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An Analysis of the Application of Machine Learning and Artificial Intelligence in Cancer Diagnosis in the Future

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Abstract: *If you are interested in the field of health and want to know about the use of computers in the field of health, then this article is only for you, because today in this article we will tell you in detail about the usefulness of computers in the field of health. Will tell Medical professionals use computers extensively to make better decisions about treating patients, Medical imaging is a method of visualizing body parts to make accurate predictions. Modern biomedical research has also become increasingly focused on bringing AI technology into clinics safely and ethically. AI-based assistance to pathologists and physicians is a major step towards predicting disease risk, diagnosis, prognosis and treatment. The clinical applications of AI and machine learning (ML) in cancer diagnosis and treatment are set to guide the future of medicine towards rapidly mapping a new treatment for each individual. Using AI base systems approach today can collaborate and digitally share knowledge to potentially heal millions of lives. In this paper, we look at combining biology with artificial intelligence as the game-changing future in clinics and how AI-based assistance can help oncologists to tailor precise treatments.*

Keywords: AI, ML, CS, Clinical, Digital etc

I. INTRODUCTION

Research in the 1960s and 1970s produced the first problem-solving program or expert system, known as Dendral.[9] While it was created for applications in organic chemistry, it led to a later system Provided the basis for MYCIN, which is considered one of the most important early uses of artificial intelligence in medicine. MYCIN and other systems such as INTERNST-1 and CASNET have not gained routine use by physicians.

The 1980s and 1990s saw the proliferation of microcomputers and new levels of network connectivity. During this time, it was recognized by researchers and developers that AI systems in health care should be designed to accommodate the absence of accurate data and to build on the expertise of physicians. Approaches related to fuzzy set theory, Bayesian networks and artificial neural networks have been applied to intelligent computing systems in healthcare. Medical and technological advances that have occurred over this half-century period have enabled the development of healthcare applications of artificial intelligence:

- Improvements in computing power resulted in faster data collection and data processing
- Growth of genomic sequencing databases
- Widespread implementation of electronic health record systems
- Improving natural language processing and computer vision, enabling machines to replicate human perceptual processes
- Enhanced accuracy of robot-assisted surgery
- Improvements to dredging techniques and data logs in rare diseases

In the future, with the help of machine learning and artificial intelligence application in cancer diagnosis, different techniques are used such as MRI, Radiography, Ultrasound, X-ray etc. Computers are also used extensively for medical training, in today's time surgeons are not only dependent on actual practice in the operation theater to acquire skills.

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Instead, simulation based surgical platforms with the help of machine learning and artificial intelligence techniques have emerged as a very effective tool for training and assessment, surgical simulation helps trainees to hone their surgical skills.

This gives them detailed feedback on their performance and also helps a lot in getting evaluations, so that they can better care and protect the patient before actually working on the patient. Skin cancer is usually difficult to detect early because its symptoms are similar to those of common skin diseases, but scientists have used machine learning and technology to effectively distinguish between cancerous skin lesions and noncancerous ones. Has taken the help of artificial intelligence. Machine learning and artificial intelligence are also used in the diagnosis of breast cancer, as technology is developing, machine learning and artificial intelligence can be used in the diagnosis of many other types of cancer in the future. The disease of COVID-19 had presented a huge challenge in the health related services all over the world, the whole world faced this disease together and machine learning and artificial intelligence can play a very important role in facing this challenge.

