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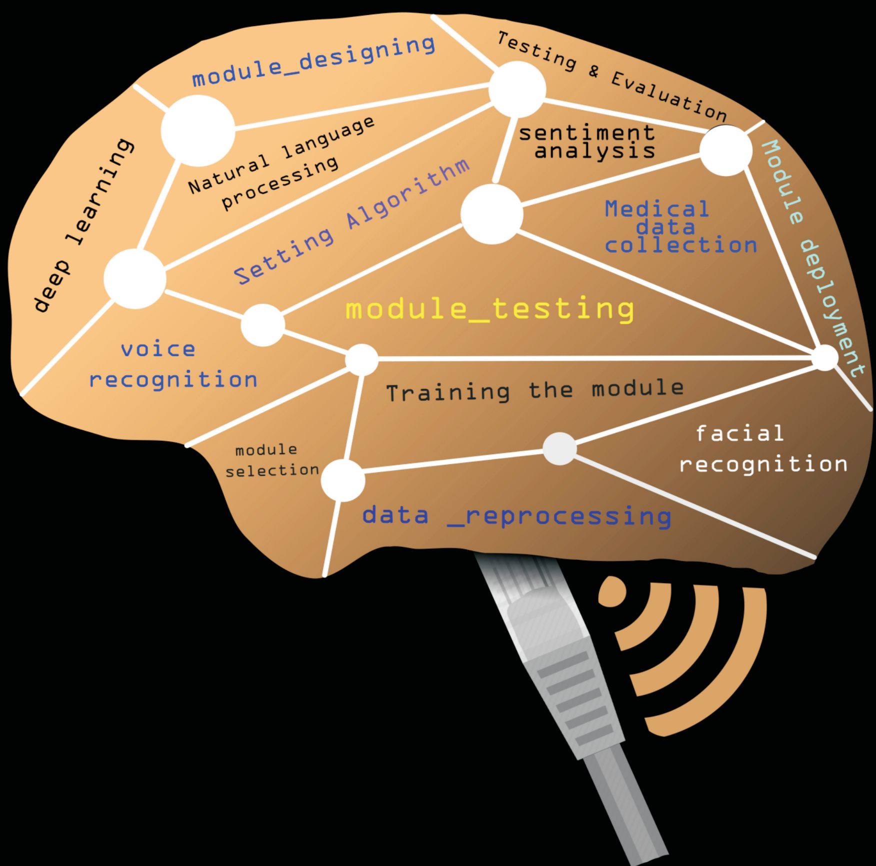
ARTIFICIAL INTELLIGENCE....



An 'e-brain' in Healthcare.

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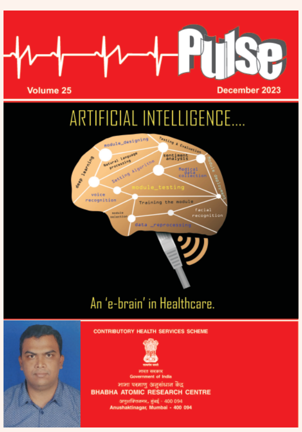

Cover Design by
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Dear Readers,

Artificial Intelligence (AI) in medicine is reshaping the entire spectrum of medical practice. It is useful in preventive and predictive healthcare as well as personalized, participatory treatment plan and follow-up care. It also has the capability of remotely diagnosing patients, thus extending medical services to inaccessible areas.

However, integration of AI in medicine has its own challenges. Medical professionals are often reluctant to use AI due to lack of knowledge and training in this aspect of technology. Digitalisation and electronic health records, although beneficial, has increased the administrative burden on the medical professional. Additionally, there is no legal clarity regarding liability of accepting or rejecting an AI based algorithm recommendation, which leaves the physician vulnerable.

While the future is not entirely predictable, in the backdrop of increased fear of AI replacing doctors, it is important to understand that AI will not replace but merely complement doctors to improve operational efficiency and free up their time. Patients do not merely require a diagnosis but need to interact with healthcare professionals who can read behavioural cues and make observations that will contribute to diagnosis and treatment.

In the recent Himalayan tunnel cave-in incident, 41 workers were ultimately rescued using the manual skills of expert rat miners after unsuccessful attempts with advanced machines. This emphasises that no technology, machine or AI can replace human instinct and skills.

This issue of Pulse gives a 360° view of AI in various specialties of medicine.

Happy reading!

Shrividya

Dr Shrividya Chellam
Chief Editor, Pulse

Dear Readers,

Greetings ! It is always a pleasure to connect through the HMD's desk of PULSE.

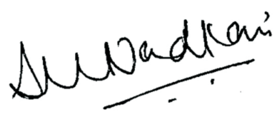
The Medical Division has been providing advanced medical care through use of latest technology and infrastructure. We have come a long way from initial stage of five dispensaries and indoor hospitalization facilities at J J Group of Hospital, to eleven dispensaries, three occupational health centres and Multispeciality Hospital at Anushaktinagar. With the commissioning of the new hospital building, the medical care extended to the CHSS beneficiaries will soon include superspeciality care like cardiology, cardiovascular surgery, neurology and interventional radiology to name a few.

The next logical step will be the use of Artificial Intelligence (AI) and machine learning. AI in its varying forms is already in use as computer system applications like hospital information system. AI is also in use - in end to end drug discovery and development, to diagnose, to communicate with patients and remotely treat patients. It is only a matter of time before humans will be completely replaced in certain roles within the medical science by AI.

However, are we losing the human touch in patient treatment, the clinical acumen and empathy provided by direct contact with the patient without the interference of AI and computer technology?

This is an ongoing debate as medicine is an 'art based on science' as said by William Osler, Professor of Medicine, Johns Hopkins School of Medicine wherein a physician's individuality interacts with that of a patient's individuality.

We are a long way from AI based services being developed which are personalized to suit individuality of the patient, till such time the debate continues......



Dr Snehal U Nadkarni

Head Medical Division

From Data to Decisions: Ethical Reflections on the Adoption of Artificial Intelligence in Modern Medicine

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As medicine continues to evolve, its integration with Artificial Intelligence (AI) holds tremendous transformative power to enhance patient care, clinical decision-making, and overall healthcare outcomes. With its ability to analyze vast amounts of medical data, identify patterns and generate insights, AI offers medical practitioners innovative tools to navigate the complexities of modern healthcare. From diagnostic accuracy and personalized treatment plans to administrative streamlining and drug discovery, the application of AI in healthcare has countless possibilities.

However, the powerful convergence of AI and healthcare also raises ethical considerations regarding bias mitigation, patient data privacy, informed consent, algorithm transparency and equitable distribution of AI-enhanced healthcare services. By carefully understanding these ethical complexities, healthcare professionals and technologists can harness the growing potential of AI to advance patient care while upholding the values that define compassionate and responsible medical practice. This involves rethinking and restructuring the standard principles of AI algorithm deployment by prioritizing the alleviation of ethical concerns.

The purpose of this article is to explore some of these ethical considerations accompanying the integration of AI in the field of medicine, specifically - algorithmic fairness, privacy and explainability.

Algorithmic Fairness

The goal of algorithmic fairness is to ensure that the outcomes, decisions and recommendations produced by AI systems do not perpetuate or exacerbate existing biases, inequalities, or disparities present within healthcare systems. This goal is inherently complex as it involves subjectivity in the definition of fairness. It leads to certain important concerns while designing AI systems for healthcare, such as - 'What should fairness mean?', 'Is ensuring fairness with respect to an individual the same as ensuring fairness with respect to a group?' A group refers to a set of individuals who share a common characteristic such as race, gender, economic background, demography, geography etc. Furthermore, 'Even if the perfect notion of fairness is found, how should it be enforced?'

An obvious question that comes to mind is why standard machine learning techniques when deployed directly should lead to outcomes which are unfair? While there are multiple explanations for the same, there are some which are widely known. Firstly, bias could be encoded in the data. Consider an AI model designed to diagnose skin diseases from medical images, such as photographs of rashes or lesions. The model is trained on a dataset containing images of patients from various sources, including hospitals and clinics. In this scenario, an example of bias being encoded in the data could be the overrepresentation of lighter skin tones in the training data, leading to a situation where the AI model's predictions are unfair and less accurate for individuals with darker skin tones.

Secondly, different groups can have significantly different distributions. It is possible that features are less predictive on some groups as opposed to other groups. Consider an AI model designed to predict the risk of heart disease in patients based on various health indicators. The model is trained on a diverse dataset that includes individuals from different demographic groups, including both men and women. Imagine a scenario in which a specific health indicator 'X' is more strongly correlated with heart disease risk in men compared to women. The unequal predictive strength of a certain feature for different groups—stronger for men compared to women can lead to a situation where the AI model's predictions are less accurate and fair for female patients.

