



How Artificial Intelligence And Machine Learning Reduces Global Challenges Faced In Medicine And Healthcare

¹Jiya Doshi

¹High School Student

¹AS level, Sciences

¹Prabhavati Padamshi Soni International Junior College, Mumbai, India

Abstract: The global healthcare system is currently grappling with critical challenges, primarily due to a shortage of skilled medical professionals and an uneven distribution of medical resources. This deficiency is exacerbated in underdeveloped regions, leading to delayed diagnoses and treatments, as well as elevated mortality rates. High-profile crises, such as the COVID-19 pandemic, highlighted these systemic issues, demonstrating the urgent need for a more robust and equitable healthcare framework.

To mitigate these challenges, the integration of Artificial Intelligence (AI) and Machine Learning (ML) into healthcare systems is proposed. The global healthcare AI market is expected to reach \$188 billion by 2030, addressing the anticipated shortfall of nearly 10 million healthcare workers worldwide. AI offers significant potential benefits, including improved patient outcomes, reduced healthcare costs, and enhanced public health management. By leveraging advanced technologies, the healthcare sector can better navigate the evolving demands and complexities of modern medicine.

Index Terms – Artificial Intelligence, Machine Learning, Medicine

I. THE ISSUE

Some of the key challenges experienced by today's world lie in the realms of Medicine. We have skilled experts, but not enough of them. I mean, if we walk around a room of teenagers and ask them how many are actually entering medicine, you would find only one in ten picking doctor as their ideal career choice according to a BBC Bitesize survey (BBC, 2024). Well, one in ten people is like 800 million doctors in the world with a population of 8 billion, except, hold it! We just overlooked all those countries lacking education or those that are underdeveloped. Considering that this survey was in the United Kingdom, a funny developed country, one in ten is still a low number. Scaling it to the world, the number of future medicinal professionals dwindles and this lack of experts is what is the root cause of so many problems.

We have solutions to diseases, but sometimes, not enough time to cure them before it's too late. Who could forget COVID19? Death of millions (BBC, 2020) of people before AND after the development of vaccinations. Surely, our technology is adequate, but the reach, not quite. Our world is split severely causing biases in the number of 'antidotes' so as to speak in certain countries as compared to others. Some countries may not even have that sort of advanced technology to identify diseases from the smallest and slightest of symptoms and it's heartbreaking that these countries are generally overlooked causing high mortality rates.

In 2022, 121,000 patients died on NHS waiting lists in England (Full Fact, 2023). And that's one country. A developed country. There are 194 more. I bet there are still remote areas across the world who don't have enough skilled doctors or have to wait for months or years before receiving treatment. Imagine having Tetanus and calling your doctor, the time ticking off, the literal deadline looming over and your doctor saying that 'Our team is currently busy.'. Well, your life is at question, but trust me, there will be so many people battling such severe conditions who would be meeting these same life and death conditions every single day.

II. THE SOLUTION

This crisis of disease and inadequate provision of treatment is collectively tackled by the introduction of Artificial Intelligence and Machine Learning. It's forecast that the global healthcare AI market will be worth almost \$188 billion by 2030. This growth comes at a critical crossroads in healthcare, with a projected shortage of nearly 10 million physicians, nurses and midwives globally by 2030 at the same time as we are faced with the increased needs of an ageing population (Garrett, 2024). A report from the National Academy of Medicine identified three potential benefits of AI in healthcare: three potential benefits of AI in healthcare: improving outcomes for both patients and clinical teams, lowering healthcare costs, and benefitting population health (Mayo Clinic, 2024).

III. TYPES OF AI

There are several types of AI, but the most common in health care include:

Machine Learning (ML) (Coursera, 2024)

Suppose you've got extensive data sets. Algorithms are trained to use those data sets and create models that perform such tasks like categorizing information or predicting outcomes.

Deep Learning (Coursera, 2024)

This is a subset of Machine Learning, but it really is a lot more complicated and deeper like the name suggests. It involves greater volumes of data, training times, and layers of Machine Learning algorithms to produce neural networks capable of more complex tasks. It can be used for analyzing medical images, for example.

Neural Language Processing (NLP) (Coursera, 2024)

Imagine trying to communicate to a computer. Well, you don't know binary and it doesn't know human language. Not anymore! NLP brings forth the use of Machine Learning to understand human language, whether it be verbal or written. It is really helpful to interpret documentation, notes, reports, and published research.

