Impact of Healthcare Predictions with Big Data Analytics and Cognitive Computing Techniques

S.Aarathi, S. Vasundra

Abstract: The world has transformed into an information society that exceedingly depends on data. Since information frameworks create large measures of records each day, consistently, it appears the world is achieving the level of data overload. Big data is used to process the enormous volumes of data into revealing shrouded designs, complex relationships, and other helpful information. This work has done a comprehensive analysis of enormous information investigation in medicinal services. A brief insight into the importance of cognitive computing in healthcare has been presented. The extensive study concludes that the Cognitive computing has more impact on healthcare predictions than the big data analytics.

Keywords: Healthcare predictions, Data analytics, Cognitive computing, Cognitive Analytics, Feature extraction.

I. INTRODUCTION

The world has transformed into an information society that exceedingly depends on data. Since information frameworks create large measures of records each day, consistently, it appears the world is achieving the level of data overload. It is obvious now that to process such volumes of data an enormous capacity is required regarding storage and computing resources. Whereas the evolution of hardware and technologies limits the growth of capacity, the growth of the data volume is unlimited [1].

Getting more particular, these days' numerous associations have received and comprehensively

Utilize information frameworks running on technological platforms, numerous of their plans

have turned out to be dependent on information. In mature organizations data directly affect the logic of business processes, information has become a core of their business or business end. Hence business demands the data, further more availability of specific data in a specific time [2]. Due to the growth in the volume of data horizontally and vertically, data analytics is required to draw some conclusions and provide information to the people. Nowadays big data has its role in various fields such as health care, business, entertainment, etc.

It is observed that there are applications of enormous information in human services specifically what's more, it is depicted in the below figure 1.

Activities such as suggesting medical test based on the person's age, gathering basic information about the patient's health, informing health policies and the best health providers in the region where the people reside, frequent monitoring of the patients' during their crucial scenarios etc. are taken for consideration.

Normally data is classified as structured data and unstructured data. The huge volume of data enhances the quality of healthcare due to the vigorous analysis by applying various machine learning techniques and thus the patient's care also could be improved.

Fig1: Various sources of Clinical data

With the help of measurements and run downs provided by information mining strategies like grouping, arrangement and affiliation rules, choice makers could decide and conclude the information for the further process. Due to the latest innovation in technological advancements, combination of big data and analytics, several fields 'gets benefits and certain issues get resolved.

II. SIGNIFICANT FEATURES OF BIG DATA

In 2012 Gartner formally presented the meaning of big data as follows: A huge volume of data that varies regarding velocity and variety needs new processing procedures to facilitate the decision process, insight discovery and optimization of the process easier are termed as Big data" [3]. Conventional database and software techniques find difficulty in handling the data due to its massive nature. The essential characteristics of big data are regarding veracity, value, volume, velocity and variety as given below [4].

- Volume: size of the information
- Speed: the speed at which the information is produced
- Assortment: Different sorts of information
- Veracity: Trust worthiness regarding the accuracy.
- Value: Big data insight

In addition to the existing characteristics, there are five other important characteristics such as Variability, Validity, Vulnerability, Volatility and Visualization [5].

2.1 Enormous information examination

Investigation is the way of investigating information to depict cloaked designs, ambiguous relationships, and other helpful information. Thus, data contributes much to the nation's economy, profitability, effectiveness and development through the analytics as shown in the below figure2. [6].
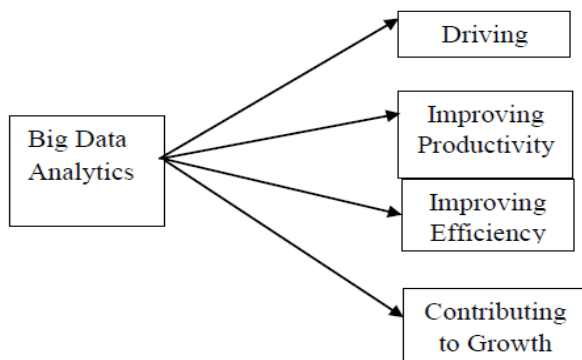

Fig2: Importance of big data analytics

2.2 Types of Big Data Analytics

It could be categorized into four types, as depicted in the below figure3.