Lastly, it is possible that some groups are inherently less predictable. Consider an AI model trained on a diverse dataset, designed to assist in diagnosing mental health disorders. It is commonly known that individuals from culturally distinct groups may express symptoms of mental health disorders in ways that are not well-captured by standardized assessments. Cultural norms, beliefs and communication styles can significantly influence how symptoms manifest and are reported. Thus, the inherent unpredictability of symptom expression among culturally distinct groups can lead to a situation where the AI model's predictions are less reliable and equitable.

Some of these scenarios can have relatively 'simple' solutions such as collecting more representative data or including features which are more predictive on all groups, which in itself is a challenging and expensive process. While some algorithms such as 'bolt-on' post-processing methods (introducing randomization to ensure fairness) have been proposed by researchers, other scenarios are more complex to solve and are still open areas of research.

Since it is evident that there is a need to augment standard principles of AI algorithm deployment to account for algorithmic fairness, we revisit the process of defining 'fairness'. Based on the vast majority of work done on fairness in machine learning, various definitions of fairness can be divided into two broad categories: statistical definitions and individual definitions. Statistical definitions focus on fixing a small number of protected groups (such as race) and defining fairness as the equality of a statistical measure across all the subgroups (Asian, Hispanics, African American - not an exhaustive list) in the identified group. Example of such a statistical measure in healthcare could be the False Positive Rate of a medical diagnosis. Fairness, in this case, would mean that the probability of incorrectly diagnosing the presence of a disease should be approximately equal across all subgroups.

Individual definitions of fairness focus on satisfying each person's perspective of fairness. Algorithmically, this can be viewed as a constraint satisfaction problem in which each person's perspective of fairness is a constraint which must be satisfied while we improve the performance of our AI model. Satisfying individual definitions of fairness is an open research question because it does not scale well. This means that the feasibility of simultaneously solving each of these fairness constraint satisfaction problems reduces as the number of individuals involved increases.

Till date, more research has been done on the statistical definitions of fairness due to its comparatively lower complexity and simpler validation. The first step is to identify which groups or attributes we wish to 'protect' when we deploy our algorithm. By protect, we mean that we want to identify which are the vulnerable or minority groups in our dataset. The next step focuses on defining what constitutes 'harm' in a system. As an example, in case of medical diagnosis, harm with respect to fairness could be a higher misprediction of the absence of a disease in a certain group in a population (referred to as False Negative Rate). Comprehending a definite notion of harm should be an essential component of the medical problem statement for which an AI solution is being developed.

There are a few challenges involved in statistical definitions of fairness. Firstly, what makes achieving fairness challenging is the subjectivity involved in defining 'protected groups' as well as 'harm'. Secondly, the concept of intersectionality - when a person can belong to more than one minority subgroup (such as race: Asian and gender: Female), adds to the complexity of the problem as now the definition of fairness must hold over all subgroups the individual belongs to. Thirdly, there are certain cases in which the violation of statistical definitions, does not necessarily mean unfairness. For example, in shared decision-making scenarios, patients' preferences play a significant role in treatment choices. AI algorithms might need to prioritize recommendations based on patient preferences even if it leads to varied outcomes across different groups.

Exploring algorithmic fairness in healthcare AI has revealed an essential crossroads where technology and ethics meet. By acknowledging the nuanced facets of fairness, we can aim to innovate more responsibly.

Privacy

The healthcare industry generates an enormous amount of patient data. AI-driven algorithms and models excel at extracting meaningful insights from this large amount of data. However, utilizing patient data such as medical records, images, genetic information and wearable device data, for research can lead to data leakage and loss of privacy of the patient. Simple anonymization of patient data does not suffice as multiple data sources can be linked to de-anonymize data related to a patient. The concept of differential privacy tackles this very issue. Differential privacy aims to protect the sensitive information of individuals while allowing useful insights to be extracted from data. It provides a way to ensure that patient data used in medical research and analysis remains confidential and secure.

Consider an example in which a large set of patient health records are to be used for medical research. With differential privacy, before this data is released or used, a controlled amount of 'noise' or 'randomness' is added to the data in a way that makes individual patient information indistinguishable. This means that any specific patient's information is hidden within the noise. It's important to note that achieving the right balance between privacy and data utility (accuracy of results) requires careful parameter tuning.

Therefore, understanding differential privacy can help medical professionals appreciate the importance of safeguarding patient information while still contributing to medical advancements through responsible data sharing and analysis.

Explainability

Ensuring explainability when AI is employed in healthcare is crucial for building trust and confidence among medical professionals. In the context of healthcare, explainability refers to the ability to understand and interpret the reasoning behind AI-generated recommendations and decisions. By utilizing AI models that provide clear explanations for their outputs, medical professionals can comprehend how the algorithm arrives at a particular diagnosis or treatment suggestion. Techniques such as interpretable machine learning algorithms, feature visualization, SHAP (SHapley Additive exPlanations), LIME (Local Interpretable Model-agnostic Explanations) etc. can help reveal the factors influencing an AI-generated outcome. This will help physicians in assessing the reliability of AI recommendations and making informed decisions. By prioritizing explainability, the medical community can leverage AI as a valuable tool while upholding the human expertise and ethical considerations that define patient care.

Consider an example in which a hospital has implemented an AI system to predict the likelihood of patient readmission within 30 days after discharge and to ensure explainability, the AI model has been deployed along with LIME. LIME works by generating local explanations for individual predictions made by the AI model. For a specific patient's case, the AI system might predict a high likelihood of readmission. With LIME, the system identifies a subset of features from the patient's electronic hospital record that were most influential in driving that prediction. It then constructs a simpler and interpretable model that shows the impact of each factor on the predicted outcome. This information is presented to the healthcare provider along with the AI's prediction. This explanation can be used by physicians to better understand why the AI predicted a particular outcome. They can see which patient attributes were significant and how they contributed to the risk assessment. Thus, by integrating explainability, AI becomes more transparent and accessible to medical professionals, facilitating collaboration and enhancing the overall quality of patient care.

In summary, the integration of AI and medicine promises a groundbreaking journey ahead. However, this convergence demands a careful consideration of its ethical ramifications.

As research continues and even though several questions are yet to be answered, it is certain that striking a balance between innovation and ethics is imperative. Safeguarding patient privacy, ensuring fairness, and prioritizing explainability are not just checkboxes; they define the conscientious application of AI in medicine. By weaving ethics into the AI-medical narrative, we ensure that progress and compassion walk hand in hand, paving the way for a future where cutting-edge technology and unwavering medical ethics coexist harmoniously.

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Application of Artificial Intelligence in Primary Care

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Dr Uday Thakre

Introduction

Artificial intelligence (AI) is poised as a transformational force in health care, including primary care.

Artificial Intelligence AI is a machine programmed to do something that a human might do for example, reminding a clinician that magnetic resonance imaging might be inappropriate for uncomplicated low back pain when it is ordered in the electronic health record (EHR). Many EHR alerts and clinical decision support tools fall under this category of "classic" AI.

Machine learning (ML) This uses algorithms that allow computers to learn from examples. Every time a machine encounters similar examples, it improves on its ability to perform the task without being specifically programmed for it for example, computers that can predict which patients are at risk for unplanned intensive-care unit transfers, preventable hospital-acquired conditions, or unnecessary hospitalizations and emergency department (ED) visits.

Deep learning (DL) This uses algorithms designed to mimic the human brain (also known as artificial neural networks) to vastly increase the computer's learning potential, even allowing it to teach itself, without the need for explicit programming. For example, computers that can analyse radiology images, pathology slides, dermatology photographs, or even a patient's physical movements and provide differential diagnoses.

Ways by which AI can transform health care

Risk Prediction and Intervention AI can take health record of entire population and calculate risk to patient based on HER data. Understanding risk at individual level allows health system to devise team-based intervention in the primary care setting to engage patients at highest risk and reduce preventable ED visits, hospitalizations and death.

Population health management AI can assist with identifying and closing care-gaps using semi-automated systems that can reach out to patients and help in cancer screening and other preventive services.

Medical advice and triage AI can triage patient complaints and free up primary care access for more appropriate care. Chatbots can provide advice for common medical symptoms.

Risk adjusted panelling and resourcing AI can ensure that clinician have time slots adjusted to address the needs of each patient based on complexity.

Remote patient monitoring AI can organize large amounts of data coming from smart devices to provide actionable clinical insights-often paired with digital health coaching.

Digital health coaching AI powered tools can help patients self-manage some of the costliest diseases, such as diabetes, obesity, hypertension, depression.

Chart review and documentation AI can listen in on patient-clinician conversations and generate a note, like a human scribe.AI can read note and extract insights from unstructured data.

Diagnostics AI powered algorithms for diagnosing disease can broaden the services of primary care physicians (PCP), reduce the need for unnecessary referrals and expand the access to specialty care in regions which lack it.

