BULLET: Jurnal Multidisiplin Ilmu
Volume 3, No. 06, Desember-Januari (2024)
ISSN 2829-2049 (media online)
Hal 704-714

Artificial Intelligence in Healthcare: Current Trends and Emerging Technologies

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Abstract

Many fields, and especially the healthcare sector that is many folds complex, are currently on the brink of disruption by AI. This piece examines the present and emerging kinds and applications of AI in the healthcare context, such as diagnostic, precise, prescription and virtual assistant IPs. Several aspects of applying AI technologies have already made significant impacts on the healthcare sector such as: Huge amount of data, correct diagnosis, treatment decisions for every specific case. However to advance and apply AI fairly and efficiently some issues that faced AI included integration, no standardization, financial issues, and privacy and bias problem. Depending on the recommendation of artificial intelligence such as machine learning, deep learning, natural language processing, and robotic surgery a long-awaited expectation comes with the issue of the improvement of the rate of health practice. The appropriateness of the AI for the betterment of health care in the future has been magnificently observed in PM, WI, and CT. Wearable technology and more, importantly, the constant surveillance by artificial intelligence can be a much better method in many such circumstances. Nevertheless, there are controversies connected with such a trust issue and the adoption among health care providers as main difficulties which need to overcome. AI presents the health sector with the prospects of a new style of, novel, optimal and affordable care regardless of the difficulties stated above. Thus, this paper concluded that for healthcare proactively benefit from AI, this sector requires fixing the technical, ethical and legal issues with an aim of improving the patients' diagnosed and the health systems globally.

Key words: AI, medicine, recovery, disease cure, new medicine, voice assistants, AI learning, natural language processing, robotic surgery, prognosis, ethical dilemmas, data privacy, algorithmic prejudice, synthesis, standardization, affordability, global, epidemics, smart technology.

INTRODUCTION

Application of Artificial Intelligence is on the rise in many field and the health sector amongst them. Artificial intelligence is the adaptation of techniques that the human brain provides in its capability to learn from experience, the data in the surroundings. In healthcare, the technologies are already influencing regards to analysis, approach to treatment and management of patient care by the clinicians. Currently, in the current developed machine learning, NLP and data analytics, AI is enhancing decision making, patient satisfaction and organizational performance [1]. The scope to reduce healthcare costs and solve major problems in this industry through Artificial Intelligence is enormous: starting from diagnostic errors to administrative work and restricted health care access. Computer algorithms can analyze hundreds and thousands of records and deliver insights about patterns that the healthcare industry can't afford to ignore to prevent mistakes as well as make better predictions. Some of the uses of AI are as follows: Use in diagnosis of diseases from images; these could be in initial stages such as cancer, cardiovascular diseases or neurological disease diagnosis where the algorithms are most often right more than human models [2].

Besides improving diagnostic capabilities, AI is also helping in the further evolution of the idea of precision medicine. When such genetic, clinical and lifestyle data are processed, by managers, it is possible to offer the patients treatment programs tailored to fit their condition and this would enhance the therapies outcome [3]. The current progress on the application to Artificial Intelligence in the field of drug discovery is helpful because it scans a pool of thousands of potential molecules and can determine the best compounds in a shorter timeframe and at a lower cost. I would also like to note that in healthcare, most application of AI does not limit itself to treatment of patients. Voice recognition, big data, analytics like virtual technical assistants and patient data tracking and monitoring outside of hospitals are rapidly reshaping how patients are treated especially in care scanty regions [4]. Therefore, the mentioned technologies are still under construction, while the overall prospect for further evolution of the sphere of health care looks optimistic – better, more targeted, and more comfortable tools for patients worldwide are anticipated [5].

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AI CURRENT TRENDS IN HEALTH CARE

Artificial Intelligence is among the most popular technologies in the world today and is slowly transforming the health systems. There is notable consideration that can follow AI's integration into the healthcare business and application in disease diagnosis, patient management, and treatment prescription, trends begin to appear. The most application I consider is in diagnostics; however, the use of the AI has recently increased in medical imaging [6]. Other areas of application of AI in software programs today include, recognition of early signs of diseases such as cancer, heart diseases and neurological diseases on medical images such as X-ray, MRI and CT scan. The models assessed are as accurate as human clinicians are in diagnosing these patterns and can do so much earlier. This trend is more beneficial to radiologists in healthcare facilities practicing in environments whereby AI enhances quicker and easier interpretation of many images [7].

