Enhanced Approaches In Decision Support System Using Ai For Achieving Precision Medicine

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Abstract: The deep learning based healthcare technology is evolving recently to identify, classify and give precision medicine to patients. Recent advancement in internet of things, cyber physical systems brings healthcare technology into doorstep. This paper reviews the various diagnosis methods of healthcare industries dealing with cancer, diabetics, heart failure which seeks computational intelligence techniques to identify and treat patients with better care. The various research articles collected from popular journals like science direct, PubMed, ACM, IEE, Clinical Oncology have been taken to analyze its experimental methods and their outcomes. This review mainly focused on dealing electronic health records (EHR), cancer prediction model using recent deep learning techniques and some of framework based mechanisms which automate healthcare process. This article deals with major recent algorithms like support structured vector machine, auto encoder, convolution neural network etc., in the clinical setting of cancer and major diseases and diagnostic setting like genomic sequence based mechanisms. The healthcare industry has their own processing techniques to deal with various predictions and treatment like gene based techniques, clinical laboratory testing, observation model, diagnostic model. It also requires many statistical reference model and medical reference to acquire quick prediction along with patient's information. As a result decision support system using AI for realizing precision medicine can be delivered by CNN positively.

Index Terms: Clinical and Diagnostic Decision Support, Artificial Intelligence, Electronic Health Record

1. INTRODUCTION

Health Care of a particular country has a major impact on economy, life time of persons and recovery from diseases, cost of treatment[1]. It is important to develop well equipped technologies for betterment of treatment with cost effective. Recent advances in artificial intelligence like machine learning and deep learning have an impact on different types of sectors particularly in automation, manufacturing and importantly in the healthcare industry. The algorithm developments and enhancements in artificial intelligence resulted had a major impact on classification and clustering in accuracy, precision, recall and f-measure. Healthcare Technology is composition of clinical and diagnostic decision support system aided with artificial intelligence techniques and related bio informatics techniques. Much advancement in artificial intelligence techniques in healthcare market enhanced the diagnosis and analysis process. These techniques are widely accepted by the healthcare practitioners[2]. Healthcare has a vital role in diagnosis, prevention, cure and rehabilitation of patients affected by health disorders. Artificial Intelligence is a computational and automation model to maximize the learning of the prediction in healthcare models. There are different models for healthcare prediction like Genome Based Model [3], Hidden Markov Model[4], Stochastic Gradient Model[5], Fuzzy Model[6] which incorporated along with artificial intelligence techniques to predict the accuracy of disease, clinical models, precision medicine, hospital readmission prediction. The advancement in artificial algorithms like LSTM, CNN, RNN, RBM,DBN, AE, GRU [7] played an important role in concepts in medical extraction, trajectory modeling of patients, inference of diseases, decision support systems in clinical environment.

The EHR (Electronic Health Records) collects various data about patients and clinical diagnostics information and it uses various medical codes to represent that information. The problem in healthcare industry is various coding standard for diseases, clinical information notes. There are several codes like ICD-10 for diagnosis, CPT for procedures, LONIC for laboratory, RxNorm for Medications. Some examples are J9600 for acute respiratory failure in like ICD-10, 67810 for Eyelid skin biopsy in CPT. It causes several issues in cross referencing models in CDSS and DDSS. It requires additional technique to unifying the codes in healthcare. There are many interoperability methods used to resolve these issues[8]. Information Retrieval plays a vital in healthcare to retrieve adequate information from large patient details and medical literature references. The large volume of data available in both patient and clinical diagnostic information's as well collected information's from sensors might need a composing mechanism to rightly discover and retrieve the information from data's. Clinical support system is set of process which acquire information about patient, diseases, reference medical data and give valuables support for making decisions over curing the disease. Clinical data such as age, level of test results are compared with normal medical references data in order to predict the severity of diseases. In case of diseases like cancer, prostate related disease there is a need to deeply study the various parameters involved to classify and identify the severity of the diseases[9]. The diagram shows the overall view of Healthcare.