Clinical decision making AI assist, built into EHR platforms, can give physician evidence based clinical suggestions at the point of care.

Practice management AI can automate repetitive administrative tasks like billing, coding, and prior authorizations; it can also automate certain aspects of inter-visit care planning and management.

Key Limitations and Ethical Pitfalls of AI

Coded Bias Like any data-powered tool, AI is vulnerable to bias and abuse.

Non generalizability AI models often score well on statistical tests of accuracy but perform surprisingly poorly in real-world clinical settings.

Profit-Driven Design Some technology companies may prioritize profit over the common good, and their algorithms may create major unintended consequences.

Primary Healthcare can take a lead in Utilising AI

Primary Care Is the Dominant Force at the Base of the Health Care Pyramid

With more visits per year to of all clinician office visits, more than all other specialties combined, primary care is where the power, opportunity and future of AI are most likely to be realized in the broadest and most ambitious scale. PCPs represent the single largest group of AI end users among health care professionals; therefore, PCPs have the most to gain, as well as the most to lose, in the coming era of innovation.

The 4 Cs of Primary Care

First Contact: The first contact patients make with the health system is with primary care. AI applied upstream has the best chance of making the most impact on people's lives and also creating positive ripple effects downstream.

Comprehensive From cradle to grave, from outpatient to inpatient, from delivering babies to minor surgeries, PCPs are subject matter experts in nearly every domain of medicine

Coordinated PCPs are the backbone of the health care team, with interconnectedness to every specialty and can use AI very well.

Continuous Unlike most other specialties, primary care physicians see patients over decades. AI applied alongside continuous rather than episodic care has the best chance of earning patients' trust, sustaining patient engagement, and improving long-term outcomes.

Primary Care Physicians Have Deep Relationships with Patients and Communities

Health care is fundamentally a social enterprise and PCPs are best positioned to answer patient concerns about AI, build confidence in new technologies over time, and play the role of a trusted champion for both patients and AI.

Ensuring That AI is Relevant and Human-Centred

PCPs can lead by working with technology developers to bring their most promising AI solutions from code to bedside. They can keep industry focused on human-centred solutions, while demanding that AI be designed around augmenting human capabilities and supporting human-driven models of care delivery, rather than replacing human providers or subverting human relationships that lie at the heart of healing.

Using Quality Improvement Methods to Implement AI in Health Care Settings

Health systems can drive AI innovation by empowering PCPs to engage in translation and implementation work supported by multidisciplinary teams of improvement experts, clinical information, and data scientists through quality improvement programs and institutional value-based funding sources.

Advocating for Equitable and Accountable AI

PCPs can lead by applying a health equity lens to every AI implementation, asking: “Who might be left behind, or harmed, with this AI solution?” Health systems and technology companies should establish health equity advisory councils to audit and correct race, gender, and socioeconomic biases in their algorithms.

Conclusion

Primary care as the dominant force at the base of the health care pyramid, with its unrivalled interconnectedness to every part of the health system and its deep relationship with patients and communities, is the most uniquely suited specialty to lead and participate in the health care AI revolution.

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Exploring The Role of AI In Anaesthesiology.

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Dr Pritee Bhirud

Artificial Intelligence (AI) refers to the development of computer systems and software that can perform tasks that require human intelligence, like understanding natural language, recognizing patterns, solving complex problems, making decisions, and learning from experience.

AI uses algorithms, which are sets of instructions. These algorithms help computers understand information, find patterns, and make decisions. AI can assimilate a huge amount of data quickly, much faster than humans, and make predictions or perform tasks from the data and algorithm.

The use of AI in anaesthesia has the potential to enhance patient safety, improve efficiency of anaesthesia administration, and optimise patient outcomes. [1]

AI can be divided into two main categories:

Narrow AI (Weak AI) is designed for a specific task or limited set of tasks examples include virtual personal assistants like Siri and Google, image recognition software, and recommendation algorithms on streaming platforms.

General AI (Strong AI) It is also known as AGI (Artificial General Intelligence), is a theoretical form of AI that possesses human like intelligence and can perform any intellectual task that a human being can such as understand, learn, and apply knowledge.

AI technologies include a wide range of techniques and approaches, such as machine learning, deep learning, neural networks, natural language processing, computer vision and robotics. Let us understand these terms and their uses in anaesthesia-

Predictive analytics is a way of using math and computer programs to analyse patterns and trends in data to make predictions about the next step in sequence.

In anaesthesia, AI can predict patient responses to anaesthesia drugs and hence help anaesthesiologists tailor dosages and techniques for individual patients and minimise risks and complications. Predictive analysis can help in recognising, counselling, planning and anaesthesia management of patients with multiple and rare co morbidities. [2]

Machine learning (ML) is teaching a computer to learn from data and make predictions or decisions without programming, similar to how humans learn from experience. ML can be classified broadly into -supervised, unsupervised, and reinforcement learning. [2]

In anaesthesia, ML analyses data and uses it to prepare optimised anaesthesia plans.

Deep learning is a type of ML, for computers to learn and make decisions from data. It uses artificial neural networks, inspired by the way the human brain works

In anaesthesia neural networks are used in imaging analysis in monitoring and USG applications. It has also been used to predict post-surgical mortality. [3,4]

Natural Language Programming Natural language processing is a subfield of AI that focuses on machine understanding of human language.

In medicine, the most common application of natural language processing is to automated analysis of electronic health record data. These can be further analysed to identify surgical candidates, assess for adverse events, or to facilitate billing. [1,2,5]

Computer vision Computer vision refers to machine understanding of images, videos, and other visual data (e.g., computed tomography).

In anaesthesiology, computer vision has largely been applied to the automated analysis of ultrasound images to assist with identification of structures during procedures. [1,2]

Drug Discovery and Development The drug discovery and development is time-consuming and costly, but AI-driven algorithms can analyse vast databases of chemical compounds and biological data to identify potential drug candidates. This accelerated drug development, makes it possible to bring new treatments to market faster and at a lower cost. Additionally, AI can optimize clinical trial designs, helping researchers identify suitable candidates and predict patient responses more accurately.

Pre anaesthesia evaluation AI has been used for risk stratification as well as predicting post-surgical mortality. Airway assessment via AI has been successful in correctly predicting the Cormack–Lehane view on direct laryngoscopy with analysis of face and neck. [3,6] AI can help create personalized anaesthesia plans based on a patient's unique medical history, genetics, and response patterns. This individualized approach can reduce the risk of complications and improve recovery times.

Intra operative management

Monitoring vital signs AI-powered monitoring systems can continuously track vital signs during anaesthesia, providing real-time feedback to anaesthesiologists. These systems can detect anomalies or trends that might go unnoticed to humans, allowing for early detection and immediate intervention in case of complications. Intraoperative cognitive robots can be integrated into alarm systems for simultaneous analysis of several parameters thereby lowering the rate of false alarms and reducing alarm fatigue in clinicians. Intraoperative analgesia-nociception monitors are available to titrate opioid administration based on changes in the sympathetic and parasympathetic systems. [7]

Automation of routine tasks AI can automate routine tasks in anaesthesia administration, such as monitoring vital signs, adjusting anaesthesia levels, and maintaining patient records. This automation enables anaesthesiologists to focus on critical decision-making and patient care.

Reducing human error AI systems can help reduce the risk of human error during anaesthesia administration by providing reminders, alerts, and double-checks to ensure that proper procedures are followed and hence minimising mistakes.

USG is largely used to perform safe and efficient regional anaesthesia. However, nerve tracking and accurate needle localization remains an ongoing challenge due to artifacts, anatomic structure variability and experience of the anaesthesiologist. The role of augmented reality (AR) to detect anatomical landmarks during simulated epidural anaesthesia was investigated; the USG transducer and the needle were viewed in a 3D-augmented environment, and the epidural space was identified using a single-element transducer at the needle tip in all the cases accurately.

Various other examples include the ML model XG Boost used to predict the sedation required for colonoscopy with AUC of 0.7. [3]

ML algorithms such as the ANI index (antinociception index) is used to quantify nociception level and anticipate a dose change in opioids to prevent hemodynamic events before they happen. [3,7]

·Various ML tools such as Prescience and HYPE are being studied to predict intra operative hypoxemia and hypotension respectively. [3]

Robots in anaesthesia A robot is a mechanical system capable of interacting with the environment according to directed interventions. They support clinicians with automating tasks and offer recommendations for clinical decision making.