With reference to accuracy and precision in the particular area of precision medicine, the role of AI is to alter the approaches used in the development of care management strategies in order to correspond to the needs of the clients. Molecular and clinical markers help define how a specific disease will progress and how the patient will respond to certain treatments. It is enriching the identified outcomes because there is a probable obtainment of the right treatment from each healthcare delivering entity, for the needs of the patient. AI contribution is also visible in the process of drug discovery and development [8]. Traditional approaches used in the discovery of new drugs have been slow and tremendously expensive. However, today the new models, based on AI technologies, allow more effective identification of the best drug candidates in much less time having received the biological data about molecules and their interactions. This has the side effect of potentially halving the time taken to bring new drugs to the consumer market. '' Virtual health assistants, and chatbots have emerged as favorites in patient engagement [9]. These applications of AI can be helpful in the following ways: they can be always available for the patient, can provide consultation, such as just a simple reminder that it is time for an appointment or that it is time to take a pill, as an example, and can help patients, thus relieving the pressure off on healthcare workers. Such trends depict how artificial intelligence in the context of healthcare improvement is making the imagined process, precision and individualized diseases more possible [10].

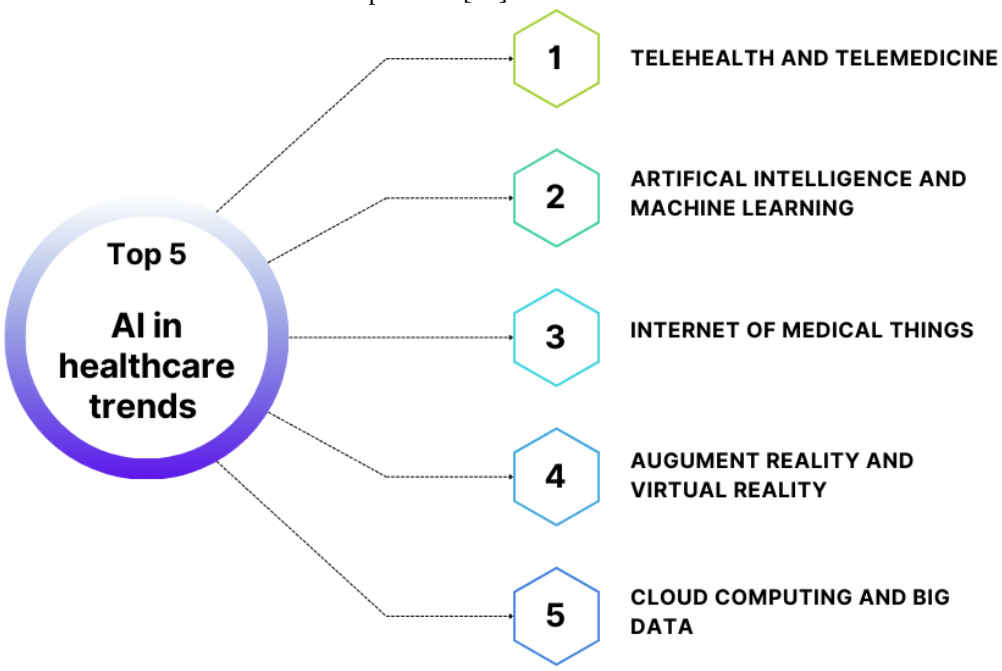

Figure: 1 showing top trends of AI in healthcare

NEW SCALES IN THE FIELD OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE

Which is why, as AI progresses, new technologies appear giving further opportunities for redesigning health care. There are several progressive innovations currently comes up within the technologies of medical practices as well as a patient's care. Machine learning and deep learning are two of the most fascinating subfields in data science. These subset of AI makes it necessary for one to develop algorithms when making forecasts from big data or when identifying and categorizing patterns or identifying and recognizing repetitive complicated work [11]. In healthcare, two of the most popular types, ML, and DL are enhancing diagnostics such as radiology, pathology,

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ophthalmology, etc. For example, through the deep learning algos, the trained AI systems are capable of analyzing from millions of images and equally as effective in diagnosing simple diseases such as cancers or retinal pathologies next to a doctor [12].