1. **Prescriptive** – This kind of analytics recommends the next action. It is like recommended actions and strategies taken based on Campion/challenger testing strategy outcomes. Advanced analytical techniques are applied to suggest specific recommendations.

2. **Predictive deals** with an analysis of what must be done in the subsequent stages .Historical patterns are used to predict specific outcomes using various algorithms [7,8].Decisions are automated using algorithms and technology.

3. **Diagnostic**–A glance at past execution to figure out what happened and why. This can drill down to the root cause, and it also isolates all perplexing information.

4. **Descriptive**–What is happening in the light of approaching information. The Objective is to provide insight into the comprehensive accurate and live data. Effective visualization could be used to provide valuable information to the Business officials.
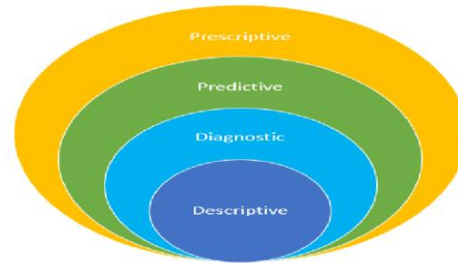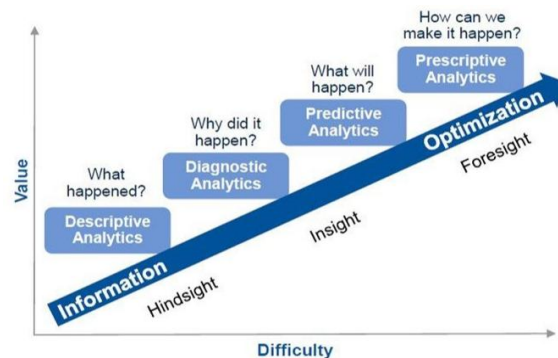

Fig 3: Types of Data Analytics

Fig 3a : Evolution of Analytics

III.   HUGE INFORMATION EXAMINATION LIFE CYCLE IN MEDICINAL SERVICES

Huge information examination is used to provide an insight view into the health care organizations so that their outcomes could be augmented, and future vision could be organized. Also, management and planning also could be performed properly. Several advantages of deploying huge information examination in social insurance are A public well being issue could be improved by analyzing the disease patterns of previous data.

Profiles of Individuals could be identified for a positive approach.

Real-time a large volume of data stored could be analyzed for further treatments

Big data Analytics comprises the following set of activities as part of various phases in its lifecycle. They are Information accumulation, Information Extraction; include choice, prescient displaying, and information perception as shown in figure4.

FIG 4: Data Analytics Life cycle.

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3.1DataAcquisition: Complex data structures are used together to, store and distribute the data ,and also, required data is retrieved to resolve an issue.

3.2 Information Extraction: Sensors collect all types of data and thus collected data is joined with the accessible EHR (Electronic Health Records) information from medical clinics. Information thus gathered could not be used for the process. It needs preprocessing and features extraction.

3.3 Feature Selection: Patient's data thus identified undergoes further processing. In this process, a
subset of appropriate and significant features could
be chosen.

3.4 Predictive Modeling: Prediction of probabilities, trends or patterns could be done by applying data mining tools irrespective of various domains. A predictive model is constructed using several predictors. These predictors play a vital role in the prediction action. As soon as the required and significant data is collected, a statistical model is devised for further process.

3.5Visualization: Through this process, charts of various types, dynamic cross tabs which make the decision process easier is performed.

IV. DATA CAPTURE/ACQUISITION IN HEALTHCARE

Health information could be represented as electronic health records and nowadays, all the health Care industry follows the HER structure. Due to the recent innovations in the technological world ,health care industries follow this structure to augment the outcomes and thus recommendations are made easier.

4.1 Data storage
As advancements in infrastructure evolve, datastorage is made efficient and furthermore, thereare numerous sophisticated ways to handle the storage effectively.