Pharmacological robots Target controlled infusion (TCI) systems are the first-generation open-loop pharmacological robots. Their in-built software has pharmacokinetic models of different drugs, based on which they deliver loading doses to achieve and maintain specific plasma drug levels. They display estimated plasma and effect-site concentrations, which may differ from the actual concentrations, depending on anthropometry and racial differences. [9]

Initial models of TCI were single input single output (SISO) systems. Recent advances have developed multiple input multiple output (MIMO) robots, addressing hypnosis (BIS guided), analgesia, and muscle relaxation (nerve stimulator guided) simultaneously as feedback for drug delivery. [9]

Mechanical Robots The first robotic intubation was done using the Da Vinci surgical system. The Kepler intubation

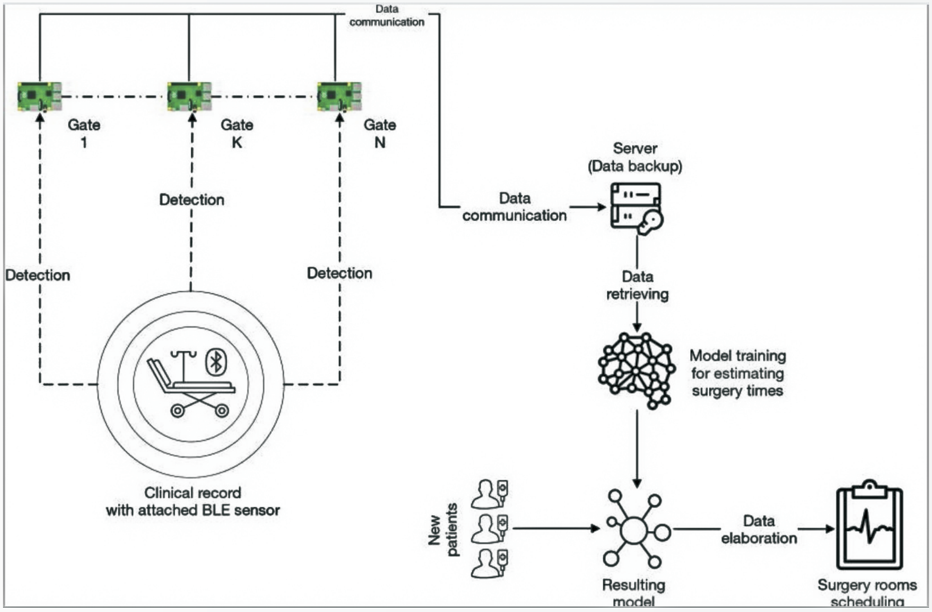

Fig. 1:Indoor tracking of patients with machine learning

system consists of a single robotic arm controlled by a joystick to guide endotracheal intubation remotely. Successful intubation within 40–60 seconds was demonstrated in 90 simulated cases. For regional anaesthesia, the Magellan system has been developed with a block needle mounted on a robotic arm. It also incorporates custom software for ultrasound-guided nerve recognition. The system was found to decrease variability among operators in the time taken for correct needle placement.[2]

OR management

Surgery is one of the most expensive items of hospitals, and making best use of resources such as doctors, paramedical personnel, instruments and operating rooms is of paramount importance. Optimization of resources is not only an economical issue but also entails safety and quality of work performed. Despite all considerations the uncertainty which is unique to the field of medicine needs accounting too. ML appears to be useful for carrying out three important tasks in OR management: surgical cases cancellation identification, occupation of the PACU and estimation of surgical case duration. The combined use of new technologies, such as ML, intelligent sensors and tracking systems, can have a further significant impact on both patient quality and safety.[3]

Refer to Logical architecture diagram of indoor tracking of patients with ML [Fig.1]. BLE sensors worn by patient are detected using Raspberry Pi v4 modules, positioned in each OR and recovery room. All data flows into a single server that will be used to create an intelligent scheduling model of surgical procedures using AI techniques. BLE, Bluetooth low energy; AI, artificial intelligence.

Post operative care AI applications in the postoperative period includes monitoring and predicting potential complications. This early detection can lead to faster response times and improved patient outcomes. Investigators have developed a ML algorithm for quantifying breathing patterns as ataxic or irregular to help with prediction of respiratory depression in the postoperative period. Advances in telecommunication have led to the development of wireless intelligent patient-controlled analgesia for feedback-enabled pain management in surgical homes. [8]

Research and training AI with the aid of data analysis and simulations, assist development of advanced anaesthesia techniques and protocols. It can also contribute to the training of future anaesthesiologists by providing realistic scenarios for practice and learning.

Challenges and Ethical considerations

Along with the advantages of AI there are challenges and ethical considerations to address:

Data Privacy and Security- AI systems rely on patient data; robust measures must be in place to protect patient information.

Bias and Fairness- AI algorithms should be carefully designed and trained to avoid bias, as biased algorithms could lead to unequal treatment and outcomes for different patient groups.

Regulatory Compliance Stringent medical regulations and standards must be complied with while Integrating AI into anaesthesia for patient safety.

Human Oversight Despite automation, the role of the anaesthesiologist in decision-making and oversight remains paramount. It's important to strike a balance between automation and human expertise.

AI systems are expensive to initiate and maintain, also over reliance on them can cause depersonalisation of patient care.

To conclude, AI has the potential to significantly enhance the safety and effectiveness of anaesthesia administration in healthcare. By utilising AI's capabilities in predictive analytics, monitoring, and personalized care, the field of anaesthesia can take a significant step ahead in improving patient outcomes and reducing complications during surgeries. However, careful attention to ethical considerations and regulatory compliance is essential to ensure the responsible and safe integration of AI in anaesthesia practices.

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Artificial Intelligence In Surgery: A Surgeons Perspective

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Artificial intelligence (AI) is defined as the development of algorithms that give machines the ability to act with human-like rationality in complex tasks, such as problem-solving and decision-making, and is poised to reshape medicine and surgery broadly. Algorithms give machines the ability to solve problems, recognize words and visual aspects within images, and make predictions based on statistical inferences. In medicine, AI is able to review large amounts of data from patient records, radiological scans, or surgical videos, and use that information to detect, classify, and predict. [1] In recent years, decision support systems based on AI algorithms are receiving considerable attention in the literature. [2,3,4] Most often, AI is used to recognize patterns, classify images, or detect objects by analyzing digital images or videos through a process called "computer vision." Not surprisingly, the technology's biggest impact has been in the diagnostic specialties, such as radiology and pathology. AI also could reduce the need to have a nurse on call by providing a chatbot to answer patient questions like , a patient who wakes up at 1:00 in the morning after a surgical operation can contact the chatbot to ask, "I'm having this symptom, is this normal?". This technology will make hospital and health system operations more efficient, less costly and help address stresses such as workforce shortages. For example, by estimating how much time is left in the surgery, AI will help hospitals plan their available hospital bed resources and more accurately inform the patient's family when the surgery might be completed.

AI can improve patient care by analyzing large amounts of data to help make more informed decisions regarding treatments. It can help enhance surgical decision-making before, after, and even during a surgical procedure by integrating information from many different data sources such as the latest surgical guidelines or research. It has the capability to review patient charts and suggest a test or a medication.

AI and machine learning offer the potential to tap large, complex data pools to develop robust predictive algorithms. By analyzing millions of historic surgeries along with patient characteristics, AI will help surgeons stratify the risks of a particular surgery for a specific patient. During surgical procedures, AI can be utilized to provide real-time guidance, helping in decision-making and minimizing the risk of complications. AI can be used in decision-making through its ability to analyze vast datasets from past surgeries, identifying patterns and trends to best improve modes of action and thereby subsequent outcomes. Thus, surgeons can make better-informed decisions and improve patient care.

In the future, AI can be used for controlling robotic surgical instruments, allowing for more widespread application of minimally invasive surgery. Most AI and robotic surgery experts seem to agree that the prospect of an AI-controlled surgical robot completely replacing human surgeons is improbable. After all, AI is intended to augment the surgeon's decision-making and execution skills, not replace them.

While AI has the potential to enhance traditional teaching methods, it is important to recognize that it will never completely replace the role of human instructors. It will serve as a supplement to traditional teaching methods, helping to improve the learning experiences for surgeons in training, but the human instructor is and remains crucial for the training process. AI is especially suited to simulation-based training. Simulation-based training has become essential to surgical education, improving both confidence and performance of trainees. By using virtual reality or other simulation technologies, AI can provide a realistic and safe environment for surgical residents and other trainees to practice and hone their technical skills. Simulation-based training allows trainees to gain experience and confidence in performing procedures without the risk of harm to actual patients

AI-powered image analysis tools can be used to identify and track surgical instruments and structures within the body, providing real-time guidance to the surgeon during the procedure. These tools can also assist in the identification of unexpected intraoperative events or complications, allowing the surgeon to take appropriate action in a timely manner. AI can also assist in the development of machine learning algorithms that can analyze data from past surgeries to identify patterns and trends, allowing for more personalized and evidence-based approaches to surgical planning and execution.

The Perils of AI: Accountability, Trust Issues, Data Bias

Although AI entails numerous benefits and improves medical education, it is not without limitations. Inspite of all its enormous potential in surgery, it also poses a variety of ethical, legal, and regulatory issues.