Another emerging area is the mentioned natural language processing (NLP), which, in turn, is designed to teach machines to comprehend speech. In the healthcare industry NLP tool is designed to handle such unstructured information, such as clinical notes, research papers or patient records. Through these sources of information, AI can help physicians in their decisions, starting analysis of new patterns in health, and improving clinical methods. It is also used in the clinical decision support system whereby literature and patient information is being processed in real time to offer recommendations from the evidence based [13]. Other fast growing fields are Artificial Intelligence surgical robots and Automation. Smart tools like the surgical robots and AI are more and more utilized in minimal invasive procedures enhancing precision and which in turn have shorter recovery period. They can to gather actual time information with regard to prior procedures and can be actually useful in providing actual time information that can assist the surgeon in improving on the operations [14].

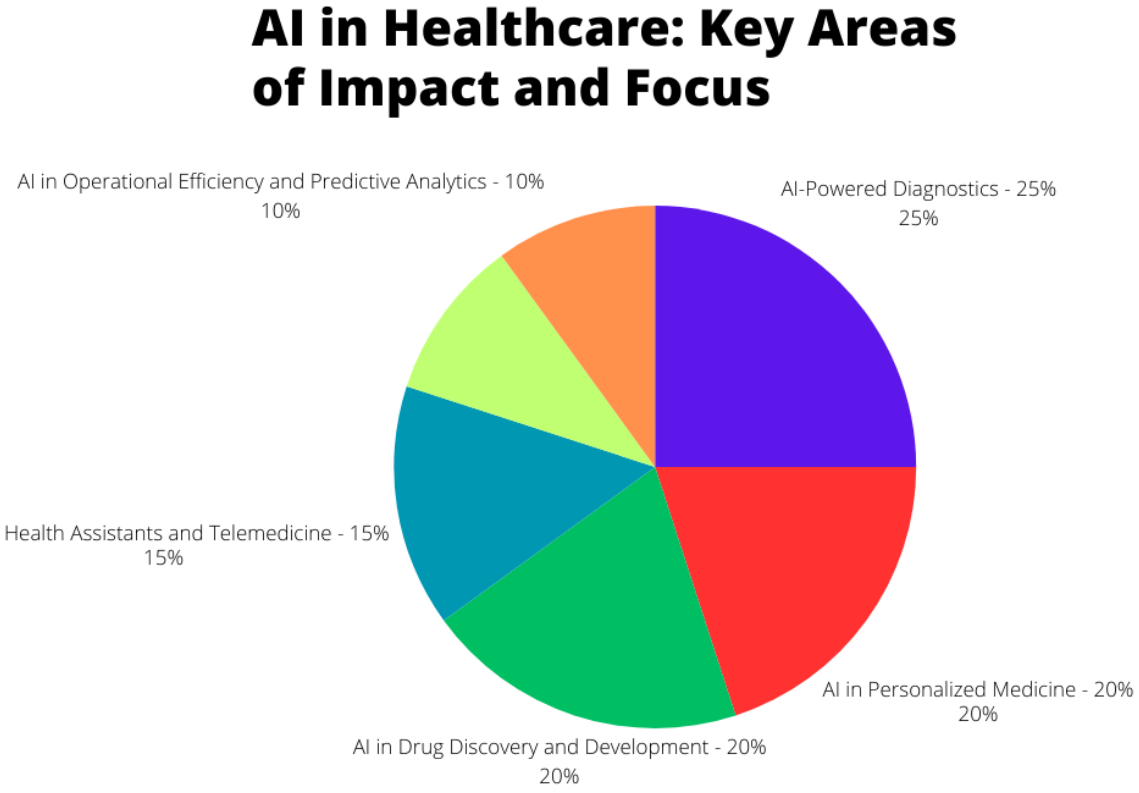

Figure: 2 showing AI in healthcare key areas of impact and focus

Through the use of the predictive analytics it is emerging how AI is revolutionizing the chances of observing patient status. They can also locate risk levels such as a patient might be at risk for specific diseases or complications so that careers can intercede at an earlier stage to manage instead of cure. These new generation AI technologies are not only enhancing the clinical practice, but are progressing towards the smart, personalized, high data driven paradigm in medicine [15].

AI IN DRUG DISCOVERY AND DEVELOPMENT

Drug discovery and development is a long, intricate, and expensive tradition that usually has taken years and billions of dollars to bring a single drug to market. However, this has not been the case due to the emerging market of the Artificial Intelligence (AI). AI technologies are reshaping the entire spectrum of drug discovery, development and commercialization as they drastically shorten the time span and are cost effective [16]. AI is able to analyze, understand, reason and solve problems much more than humans within a very short span of time, thanks to the handling of large amounts of data and the expertise of programming, which is its chief strength for pharmaceuticals. Another area in which AI is applying transformative change to HDI is by predictive modeling and data analysis [17]. Previously the researchers were in the dark, they had to work through differential equations, experimental trials and errors before they could possibly find a compound of any potential. In AI, the machine

learning algorithm is able to determine efficacy based on new data such as chemical characteristics, biological data, and past clinical trial data. It also allows for the identification of future drug candidates at a much earlier stage increasing the chances of success in the clinical trial phase and decreasing the number of setbacks that are par for the course in the industry [18].