Robotic Process Automation (RPA) (Coursera, 2024)

Administrative tasks require long hours, caffeine deprivation and ultimately low efficiency and mistakes. It's human to make mistakes, but what if we replace this with RPA? The use of AI in computer programs to automate administrative and clinical workflows improve the patient experience and the daily functioning.

Clinical Decision Support Systems (CDSS)

This is a really helpful system for healthcare providers. They analyze patient data and provide recommendations backed up with evidence helping in making the best decisions possible. This also kicks out the probabilities of possible 'bias'.

Predictive Analytics

Historical data is seen and used to predict the future. This is really helpful when it comes to patient readmissions or disease outbreaks. I mean, if anyone predicted the spread of Spanish Flu or Black Death, I'm sure measures could have been taken to avoid casualties.

Virtual Health Assistants

This is probably one of the most useful types of AI. AI-powered chatbots and virtual assistants can help patients with scheduling, symptom checking, and even providing health information. This helps to reduce human error and makes services available 24/7.

IV. HOW MACHINE LEARNING COULD HAVE PREVENTED THE SPREAD OF COVID-19

Machine Learning, as mentioned before, helps to analyze large data sets and predict outcomes. For example, if a new pandemic, something like COVID-19, ever comes up, we could predict the waves, the spread and the threat using this. This could save millions of lives across the world, because governments would issue laws according to these predictions and ensure the strictness of the decrees passed match the severity of the situation. It all started with washing your hands more often, but if we knew the sort of seriousness this issue held, we probably could have started social distancing right when COVID-19 first came into the picture and ended it way quicker. During the era of Corona virus, the gray areas of the RT-PCR and RAT tests (Pradhan et al., 2022), could actually be resolved using AI and Machine Learning's abilities to recognize complex patterns in a large data set.

What gray areas am I talking about? Well, according to the article cited above, "RT-PCR has difficulty discriminating true positives from true negatives in COVID-19 affected patients (Yang et al., 2020). Another flaw is the false-negative rates which are highly variable. The false-negative rates (Kucirka et al., 2020) are maximum during the first five days after exposure (up to 67%) and least during the eight-day after exposure (21%). Furthermore, due to the acute shortage of RT-PCR test kits in underdeveloped countries, testing and detection are delayed. This [RAT] test identifies antigens and small proteins on the virus's surface and gives the result within 15–30 min. Its primary disadvantages have been its low specificity (77.8%) and sensitivity (18.8%)." (Burog et al., 2020)

So many people around the globe who were denied international travel due to a false test report could actually have been saved with Machine Learning. Even having a false positive report could affect the psychology of a person and it's important to realize that such diseases did affect a person physically, but its mental impact was equally detrimental. This could have been prevented by the introduction of Machine Learning.

Furthermore, so many who travelled, unknowingly carrying the virus to other countries could have been stopped and been warned about it. It could have been controlled and curbed. Maybe it wouldn't even have spread to the whole world. This could have saved MILLIONS of lives, but the lack of new age technology led to being obligated to stick to tests that were accurate, but not totally, were reliable, but not fully.

Machine Learning has been used to predict the outbreak of COVID-19 in different countries, estimate the occurrence of the next wave and its severity, calculate mortality rates, contact tracing, detect of people not wearing facemasks or practising social distancing, develop vaccines to better understand the correlation of the underlying problems of the patient with mortality rate, etc. (Pradhan et al., 2022) (Lalmuanawma, Hussain and Chhakchhuak, 2020). This has been a driving force in establishing government laws to prevent a steep increase in the cases of COVID-19 and has helped assess the vulnerability of patients and increase the speed of vaccine discovery.

V. MACHINE LEARNING AND RADIOLOGY

Moreover, when it comes to scanning and Radiology, whether you talk about CT scans or X-rays, there is a severe shortage of skilled experts who could interpret images and this causes long waiting times and reduced access to necessary care. These delays can be life-threatening. Atlantic Health introduced an AI algorithm in 2020 to analyze CT scans for signs of pulmonary embolism and physicians there confirm its speed and efficiency. A waiting time of 15 hours was reduced to under 90 minutes (Artificial intelligence can transform healthcare for patients and doctors, n.d.). In addition, assessing total kidney volume, though incredibly informative, involves analyzing dozens of kidney images, one slide after another — a laborious process that can take about 45 minutes per patient. With the innovations developed at the PKD Center at Mayo Clinic (Mayo Clinic, 2024), researchers now use artificial intelligence (AI) to automate the process, generating results in a matter of seconds.