Computers have helped a lot in the treatment, control and prevention of COVID-19, research was done on the virus of this disease through computers and later different vaccines of COVID-19 were prepared. Artificial intelligence (AI) and machine learning (ML) are gradually gaining ground in everyday life and are expected to have a major impact in digital healthcare for disease diagnosis and treatment in the near future. Technological advancements in AI and ML have paved the way towards autonomous disease diagnosis tools using large data sets to meet future challenges for early stage human disease detection, especially in cancer. ML is the subset of AI, where neural network base algorithms are developed to allow machine to learn and solve problems like human brain [1, 2]. In turn, Deep Learning (DL) is used to process data to recognize images, objects, process languages, improve drug discovery, upgrade precision medicine, improve diagnosis, and help humans make decisions. is a subset of ML to mimic the human brain's ability to It can also work without human supervision and suggest outputs [3]. DL can process data including medical images by artificial neural network (ANN) to mimic human neural architecture and is composed of input, output and various hidden multi-layer networks to enhance the processing powers of machine learning. In medicine, the virtual and physical aid of technology through information management and robotics systems is the future. AI-based approaches in medicine are considered to solve complex biology puzzles, determine complex protein-protein interactions, and identify therapeutic targets. The review also discusses various trained deep-learning design models to aid in new drug discovery and robotic surgery. AI also provides medical imaging technology with extraordinary progressive potential to determine abnormal changes at the cellular level and will improve diagnostic accuracy. It also covers "AI-based precision oncology approaches" to precisely target individual cells and its role in overcoming the limitations of NGS by AI-assisted toolsets. AI-based applications in digital pathology and ethical concerns are also discussed in detail in this review to update readers about the future of medical technology.

II. ARTIFICIAL INTELLIGENCE IN MEDICINE

Artificial intelligence in healthcare is the use of complex algorithms and software, in other words artificial intelligence (AI) is the analysis, interpretation and human understanding of complex medical and healthcare data to simulate human cognition. Specifically, AI is the ability of computer algorithms to draw predictive conclusions without direct human input.

What differentiates AI technology from traditional technologies in healthcare is its ability to receive information, process it, and deliver a well-defined output to the end-user. AI does this through machine learning algorithms and deep learning. These algorithms can recognize patterns in behavior and build their own logic. To reduce the margin of error, AI algorithms need to be tested repeatedly. AI algorithms behave differently from humans in two ways: (1) Algorithms are literal: if you set a goal, the algorithm cannot adjust itself and can only understand what it is explicitly told , (2) and it is not possible to explain the internal behavior of some deep learning algorithms. [1]

The primary objective of healthcare AI applications is to analyze the relationship between prevention or treatment techniques and patient outcomes. [2] AI programs have been developed and applied to practices such as diagnostic procedures, treatment protocol development, drug development, personalized medicine, and patient monitoring and care. Medical institutions such as The Mayo Clinic, Memorial Sloan Kettering Cancer Center, [3] [4] and the British National Health Service, [5] have developed AI algorithms for their departments. Large technology companies, such as

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IBM [6] and Google, have also developed AI algorithms for healthcare. Additionally, hospitals need AI software to enable operational initiatives such as increasing cost savings, improving patient satisfaction, and meeting their staffing and workforce needs. [7] Companies are developing predictive analytics solutions that help health care managers improve business operations through increasing utilization, reducing patient boarding, reducing length of stay, and optimizing staffing levels.[8] Clinical researchers are now focusing extensively on ML algorithms, which are believed to enable computers to learn from vast pharmaceutical big data on an industrial scale, using super-computers and machine learning at low cost and in less time. Gives the ability to discover new drugs. equipment, as previously used in self-driving cars. The Exascale Compound Activity Prediction Engine (XCAPE) project, funded by Horizon 2020, a European funding program, is one of the big data analysis chemogenomic projects for chemical compound targeting biological proteins in silico models. It aims to compile comprehensive datasets of chemogenomics from authoritative databases (ChEMBL and PubChem) to predict protein interactions and gene expression for industrial scale pharmaceutical companies. ExCAPE is a scalable ML model for complex information management and its application at the industrial scale, especially in the pharmaceutical industry to predict compound biological activity and its interactions at the protein level. Nevertheless, various complex cellular limitations need to be addressed at a scalable level through algorithms and this project is expected to be further expanded by accelerating ML-based super-computers for rapid drug discovery. Recent advances in medicine for chemical synthesis include microfluidic and AI-assisted drug-designing. It has been widely proven that the trained DL-derived ML model outperformed all comparable practice strategies when applied to a database of pharmaceutical companies.