Target identification and validation is another area where AI shows fantastic opportunities. It is critical to know what belongs in a cell and what does not, and to figure out which is the right target to treat a given disease. Due to the involvement of omics data genomics, proteomics, metabolism, AI can identify the promising drug targets and the researchers should then focus on the selected paths. This has been particularly useful in diseases with many layers of pathophysiological mechanisms like cancer and neurodegenerative diseases where simple afferent strategies may not work [19]. Besides using AI in the early stages of drug identification, it is also finding its way in drug delivery systems. Information can be fed into the algorithm to estimate the medical compounds' action on organisms; how they are absorbed, delivered, metabolized and excreted (ADME). In this way, AI is capable of mimicking these processes to enhance some key properties of drugs before entering clinical trials and possibly sparing clinical trial's costly and time consuming trial and errors [20].

The enhancements to the cybersecurity domain that present AI technology provides are primarily in threat disclosing and opposition. Nowadays new approaches such as machine learning and deep learning are being incorporated to enhance the way through which the cyber threats can be identified and analyzed at a faster and more accurate way. By so doing, these AI systems analyze large data sets and, more to the point, they are able to pinpoint signs of existing and preexisting cyber-attacks that, in effect, can signal a need to increase the security [21]. New information learnt and adaptability also improve the effectiveness of the AI based approach in identifying new threats like zero day threats which are difficult to analyses using conventional methods. This has shifted the challenge of how organizations address any threats in the area of information technology security since responses can be given with better efficiency and precision. With increasing incidents like ransom ware, the call of AI becomes a more and more anchored function to avoid loss, particularly in the area of risk detection in cyberspace and the minimization of risks to fraud [22].

AI is also being used in drug repurposing the process of identifying more uses of a particular drug that is already in circulation. Another mechanism of getting novel targets is by understanding how existing drugs work and which pathways represent new indications for the medicine. This is is particularly useful for making quick searches in response to emerging public health threats, for example, the search for cures during the COVID-19 outbreak. In such cases, it can easily look into which drugs being prescribed may hold the potential of being effective with new diseases that surface in the market thus saving time [23].

However, these are some of the great progress that have made in the application of AI for drug discovery; there are still some problems that need to be solved in order to popularize the technology. A major challenge is data quality and availability AI models have a dependence on large, clean data sets in which many pharm companies are still challenged by inconsistent or incomplete data. Moreover, regulatory agencies are actively striving to develop standards for AI methods in drug discovery, so the tools themselves can be as accurate as clinical trial-based approaches [24]. Thus, it could be stated that there is no part of drug discovery and development that AI is not actively changing. From primary drug discovery to managing the trials themselves, AI stands to greatly decrease the time, cost, and uncertainty to get the new products to patients. Day by day, AI technologies are gaining bigger prominence as they will contribute a major part in upgrading the generation of treatment to serve the patients better and to enhance the speed of pharmaceutical enhancements [25].

ETHICAL-LEGAL CONCERNS

Artificial Intelligence (AI) opens a range of important ethical and legal issues regarding its application in the sphere of health care that should be taken into consideration to avoid abusive use of these technologies. These points are important to stall AI while communicating the technology that could before enhance patient experience of the health system. The first of the large ethical issues that must be addressed is the question of gathering, securing and preserving individual information. AI systems rely on large amounts of patient data, including considerable quantities of the most sensitive patient information [26]. This is why it is of immense importance to secure this information because if there is a break in, an identity of particular individual, credit card details or even patients might be at risk. This is because today's healthcare organizations have been demanded new legislation, which is HIPAA in United States or its equivalents in other parts of the world, for the proper protection of the information. As crucial as this is, there exists a question of who owns the data given the advent of AI – how may that data be used and in case it is transacted across various platforms for research or development [27].

