targeted pressure in acquiring more data from a certain group of people, which may not be used for its intended purpose. There should be strict rules and regulations in place to protect the privacy of all people during this process, and to ensure the data had been acquired through proper consent (Andreotta et al., 2021). The future outlook of this ensures that AI benefits people from underrepresented communities as much or at least almost as much as people from overly represented communities. This impacts society through ensuring there is equality in the treatment for all people, and equity in place to make the benefits that privileged groups receive, equivalent for everyone. A society which has these traits is crucial to foster inclusivity and the well-being of the whole population in not just healthcare but also in education, employment, entertainment, anymore. It’s important to note that these different aspects of life are related to healthcare, for example education is required for professionals who contribute to the health industry, there are professionals who are employed in the health industry, there are certain types of entertainment and leisure which have a higher risk of injury. Therefore, as AI improves efficacy in all these aspects through its commitment of equality and equity, it would influence the equivalent for the medical field.

Five Year Breakdown of AI Development in the Healthcare Industry

Wrapping up as we explore the potential trajectory of artificial intelligence (AI) in healthcare through speculation, we navigate a landscape with both promise and uncertainty. As we investigate the next five years, it's crucial to frame our projections within the context of the rapid recent AI advancements and the inherent unpredictability of how quickly AI continues to develop. This exploration seeks to outline a vision for the integration of AI into healthcare, balancing hopefulness with the acknowledgment of the fluidity and challenges that define the future of technological advancement.

Starting this year in 2023, projections show significant efforts directed towards expanding the capabilities of AI through the sheer cultivation of its training datasets. By cultivation, we mean inclusivity, aiming to augment AI technologies that are not merely advanced but are fundamentally attuned to the diverse health needs of populations worldwide. Such a step is critical for setting the foundation for an equitable healthcare future, where the transformative benefits of AI are universally accessible, transcending geographical and socio-economic barriers (Zhang et al., 2023; Eskreis-Winkler et al., 2021). Alongside these technological advancements, the creation and establishment of solid ethical guidelines are almost of necessity within this trajectory. The integration of AI into patient care introduces difficult ethical considerations, requiring the need for a thorough framework to responsibly navigate the progression of AI technologies in any which it may develop. This framework is designed to ensure a commitment to protecting patient privacy and rights, serving as a moral compass amidst the rapid pace of innovation (Andreotta et al., 2021).

As of 2025, the integration of AI with genomics stands equipped to revolutionize the industry of personalized medicine. During this time, we may see the introduction of treatments that are tailored to the individual genetic profiles of individual patients, indicating a ripple within healthcare towards more effective and side-effect-minimized therapies. This leap in personalized medicine not only showcases unfathomable technological innovation but also aligns with a broader movement toward proactive and preventive healthcare strategies. Additionally, diagnostics is anticipated to undergo a massive transformation, with AI-driven diagnostic tools being the first place of early disease detection, surpassing human capabilities three-fold. These tools, characterized by their unparalleled precision, promise to significantly enhance the accuracy and timeliness of diagnostics, and represent a futuristic approach to healthcare that prioritizes early intervention (Paul et al., 2021; Callaway, 2022).

By 2026, the integration of artificial intelligence in clinical and remote health services is anticipated to noticeably improve how medical care is provided and accessed. This era signifies the evolution towards a healthcare system that prioritizes patient well-being, harnessing the capabilities of AI to guarantee comprehensive care for everyone, irrespective to their geographic location. This advancement towards a more inclusive and efficient model of healthcare underscores our dedication to catering to the varied necessities of patients in diverse environments, paving the way for a future where technology and patient care blend effortlessly, maintaining professionalism and empathy at the forefront (Fong et al., 2020; Vaishya et al., 2020).

As we move into 2027 and 2028, we're setting our sights on refining and broadening the role of AI within the healthcare sector. During this time, we expect AI to take center stage in revolutionizing drug development and fine-tuning treatment strategies, addressing complex health issues with unparalleled precision and insight. The aim for these years is to achieve seamless incorporation of AI across all facets of clinical practice, from initial diagnostics to the crafting of treatment plans. With AI systems designed for continuous learning and adaptation, this advanced phase in AI integration is poised to mark the beginning of a new chapter in healthcare. This period promises to bring forth cutting-edge solutions that resonate with the real-world needs of both patients and healthcare professionals, ushering in a future where healthcare is more innovative, effective, and closely tailored to individual needs (Mock et al., 2023; Chun, 2023).

Conclusion

In concluding our analysis of artificial intelligence's (AI) trajectory within healthcare, we stand at the brink of significant evolution. The next few years hold the promise of expanding AI's contributions, driven by inclusivity, ethical integrity, and innovation. From improving diagnostic accuracy and enabling personalized medicine to transforming drug development and broadening care access, AI has the potential to alter healthcare profoundly. However, this journey comes with challenges, as we address complexities related to data privacy, ethical application, and equitable benefits distribution. Looking toward a future where AI integrates seamlessly into healthcare facets, our vision focuses on developing a system that is efficient, effective, and inclusive, embodying care and compassion's highest standards. This represents the AI promise in healthcare—a future where technology and humanity merge to enhance health outcomes for all.

In our journey as Group 28, exploring artificial intelligence (AI) within healthcare, we've identified potentials that AI holds for transforming healthcare domains such as diagnostics, patient monitoring, drug development, and epidemic tracking. Our exploration, based on a review of current implementations and advancements, guides us to understand AI's future in medical innovation.

We uncover that AI's precision in cancer detection through medical imaging diagnostics marks a significant stride towards disease identification and treatment optimization. Leveraging deep learning algorithms, AI distinguishes complex patterns within imaging data, achieving a level of accuracy beyond traditional methods. This breakthrough is pivotal for disease detection, like breast and brain cancers, and creating personalized treatment strategies to elevate patient care outcomes.

Further, our research highlights AI's influence in precision medicine and health monitoring. Through AI's analysis of genomic data and patient behaviors, personalized healthcare is transitioning from an ideal to a reality. This move towards individualized treatment, powered by AI, is poised to revolutionize healthcare by making treatments more effective and tailored to specific patient needs.

In pharmaceuticals, our findings highlight AI's role in expediting drug discovery. AI's capabilities in predictive modeling and novel protein design streamline the transition from research to clinical trials and enhance cost-effectiveness. This acceleration promises to bring therapies to market quicker, addressing healthcare needs efficiently.

Moreover, our examination of AI's utility in identifying disease hotspots underscores its role in public health strategy. AI's ability to parse through extensive datasets for early outbreak signals is crucial for pre-emptive healthcare, a utility proven during the COVID-19 pandemic. This analytic prowess of AI is a testament to its value in public health management and disease prevention.

However, alongside our projections, we remain aware of the challenges and ethical dilemmas with AI's healthcare integration. Issues surrounding data privacy, the need for comprehensive and diverse datasets, and the establishment of ethical guidelines for AI use are critical. We advocate for a global initiative towards standardizing AI healthcare applications to ensure equitable benefits, avoiding the intensification of existing disparities.

Looking into the future from 2024 to 2028, we anticipate that AI will refine its diagnostic and treatment facilitation capabilities and emerge as a key player in advancing personalized treatment solutions and augmenting healthcare delivery via telehealth. This trajectory underscores AI's potential to redefine healthcare, steering it towards a more effective paradigm.

To conclude, our inquiry positions AI as a catalyst for revolution in healthcare. As we navigate these transformative changes, we are encouraged by AI's potential to reshape healthcare delivery, enhancing outcomes and fostering a more inclusive, efficient ecosystem for future generations.

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