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ijirset@gmail.com

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A Review on Growing Clinical Health Record and its Role in Health Care Informatics

Manju Payal

Software Developer, Academic Hub Ajmer, India

ABSTRACT: The amount of digital information in electronic health records (EHRs) has exploded in the recent decade, following the overall trend. EHRs are no longer used to record basic patient information and administrative activities, as they formerly were, but they may now incorporate a variety of data, such as the patient's medical history, laboratory test results, and other information. Data scientists may work on various parts of healthcare research by applying sophisticated analytics to EHR clinical data, thanks to the growing number of electronic health records (EHR) in recent years. The application of machine learning in health care is discussed in this study. The benefits of machine learning in health care is discussed in this study.

I. INTRODUCTION

ML is an important part of the AI. Here, ML is referred to as Machine Learning and AI is referred to as Artificial Intelligence. ML may be used to discover data patterns. Machine learning methods learn necessarily and experimentally. Machine learning based methods do not require any explicitly programmed. [1] In another way, the machine learning methods depend on samples. Explicit programming is dependent on the limited hypothesis. ML also enhances the reliability and efficiency. Machine learning is also used to minimize the costs in computational processes. Additionally, this can rapidly and accurately produce models using data analysis. [2]

ML in healthcare can analyze large quantities of data and provide significant insights to aid healthcare workers in making timely choices. [3] This also enables them to examine a patient's medical history and forecast results dependent on treatment and lifestyle choices. They can, on the other hand, plan ahead of time by recommending a holistic therapy to the patient, resulting in cheaper expenses and a better overall patient experience. [4]

With the fast increase of the population, this appears that recording and analyzing the huge quantity of data about patients will be difficult. ML allows us to automatically identify and analyze this data, making the healthcare system more dynamic and resilient. [5] In healthcare, ML combines two kinds of domains which are below:

1. First domain in the healthcare is the computer science.
2. First domain in the healthcare is the medical science

Machine learning advances medical science by analyzing complicated medical data and recommending additional research.

When it comes to human wellbeing, the healthcare business is one of the most vital industries. According to actuaries from the US federal government, Americans spent \$3.65 trillion on health care in 2018 (Axios research), while the Indian healthcare industry is predicted to reach \$372 billion by 2022. [6]

Google recently released a ML method that can detect malignant tumors. Stanford University is researching on using ML to identify skin cancer in health care. With the use of 3D images, Microsoft Project InnerEye employs AI and ML in healthcare to distinguish among tumorous and healthy anatomy. [7]

ML combines millions of data points to produce near-perfect predictions. ML helps healthcare practitioners to make timely recommendations, estimate illness risk, and allocate appropriate treatment resources.

Benefits of Machine Learning in Healthcare

Quick decision-making is one of the most critical aspects of healthcare. Clinicians and healthcare professionals can reduce risks by making treatment-related choices ahead of time if they have more knowledge. [8]

1. Identify health risks

▪ Additional major advantage of ML in healthcare is that physicians may detect health hazards before they become diseases by evaluating enormous amounts of patient data. [10]



- Clinical institutions may utilise ML in health care to detect strokes caused by current health issues, assess heart health, and detect other difficulties.[11]
- Doctors and clinical experts may detect potential much earlier thanks to Machine Learning algorithms that give real-time data and analysis.[9]

2. Analyze medical history

- ML is a blessing in disguise for the healthcare business. There is a hug of unstructured data in the form of patient records, previous therapies, and the patient's family's medical history.[12]
- ML aids physicians in assessing patient historical data and predicting correct health problems.[13]
- In healthcare, machine learning helps them to draw insights from prior data such as illnesses, family history, and genetic disorders, among other things, and make swift judgments.[14]

3. Administrative task management

- Healthcare ML allows professionals to automate a variety of administrative activities so that they may focus on providing better care to their patients.
- ML can handle online appointment scheduling by intelligently examining physicians' calendars and assigning an appointment date.[15,16]
- They can handle billing, rescheduling appointments, filing appointment records, providing patient recommendations, setting up reminders, redirecting emergency calls, and more.