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The last undesirable effect is that like everyone else artificial intelligence algorithms have prejudice. This form of AI learns from data of the past, and it's possible to attribute the bias to it hence serves the bias especially if the data that feeds this AI is not diverse. It can lead to differential treatment at some point, for instance, minorities get an in efface diagnosis or information about a certain disease. Bias can be prevented if only the developers of AI will take necessary measures to ensure that no biases infuse the data and set used for developing AI, and that the algorithms must be checked and updated regularly due to biases [28]. This makes regulatory issues as another factor that limits the use of AI in health care sectors for it integration at a larger scale. New nature of AI technologies at times presupposes that developers are not provided with some specific instructions concerning the evaluation of AI tools for their utilization in clinical practice [29]. Safeguarding concerns include awareness something regarding the systems as safe, safe & efficient as well as ethical that so as not to put matters into a context where the AI hampers a patient, or a group of them, on the hand the public remains wary of the utilization of other forms of application of AI in health care delivery systems. That is why there are some ethical and legal issues in healthcare AI, which has to be answered soon to integrate AI technology, which would be necessary for increasing patients' outcomes, and for respecting patients' rights and their safety [30].

CHALLENGES OF APPLYING ARTIFICIAL INTELLIGENCE IN HEALTH CARE

However, there are numerous challenges on the use Artificial Intelligence (AI) to healthcare since it is such a vast sector with almost endless potential. These are some of the barriers that I believe needs to be eliminated fully in order to harness fully the potential of AI while at the same time providing safe human healthcare services in a fair and efficient manner [31]. On this count, one main issue often raised is on the way the system will interact with other healthcare systems. A large portion of the healthcare organizations maintain conventional structures and systems that cannot accommodate the majority of present-day artificial intelligence constructs [32]. To implement these tools into systems, usually requires substantial changes in data structure and dialogue between systems and tools. This process is a challenging, time consuming and costly affair particularly within academia particularly those with limited financial capital to improve on their technological capabilities. Overcoming this is going to require AI developers and healthcare stakeholders to work in tandem, on developing a set of products that shall fit seamlessly into the current setting and practices [33].

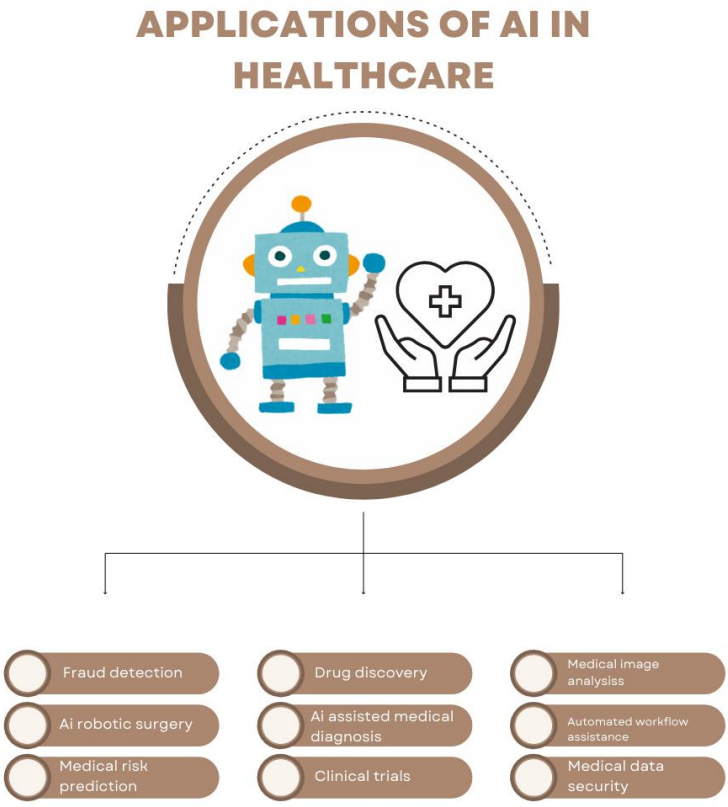

Figure: 3 showing applications of AI in healthcare

Another important factor is that there are no standards in AI technologies being adopted in the market at least in the USA. AI is useful in various healthcare applications and different architectures and systems of the AI are used

to complete individual operations like diagnosis and care etc. Inadequate prescriptive character in the creation and use of AI instrumentations may lead to challenges in selecting and implementing these technologies, and to developing their trustworthiness for healthcare practitioners [34]. This can also make it challenging to educate health care providers about different AI instruments where each tool is in some way different from any other one. AI technologies should be standardized because there is always constant fluctuations in the advanced progressive developing regularity and stability result across the health system [35]. They are largely contentious and enormous particularly in the developing world in terms of the financial and resource base. While the application of Artificial Intelligence may reduce the general cost in the longer run, the cost of obtaining AI solutions, the establishment of new technology, and resources required to introduce AI solutions may sometimes be considerable. It is therefore likely to pose a challenge for the smaller hospitals or clinic to imagine these costs right especially in the region where there is little money to fund radical hospital ideas [36].

