THE SURGE OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE SECTOR

Abstract

Artificial intelligence (AI) is making intelligent machines for the purpose of solving the problems and tasks by combining various subfields like machine learning (ML) and deep learning (DL). AI has diverse applications in each branch of science. It solves the problem of understanding, replicating intelligence and cognitive processes. AI is also playing a crucial role in new drug discoveries and management of medical data. It improves the accuracy of health care analysis. Recently applications of AI in the healthcare sector have been increased with several advantages and some limitations.

Keywords: Artificial intelligence, deep learning, machine learning, drug discovery, robot surgery, health care

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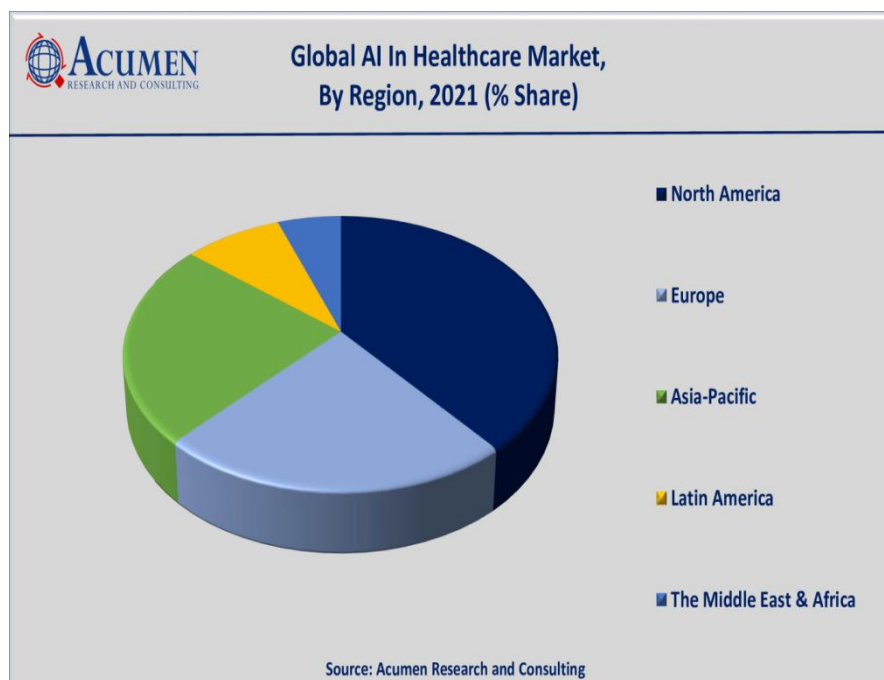Bathinda, Punjab, India

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I. INTRODUCTION

Artificial intelligence (AI) is defined as the technique of making intelligent machines to solve the problems and tasks by combining various subfields like machine learning (ML) and deep learning (DL). AI is an interdisciplinary approach that utilizes tools and principles from various sources like mathematics, biology, computation, logics. It is a computer science branch where the systems are able to simulate problem solving, visual perception and speech recognition like humans do. AI solves the problem of understanding, replicating intelligence and cognitive processes. There have been published multiple cases giving the evidence how AI can be used to enhance the access and efficiency of healthcare sector. AI has many applications in various domains such as Robotics, recognition of images, voices and expert systems. Literature published in 1950s shows the applications of AI in medicine with improved diagnostics using computer-aided programs (1, 2). MYCIN was devised for conducting the diagnosis of blood borne bacterial infections (3); and a computer based programme was used to identify the cause of abdominal pain of acute type in 1970s by AI (4). The applications of AI in the healthcare sector are on a rise since past few years (5) and are still in the initial developmental stages (6-9).

1. **Branches of AI:** Branches of AI are physical AI and virtual AI. The virtual branch deals with informatics ranging from management of knowledge about deep learning to its influence on healthcare management systems. Thus enabling the maintenance of electronic health records (e health records) as well as actively guiding the physicians in decisions making for treatment.

   The physical branch may be described best by robots which may help the operating surgeon or elderly patient and targeted unique new drug delivery system named as nanorobots. According to the Acumen Research report, the Artificial intelligence market in the healthcare sector is estimated to increase exponentially by the year 2026 globally.