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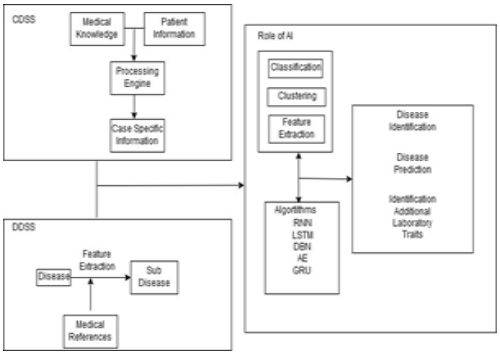


Figure 1: *Health care overall view.*

Diagnostic decision support system involved analyzing the various laboratory and medical references to classify the diseases and their reference range there suitable attributes[10]. It also plays an important role interpreting the output of the device and predicting the stage and severity of the disease.

2. Discussion on Processing EHR Records

Electronic Health Record (EHR) used to digitally record all the investigations and treatments made to the patient. EHR records contains patients age, gender, blood group and the various clinical test their results are recorded and patients prescriptions and discharge summary notes, clinical advisor summary are recorded in the EHR. These records play important role in following patient's history and their treatment process. The figure 2 shows information available EHR records.

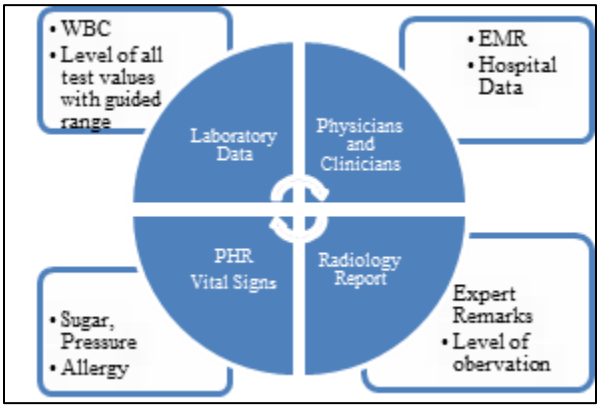


Figure 2: *EHR Digital Document information*

The Table 1 shows some of the recent researches for processing EHR records to make more personalized medicines and treatment care.

Table 1: *Various Study Methods to Process EHR Data.*

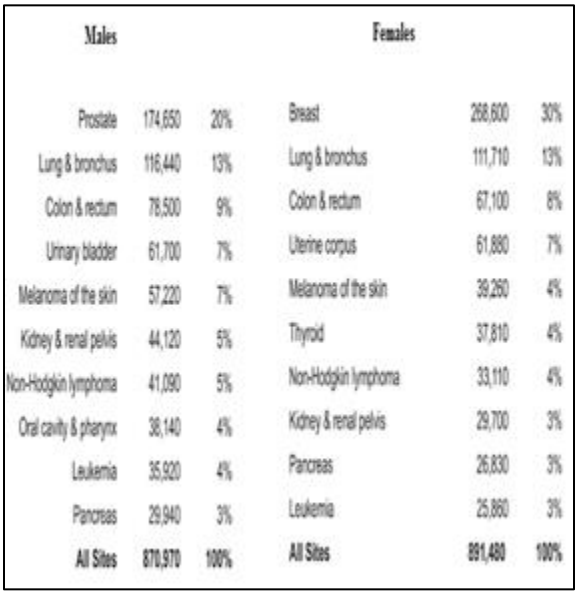
Author	Method	Accuracy
Zhengxing Huang et al.[11]	RSDAE-SM and SDAE-SM	86
Theodora S. Brisimi et al.[12]	K-LRT	78.74
Qiuling Suo et al.[13]	CNN_softmax	84
Yu Cheng et al.[14]	CNN Based Model	Increased by 5.2 %
Alvin Rajkomar et al.[15]	Deep Learning Approach	90
Jeremy C. Weiss et al.[16]	RFGB	79.1
Shakuntala Jatav et al.[17]	F-KNN with FCM	99.35