But there is never trust and therefore adoption by the healthcare professionals. There is also likely to be concern amongst many clinicians regarding the capability of AI or apprehensions about of AI or AI threatening their jobs. This is why trust will be a major component of managing the resistance to AI, because validation, education, and openness will have to be done well in order to really make the most of the possible benefits that are inherent in use of these particular technologies. These are issues that really require some attention to assist in the creation of the kind of environment that will see the implementation of more optimal artificial intelligence systems throughout the health industry [37].

AI-POWERED DIAGNOSTICS: REVOLUTIONIZING ACCURACY IN HEALTHCARE BUILDING EFFICIENCY

Diagnostics in healthcare sector is one of the biggest fields that are equally being impacted by Artificial Intelligence (AI). Diagnostic precision and optimization of time to increase further the quality of the prognosis are one of the revolutionizing aspects that AI introduces to the medical field. With the use of the ML techniques, DL and NLP techniques AI is now starting to relieve clinician burden by offering more precise, timely, and knowledge informed assistance. The biggest strength of AI-based diagnostics, therefore, is the ability to manage and analyze data many times beyond the limits of people's endurance and capability [38]. Other areas in which AI is used are radiology, pathology and ophthalmology since the model can analyze medical images with great accuracy. As for the examples of ML, when thousands of images of distinct patients are labeled and given instructions, the other almost unnoticed features in the pictures may be distinguished only by the indicating of the accurate ML algorithm [39]. These systems are special applicable to early stage diseases like cancer, cardio-vascular diseases and some kinds of retinal diseases. For instance, such AI models have been applied in diagnosing breast cancer in mammography with the same or even higher precision than an expert radiologist, the outcomes that decreases misdiagnosis rates and guarantee earlier preventive actions [40].

In pathology AI is applied in diagnosis of tissue samples to assist pathologists in determining diseases such as cancer, tuberculosis and infectious diseases. In addition to increasing the speed of diagnosis AI helps to minimize the possibility of an incorrect interpretation of slides, especially in the case of complicated tasks that demand the great experience and qualification of an expert [41]. These applicative fields have shown that foreseeing, mining, and analyzing diagnosis through AI technologies produces faster and more consistent and reproducible results, so that treatments can be promptly provided by healthcare providers. It is also transforming genetic testing and the concepts of personalized medicine [42]. More and more, AI is used to screen genomics for alterations and possible biomarkers that can further the development to disease or impact the effectiveness of drugs. All of this information can be used to try to design more appropriate treatments or interventions to the patient and can be applied in oncology, genetic disease, pharmacogenomics and personalized medicine. The information integrated with genomic data would be clinical data as AI systems can predict the way in which specific patients will likely to respond to various treatments for enhancing the efficacy of the latter and reducing the risk that negative side effects [43].