4. Electronic Health Records(EHRs)

A digital compendium of all accessible patient data compiled into one database is known as an electronic health record (or EHR).

Medical history, treatment record data such as diagnoses, prescriptions, treatment plans, vaccination dates, allergies, radiological pictures, and laboratory and test results are all included in EHR.[17]

- After the enactment and signing of HIPAA (Health Insurance Portability and Accountability Act) in 1996, the industry began to implement EHR in the late 1990s. Things moved slowly, though, due to technological restrictions.
- The HITECH (Health Information Technology for Economic and Clinical Health) Act of 2014, which outlined the whats, whys, and hows of EHR deployment, gave the technology a substantial boost.[17,18]

The critical characteristics of Electronic Health Records are:

1. Security –

Authorized users have access to and transform the data. Extensive access management procedures, encryption, anonymization, and data loss protection routines ensure that all patient data is kept safe.[20]

2. Availability –

EHR data is structured and updated in real time for data science operations including diagnostics, descriptive analytics, predictive analytics, and, in certain situations, prescriptive analytics. It is accessible at all times and shared with all parties engaged in a patient's care, including laboratories, specialists, medical imaging labs, pharmacies, and emergency rooms.[19]

3. Workflow optimization –

Routine operations, such as recurring Automate and simplify provider workflow, can be automated using EHR technologies. Furthermore, by establishing needed procedures during data processing, EHR automation can address healthcare data processing requirements such as HITECH, HIPAA (USA), and PIPEDA (Canada).[21]

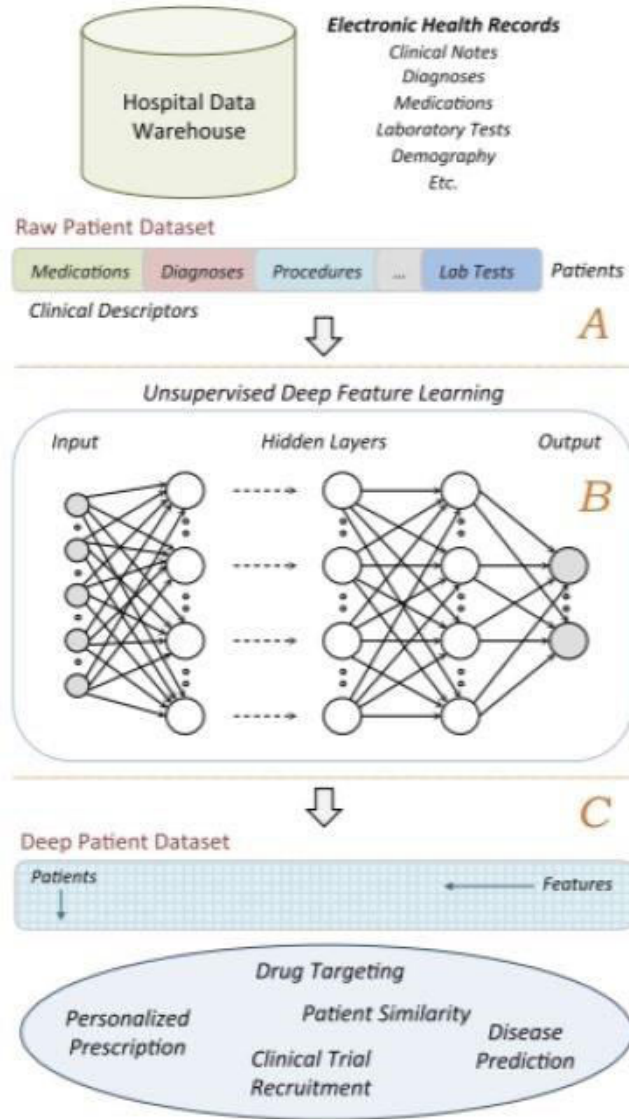
Electronic health records have been around for a few years in the healthcare business. These documents are available in digital form, allowing various parties to access them as needed.[22]

EHR (electronic health records) systems keep track of information about a person's health (including demographic information, diagnoses, medications, laboratory tests and results, medical images, clinical notes, and more). While the fundamental purpose of the electronic health record (EHR) was to enhance the efficiency and accessibility of health systems, it has a wide range of applications in clinical informatics and epidemiology. Medical concept extraction, illness and patient clustering, patient trajectory modelling, disease prediction, and data-driven clinical decision support are just a few of the applications for EHR.[23]

For healthcare firms, EHRs constitute a significant leap in ML. One clinician, for example, can use the EHR system to look up a patient's past treatment history.