VI. AI AND RARE DISORDERS

The ability to identify and analyze extensive data sets has made AI identify large volumes of genetic data to identify rare disorders and recommend tailor-made treatments. Even if it is so rare that 1% of the population of the world has it, or maybe even lesser, it is important to know that these rare genetic conditions can be expressed in future generations and hence can multiply, causing an exponential increase in the genetic disorders. This can pose a significant threat worldwide in the long run. However, with AI, these rare disorders can be identified and tailor-made cures can be found out to ensure that it is curbed.

VII. IMPACT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Machine Learning, with its neural networks and statistical models, plays a pivotal role in categorizing health information and expediting decision-making. AI also significantly contributes to disease diagnosis, utilizing extensive datasets, patient histories, and medical imaging to assist healthcare professionals in making accurate and timely decisions (Abdallah et al., 2023) (Davenport and Kalakota, 2019). AI, hence, can boost telemedicine by helping in diagnosis in remote areas globally. For example, you have high blood sugar levels. Machine Learning can compare your results to those of patients worldwide and give you the probability of diabetes, heart attack, etc. securing a healthier future and ensuring a longer lifespan and a lower death rate.

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Humans are prone to error. Sometimes, a patient might be prescribed the wrong medicines or is overdiagnosed. According to the National Academies of Science, Engineering, and Medicine report of 2015, the majority of people will encounter at least one diagnostic mistake during their lifespan due to lack of proper symptoms, rare disease conditions or the omitting of a disease from consideration (Balogh, Miller and Ball, 2015) (Ahsan, Luna and Siddique, 2022). In a Mayo Clinic cardiology study, AI successfully identified people at risk of left ventricular dysfunction even though the individuals had no noticeable symptoms. “We have an AI model now that can incidentally say, ‘Hey, you’ve got a lot of coronary artery calcium, and you’re at high risk for a heart attack or a stroke in five or 10 years,’ ” says Bhavik Patel, M.D., M.B.A., the chief artificial intelligence officer at Mayo Clinic in Arizona. (AI in healthcare: The future of patient care and health management - Mayo Clinic Press) “We have an AI model now that can incidentally say, ‘Hey, you’ve got a lot of coronary artery calcium, and you’re at high risk for a heart attack or a stroke in five or 10 years,’ ” says Bhavik Patel, M.D., M.B.A., the chief artificial intelligence officer at Mayo Clinic in Arizona (Mayo Clinic, 2024). Machine Learning, on the other hand, can output possible diagnosis from a database of inputs containing symptoms, rare genetic diseases and treatments. This reduces human error by a great deal, helping in accurate conclusions.

And lastly, AI is known to improve convenience. You don’t need to travel miles across the country or wait for hours for treatment. AI can revolutionize the world if used correctly. Sure, maybe sometimes it may identify risk of diseases that may never happen to you, but by presenting a probability it can make you more self-aware. But that’s on your personal level. On a global scale, AI can improve treatments and make the impossible possible. It can raise awareness to any potential outbreak of pandemics and with this, maybe COVID19 would not have been as severe as it was. If AI and ML was implemented, maybe the millions of people who died would have been alive right now.

It's not a matter of life and death, it's a matter of survival.

VIII. CONCLUSION

As species, according to Darwin, we follow the Survival of the Fittest. Do we really need to compete to stay alive when we can have a more inclusive and open environment where every individual has access to telemedicine and treatments on time and no one really dies on the waiting lists? Do we really need to fight for the last morsel of treatment when we can adopt a way by which it's a win-win from all sides?

We're humans, Homo sapiens, the thinking men; we don't kill each other to survive – we find ways to make it through together. And global collaboration is needed to establish Artificial Intelligence and Machine Learning into all the healthcare systems.

This arises the need to reinforce that AI and Machine Learning can solve the problem of diagnosing and curing diseases and open new gateways for the fields of medicine. It can reduce the severity of pandemics by alerting governments beforehand of the severity; it can connect people across the globe through telemedicine, and

improve efficiency, ensuring fewer death rates due to long waiting lists, and reducing the delays in life-threatening diseases, securing a brighter future for everyone.

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