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ARTIFICIAL INTELLIGENCE: IMPACT ON MEDICAL SCIENCE

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Abstract:

The practice of medicine is changing with the development of new Artificial Intelligence (AI) methods of machine learning. Coupled with rapid improvements in computer processing, these AI-based systems are already improving the accuracy and efficiency of diagnosis and treatment across various specializations. The increasing focus of AI in radiology has led to some experts suggesting that someday AI may even replace radiologists. Our analysis reveals that AI has improved diagnostic accuracy, streamlined clinical workflows, and enhanced patient outcomes. However, we also address concerns regarding data privacy, algorithmic bias, and the need for regulatory frameworks. Ultimately, this paper demonstrates AI's transformative potential in medical science and emphasizes the importance of responsible AI development and deployment. To that end this paper researches the role of AI-based systems in performing medical work in specializations including radiology, pathology, ophthalmology, and cardiology. It concludes that AI-based systems will augment physicians and are unlikely to replace the traditional physician–patient relationship.

Key words: *Artificial Intelligence, Medical Science, Data privacy and ethical concerns.*

Introduction:

Artificial intelligence (AI) has emerged as a game-changer in medical science, transforming the way researchers and clinicians approach disease diagnosis, treatment, and prevention. AI's unique ability to analyze vast amounts of data, recognize patterns, and make predictions has opened up new avenues for medical research and practice. AI is poised to play an increasingly prominent role in medicine and healthcare because of advances in computing power, learning algorithms, and the availability of large datasets (big data) sourced from medical records and wearable health monitors. Big data is also well supported by practically endless storage in the cloud. Learning algorithms are becoming more precise and accurate as they interact with training data, allowing newer insights into diagnostics, treatment options, and patient outcomes. The flood of health care data is helping push the development of new AI applications that promise to the efficiency and effectiveness of patient care. Healthcare related big data is available from Sources such as Electronic Medical Records (EMR) and wearable health trackers, which can be analyzed in new ways. The rise of AI in the era of big data can assist physicians in improving the quality of patient care and provide radiologists with tools for improving the accuracy and efficiency of diagnosis and treatment. AI is well-suited to handle repetitive work processes, managing large amounts of data, and can provide another level of decision support to mitigate errors.

Promise of AI in Medical Science:

As pointed out earlier, several factors have come together recently to support the quickening pace of AI developments in medicine (Pratt, 2018). These include the amount of healthcare data collected in recent years,

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the high-level computing power at low cost now available to process large datasets, the increasing prevalence of EMRs, and overall advances in computing technologies, which have all fueled AI's advancements in medicine (Pratt, 2018). While AI in medicine is still in its early stages, it is well positioned to make positive impacts in clinical medicine. As an example, AI could collect and analyze patient data gathered from multiple sources such as fitness trackers and at-home monitors and enable physicians to monitor patients' health in ways that time and resources without AI would not permit (Pratt, 2018).

Applications of AI in Medical Science:

1. Medical Imaging: AI-powered algorithms can analyze medical images, such as X-rays, CT scans, and MRIs, to detect abnormalities and diagnose diseases more accurately and quickly.
2. Disease Diagnosis: AI-driven systems can analyze patient data, medical histories, and symptoms to diagnose diseases more accurately and at an earlier stage.
3. Personalized Medicine: AI can help tailor treatment plans to individual patients based on their genetic profiles, medical histories, and lifestyle factors.
4. Clinical Trials: AI can streamline clinical trial design, patient recruitment, and data analysis, accelerating the development of new treatments and therapies.

Benefits of AI in Medical Science:

1. Improved Diagnostic Accuracy: AI can reduce diagnostic errors and improve patient outcomes.
2. Enhanced Patient Care: AI-powered Chabot's and virtual assistants can provide patients with personalized support and guidance.
3. Increased Efficiency: AI can automate routine administrative tasks, freeing up clinicians to focus on more complex and high-value tasks.
4. Accelerated Research: AI can analyze large datasets, identify patterns, and make predictions, accelerating the discovery of new treatments and therapies.

Challenges and Concerns:

1. Data Privacy: AI requires access to large amounts of patient data, raising concerns about data privacy and security.
2. Algorithmic Bias: AI algorithms can perpetuate existing biases and disparities in healthcare, exacerbating health inequalities.
3. Regulatory Frameworks: There is a need for regulatory frameworks to ensure the safe and effective deployment of AI in medical science.
4. Clinical Validation: AI-powered medical devices and systems require rigorous clinical validation to ensure their safety and efficacy.