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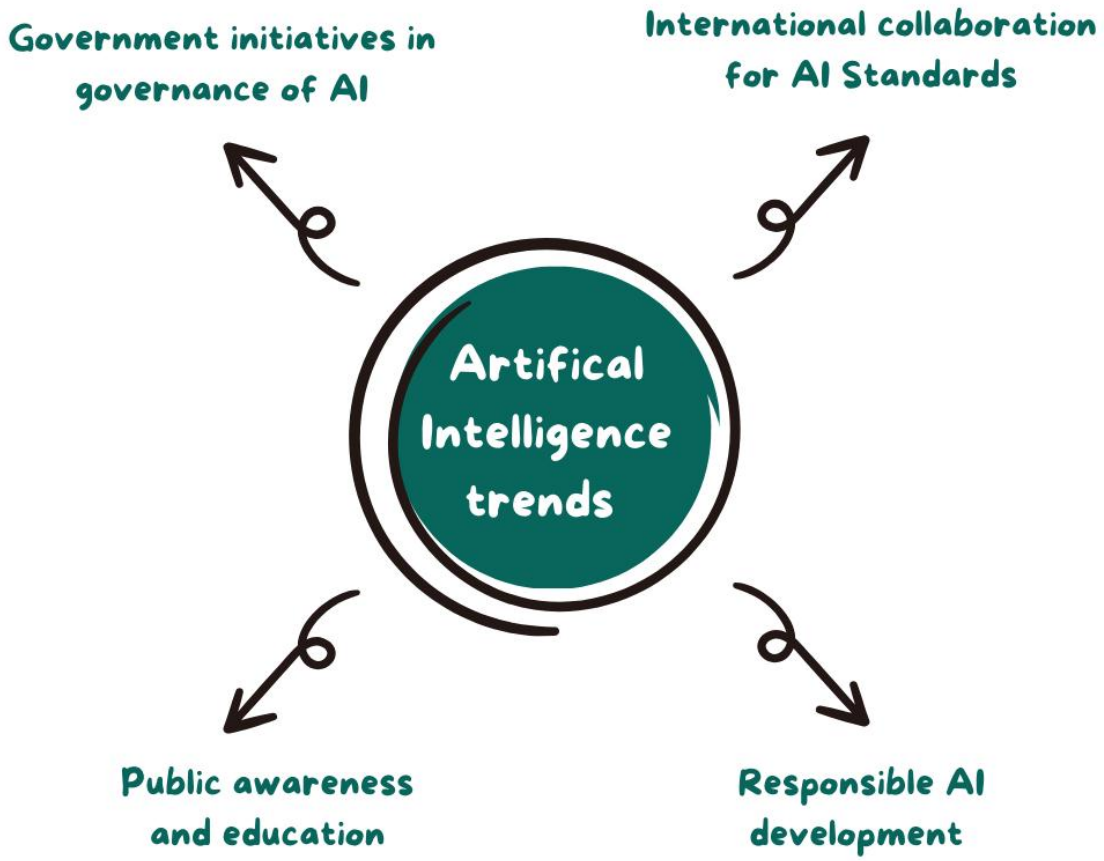

Figure: 4 showing trends of AI

However, apart from leveraging radiology image analysis and genomics, NLP is now assisting in diagnosis to fully extract data from unstructured EHRs. By leveraging NLP mechanisms, clinically-relevant data may be extracted from clinical notes, patient histories, and lab reports as well as from study articles and made available to clinicians to help them improve the diagnostic decision-making process. AI-based NLP solutions are also making EHRs more accessible and usable, thereby impacting clinical workflows, while empowering doctors to make better decisions in the fly [44]. CDSS is also finding application in diagnostics and is powered by Artificial Intelligent algorithms. These systems can review as much information as the patient information, his or her history, the results of the diagnostics, and the present symptoms and may recommend certain diagnosis and treatment. Due to the ability of the AI-CDSS to present clinicians with best practices, its reliability in the prediction of diagnostic mistakes, and its determination of the management of the complicated condition, the reliability of the procedures and the overall delivery of healthcare is assured [45].

However, there are still some drawbacks pertinent to the application of AI in diagnostics even with the many developments presented. The convergence of AI and power include obvious problems like data privacy and fairness, algorithmic bias, and the large datasets needed to train AI systems which must be resolved to guarantee AI is used fairly and ethically [46]. In addition, the incorporation of the advanced AI into clinical environments, as well as the establishment of credibility concerning the use of the applications by the healthcare workforce, is an extensive undertaking involving the further training in addition to the prototyping of such tools. The application of diagnostics based on techniques of Artificial Intelligence (AI) can be considered as the trending and highly perspective branch in the sphere of healthcare [47]. AI capabilities are being widely applied in Diagnosis and Health Care Management from Imaging and Pathology, Molecular and Functional Diagnostics, Genetic Diagnostics, and Clinical Decision Support Systems. The conclusion is that as technology progresses, AI is set to

become an essential part of the clinicians' utility belt which is bound to improve the health care system in its function and benefit patients [48].

FUTURE DIRECTIONS: AI IN THE FUTURE OF HEALTHCARE

Since the arrival of Artificial Intelligence (AI), the probability of transforming healthcare encounters becomes more realistic. AI appears to be promising for it is said to offer radical innovative approaches in healthcare delivery, elimination of health inequalities and prevention and management of numerous health challenges. When looking deeper into AI's future, several areas need to be highlighted, and, thus, create a better and more balanced healthcare system [49]. In particular, AI has been promoted for one of the most okay areas namely precision medicine. Applying AI brings understanding of a patient's genetic predisposition or other occurrences happening in an external environment and come up with actual to provide for the specific individual effective treatment modalities to be administered to the intended patient [50]. Incorporation of people's genetic changes, behavioral patterns, and biomarkers in the treatment may assist to personalize treatments for various chronic diseases such as cancer, cardiovascular diseases, and autoimmune diseases. At a more advanced level, they may assist in evaluating a particular form of therapy the patient will likely respond to and when and how the therapy will be effective [51].