4.2 Data access and Analysis
Accessing the data and data classification depends on the level of sensitivity the data is classified based on three sensitivity levels.

4.3Restricted Data
An unauthorized discovery , modification or data destruction could raise the risk level in anyorganization. The data thus identified could be categorized as restricted data. Few examples ofrestricted data are state or federal privacy regulations, data protection by applyingconfidentiality agreements. Restricted data must have the top level of security measures to beapplied.

4.4 Private Data
Data is treated private data when any modifications to the data raise the risk level to moderate.To keep the private data safe, reasonable and rational level of security controls could beapplied for keeping the private data safe.

4.4 Public Data
Data that is accessible by the public is considered as the public data. Changes in the data would not create any risks. Examples are course information, research publications and press releases.

V. RELATED WORKS

The following section deals with previous methods regarding the impact of enormous informationexamination in human services domain. Priyanka what's more, N Kulennavar [10] provided the general idea of huge information examination in social insurance.The authors have discussed the features huge information and its contribution to healthcare. Moreover, the types of huge information in human services have been presented. Several examples huge information examination in social insurance research Difficulties have been issued in detail.

From Mironetal.studies[11], it has been observed that there is a need for patients to provide awareness about the data that must be issued to medical professionals. Data must be highly tested and preprocessed, and it must be stored securely.

Turner [12](2011)conceded that social media played a vital role in the collection of patient's data through online forms. This facilitates to keep track of their health regularly and generate reminders for monthly tests and suggests suitable treatment when required.

Senthil kumar SA et al. [13] (2018) analyzed the process an dosage of enormous information in medicinal services the executives. Also, the authors have analyzed the effective tools deployed for huge visualization and suggested new devices to deal with the huge information in the medicinal services industry.

Mohammad Ahmad Alkhati betal.[14](2015)analyzed the health care data analytics and Show cased the importance of information examination apparatuses and systems that were utilized to augment the human services execution in several fields for example, decision making, medicinal tasks, prediction ,and prevention system. Further more, this review has presented the potential reasons what's more, issues related to the human services information investigation dependent on land dispersion topic.

The below table showed the findings of implementation of enormous information in human

Services that have been identified in various research works, and it has been tabulated.

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Table1: Research works in implementing enormous information in human services

Sno	Author and Paper Title	Findings
1	Wang et al. [15] Using Huge information examination to comprehend its competence and potential advantages for social insurance associations	Five methods for human services organizations were suggested for implementing big data analytics technologies. This work provides the fundamentals, capabilities, and benefits of big data. Also, it motivated to explore effective data-driven analytics strategies further.
2	A. Swain, [16] To aid in the basic leadership process in the human services domain big	This work determined demographic and day-to-day features related to adult obesity. With the help of SAS Enterprise miner, two predictive models were built to professionals and administrators to make decisions and maintain the early intervention methods.
3	A Forkan et al. [17], ViSiBiD, A learning model for ahead of schedule prediction of clinical actions	An analytical model ViSiBiD has been deployed to determine the critical clinical events of patients those who reside at home with the help of knowledge gained from the examples of various important indications from a huge number of like patients. A novel method that combines the already devised data mining methods with extracted features from vital sign correlations has been developed. From the experimental results, it is proved that this model can envisage various clinical events with high accuracy when the hybrid set of features are chosen. Also, it also decreases false predictions and early warnings could be sent to the patients.
4	N. Bringing down, A. Cloninger, A. Venkatesh, A. Hsieh, E. Drye, R. Coifman, [18], The exhibition of U. S. emergency clinics has been exploited by applying enormous information examination	Distinguishing hospital performance in the U.S across a wide range of publicly reported quality measures has been done. This work analyzed and portrayed certain hospital performance profiles that occur similarly and the difference between hospitals has been computed. To deploy, the authors had deployed a novel semi-regulated AI procedure. This method is used to build a diffusion map that allows the visualization of similarities and dissimilarities between hospitals' performance. Moreover, the cluster of clinics with divergent execution profiles and basic attributes have been determined.
5	M. Chen [19], "Machine learning techniques are applied to predict the disease over big data from healthcare communities	The accuracy of prediction will be reduced when the medical data is incomplete. Predictions of chronic diseases are Based on exclusive features of regional diseases. Machine learning algorithms were implemented for the forecast of persistent disease. Latent factor model has been used to overcome the complexity of incomplete data. A new convolutional neural network basedmultimodal disease risk prediction (CNN-MDRP) algorithm using structured and unstructured data has been suggested in this work. It has been shown that the algorithm has reached 94.8% prediction accuracy. The algorithm showed a concurrence speed which is faster than that of the CNN-based unimodal disease risk prediction (CNN-UDRP) algorithm.

