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Artificial Intelligence and its Role in Life Sciences Applications

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ABSTRACT
Digital technologies and artificial intelligence (AI), particularly machine learning, are transforming medicine, medical research and public health.Artificial intelligence is bringing a paradigm shift to healthcare, powered by increasing availability of healthcare data and rapid progress of analytics techniques.AI can be applied to almost any field in medicine, and its potential contributions to biomedical research and healthcare delivery are revolutionizing the healthcare arena. AI can serve roles in diagnosis, clinical decision making,and personalized medicine. Potential areas of promise in healthcare include drug discovery and development, automated devices, wearables, diagnostic and medical imaging devices, remote monitoring of patients, predictive medicine, and robotics among others.

I. INTRODUCTION-

The healthcare sector is one of the largest and fast-growing industries in the world. Innovations and novel approaches are critical for the research and development for better products and molecules..Artificial intelligence a disruptive tool for a smarter precision based medicine.Popular AI techniques include machine learning methods for structured data, such as the classical support vector machine and neural network, and the modern deep learning, as well as natural language processing for unstructured data.Technologies based on AI are now used in health services in countries of the Organization for Economic Co-operation and Development (OECD), and its utility is being assessed in low- and middle-income countries (LMIC) (1- 2).

Definition

"Artificial intelligence" generally refers to the performance by computer programs of tasks that are commonly associated with intelligent beings. The basis of AI is algorithms, which are translated into computer code that carries instructions for rapid analysis and transformation of data into conclusions, information or other outputs. Enormous quantities of data and the capacity to analyse such data rapidly fuel AI (3).

A specific definition of AI in a recommendation of the Council on Artificial Intelligence of the OECD states: An AI system is a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions influencing real or virtual environments. AI systems are designed to operate with varying levels of autonomy (4).

Artificial intelligence in Healthcare & Life Sciences Applications

Artificial intelligence (AI), which includes the fields of machine learning, natural language processing, and robotics, can be applied to almost any field in medicine, and its potential contributions to biomedical research, medical education, and delivery of health care seem limitless. With its robust ability to integrate and learn from large sets of clinical data, AI can serve roles in diagnosis, clinical decision making,and personalized medicine. For example, AI-based diagnostic algorithms applied to mammograms are assisting in the detection of breast cancer (5-10).

AI can assist physicians in the following realms–

- Clinical decision making - better clinical decisions
- Replace human judgement in certain functional areas of healthcare (eg, radiology).
- Updating the knowledge of medical information from journals, textbooks and clinical practices
- 24x7 availability of expert

Diagnosis and prediction-based diagnosis AI-driven tools rely on people's data to assess the previous and present health issues of patients. By comparing the disease details, healthcare professionals are positioned to diagnose more accurately.

- Prediction of outcome of the disease as well as treatment
- Feedback on treatment
- Reinforce non pharmacological management

- Reduce diagnostic and therapeutic errors
- Increased patient safety and subsequent cost savings,
- AI system extracts useful information from a large patient population
- Assist making real-time inferences for health risk alert and health outcome prediction

Uses of AI in Drug Development

- AI has the potential to accelerate drug development. AI could change drug discovery from a labour-intensive to a capital- and data-intensive process with the use of robotics and models of genetic targets, drugs, organs, diseases and their progression, pharmacokinetics, safety and efficacy.
- AI could be used in drug discovery and throughout drug development to shorten the process and make it less expensive and more effective

AI for health research

- An important area of health research with AI is based on use of data generated for electronic health records. Such data may be difficult to use if the underlying information technology system and database do not discourage the proliferation of heterogeneous or low-quality data. AI can nevertheless be applied to electronic health records for biomedical research, quality improvement and optimization of clinical care

AI in health systems management and planning Health systems-

- Healthcare service delivery can be very complex. There may be numerous actors who contribute to, pay for or benefit from the provision of health-care services. AI can be used to assist personnel in complex logistical tasks, such as optimization of the medical supply chain, to assume repetitive tasks or to support complex decision-making. Some possible functions of AI for health systems management include: identifying and eliminating fraud or waste, scheduling patients, and assisting in identification of staffing requirements (11)

AI in Public Health and Surveillance-

- Health promotion AI can be used for health promotion or to identify target populations or locations with "high-risk" behaviour and populations that would benefit from health communication and messaging (micro-targeting).
- Disease prevention AI has also been used to address the underlying causes of poor health outcomes, such as risks related to environmental or occupational health. AI tools can be used to identify bacterial contamination in water treatment plants, simplify detection and lower the costs. Sensors can also be used to improve environmental health, such as by analysing air pollution patterns or using machine learning to make inferences between the physical environment and healthy behaviour (12)
- Surveillance (including prediction-based surveillance) and emergency preparedness AI has been used in public health surveillance for collecting evidence and using it to create mathematical models to make decisions. Data that are not generated specifically for public health purposes (such as from blogs, videos, official reports and Internet searches) is being leveraged for public health surveillance (13).
- Outbreak response The possible uses of AI for different aspects of outbreak response have also expanded during the COVID-19 pandemic. They include studying SARS-CoV2 transmission, facilitating detection, developing possible vaccines and treatments and understanding the socio-economic impacts of the pandemic (14).