III. ARTIFICIAL INTELLIGENCE IN HEALTHCARE

Artificial intelligence in healthcare is a broad term used to describe the use of machine-learning algorithms and software, or artificial intelligence (AI), to mimic human cognition in the analysis, presentation, and understanding of complex medical and healthcare data. is done for Surpass human capabilities by providing new methods of diagnosing, treating, or preventing disease.[1][2] Specifically, AI is the ability of computer algorithms to draw predictive conclusions based only on input data.

The primary objective of healthcare AI applications is to analyze the relationship between clinical data and patient outcomes.[3] AI programs are applied to practices such as diagnosis, treatment protocol development, drug development, personalized medicine, and patient monitoring and care. What differentiates AI technology from traditional technologies in healthcare is its ability to collect larger and more diverse data, process it, and produce a well-defined output for the end-user. AI does this work through machine learning algorithms and deep learning. These processes can recognize patterns in behavior and build their own reasoning. To obtain useful insights and predictions, machine learning models must be trained using a large amount of input data. AI algorithms behave differently from humans in two ways: (1) Algorithms are literal: once a goal is set, the algorithm learns exclusively from the input data and can only understand what it has been programmed to do. (2) and some deep learning algorithms are black boxes; Algorithms can make predictions with extreme accuracy, but provide little or no understandable explanation of the reasoning behind its decisions other than the data and the type of algorithm used.

Since the widespread use of AI in healthcare is relatively new, research is ongoing on its application in various fields of medicine and industry. Additionally, unprecedented ethical concerns related to its practice, such as data privacy, automation of jobs, and representational bias, are receiving more attention.[5]

IV. ARTIFICIAL INTELLIGENCE BASED MEDICAL IMAGING

We are now at the beginning of an AI-based technological era, whereas only 10 years ago, the number of publications on AI related to medical imaging was very limited. This number reached 800 in the year 2016-2017 and it is expected to increase drastically in the coming years. AI offers excellent progressive opportunities to Medical Imaging Technology (MIT) and is based on computational models and bioinformatics based algorithms. It can determine any abnormal cellular growth and biological changes in the body. AI-assisted MIT is not only going to play a pivotal role in radiology, but it is also going to have a huge impact on medical resonance imaging and neuroradiography. The healthcare system would be incomplete without radiology, especially in cancer and other cancer related complications. Radiologists are expected to have more digital knowledge than any other medical professional. They have always been

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at the forefront of the adoption of digital information related to medical imaging [35]. AI can identify abnormal results at first glance, showing a higher sensitivity rate than other traditional technologies. Of course, radiologists should play a key role in communication with patients about AI-interpreted results. At this point in time AI will never replace radiology, but the need for radiologists is decreasing over time due to image interpretation efficiency by AI. Technology-oriented experienced radiologists are highly needed to design specialized algorithms for high-throughput data analysis with high precision and accuracy. After performing a wide range of experimental analysis, AI-based algorithms can detect particular patterns to provide insight into unusual findings. Traditional computer aided detection (CAD) systems can indicate the presence or absence of image characters, while AI-based systems extract all visible and non-visible image features to produce more accurate results.

The algorithm can detect the texture, color, shape of the lesions as a doctor would. Users receive an instant risk assessment for skin lesions within 30 seconds and the algorithm has been proven to detect 95% of skin cancers at an early stage. However, physician intervention is still necessary as we cannot trust the algorithm 100%.

DL is superior to traditional ML due to its high performance and AI-based cognitive ability. This has not only increased the image graphics but also reduced the cost and length of the process.