Global AI In Healthcare Market, By Region, 2021 (% Share)
- North America
- Europe
- Asia-Pacific
- Latin America
- The Middle East & Africa

Source: Acumen Research and Consulting

2. **Global AI:** North America (includes US, Canada and Mexico) is the AI global market leader due to the high expenditure on healthcare and a well-developed healthcare sector. The government supports for the research and leading players provide the necessary support for artificial intelligence in this area. The AI market is also growing at a faster pace in Asia region particularly in India and China further aided by support from government. Well known Healthcare companies like Microsoft, Johnson & Johnson Services, IBM, Philips N.V, Siemens, GE Healthcare, Google,Intel, CareSkore, Amazon CloudMedx Inc., Clarify Health Solutions, Qventus Inc., Anju Software Inc. (Zephyr Health), Medical Vision Ltd are expanding their global artificial intelligence market.

3. **Common applications of AI in Healthcare:** AI applications in health care include various fields like medical diagnosis, medical management (prevention and treatment), surgical management, rehabilitation and predictive medicine. It can also improve healthcare access and patient experience. AI is also playing a crucial role in new drug discoveries and managing medical data, records and the accuracy of health care analysis.

4. **Medical data and record management:** Maintaining patient medical record and data management by using AI is an emerging branch of medical research (10). Robots are being used to collect and store the data to provide more accurate & consistent access. AI helps to connect the significant data even from the past records and therefore fastens the process of forming a diagnosis and developing the new medicines and drugs. AI can generate patient data records and sum up the health issues for the doctor. AI helps to find the required data at a faster rate, draws attention towards the significant information (11). Tempus located in Chicago, Illinois examines thoroughly the world's largest library of clinical and molecular data to customize healthcare treatments. The company generates AI tools that improve the doctor's perception about the treatment options. ICarbonX located in Shenzen, China gives an insight at digitalized human life using AI. By examining the health and actions of human beings in a "carbon cloud," the company hopes to support various aspects of health. The technology can be used to collect data to sort the symptoms and evolve better treatment alternatives. Another notable role of AI in healthcare is that it can be used to execute tedious but less important tasks automatically. It allows the administrators to work on other important assignments. Olive, an AI-based programme integrates with the hospital software easily and automates the processes like medical claims and sends the required data to the concerned professionals and therefore saves lot of time.

II. AUTOMATED IMAGE DIAGNOSIS

Over the past few years, AI has made an extraordinary progress in the field of medical imaging. AI systems use deep learning techniques and are equipped with set of operator instructions offering steady interpretation of complicated images including CT scans and MRI. The automated image diagnosis system relieves the workload, enhances the performance of doctors and provides better diagnoses of diseases. Interpreting tests, X-Rays, CT scans etc. can be done quickly and accurately by robots. The data to be analyzed can be huge and therefore time consuming particularly in cardiology and radiology departments. AI can be used as a tool to screen images, to even partially complete the reports for physicians who can later improve and approved them (12). Optellum (13) is one such tool that scans the lung X-rays automatically and highlights critical cases needing physician's attention. This

would help the cardiologists and radiologists to attend most complicated cases in the need of intervention. Therefore, AI can even help to combat the deficiency of radiologists, cardiologists and other health experts in the healthcare industry.

Enlitic located in Fort Collins, Colorado devises DL medical tools to improve the diagnosis in radiology. The company's platform examines the unstructured medical data — radiology images, blood tests, EKGs, genomics, patient medical history – which gives doctors better view of patient's health.

Arterys located in San Francisco, California designs tools to aid precision medicine. Its medical imaging AI platform can perform tasks like: detect breast cancer, scan cardiac MRI images, read X-rays, track lung nodules, diagnose brain tumors and ascertain strokes.

1. **Predictive Medicine:** Predictive and prognostic evaluation is another field where AI is contributing in a big way (14, 15). AI can support diagnostic, treatment and prediction outcomes for many diseases (16). Predictions are possible to identify risk factors for each patient to help in the diagnosis and treatment for better results (17).

2. **Improved Healthcare Access and patient experience:** The COVID-19 pandemic increased opportunities in patient diagnosis via telemedicine that helped in observation of patients at remote places and gave benefits of support services and tools for physicians as well as nurses (18, 19, 20). AI system can give medical updates to health professionals from different sources like textbooks and e-journals (21). The contribution by these applications has become even more crucial during pandemic, during which information exchange was of utmost importance in health care (22).

   AI applications improve the efficiency of hospitals as doctors can retrieve the data instantly when required, nurses can administer the medicines to the patient more safely and patients can communicate with the health professionals in a better way. AI applications are also helpful to train the healthcare workers to reduce the gap between urban and rural health services (23).