One of the most interesting further development in AI application is the one in the work on global health. In the low resource, hard-to reach areas, AI will act as an assistant to the affected patients so that they can access the necessary clinical care. This would have resulted to generalists in rural areas obtaining similar diagnostic accuracy to those of experts, without the drawback of having to spend a fortune on equipment [52]. When used together with Artificial Intelligence, mobile health applications could enable case consultations and continuous and steady health check on mostly farming populations and other groups who have little or no access to health facilities. Also, artificial intelligence would assist in managing other resources which are useful in the event we encounter health crises through coming up with better solutions regarding; the distribution of other health products in the affected nations, and human resource. As for the function of AI, there is an important assertion that AI will play a very large role in maintaining and wards of public health emergencies [53]. Through these programs, the computers are able to interpret very large sets of data for instance patients' health records, communication data, news feeds and web content in order to produce programs that can detect such risk factors and progression of the diseases. For example, the COVID-19 has been traced, the patterns of the existence of the virus have been followed, as well as the likely health care needs have been forecasted using AI. AI may prove useful in future pandemics because the degree of automation involved with coping with one makes this type of circumstance much easier to manage [54].

Another promising future direction is the integration of AI with wearable's and implantable. Devices like smart watches and glucose monitors, powered by AI, could continuously monitor a patient's vital signs and detect abnormalities in real time. These technologies would not only enhance chronic disease management but could also prevent medical emergencies by alerting patients and healthcare providers to potential risks before they become critical. Collaborations between AI and healthcare professionals will be essential for the future of healthcare [55]. As AI tools become more advanced, they will act as powerful assistants to clinicians rather than replacements. By combining human expertise with AI-driven insights, healthcare providers will be able to make faster, more accurate decisions, enhancing patient outcomes and optimizing treatment strategies [56]. The future of AI in healthcare is filled with immense potential. From advancing precision medicine to improving global health, AI is poised to address many of the most pressing challenges facing the healthcare system today. As AI technologies continue to evolve, they will undoubtedly shape a new era of healthcare that is more personalized, efficient, and accessible for all.

Conclusion

Healthcare is an area that has been infiltrated by Artificial Intelligence (AI) with high levels of possibility in enhancing patient care and service delivery in this industry. It has worked in providing diagnosis, fine tuning the use of drugs for each patient, drug discovery and many more aspects and is being used to redesign methods of delivering care as well as how patients find those services. The proactive expansion of innovative solutions, including diagnostics based on artificial intelligence, virtual assistant for health, and predictive analytics are already actively used and significantly improve the opportunities for early detection of the disease, individual treatment, and organizing the healthcare system more efficiently. Skills of machine learning, deep learning, natural language processing, robotics in surgery, and others that are still considered as the part of AI, expand the possibilities of healthcare. They are designed to change the face of clinical practice providing clinicians with new accuracies, speed and individualization. However, the large-scale deployment of these technologies often encounters problems as follows: integration with other systems, absence of universality, cost, and data privacy and fairness issues. Mitigating these challenges will therefore be crucial to AI's effective integration into the worldwide health delivery systems appropriately.

In future, there are greater expectations to come in the field of applying of AI to health care. It can be expected that AI could significantly contribute to the further development of the concept and practice of the precision medicine targeting to provide patients with specific and personalized care. The opportunity to work on such issues as the global imbalance in health care and helping to solve various global problems related to AI are the exquisite examples of how this technology can operate on the international level. New technologies such as wearable and monitoring devices could benefit from AI in order to move to a more preventive medical care system to alleviate the stress of chronic diseases and medical emergencies. Still there are some obstacles that need to be overcome, advancement in artificial intelligence in the field of medical sciences is all set to open a new era of a better and convenient healthcare system. So, by integrating smarter technologies and innovating healthcare for the future, AI will empower disagreement and enhance patient-focused healthcare for the future world. When thrown with ethical, technical, and regulatory challenges, the healthcare industry can realize the full measure of AI potential, and subsequently, enhance patients' health and revolutionize healthcare systems globally.

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