Literature Review:

A systematic literature review (SLR) is an academic method that evaluates all relevant literature on a topic to draw conclusions about a research question. SLRs use transparent and repeatable methods to minimize bias.

Study	Objectives	Design	Results	Quality
AlTehewy,[14] Egypt, 2009	To determine the effect of accreditation on patient satisfaction and provider satisfaction and the impact of accreditation on compliance to some accreditation standards	A prospective cohort study of 60 health units — 30 units already submitted for accreditation and 30 pair-matched units not programmed for accreditation	Mean patient satisfaction scores were significantly higher among the accredited non-governmental health units regarding cleanliness (mean, 81.3 vs. 71.8; $P<.001$), waiting area (mean, 85.7 vs. 73.8; $P<.001$), waiting time (mean, 75.2 vs. 67.8; $P<.005$), unit staff (mean, 90.6 vs. 83.2; $P<.005$), and overall satisfaction (mean, 90. vs. 79.5; $P<.001$).	Good
Barker et al.,[15] 2002, US	To identify the prevalence of medication errors among 36 institutions accredited by JCAHO and non-accredited hospitals	A prospective cohort study	The distribution of error rates by error category was similar between accredited and non-accredited hospitals. There was no significant difference in error rates by accreditation status. Five non-accredited hospitals achieved accreditation status during the study period (7 months).	Good
Beaulieu et al.,[16] 2002, US	To determine the performance of accredited plans on quality indicators and the impact of accreditation on enrollment.	Analysis of databases containing 1996 data on health plans' National Committee on Quality Assurance (NCQA) accreditation status, organizational characteristics, Health Plan Employer Data and Information Set (HEDIS) scores, and patient-reported quality and satisfaction scores.	Accredited plans have higher HEDIS scores but similar or lower performance on patient-reported measures of health plan quality and satisfaction. A substantial number of the plans in the bottom decile of quality performance were accredited suggesting that accreditation does not ensure high quality care. Accreditation was associated with increased enrollment in the early years of the accreditation program; however, plans denied NCQA accreditation do not appear to suffer enrollment losses. NCQA accreditation is positively associated with some measures of quality but does not assure a minimal level of performance.	Good
Brown et al.,[17] 2004 US	To compare concordance of findings of carotid duplex ultrasound scanning between accredited and non-accredited laboratories.	Retrospective review of carotid duplex ultrasound scanning.	In 104 vessels (88 patients) the study from a non-accredited vascular laboratory overestimated the degree of stenosis. In 19 arteries (19 patients) disease severity was significantly underestimated by non-accredited vascular laboratories. The study involved a large number of non-accredited laboratories, but only a few accredited laboratories.	Fair
Bukonda et al.,[7] 2003, Zambia	To describe outcomes of Zambia Hospital Accreditation Program from 1997 to 2000	Data were collected through a review of written documents, interviews with major stakeholders, hospital visits and discussions with implementers	Significant improvement in compliance with standards occurred in overall scores (0–10 score) and in 7 out of 13 functional areas, including the following: Management of information1 (mean, 6.9 vs. 8.8; $P=.030$) Leadership (mean, 5.4 vs. 8.5; $P=.004$) Patient care (mean, 5.8 vs. 8.2); $P=.011$) Admission and assessment (mean, 5.6 vs. 7.9; $P=.002$) Laboratory services (mean, 5.5 vs. 7.9; $P=.013$) Human resources1 (mean, 3.2 vs. 6.9; $P=.0001$) Radiology services1 (mean, 5.2 vs. 6.2; $P=.05$) Overall1 (mean, 4.8 vs. 6.6; $P=.01$)	Good
Chandra et al.,[18] 2009, US	To evaluate the association between the Society of Chest Pain Centers (SCPC) accreditation and adherence to evidence-based guidelines for non–ST-segment elevation myocardial infarction (NSTEMI). The secondary objective was to describe the clinical outcomes and the association with accreditation	Analysis of data from patients with NSTEMI.	Of 33 238 patients treated at 21 accredited hospitals and 323 non-accredited hospitals, those at SCPC-accredited centers (n=3,059) were more likely to receive aspirin (98.1% versus 95.8%; odds ratio [OR], 1.73; 95% confidence interval [CI], 1.06 to 2.83) and B-blockers (93.4% versus 90.6%; OR, 1.68; 95% CI, 1.04 to 2.70) within 24 hours as compared to patients at non–SCPC-accredited centers (n=30 179).	Good

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Research Objective:

This paper attempts to study the scope and significance of technology in Artificial Intelligence.