Another doctor who wants to know which therapies have worked in the past can look at the same paper. EHRs are not confined to a single element of patient data and encompass a wide range of information.[24]



Deep Patient: Conceptual framework used to derive the deep patient representation from EHR data warehouse

Deep ML can assist improve treatment efficiency and speed up clinical decision making for patients by leveraging data from electronic medical records (EHRs). However, there are significant challenges in making effective use of data recorded in patient records as text notes for predictive modelling. Despite the challenges of employing an unstructured medical text in an analytical environment, the potential importance of these sources should not be overlooked, since they are frequently the most significant in actual diagnosis.[26,26]

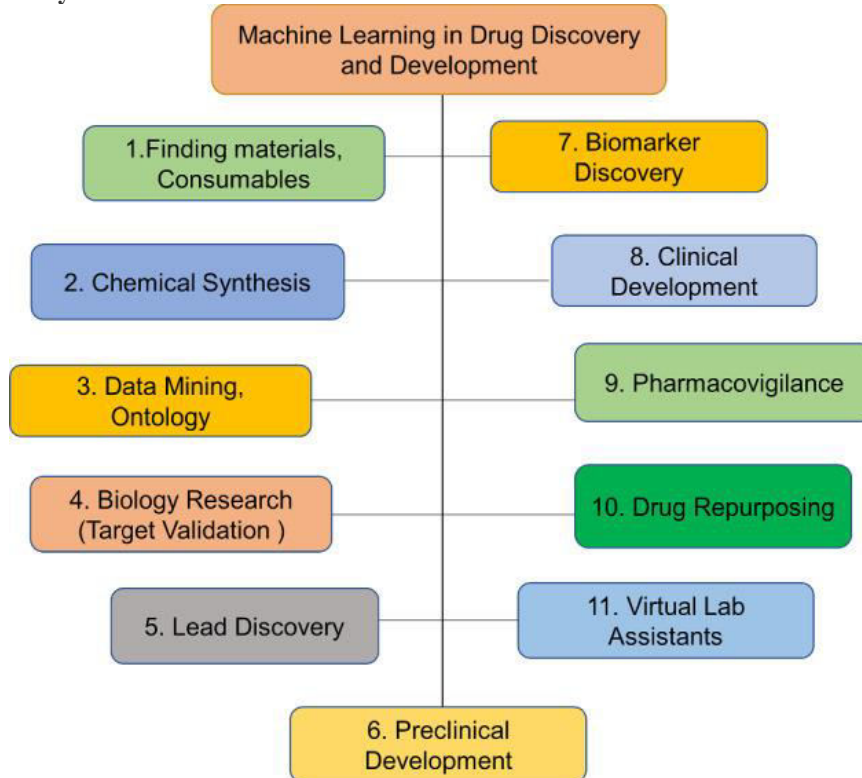
5. Medical imaging & diagnosis

- Medical imaging and illness diagnosis are perhaps one of the most important advancements in Machine Learning for health care. Despite all of the advances, physicians still have difficulty detecting illnesses.
- ML analyses patient data and aids in the detection of illnesses that may present in the body but are difficult to detect.



- Machine Learning improves medical imaging by allowing procedures to analyse large amounts of radiology and pathology data and make faster choices.
- This also aids in the detection of tumours that may expand in size and provides an accurate image of them so that doctors can see how the sickness is progressing.[27,28]

6. Drug discovery



Various variables have recently emerged as a result of increased interest in using machine learning technologies in the pharmaceutical business. Below figure explains how machine learning is used in numerous domains of drug discovery and improvements. To express therapeutic notions, each phase was carried out in the manner of a pipeline. The various phases reflect distinct time and cost expenditure iterations. Each phase is carried out here to demonstrate the efficacy of the restorative treatment. Using some 'omics' and 'smart automation techniques,' the medical data was mined and precisely calculated. Extending these approaches into the biological area expands the pharmaceutical industry's prospects while also posing new problems. Because it is the goal of many pharmaceutical companies to identify the most convincing clinical hypothesis.[29,30]