   AI has helped development of medical softwares that offer customized and interactive services like fixing the appointment with doctors. Doctor's visit is recommended only if required; otherwise the patient is suggested to take the medication for minor ailments. UK's National Health uses machine learning based Babylon chatbots (24) to give medical consultations. The chatbots can establish a medical diagnosis by taking personal medical history. The patients report the health problems into the app that uses the speech recognition to study and analyze the archives of diseases and guides the patients for next healthcare action to be taken. This allows the better access to the hospitals and reduces the workload on doctors and nurses.

   Johns Hopkins Hospital uses AI tools in collaboration with GE Healthcare to reinforce the patient flow. It helps the hospital to prioritize the various hospital activities for the enhanced benefit of the clients. Since then, the patient admission to the hospital emergency department has increased tremendously. Many smartphone AI tools give patients counseling without visiting a hospital. These tools can diagnose diseases and suggest in case any further help is needed (25). Virtual health assistants and virtual nurse's tasks include answering the questions of patients via emails, phone calls, handling

medical records of the patients and hiding sensitive data, planning doctor appointments and follow up reminders to the patients etc.

A virtual nurse, Molly has been devised by startup Sense.ly that helps to observe patient's condition and treatment follow ups in between visits to the doctor. This program is specialized in chronic illnesses and supports the patients by using machine learning.

Boston Children's Hospital has developed an app for Amazon Alexa to give basic health advice to parents of sick children. The questions asked about medications are answered by the app and guides the parents whether the presenting complaints need a visit to the hospital. It significantly reduces the frequency of hospital visits giving both patients and healthcare experts an advantage of healthcare services.

AI can help in medical management and health monitoring of patients also. The AiCure app helps to keep a check on the patient for taking the medications prescribed by the doctor. A smartphone's webcam using AI confirms whether patients are taking the medications and helps them to manage their symptoms. Wearable health trackers and smartwatches – like those from FitBit, Apple, Garmin and others – monitor heart rate and activity levels and can even assist in managing chronic diseases like diabetes or asthma and helps to prevent hospital admission (26). They can send alerts to the person, share this information to doctors as well as with AI systems and provides additional data points about the needs of patients.

3. **Drug discoveries:** AI techniques are helpful in formulation of novel drugs molecules, tracking patients and designing patient treatment plans (27). Developing a new drug through clinical trials is costly and time consuming task. AI helps to make this process cheaper and faster. AI assists the healthcare professionals to explore available drugs and redesign them to target specific ailments. During the recent Ebola virus scare, AI was used to serve the same purpose.

BioXcel Therapeutics develops new drugs for immuno-oncology and neuroscience using AI. Also, AI is employed to design new tools to scan pre-existing drugs and to recognize new patients. Atomwise, San Francisco uses AI for Multiple Sclerosis and Ebola. AtomNet, aids in prediction of bioactivity and identifies patients for trials. It can scan millions genetic compounds daily and provide fast results. ReveireLabs, Cambridge Massachuttes employs Machine learning tools to discover and design new cancer medicines.

4. **Robot Assisted surgeries:** There has been excellent growth in rehabilitation therapy as well as surgeries by AI. This is only possible with robots designed all over the world to support and manage these tasks. Recently Robot-assisted surgeries are quite popular and surgeons prefer to use robotics whenever possible. It is used in open-heart surgeries with more accuracy than humans. These surgeries lead to lesser complications, comparatively lesser pain and quick recoveries of the patients. Surgery with robots assisted cameras and mechanical arms aid in more precise, efficient surgery with improved surgical skills and knowledge. Robot yields 3D view of the surgical site which is otherwise impossible in routine practice.

5. **Rehabilitation therapy:** In Rehabilitation therapy robots provide physical support and guidance to patient's limb during motor therapy (28). In surgeries AI has transformed surgeries through devices giving semi-automated surgical tasks to diminish human made error maintaining accuracy and precision (29). The Robotics Institute at Carnegie Mellon University Pennysylvania developed HeartLander, a miniature mobile robot for heart therapy. The robot enters the chest through a small incision, traverses certain locations of the heart and attaches to the surface of the heart performing the required procedure only under physician's supervision.