Further, AI is far from ready for independent operation, requiring lifelong guidance for proper medical application. AI may also currently lack the ability to detect conversational cues, which may help in guiding communication to individual levels suited for best delivering the information to each patient in a personalized way. Artificial intelligence needs large amounts of data for machine-learning to enable robust decision-making. In some surgical specialties, the number of specific diagnoses is limited, hampering the application of machine-learning

in given situations. For machine learning algorithms to learn and improve their performance, they require large amounts of data. It can be difficult to collect and label these data accurately, possibly impacting the performance of the AI system. There are ethical considerations to consider when using AI in surgical learning. There is a potential for bias in the data used for training the system, and the potential for the AI system to make decisions opposite to that of the surgeon or patient. Therefore, while AI can assist the surgeon in learning and improving, surgeons must be strong within the knowledge component and maintain decisive roles within patient care. Further, the surgeon may find it challenging to understand how the AI system arrived at a particular decision or recommendation. In addition, it is central that the AI systems are highly reliable and safe, as any errors could have catastrophic consequences, posing challenges when the AI system is learning and adapting. As the readiness of an AI system using machine learning depends on the specific application and the needs of the user, the implementation needs to be gradual and individual. There are several factors to be considered when determining readiness, of which the most important are safety, robustness, explainability, and ethical considerations.

In conclusion, the use of AI in surgical learning has the potential to significantly improve patient care by enhancing the efficiency and effectiveness of surgical training. There is a need for more systematic analysis of the current literature on AI in the field of surgical learning, and it is important to ensure that large datasets are used in a manner that provides context for interpretation and considers the clinical implications. While machine learning may not yet be at the same level as human learning, it can be used to augment our cognitive abilities and allow us to focus on more complex and creative tasks. It is important to use AI appropriately and not become overly reliant on it, as it should be viewed as a tool to enhance rather than replace human learning.

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Could Robotic Drills Replace Human Skills?

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Introduction

Artificial intelligence (AI) is forging a revolution in myriad industries including the healthcare sector, thereby improving experiences for clinicians and patients akin. The spectrum of AI ranges from diagnosis & treatment planning to education and prevention. The first global report on AI, titled ethics and governance of artificial intelligence for health, was issued by World Health Organization in 2021. It stated that the principles of design and use of AI in healthcare are to improve the speed and accuracy of diagnosis and screening for diseases; to assist with clinical care; strengthen health research and drug development, and support diverse public health interventions, such as disease surveillance, outbreak response, and health systems management. [1] AI is a part of predicted future in which dentistry will transform into cutting edge avatars to effectively fight disease such as dental decay, periodontal inflammation, oral potentially malignant lesions etc.

The various types of AI technology include Machine-Learning, Neural Networks (ANN), Computation, Vision Robotics, Expert Systems, Speech Processing and Natural Language Processing. AIs are commonly categorized into three types: artificial narrow intelligence (ANI), artificial general intelligence (AGI), and artificial super intelligence (ASI) (Fig 1). ANI, known as weak AI, do not perform outside the single task for which they are designed. Presently, in dentistry, ANI works in cone beam computed tomography (CBCT), digital scans of occlusion, that are suitable for more complex AI implementations. AGI known as "strong" or "deep AI" is about as capable of solving problems as a human. ASI will exceed human capabilities and will be able to learn and improve itself beyond our comprehension.[2]

This article will provide a gist of the potential applications of AI in dentistry, the benefits it offers and the challenges it presents on the horizon of becoming seamless with our practices. (Table 1)

Clinical Information System (CIS)

Management of information in a dental office includes storing and using information generated while recording case history, relevant medical history, habits, genetic predisposition, treatment offered, outcomes of treatment, tangible or intangible benefits etc.[3] Pearl is an FDA approved system wherein the AI optimizes patient bookings and recalls when hooked into a practice management software, that can be used across total healthcare systems. With CIS, robotic process automation solutions have the potential to enhance accuracy in patient treatment, provide quick access to information, minimize human error and streamline work flows. [4]

Image Analysis and Interpretation

Convolutional neural networks (CNN), as a part of deep learning, have been successfully employed to assess dental images e.g., landmark detection, tooth classification or restoration segmentation on photographs, radiographs or surface scans as well as pathology detection on radiographic, trans-illumination or photographic imagery. [5] CNNs are used clinically for, apical lesion detection, detection of root fractures, detection of periodontal disease, cystic lesions, caries detection, staging of lower third molar development, tooth detection, diagnosis of jaw lesion, and other pathologies detection. [6] Currently available systems such as Diagnocat, Relu, Promaton, Velmeni, Dentbird, Ceppro, Orca etc. are powered by AI algorithms for 3D X

Table 1 Applications of Artificial Intelligence in dentistry

Application of AI in Dental Care	Description
Clinical Information System	Analysis, of patient dental records, by algorithms to assist dentists in reaching moreaccurate diagnoses and develop tailor made customised treatment plans. One size fits all is not relevant anymore
Image Analysis and Interpretation	Analysis and interpretation of 2D and 3D dental x-rays and CT scan images, to identify deviations from normal, helping dentists stay *au courant*.
Predictive Analytics for Disease Prevention	Analysis of patient records to establish patterns and predict the likelihood of certain dental diseases, enabling more effective intervention and prevention.
Virtual Reality Simulations for Patient Education	Provides patients with an interactive and riveting experience to better understand various dental procedures and their potential outcomes, thus reducing patient anxiety and imparting educational
Dental Robotics	AI-powered dental robots can perform simple and repetitive tasks such as cleaning and polishing teeth, freeing up dentists to focus on more complex procedures.
Automated Patient Communication	AI-powered chatbots and voice assistants provide patients with 24/7 access to information about dental care, treatment options, and appointment scheduling, reducing wait times and improving patient satisfaction.

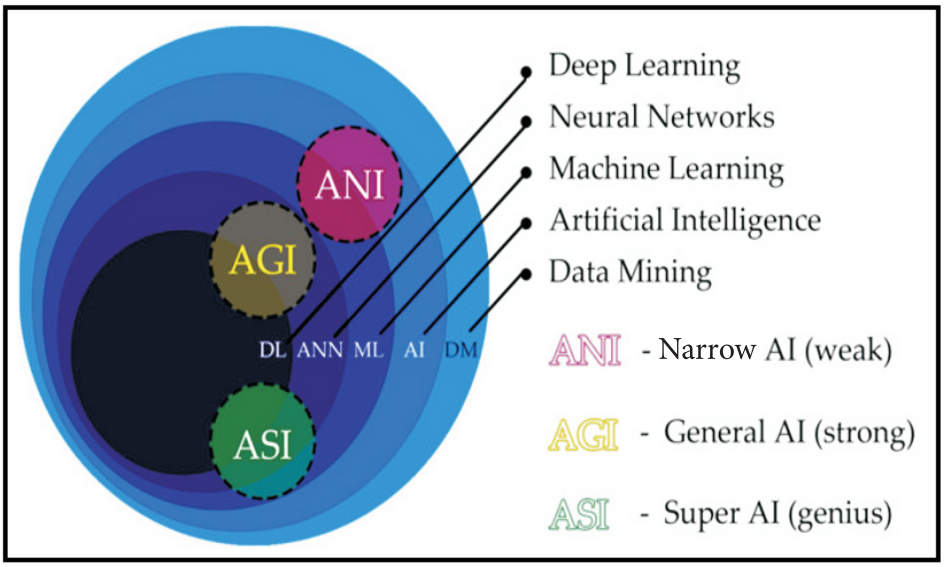

Fig. 1: General AI categorization defines three types: artificial narrow intelligence (ANI), artificial general intelligence (AGI), and artificial super intelligence (ASI)

ray image analysis. Diagnocat is one of the first to enable fully automated and AI-driven segmentation of facial bones, x-rays, and now even airway spaces and sinuses that uses coarse-to-fine volumetric segmentation of teeth in CBCT images which are efficient for handling large volumetric images for tooth segmentation. [7] The 2D X-ray group consists of Apteryx, V7Labs, Denti.ai, Overjet and VideaHealth. Overjet and Videahealth have approvals for caries and radiographic bone loss and Denti.ai has one for auto charting. Videahealth's AI functionality is embedded into both their Dentrix and Ascend software (both FDA approved) for diagnostic workflows. [8]

Dentists with AI support of software such as dentalXrai Pro, dentalXrai Ltd. have reported more sensitivity in detecting caries on bitewing radiography, especially for early caries detection, than dental experts without AI support. This may help in managing them non- or micro-invasively (e.g., using fluoride varnish or caries infiltration), which is expected to come with health gains and a reduction in expensive invasive care. [9]

LabelMe (MIT, USA) software is an open annotation tool for computer vision research. This has been used for dental plaque detection in photos of teeth stained with plaque disclosing agent. The adopted AI model showed clinically acceptable performance in detecting dental plaque on primary teeth compared with an experienced paediatric dentist. [10]

The digital scanner Trios 3Shape (in Dental Unit BARCH) has AI-driven services like their model builder and 3Shape's Automate which can completely design single and multiple-unit tooth-borne restorations within a few minutes. A case workflow has been illustrated in Fig 2,3 & 4. It has a caries detection feature as well. 3D printer company Sprint Ray can design and print AI-based night guard and aligners. iTero Element 5D Plus line of scanners is implementing AI diagnostics of 2D X-rays directly into their scanner software. [8] It may become a run of the mill protocol that when a patient needs an implant, taking a CBCT & uploading it to AI software, the dentist can get back a surgical guide design almost instantly, that can be confirmed, and printed all within minutes.