Given their complexity and highly interdisciplinary nature, the life sciences provide ample opportunities for AI to impact R&D efforts in a variety of ways.

- Diagnosis and Disease Identification: AI is revealing new ways to streamline workflows in imaging systems. For example, deep learning in medical imaging can help prioritize images for a patient with a potentially fatal brain bleed over others in the queue. In other cases, AI can help evaluate images quickly and accurately.
- Personalized Medicine: With precision medicine, clinicians use a combination of genomic data, health records, lab tests, and other patient data to help customize care. In this way, they can provide the right and tailor made treatment to the right patient at the right time. Precision medicine can also reveal an individual's susceptibility to certain diseases before time. In this new era of truly personalized medicine, patients can receive more accurate diagnoses, earlier interventions, more efficient pharmaceutical therapies, and customized treatment plans. Precision medicine already has applications in diabetes and cancer treatments, especially for cancers of the breast, lung, skin, colon, prostate, and pancreas. Clinicians are specifically looking at applying precision medicine to rheumatoid

arthritis, Alzheimer's disease, and multiple sclerosis.

a. Molecular Diagnostics and Genomic Analysis: Molecular diagnostics involves analyzing a patient's biomarkers—primarily their genetic code and how their cells express genes. These tests reveal information that can be used to provide the most effective treatment or predict which drugs will work best for the patient. Molecular diagnostics often requires genetic sequencing.
b. Molecular Imaging: plays a role in the drug discovery process, helping capture biological processes at the molecular and cellular level. This enables a deeper understanding of protein structures, cell functions, and molecular processes in living organisms. Because it offers a more complete view of healthy and diseased tissues in the body, molecular imaging plays an important role in precision medicine, particularly in cancer management.
c. Molecular Dynamics: is a computational method that quantitatively predicts how effectively a drug will interact with a protein target responsible for a particular disease. In combination with other tasks in the overall drug discovery workflow, molecular dynamics offers atomic-level insights into the interface between medications and the fundamental source of a disease

- Drug Discovery and Molecular modelling: Artificial intelligence and machine learning have demonstrated their potential role in predictive chemistry and synthetic planning of small molecules. Lead optimization is currently one of the most difficult and complex steps in early phase drug discovery and has traditionally relied on the skills and judgment of medicinal chemists. AI can help in lead optimization of a 'potential drug molecule', allowing the rapid selection of the safest compounds for synthesis.
- Clinical trials: AI is being integrated into most aspects of the early phase of drug discovery, including target identification, hit/lead discovery, lead optimization, pharmacokinetic property and toxicity prediction, and clinical trial structuring. AI can help to overcome the existing shortcomings of current clinical trial design. Machine learning (ML), and deep learning (DL) in particular, are able to automatically find patterns of meaning in large datasets such as text, speech, or images. Natural language processing (NLP) can understand and correlate content in written or spoken language, and human–machine interfaces (HMIs) allow natural exchange of information between computers and humans. These capabilities can be used for correlating large and diverse datasets such as electronic health records (EHRs), medical literature, and trial databases for improved patient–trial matching and recruitment before a trial starts, as well as for monitoring patients continuously during the trial, thereby yielding more reliable and efficient endpoint assessment.
- Predictive Analytics and the Future of Healthcare: Predictive data analytics is helping health organizations enhance patient care, improve outcomes, and reduce costs by anticipating when, where, and how care should be provided. Healthcare has become digitized, including electronic medical record (EMR) systems, health claims data, radiology images, and lab results. In the near future, genomics data will also grow significantly. New data is also being generated by a growing number of medical devices, including patient wearables. Outside the clinical setting, patients are generating quasi-health data through the use of personal wearable devices, fitness trackers, and health applications. By incorporating data from these sources, health providers can power new solutions in predictive analytics for medical diagnosis, predictive modelling for health risks, and even prescriptive analytics for precision medicine.

- Healthcare is moving towards the digital platform, more patient-oriented and data-driven. Availability of data, irrespective of the location of the patient and the clinician, has become the key to both patient satisfaction and improved clinical outcomes..

II. SUMMARY

AI tools, will result in better disease prevention, earlier diagnosis and improved, cost-effective drug discovery, enhancing patient care. AI has the potential to reform the current landscape of health systems by early diagnosis, quicker entry of drugs into the markets, precision medicine, emphasis on prevention than treatment resulting in a new healthcare model.

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