6. **Medical diagnosis and treatment:** Deep learning (DL) is valuable in detecting breast cancer, TB, irregular heart rhythms and diabetic retinopathy (30-33). AI can interpret scans and prioritize the most significant ones thus acting as an analytical tool helping doctors to attend crucial cases earlier. This is time saving and resource saving approach (12, 13). One example is CADx, a DL model which classifies breast tumors with diagnostic precision and sensitivity on a higher level than previous algorithms (34). AI plays a role in managing stroke, in tissue plasminogen activator treatment and to forecast the chances of intracranial haemorrhage (16). AI can help in accurate cancer diagnosis. Body scans of a person can detect cancer and any vascular disease at initial stage based on genetics. Using the technologies like AI and Deep Learning, Benevolent AI has is delivering the 3Rs approach in pharmacy namely right treatment, right patients and right time.

   AI techniques are proved to be of immense help in early diagnosis of fatal diseases like Parkinsonism. BERG is active for the treatment of Parkinsonism. It works on charting the diseases to create advanced medicines and vaccines at a faster rate. BERG uses AI to find the connections among unknown human body chemicals.

III. APPLICATION IN PATHOLOGY

   PathAI uses machine learning applications allowing the pathologists to correctly diagnose the cancer patients. Due to accurate diagnosis, such patients can be cured at an early stage before turning fatal and therefore saving many lives. PathAI decreases fallacies during the process of cancer diagnosis and offers a range of new techniques for personalized medical treatment. Due to improved precision many of them can be completely cured; saving lives.

1. **Application in microbiology:** AI helps to diagnose fatal blood-related diseases at initial stages. With the help of AI-empowered microscopes, potentially dangerous bacteria such as E. coli and Staphylococcus etc can be scanned at a much faster rate. For example 25,000 blood sample images were used by the scientists to enable the machines to learn to find the harmful bacteria. AI empowered machines could detect the bacteria in the new samples with 95 % accuracy (35).

2. **Clinical trial Participation:** Clinical trials are essential to be conducted for safety and efficacy of new drugs (36). For clinical trials to be conducted, vast information has to be collected and arranged. By using AI tools, it becomes easier for hospitals to form an aim oriented approach for clinical trials. AI tools have helped the investigators to search the appropriate candidates to test the drugs for numerous medical conditions.

AI have largely attributed to decrease the investment and increase the speed for conduct of clinical trials and therefore healthcare industry have seen an exponential rise in the number as well success of the clinical trials. Zippel et al. analyzed the application of Machine Learning in clinical research (35), Dong et al. and Liu et al. described the current status of registered trials for AI in diagnosis of cancer (37), critical care, and emergencies (38).

3. **Benefits of AI in healthcare:** In a nut shell benefits of AI are:

- Maintaining patient medical record and data management
- automated image diagnosis system
- diagnostic, treatment and prediction outcomes for many diseases
- opportunities in patient diagnosis via telemedicine
- improved efficiency of hospitals and training of the healthcare workers to reduce the gap between urban & rural health services
- develop medical softwares and reinforce the patient flow
- reduced frequency of hospital visits giving both patients and healthcare experts an advantage of healthcare services
- medical management and health monitoring of patients, health tracking
- formulation of novel drugs molecules and designing patient treatment plans
- Robot Assisted surgeries with lesser complications, lesser pain and quick recoveries of the patients
- semi-automated surgical tasks to diminish human made error maintaining accuracy and precision
- Medical diagnosis and treatment interpreting scans and prioritizing the most significant ones
- aim oriented approach for clinical trials
- decreased investment and increased speed for conduct of clinical trials.

4. **Limitations of AI in healthcare**: In spite of several benefits of AI in the healthcare there are various drawbacks such as:

- ethical issues
- potential to make errors in decision making
- difficulty in adapting to new technologies
- human supervision
- problems in learning Artificial Intelligence
- implementation challenges

IV. CONCLUSION

The most frequent applications of AI is clinical prediction, diagnosis and treatment. AI in general, has assisted healthcare workers in various aspects in recent years like Machine-learning has become the most operational & successful type of AI technique that is concerned with image recognition in imaging. Another use of AI is to collect statistics in cancer patients. It is also proved to be an excellent technology for designing faster, cheaper and effective anti-cancer drug model. Applications of AI have enormous capacity to deal with

a mass of big medical data and unlock clinically relevant hidden information. AI has reduced costs of patient care with reduced chances of re-surgery by enhancing the creativity and critical thinking of medical professionals in clinical practice. Future scope will target on machine learning (ML) based on information collected by the recent diagnostic measures.

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