Predictive Analytics

In orthodontic treatment, it is essential to plan treatments carefully to achieve predictable outcomes for patients, ensuring that the best clinical decision is made before initiating irreversible procedures. A Bayesian based ANN has been used to help determine the need for tooth extraction before orthodontic therapy. AI algorithms can take a starting point and target endpoint and calculate the best way for a tooth or group of teeth to reach their optimal destination. [11] AI is expected to play an important role in genomics. In health research, for example, AI could

Fig.2: Tooth preparation being scanned with Trios 3 Shape Digital Scanner

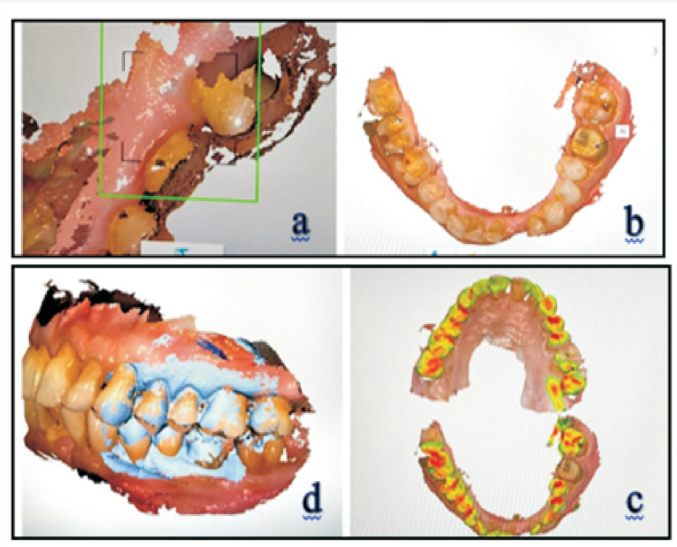

Fig.3: a and b. Real time scanning recording of tooth preparation, c. Clearance indicator with AI reconstruction and d. Automatic occlusion detection

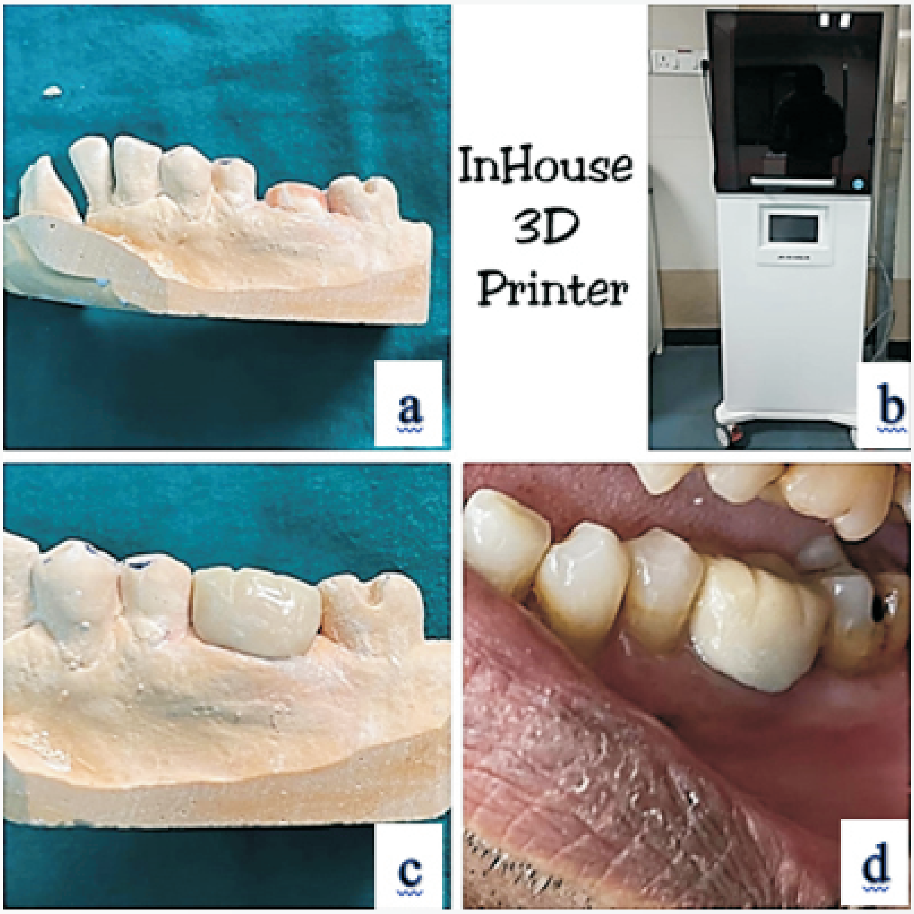

**Fig. 4 a. & b. Model printing with 3D digital printer,
c. Fabrication of a resin interim crown and d. Fixing it
intra-orally in the patient's mouth without any modification**

improve human understanding of disease or identify new disease biomarkers in field of oral cancer, autoimmune diseases etc. It is worth mentioning that AI also plays a role in managing cleft lip and palate in risk prediction, diagnosis, pre-surgical orthopaedics, speech assessment, and surgery. [12]

AI in forensic dentistry has shown to be quite effective in determining the biological age and gender of the healthy and ill. Additionally, it is employed for analysing bite marks and predicting mandibular morphology. [13]

Virtual Reality Simulations

To enhance competency-based skill development, AI is frequently employed in the field of dental education. Scenarios that imitate clinical work on patients are generated which minimize all the hazards involved with training on a live patient. By allowing students to assess their work and compare it to the ideal, the interactive interphase creates high-quality learning settings compared to conventional simulators. [14]

Automated Patient Communication

In dental emergencies, especially if the practitioner is not available, the patient has the option of emergency tele-assistance powered by AI supported chatbots. This was heavily relied upon during covid pandemic times. AI could assist in self-care, including health monitoring and risk prediction tools designed specifically for individuals with disabilities. It has been suggested that AI could fill gaps in the absence of health-care services or skilled workers. [1]

Future Outlook

Soon, dental chairs will be able to monitor a patient's vital signs, anxiety level, weight, and the length of the process while also comforting the patient, warning the operating doctors if any variations are found. The integration of AI into data analysers such as smartwatches and fitbits that record vital information in real time can revolutionise early detection of diseases. A methodical shift from 3D to 4D advanced diagnostics is on the cards. [15]

Last but not the least, one of the most creative uses of AI is in the field of "bioprinting," which allows living tissue and even organs to be created in successive thin layers of cells and may one day be used to reconstruct oral hard and soft tissues that have been lost due to pathological or unintentional causes. [14]

Challenges

- Technical and ethical issues spanning from data scarcity to racial bias in different geographical region or context.
- Constant changes in computing and information technology management, whereby systems become obsolete ("software erosion") and companies disappear.
- Adopting new technology often requires a higher capital investment, especially at the "innovator" or "early adopter" stage.
- Lack of training, knowledge and desire.
- The data needed for training artificial intelligence in dentistry needs to be anonymized, or collection requires patients' consent.
- Watchfulness by regulatory authorities

Conclusion

"The world began without man, and it will complete itself without him….." Cloude Levi Strauss.

It can be speculated that AI can supersede humans, but machines cannot provide clinical intuition, intangible perception, or empathy, which are essential to providing individualized healthcare and professionalism. AI should be seen as a tool, not to replace our own clinician judgments and decision-making, or aptly put as a "second opinion".

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Artificial Intelligence: An Overview

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Introduction

Artificial Intelligence (AI) is the term used to describe the use of science, computers and technology to simulate the intelligent behavior and critical thinking like human beings. John McCarthy (in 1956) described the term AI as the science and engineering of making intelligent machines.

AI has great potential to assist with complex patient care data and can thus assist basic clinical leadership of clinicians

In this report, we review common general applications of AI in healthcare along with its current and potential applications.

Common healthcare applications

Performing routine tasks

As the volume of data continues to increase at an exponential rate, AI can make the process simplified like carrying out x-rays, CT scans, analyzing tests and carrying out other tasks like data entry etc. thereby improving clinical workflow, efficiency, reduce medical errors and ensures patient safety. AI has improved surgery scheduling, saving significant revenue, and decreased patient wait times for appointments and triaging critical patients who require early or immediate attention.