- **Improve Diagnostics:** Utilize AI algorithms to detect diseases earlier and more accurately through medical imaging, pathology, and genomics and also develop AI-driven predictive models for customized treatment plans based on patient data and genetic profiles.
  - Workflow Optimization: Automate administrative tasks, medical documentation, and patient scheduling to streamline operations and reduce physician burnout.
  - Ethical AI Development: Establish frameworks for ethical AI usage, data privacy, and fairness to ensure responsible AI deployment in healthcare.

Research Methodology:

This paper is entirely based on secondary data. The author has relied on research papers, online news articles, governmental websites, and documents.

Assessing the Impact of AI on Physicians:

In terms of predictive analytics and image recognition, AI may soon become more effective than physicians, who cannot handle millions of images in any reasonable timeframe. This has led to some concern that AI-based systems will replace physicians, especially radiologists. One narrative suggests that AI will interpret even the most complex clinical images as accurately as today's most experienced radiologists and eventually replace radiologists. The contrarian view is that this will not happen; rather AI will augment radiologists but not replace them. There is yet another middle of the road view that at some point in the future AI will indeed replace radiologists, but it is not worth worrying about as that will happen in the distant future. While it is difficult to project the impact of AI on radiologists in the future, Recht et al. provide a nuanced opinion in that "AI will become a routine part of radiologists' daily lives, making their work more efficient, accurate, and valuable". AI-based machines will perform routine reading tasks such as quantification and segmentation and help free up radiologists to "perform more value-added tasks, such as integrating patients' clinical and imaging information, having more professional interactions, becoming more visible to patients and playing a vital role in integrated clinical teams to improve patient care."

AI's impact on data privacy and ethical concerns:

While looking to the future it would be remiss on our part not to assess the impact of AI on the privacy of medical and patient data. As the use of AI in medicine is increasing there is a corresponding increase in new threats to the privacy of healthcare related data A new study from the University of California, Berkeley suggests that progress in AI have rendered the privacy standards set by the Health Insurance Portability and Accountability Act of 1996 (HIPAA) obsolete (Na et al., 2018). It points out that removing healthcare data of identifying information doesn't guarantee HIPAA compliance and this is a matter of concern. Specifically, it is now become possible due to AI to identify individuals by learning daily patterns from data collected by activity trackers such as smartwatches and smartphones, and then correlating it to demographic data (Redmore, 2019; Na et al., 2018). Per the authors, "machine learning successfully identified the physical activity data of most children and adults when using 20-minute data with several pieces of demographic information".

The important conclusion is that privacy standards associated with the 1996's HIPAA legislation need to be revisited and reworked such that the advances of AI and its impact on data privacy as it pertains to healthcare are factored.

It is reasonable to think that as AI makes it easier for companies to gain access to health data the Likelihood of companies using it in unethical ways also increases.

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It may become possible for employers, credit card companies and others to use this AI generated data to discriminate based on pregnancy or disability status, for instance. Another potential example is cited in (Redmore, 2019) where genetics companies are selling customer data to pharmaceutical and biotech firms. The loophole here is that the service provided by companies of providing ancestry related information from DNA does not legally count as a healthcare service and so HIPAA privacy rules do not apply. This opens the door for insurance companies to use genetics data to make biased decisions as they pertain to insuring people and prices of insurance policy premiums.

Future Directions:

1. While predicting the future of AI in medicine is no easy task it can certainly be said that AI has a role to play in medicine as a partner. Responsible AI Development: Developers must prioritize transparency, explain ability, and fairness in AI system design.
2. Clinical Validation: AI-powered medical devices and systems must undergo rigorous clinical validation to ensure their safety and efficacy.
3. Regulatory Frameworks: Governments and regulatory agencies must establish frameworks to ensure the safe and effective deployment of AI in medical science.
4. Public Engagement: There must be ongoing public engagement and education about the benefits and risks of AI in medical science.

Conclusion:

Artificial intelligence has the potential to transform medical science, improving diagnostic accuracy, enhancing patient care, and accelerating research. However, it is crucial to address the challenges and concerns associated with AI in medical science, ensuring that its benefits are equitably distributed and its risks are mitigated.

AI will support the future needs of medicine by analyzing the vast amounts and various forms of data that patients and healthcare institutions record in every moment. AI is likely to support and augment physicians by taking away the routine parts of a physician's work hopefully enabling the physician to spend more precious time with their patients, improving the human touch. While AI is unlikely to replace physicians in the foreseeable future, it is incumbent on medical professionals to learn both the fundamentals of AI technology as well as how AI-based solutions can help them at work in providing better outcomes to their patients. Or, it might come to pass that physicians who use AI might replace physicians who are unable to do so.

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