Zhengxing Huang et al.[11] given solution from a big volume of electronic health records (EHR) on clinical risks of acute coronary syndrome patients using a regularized stacked denoising auto encoder (SDAE) model for classification of information. The problem with this research is not considered the missing data and deep learning methods. This method achieves 86% accuracy compared to SVM, LR, RF, NB, MLP. Theodora S. Brisimi et al.[12] identified for predict hospitalizations of chronic, heart, diabetes using data driven methods . They used a likelihood ratio test-based method K-LRT and joint clustering and classification (JCC) method which identifies hidden patient clusters and adapts classifiers to each cluster. The accuracy increased by 78.74% compared to RBF, SVM, and ACC. Qiuling Suo et al.[13] developed a method based on the metric learning methods. This research performs two tasks representation learning and similarity learning. This method increased accuracy of 84% on disease prediction. This article proposes CNN for vector representation of patient's sequential information then it uses soft-max and triplet loss based method to learn the similarity of patients. Yu Cheng et al.[14] proposed a model to extract phenotyping from patient medical records. Yu Cheng used layer based model and represented the information in longitudinal to support time line. This model not handled over-fitting. This method may be analyzed for other diseases. This model increased it accuracy percentage by 5.2 compared to traditional mechanisms. Alvin Rajkomar et al.[15] demonstrated representing digital medical records in unified format such as FHIR (Fast Healthcare Interoperability Resources) . This approach used deep learning approach to predict and align the formal formats into new format. The FHIR recorded and temporal order of all events uses full history to make prediction. The attribution mechanism gives more insight into patient details that influenced the prediction. They used tensor flow and boosting models to implement their research. Jeremy C. Weiss et al.[16] proposed a method for personalized medicine from electronic health records using machine learning techniques. The author predicted myocardial infraction using statistical relational learning (SRL). This research used RFGB algorithm to generate patient relations with feature generation for achieving personalized medicine. This algorithm improves accuracy by 79.1% compared to SVM, RF. Shakuntala Jatav et al.[17] developed a framework focused on predicting kidney, diabetes and liver diseases. This paper had used support vector machine and random forest to classify the disease database. This algorithm produced 99.35 % accuracy in predicting diseases. Optimization technology integrated along with this paper may produce better results.

3 DISCUSSIONS ON CLINICAL SUPPORT SYSTEM FOR CANCER

Cancer affects many peoples across all countries. Cancer starts from defect of a cell and grows gradually effect other cells, if it's identified early stage it's controllable and curable. There are many research conducted on different types of

cancer and its sub types along with its evaluation in human body. Delivering cancer from tissues is a complicated process and it involves complex study identifying the difference between normal and effected tumors [18]. Every year the new cancer cases increasing and death rate also gradually increased according to the study of the American cancer society[19]. The Table 2 shows about various types of cancers which effects both male and female and their death rate.



Males			Females		
Prostate	174,650	20%	Breast	268,600	30%
Lung & bronchus	116,440	13%	Lung & bronchus	111,710	13%
Colon & rectum	76,500	9%	Colon & rectum	67,100	8%
Urinary bladder	61,700	7%	Uterine corpus	61,880	7%
Melanoma of the skin	57,220	7%	Melanoma of the skin	39,260	4%
Kidney & renal pelvis	44,120	5%	Thyroid	37,810	4%
Non-Hodgkin lymphoma	41,090	5%	Non-Hodgkin lymphoma	33,110	4%
Oral cavity & pharynx	38,140	4%	Kidney & renal pelvis	29,700	3%
Leukemia	35,920	4%	Pancreas	26,830	3%
Pancreas	29,940	3%	Leukemia	25,860	3%
All Sites	870,970	100%	All Sites	891,480	100%

Figure 2: *Cancer Statistics on Males and Females[19]*

Image and Data Based analysis are the two wider area of treatment of cancers. The following section analyses some reason advancements in cancer treatment. Chaoyuan Liu [20] developed for lung cancer treatment using Watson for Oncology(WFO). It was developed for chinese patients with lung cancer. It provides much better result than experts on that field. WFO has pre knowledge about cancer cases. It uses reasoning approaches by computing for specific cases. The Table 3 shows the various algorithms to predict cancer diseases.