Disease diagnostics and imaging

AI-powered diagnostic tools can analyze patient data, including symptoms, medical history, and lab results, to assist physicians in making accurate diagnoses. These tools provide additional insights and suggestions, helping doctors consider a wider range of possibilities and make informed decisions.

Managing data and health records

Compiling and evaluating a large amount of data like past history and medical records is generally a first step in healthcare industry. Electronic health records (EHRs) such as the Computerized Patient Record System used in Veteran Affairs medical centers (VAMCs) uses digital automation and artificial intelligence to simplify data management up-to a large extent. Much of patient information existing as HCP notes, laboratory and radiology reports, medication records, etc. Natural language processing (NLP) allows platforms to sort through extensive volumes of data on complex patients at rates much faster than human capability, which has great potential to assist with diagnosis and treatment decisions.

Treatment design

AI have been developed and deployed to analyze information, so that medical professionals can select the accurate, individually customized path of treatment for a particular patient. The information required for processing may include patient's history, file records, lab records and scans etc. AI helps in interpreting many types of medical images, including pathology slides, radiographs of various types, retina and other eye scans, and photographs of skin lesions. Many studies have demonstrated that AI can interpret these images as accurately as or even better than experienced clinicians.

Digital consultation

Some apps e.g. Babylon used AI to provide medical consultation to patients, based on common knowledge in medicines and basic medical history.

Medication management

AI is integrated into the webcams of smartphones, confirming that patients take the prescribed medicines at the right time.

Virtual nurses

A startup named Sensely had developed a digital nurse named Molly, that can monitor the vitals and conditions of the patient and provide treatments as follow ups, between the doctor visits.

Precision medicine

Genomics and genetics seek mutations, connections and links to a disease from DNA information. AI helps to spot vascular diseases and cancers early, so that doctors can take necessary actions for better patient outcomes. AI have the potential to rapidly sort through this extensive medical literature and relate specific verbiage in patient records guiding therapy.

Monitoring health

Many devices are available now to monitor the activity levels and heart rate of the users, e.g. these AI- integrated smart devices can carry out alerts for necessary activities and share them with the physicians for reference purpose.

Creating drugs

The drug discovery process is time-consuming and costly. AI accelerates this process by analyzing massive datasets to identify potential drug candidates, predict their efficacy, and simulate their interactions with the human body. This expedites the development of new treatments and therapies. AI powered programs are used for scanning the existing drugs and medicines, so that researchers can modify or redesign them to combat a particular disease.

Analyzing the healthcare system

AI simplifies the analysis of healthcare system, e.g. 97% of the invoices in healthcare industry of Netherlands are digital.

Public health and epidemiology

Applications using AI can stratify the risk of outbreaks based on multiple factors, including age, income, race, atypical geographic clusters, and seasonal factors like rainfall and temperature etc. It helps in identification of infectious outbreaks, such as tuberculosis, malaria, dengue fever, and influenza and also to predict transmission patterns of the Zika virus and the recent COVID-19 pandemic.

Sepsis prevention

SPOT- (sepsis prediction and optimization tool) is used by HCA (Hospital Corporation of America) healthcare. This tool is designed to monitor and interpret available data every moment every day, and when combinations of lab data seem to be consistent with sepsis, the system responds by alerting the doctors immediately so that necessary steps and potentially life-saving interventions can be taken.

Hospital Acquired Infections

MONI (Monitoring of Nosocomial infections) is an intelligent tool for detection and surveillance of healthcare associated infections in intensive care medicine. It uses the medical documentation systems of healthcare institutions and automatically imports electronic clinical raw data to process it into surveillance information thereby predicting Hospital Acquired Infections.

Medical specialty applications

Radiology

Currently > 70% of FDA-approved AI medical devices are in the field of radiology like X-rays, ultrasounds, positron emission tomography, mammograms, computed tomography (CT), and magnetic resonance imaging (MRI). e.g. one FDA-approved platform improvised X-ray diagnosis of wrist fractures when used by emergency medicine clinicians. AI has been applied to chest X-ray (CXR) interpretation of many conditions, including pneumonia, tuberculosis, malignant lung lesions, and COVID-19.

A large study demonstrated that ML platforms significantly reduced the time to diagnose intracranial hemorrhages on CT and identified subtle hemorrhages missed by radiologists. These features help in busy urban centers but may play an even greater role in areas with limited access to health care or trained specialists such as radiologists.

Cardiology

AI has been applied to echocardiography to measure ejection fractions, detect valvular disease, and assess heart failure from hypertrophic and restrictive cardiomyopathy and amyloidosis. Applications like cardiac CT scans and CT angiography have successfully quantified both calcified and noncalcified coronary artery plaques and lumen assessments, assessed myocardial perfusion, and performed coronary artery calcium scoring.

Likewise, AI applications for cardiac MRI have been used to quantitate ejection fraction, large vessel flow assessment, and cardiac scar burden. AI allows ECG interpretation on par with trained cardiologists. Numerous such AI applications exist, and 2 FDA-approved devices perform ECG interpretation. One of these devices incorporates an AI-powered stethoscope to detect atrial fibrillation and heart murmurs.

Pathology

Advancements in whole slide imaging, which rapidly digitizes entire slides, hold significant potential for AI applications in pathology. A landmark study showcasing AI's potential involved assessing sentinel lymph node metastases in breast cancer patients.

AI has shown promise in diagnosing various conditions, including prostate, lung, colon, breast, and skin cancer, even aiding in quantifying critical prognosis and treatment biomarkers like Ki-67 and PD-L1. Pathologists often struggle with tumor classification and identifying the source of metastases, frequently relying on limited IHC techniques. AI's unique image analysis capabilities offer promise in classifying complex tumors and pinpointing metastasis origins based on morphology.

AI interpretation can potentially detect molecular mutations in tumors from different sites, enhancing prognostic predictions when combined with histology and genomic data. Furthermore, AI analysis shows promise in predicting tumor recurrence or prognosis based on cellular features, as demonstrated in lung cancer and melanoma studies.

Ophthalmology

AI could diagnose diabetic retinopathy and diabetic macular edema with specificities like ophthalmologists. This diagnostic system classifies retinal images and recommends referral for patients determined to have "more than mild diabetic retinopathy" and reexamination within a year for other patients. Significantly, the platform recommendations do not require confirmation by a clinician.

AI has been applied to other modalities in ophthalmology such as optical coherence tomography (OCT) to diagnose retinal diseases and pathologies and to predict appropriate management of congenital cataracts.

Dermatology

Identifying specific skin lesions, like distinguishing between keratinocyte carcinomas and benign seborrheic keratoses or malignant melanomas and benign nevi, is complex. Artificial Intelligence (AI) is relevant in various dermatological imaging methods, including dermoscopy, high-frequency ultrasound, and reflectance confocal microscopy. However, a notable limitation is their ability to differentiate only a limited number of diagnoses.

Dermatology can utilize smartphone apps to capture lesion images for AI analysis, aiding in assessing the need for further evaluation or recommending treatment. While current app outcomes may not be highly promising, their significance is expected to grow with advancing AI technology, potentially expanding their role in dermatological diagnoses and treatment recommendations, benefiting clinicians and patients.

Surgery

AI-equipped robots assist surgeons in performing complex procedures with greater precision and control. These robots can analyze real-time data, enhance visualization, and execute delicate maneuvers, reducing human error and improving surgical outcomes.

Oncology

AI holds immense promise in managing the vast quantities of patient data in the field of cancer genomics. The advent of next-generation sequencing has facilitated the identification of millions of DNA sequences within a single tumor, enabling the detection of genetic anomalies. Within individual tumor samples, thousands of mutations may be present, a magnitude of information that surpasses human capacity for efficient analysis.

The applications of AI within oncology encompass a broad spectrum, including prognostic prediction for cancer patients based on histologic and genetic data.AI programs have the capability to anticipate the prognosis for patients afflicted with cancer with the help of both histologic and genetic information. These programs can estimate the likelihood of postoperative complications and predict the risk of recurrence following surgery for malignancies.

Additionally, AI's involvement extends to treatment planning, providing insights into optimal therapeutic strategies, and predicting the potential failure of radiation therapy. The integration of AI into cancer genomics not only enhances the speed and accuracy of data processing but also offers critical insights that can drive informed medical decisions and ultimately lead to improved patient outcomes.

Gastroenterology

AI's use in endoscopic analysis proves effective for evaluating various gastrointestinal conditions, including malignancies. It gauges depth of invasion and successfully distinguishes benign from premalignant colon polyps. Harnessing AI in endoscopy enhances diagnostic accuracy, streamlines assessment, and informs decision-making, improving patient care across a range of medical scenarios.