V. ARTIFICIAL INTELLIGENCE IN DIGITAL PATHOLOGY AND DRUG DISCOVERY

The first large scale clinical study in digital pathology was conducted by examining approximately 2000 patients with over 16,000 reads (data files in various diagnostic formats) of various tumor types. This study paved the way towards digital diagnosis using the digitized WSI system. Various developmental projects for innovative AI-based image analysis in oncology have been undertaken by biomedical engineers and data scientists. Currently, technology involvement of AI-based analysis of patient's radiology, morphological patterns and histopathology data is considered to improve diagnostic accuracy using new biomarkers for precision oncology.

The learning process of artificial intelligence and ANN works in layers. Each layer is a container of neurons and data processing requires grouping between different layers (neurons). All different layers are specialized to perform specific transmission like human differentiated cells, including dense (fully connected) layers, concentric layers, pooling layers, recurrent layers, normalization layers, and many others. Convolutional layers are specialized for processing imaging data such as digital pathology images.

VI. AI TO DECODE MOLECULAR SIGNALING CASCADES AND CANCER MECHANISMS

Various high-throughput technologies have been used to quantify gene expression. Microarray technology is commonly used to determine genetic expression, but has some limitations as it is expensive, requires expert handling, and interprets genetic information with a large pool of data sets. Therefore, oncologists realized the need for cancer molecular signatures to detect abnormal gene expression. He monitored patient response to drugs and then devised methods for precise disease management. ML has now been successfully applied to CAD. Medical experts around the world are sharing their diagnosis and treatment data and with applications of AI, such information can be automatically stored (cloud scaling). This has led to the establishment of the Tumor Atlas.

AI basically uses two approaches, neural networks and fuzzy logic, to overcome human intelligence. Neural networks are extremely difficult to explain (black boxes) while fuzzy logics are easy to explain. However, both are used by medical experts to diagnose breast cancer. There are several types of cancer, including pancreatic and gastric cancer, that are diagnosed only after they reach an advanced stage. Similarly, screening for lung cancer is a very complicated process. Medical experts used a low-dose CT scan method for screening, which is an inadequate procedure for monitoring this cancer type compared to blood profiling, in which AI-based tools analyze plasma profiles of ctDNA and miRNA .

Cancer treatment is about to be revolutionized with the help of AI, the most powerful yet smart weapon in the fight against cancer. Nonetheless, the lack of computational algorithms and knowledge of information technology by physicians and practitioners prevents the implementation of AI in developing countries.

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VII. AI IN SURGERY

Recent developments in innovative AI-based applications and surgery are a very exciting area of research. Clinical machine interaction has been aiding oncologists for decades. It has been observed that AI assistance significantly contributes by reducing the incidence of breast conserving surgery (mastectomy) by 30.6%, whereas, in previous practices, high-risk patient tissue biopsies were found to be benign only after subsequent surgery. ML models that accurately predict high-risk cancer lesions through image-guided needle biopsies and pathological updates are a core need of today's clinical practice: they can limit unnecessary surgical excision. Random forest ML models have been developed by various research groups for the prediction of cancer survival and long-term cognitive outcome. In a clinical study, 335 high-risk cancer patients were analyzed by the Randomized One ML model and observed that it could prevent about one-third of unnecessary surgeries. Collective surgical consciousness (CSC) has recently been noted for surgical procedures in the operating room, for individual and population data analysis. Computational algorithms have been used in some clinical settings where pre-operative comprehensive risk scores were calculated by artificial neural networks (ANNs) based on digital image analysis. Similarly, ML assistance is also available during surgery, virtually via surveillance cameras and real-time video images, assisted by ANNs based on whole population data analysis from specific genetic pool data (patient age, gender, and other bodies) Can give clinical judgment and predictions. biological parameter). Such AI support also suggests clinical care and personalized care management strategies after comprehensive analysis in real-time, just like Siri.