Table 2: *Various Study Methods Cancer Diagnosing Methods*

Author	*Method*	*Accuracy*
Kemal Adem a et al[21]	*Stacked Auto encoder*	*97.25*
Hussain AlSalman et al [22]	*IDSS*	*96.5625*
Mercy Nyamewaa Asiedu et al[23]	*KNN* *RF*	*93.5* *95.5*
Chi Liu et al[24]	*SetSVM*	*76.78*

Kemal Adem a et al[21] analyzed a study on cervical cancer and discussed about the uses of stacked autoencoder method and its efficiency in determining the complex relationships by using machine learning method.in order to find the exact measurement of the tumor size, depth etc., this methods seemed to be a great solution and it achieves higher accuracy by extracting un-necessary attributes. This research applied matlab R2017b.Its performance shows better result when compared to SVM and decision tree. Hussain AlSalman et al [22] deals with intelligent support system for diagnosing the breast cancer with the help of four stages(processing, segmentation, feature extraction and classification). In first stage preprocessing they extracted noise and artifact. In the second stage used K-means algorithm. In feature extraction stage they used DWT and GLCMs and at last ANN used for classification. They used dataset MIAS (Mammographic Image Analysis Society) for predicting breast cancer. This research achieves 96.56% accuracy. Mercy Nyamewaa Asiedu et al[23] processed with the algorithm developments for automated detection of cervical pre-cancer at efficient and reasonable cost, point of care and pocket colposcope. This method uses a minimum power microscope to capture the changes in cervix by applying contrast agents such as acetic acid and in some cases Lugol's iodine. As a result of adopting this contrast agent method it gives the unbiased atomization of cervigrams and gives an expert level in diagnosing pre cervical cancer. This research achieves 93.5% Accuracy and it uses GE mico array datasets. Chi Liu et al[24] proposed a study on setSVM in cancer detection challenges. This paper mainly focused nuclear morphology by using different types of nuclear quantifications which supports for all types of clinical cancer decision support system. The work focused on the single nuclei to analyze the disease depth.

4. DISCUSSION FRAMEWORK BASED APPROACHES

In recent uplift of cyber physical systems(CPS) [25] along with internet of things with smart sensors played a vital role in monitoring and quick actionable accountability of patients vary from old age to homely admitted patients. It is framework based approach, in the sense using CPS, Cloud, IoT, Smart City, Mobile Apps, Intelligent systems that all integrated in a systematic manner to form framework that will complete take care of patients. The wearable devices[26] that also integrated with this kind framework may provide more accuracy to data. Using bionano technology there enormous electronic devices are developed and used for diagnostic purpose for patients. Eirini C. Schiza et al[27] proposed a framework eHealth for all countries specially in the European scenario which specially deals with interoperability of standards and various medical systems (Pathology, Radiology, Cardiology, Laboratory, Pharmacy, Oncology). The following framework components are identified cloud, legal ie security, financial etc., It provides a complete platform for all dimensions like doctor, patient, insurance, clinical analyst, medical references data etc., Shuo Yang et al[28] addresses the following issues rapid growth of data, interoperability problem of medical codes, need of personalization and profession. This research proposes a new clinical diagnosis and treatment system (CDTS) based semantic interference model contains two stages knowledge extraction and reasoning. First it read patient data and performs ML algorithm to process, second collecting expert input by rule editor, finally making semantic interferences and making output by comparing various semantic best interference rule.

5. CONCLUSION

The technology advancements in artificial intelligence, clinical and diagnosis systems have evaluated lot in predicting and

diagnosing the basic level to advanced level diseases. Our study focused on EHR based mechanisms and advancement techniques to predict and analyze cancer related issues. The processing EHR studied about autoencoder mechanism [11], CNN Methods[13, 14] , deep learning algorithms[15], k-means algorithm [12, 17], RFGB[16]. The cancer related methods was stacked auto encoder[21], IDSS[22], KNN and RF[23], setSVM[24]. The study shows disease prediction accuracy was comparatively improved using artificial intelligence methods but depends on the technical accuracy of the data. The current investigations on the healthcare study based on artificial intelligence identified that CNN based mechanisms outperform. In future along with these methods mind based investigation [29] also integrated in clinical practice.

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