Neurology

In the context of Large Vessel Occlusion (LVO), a noteworthy achievement has been the approval by the Centers for Medicare & Medicaid Services (CMS) for AI reimbursement in stroke diagnosis. This innovative solution, named Viz LVO, employs CT scans to identify early ischemic strokes, enabling timely alerts to the medical team. Consequently, this intervention not only accelerates the path to treatment but also averts potential complications.

Beyond Viz LVO, there exists a multitude of AI platforms either in use or under development. These platforms leverage both CT and MRI scans to facilitate early stroke detection, as well as contribute to treatment strategies and prognostic assessments.

Additionally, the scope of AI extends to neurodegenerative conditions like Alzheimer's and Parkinson's diseases, yielding insights that aid in disease management. Furthermore, AI technologies have demonstrated applicability in seizure disorders, enhancing diagnostic accuracy and enabling more tailored therapeutic approaches.

Mental health

Due to the interactive nature of mental health care and heavy reliance on textual information (Ex- clinic notes, mood rating scales, and documentation of conversations), the field has been slower to develop AI applications. Some studies investigating the application of AI to mental health have incorporated data such as brain imaging, smartphone monitoring, and social media platforms, such as Facebook and Twitter.

General and personalized medicine

AI-driven smartphone apps can be beneficial to both patients and clinicians. Examples include predicting nonadherence to anticoagulation therapy, monitoring heart rhythms for atrial fibrillation or signs of hyperkalemia in patients with renal failure, and improving outcomes for patients with diabetes mellitus by decreasing glycemic variability and reducing hypoglycemia.

Risks and limitations

As healthcare organizations are increasingly investing in AI for a varied range of tasks, the challenges facing this technology must be addressed, as there are many regulatory and ethical issues that may not apply elsewhere.

One of the most insisting challenges include data privacy and security, patient safety and accuracy, training algorithms to recognize patterns in medical data, integrating AI with existing IT systems, gaining physician acceptance and trust, and ensuring compliance with federal and ethical regulations.

Data privacy and security is also important as medical information is very sensitive and is at a risk of misuse for malicious purposes if not handled properly.

Patient safety and accuracy are also important concerns while using AI systems. AI systems must be trained with precision to recognize patterns in medical data, understand and interpret the relationship between different diagnosis and treatments, and provide accurate recommendations that are tailored to an individual patient.

Finally, gaining acceptance, trust and confidence from medical practitioners is important for successful adoption of AI in healthcare. Integrating AI with existing IT systems can cause extra complexity for physicians as it might require deep understanding of how existing technology works for a seamless operation. Physicians must have insight into how the AI system is making decisions so that they can be sure it is using valid and up-to-date medical research.

Conclusion

In this complex world of healthcare, AI tools can support human healthcare providers to provide faster service, diagnose issues and analyze data to identify trends or genetic information that would predispose someone to a particular disease.

When saving minutes can mean saving lives, AI and machine learning can be transformative not only for healthcare but for every single patient.

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ACADEMIC ACHIEVEMENTS

Paper Presentations

1. A paper on 'Histopathological study of endometrial carcinoma and five-year survival analysis' Authors: Dr Vaishnavi Kumba, Dr Raji T Naidu, Dr Susan Cherian, Dr Uma P Chaturvedi, Dr Prachi Gaddam was presented by Dr Vaishnavi at MAPCON 2022 on 24th September 2022 held at MGM Hospital, Aurangabad.
2. A paper on 'Granulomatous Mastitis :Cytologic features and clinicopathologic review of 11 cases' Authors: Dr Hemangi S Gaonkar, Dr Raji T Naidu, Dr Susan Cherian, Dr Uma P Chaturvedi, Dr Prachi Gaddam was presented by Dr Hemangi S Gaonkar at MAPCON 2023 on 21st October 2023 held at Symbiosis Medical College, Pune.
3. A paper on 'Beneficial applications of radiological imaging technologies during COVID-19 pandemic' by M. Kumaresan, Ajay Choubey, Surita Kantharia, Shubhra Gupta, Pratishruti Hui was presented by: M.Kumaresan at 6 th Asian Oceanic Congress on Radiation Protection at Nehru Centre in Mumbai held on 8th February 2023
4. A paper on 'Can COVID-19 infection have post acute implications on peri-implantitis? A case series' by Dr Himani Gupta was presented at 29th Indian Society of Oral Implantologists Conference held on 6th -8th October 2023 in Mumbai
5. A paper on ' Comparison of PENG block vs femoral nerve block for analgesia of positioning pain during spinal anaesthesia in hip fracture patients' by Dr Jalpa Kate, Dr. Shrividya Chellam, Dr Pratibha Toal , was presented by Dr Jalpa Kate which won the best paper award in original research category at World Anaesthesia Day conference 2023 in Mumbai .
6. A paper on Knowledge, Attitude and Practice On 'TB : Study Amongst Urban Adults visiting the community Health Centre' was presented by Staff nurse Ms. Laiby Reji in 'International conference on contextualizing Health in Social Science :Global and National perceptive' held jointly with Sharda University and IAASH at Greater Noida on 15th March 2023.

Publications

1. Jadhav R, Reji L, Kulkarni A, Nair B, Sampatkumar L, Bhandarkar P. Experiences of Covid-19 early vaccination: A survey based study from the community healthcare setup in India. Int J Med Public Health.2023;13(1):37-41
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3. Sruthi Mayura, Susan Cherian, Prachi Gaddam. Diagnostic Significance of "Intermediate Lesion" in Breast Cytology: Is the Risk of Malignancy Underestimated ? International Journal of Science and Research (IJSR), Volume 12 Issue 7, July 2023, pp. 1190-1195.
4. Raji Naidu, Susan Cherian, Vaishnavi Kumba, & Uma Chaturvedi.. Sinonasal Glomangiopericytoma: A Case Report. International Journal of Head and Neck Pathology. 2022; 5(2), 13–19.
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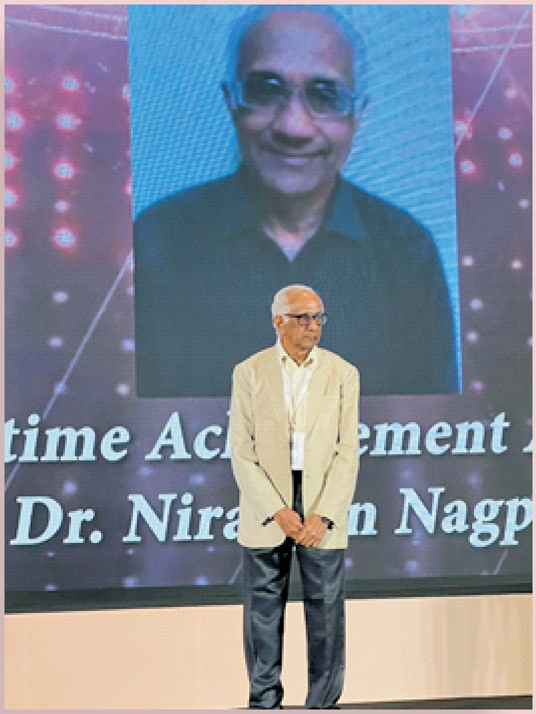
6. Chiplonkar S, Kate JA, Toal P, Chitravanshi N. Ultrasound guided femoropopliteal block in gas gangrene patient with coagulopathy. Journal of Anaesthesia and Critical Care case reports, 2023;9(1):01-03
7. Chitravanshi N, Chiplonkar S, Chellam S, Volvoikar P, Toal P. Unusual presentation of left bendle branch blockfollowing peripheral nerve block. International Journal of Scientific Research.2023;12(5)
8. Prabhu S, Mishra N. BARC Hospital Fertility Clinic. Popular Science, BARC News Letter, 2023;May-June:63-64. ISSN:0976-2108..

LIFETIME ACHIEVEMENT AWARD

Our senior part time dermatologist **Dr. Niranjan Nagpur** was presented with Lifetime achievement award by Sun Pharmaceuticals in collaboration with American Academy of Dermatology in Mumbai on 2nd November 2023 for his contribution to the medical field.



Candidates passing DNB exam in 2023.

Congratulations!!

Dr. Akshita Puppala
Dept. of Anaesthesia

Dr. Meet Kalathiya
Dept. of Obstetrics & Gynaecology

Dr. Ankita Sankhala
Dept. of Anaesthesia

Dr. Mayank Choudhari
Dept. of General Surgery

Dr. Rohan Mishra
Dept. of General Surgery

Extracurricular Achievements

Dr Pratibha Toal , Head, Department of Anaesthesia, finished 'Satara Hill Half Marathon' for the 5th time on 3rd September 2023

Educational Video

Educational Video on blood Donation made by **Dr.Prachi Gaddam**, Department of Pathology, BARC Hospital

To view, click here.

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