Ethical concerns of artificial intelligence and machine learning based robotic therapy

ML has a substantial impact on health care processes. This may affect treatment and diagnosis, reflecting serious ethical considerations. ML healthcare applications range from fully autonomous AI for cancer diagnosis to non-autonomous mortality prediction to guide the allocation of healthcare resources [5]. AI and ML therapeutic innovations range from virtual psychiatrists to social robots in dementia and autism disorders. therapeutic chatbots, avatars and social assistant devices are translated into clinical application and their ethical concerns mainly focus on long-term applications of AI and therapeutic robots, thereby reducing complete patient dependence (not socially acceptable) Might be possible. Furthermore, the integration of AI tools into everyday life and medical care is changing ethical judgments and societal expectations as there is a great deal of difference between human and machine communication [6]. One of the toughest issues in today's AI is transparency. Many AI and ML algorithms, especially deep image analysis algorithms, are impossible to explain or explain. Even researchers or doctors who are familiar with this operation are unable to explain them [3]. Others have argued that continued use of AI and ML in treatment or diagnosis may be harmful as distributional changes may occur, thus suggesting that target data will not match ongoing patient data and lead to erroneous conclusions. . The relationship between data elements is likely to change due to changes in population (gene pool), technology, and process of care. Another application of AI is in mental health practice centers, where it can facilitate patient autonomy. These AI and ML technologies need to be used to instruct patients to ensure that the patient does not mistake the intelligent system for a human-driven application. In addition, the consent of applications obtained outside the medical environment raises worrying concerns [8]. AI is sensitive to wrong decisions and wrong risks.

Implication

The use of AI and ML is predicted to reduce medical costs as there will be greater accuracy in diagnosis and better predictions in treatment planning as well as greater disease prevention.

Other future uses of AI and ML include brain-computer interfaces (BCIs), which are anticipated to help people move, speak, or those with spinal cord injuries. BCI will use AI to help these patients move and communicate by decoding neural activations.

As technology develops and is implemented in more workplaces, many fear that their jobs will be replaced by robots or machines. The US News Staff (2018) writes that in the near future, doctors who use AI and ML will "win out" over doctors who do not. AI and ML will not replace healthcare workers, but will allow them to devote more time to bedside cars. AI can lead to healthcare worker burnout and cognitive overload. Overall, as Quan-Haase (2018) states, technology "extends the accomplishment of societal goals, including higher levels of security, better means of

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communication across time and space, improved health care, and increased autonomy". ". As we adapt and use AI and ML in our practice, we can enhance our care for our patients resulting in greater outcomes for all.

VIII. CONCLUSION

There is no doubt that surgery, chemo and radiotherapy will remain standard cancer therapy for many years to come, but at the same time, there is growing interest from the scientific community to further mature current clinical strategies to combat cancer. The involvement of computational input and assistance will be a tangible reality for the clinical setting of the future and will produce a significant technological revolution to predict and diagnose issues related to human health in near real time.

AI avoids emotional problems, cultural and ethical beliefs, and fatigue. The intelligence of optimal decision-making and continuous upgrades through artificial neural networks and DL will be excellent tools to aid medical practitioners in the diagnosis and discovery of carcinogenesis in a quicker time frame. The natural human brain has a limited capacity to process large amounts of data and information available.

Driven by huge fascination among the technology-oriented scientific community, AI-based DL tools have a lot of scope for the healthcare sector at the micro and macro level. These limitations include unsupervised training set algorithms, unsupervised learning implementation, patient data privacy, data set size, and classification based on more than 100 different cancer types, which warrant significant attention to the use of human computer interface (HCI) and AI. Let's demand Reproducibility of clinical experiment is one of the major hurdles in molecular drug discovery, which takes many years after clinical trials to launch effective formulations in the market. Reproducible computational drug designing has been a promising tool for future drug development with increased specificity and reduced cost.

The evaluation of a large set of complex and diverse healthcare data can be managed by the analysis of big data and ML tools to reduce limitation and false-positive data. Finally, AI in clinics is not meant to put radiologists and other medical professionals out of business. AI is not fully autonomous and cannot grow beyond human participation. AI in the medical profession is a novel and potential tool to achieve a specific treatment performance and identify the correct diagnosis at the highest possible level.

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