Practitioners or professionals can design drugs based on the findings. Machine learning algorithms have been used to evaluate the performance of any type of medicine in the pharmaceutical industry. At this stage, assuming limitless storage is offered, improvements in datasets such as size and kinds can provide a foundation for machine learning. It will be able to acquire massive amounts of data from the pharmaceutical industry in this way. Textual data, pictures, assay information, biometrics, and high-dimensional omics data are examples of data kinds that can have many configurations.[31,32]

- Early-stage medication development is another advantage of Machine Learning in healthcare. Pharma practitioners can use AI and Machine Learning in healthcare for next-generation sequencing at this time.
- Machine Learning in healthcare aids precision medicine by identifying alternative treatment options for complex disorders.
- Pharma makers may use Machine Learning algorithms to blend medicine formulations and determine which ones perform best.
- They can gather vast data from a big number of experiments and decide which composition will be the most helpful for certain ailments.

7. Clinical research

- ML has a wide range of applications in healthcare, including clinical trials and research. Clinical research is expensive and time-consuming.



- ML aids researchers by predicting the best candidates for clinical trials, reducing the risk of mistake. It looks at a range of factors, such as medical history, therapies, and health, to determine who is eligible to participate in clinical trials.[37]
 - For healthcare companies, AI and Machine Learning are useful in giving real-time data on study participants. It's a great approach to make judgments and adjust testing processes when new information becomes available.
 - Researchers frequently encounter difficulties in digesting data and determining the next best treatment option. ML prototypes aid in the analysis of this data and determining the optimal pathways for researchers to take in order to attain the greatest test output.[33]
8. **Personalized Healthcare**
- ML has taken the lead as wearable smart gadgets have become a notable innovation in personal health monitoring.
 - ML in health care supports personal health by offering solutions to patients' common questions via applications. Artificial Intelligence bots can detect typical questions, recognise patterns, and route them to the appropriate doctors.[36]
 - Patients, on the other hand, may make better health decisions and adjust their lifestyle by uploading health data to smart devices. When older adults want assistance, they can also sound an emergency alert, which has already saved many lives.
 - While consumers are still getting acclimated to smart gadgets, there are several advantages to using ML in healthcare. Since this information is available online, anybody may view it and learn about the patient's current health status.[34,35]

II. LITERATURE SURVEY

In a separate study conducted by the Harvard Business Review, over 300 healthcare executives and clinical leaders stated that patient involvement is a concern. More than 70% of respondents said fewer than half of their patients are extremely interested in their therapy, while 42% said less than a quarter of their patients are very engaged. One of the key factors of projected growth is a large amount of data and a large number of startups in this area. The implementation of machine learning and, specifically, deep learning in healthcare applications for medical imaging, disease identification, and drug discovery is expected to take the lead and drive the growth of the market.

Fatemeh et al. [12] suggested machine learning algorithms based on EHR data for predicting initial emergency admission. For the prediction of risk for initial emergency admission, the authors employed the Cox model on a sample of 4.6 million patient samples, followed by the random forest and gradient boosting algorithms. The authors discovered that the gbm model performed the best, with an AUC of 0.779.

III. CONCLUSION

Generic ML methods, such as enhanced DL architectures and sequential algorithms (that have been shown to be beneficial in a variety of non-biology related fields of research), are becoming increasingly popular in biomedical research. We've shown how machine learning may be used to evaluate structured data in electronic health records in order to help with pharmacovigilance operations like recognising adverse medication occurrences. Predictive models learnt from electronic health records might be included into adverse drug event warning systems at the point of care, particularly to aid in the accurate encoding of adverse drug events, which would address the issue of under-reporting and lead to more trustworthy statistics. It's critical to pay close attention to which data to utilise and how to effectively represent it when creating high-performing predictive models, especially when dealing with high-dimensional and sparse data.

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