5.1 Issues with Big Data

Specific challenges in big data such as data usage, data protection, collection and sharing of health data must be resolved [20]. The important process that is needed for data processing must be performed by a big data analytics platform for healthcare applications. Certain measures such as scalability, data availability, continuity, ease of use is needed to operate at various levels of quality assurance, granularity and privacy [21]. Several imperative administrative issues of ownership, standards and authority must be measured. Among these,

continuous data acquisition and data cleansing must be resolved. Recently big data analytics has captured the world, issues such as security, assuring privacy, launching standards, authority and persistent improvement of tools and technologies will acquire attention [22].

Data about the medical equipment, medicine, and interaction of doctors and patients could be recorded to give valuable information so that planning of purchase, staff training and efficiency could be improved. Wireless sensors are used to capture the information about the patient, and it is transmitted for further analysis so that the caretakers could react rapidly in sudden situations. Storing this data facilitates healthcare predictive analytics to assist the patients regarding the likelihood of an emergency. The usual issue with the prevailing healthcare system is re-admission rates. Chances are there for the patients to skip their medications or neglect the advised diet after going home. Healthcare specifically on a nation-wide analysis is a major challenging task due to the changes in the lifestyle of people.

As a result of this, healthcare data analytics finds its revolutionary changes to be cadence with the evolutionary changes [23]. Cognitive computing is used to help human experts in the formulation of better decisions through keen insightful about the complexity of big data. As per IBM, cognitive computing is defined as the system that learns and cooperates with people to extend the actions that human or machines could perform. It is understood from various studies that cognitive computing possesses powerful features and thus it leads to the current development of traditional AI to the new innovative AI algorithms and to the accessibility of data that originates from various devices.

Consequently, this leads to the implementation of efficient cognitive systems that makes them do various tasks such as reasoning, discovery in several areas [24] such as education, insurance, science and healthcare [25]. In the end, it is observed from Noor [26], that recently cognitive computing contributed much in engineering systems of the future.

5.2 Impact of Cognitive Computing in Healthcare

Various studies concluded that Cognitive Analytics has a much larger perspective compared to Big Data Analytics. When the problems are intrinsically uncertain, by applying cognitive analytics, problems could be solved, and the solutions obtained are probabilistic. It is a great challenging task to make smart decisions in the medical field since the volume of data might originate from several heterogeneous devices. The data thus obtained must be shared and joined with the regular inspection of clinical research and social health data through cloud computing. IBM Watson recommends cognitive computing power to the stored data for a detailed analysis [27]. Maymir focused on the application of health informatics. To mine information from an enormous volume of different medical data, cognitive computing and analytics could be used. Intelligence in healthcare systems could be achieved by applying

natural language processing, dynamic learning and probabilistic computing in such a way that user's interaction must be progressed. This results in driving business and

providing an insightful view of the patient's data to provide safety to patients. The size and complexity of the knowledge management infrastructure grow nowadays as the population increases. Therefore, the process of interconnection of healthcare systems and by implementing advanced cognitive analytics would facilitate the clinicians, medical institutes to formulate the best treatment decision [28]. Sengupta [29] posted recommendations to develop cognitive tools and the same could be deployed for automated analysis of big functional datasets. As the size of the data grows huge, mining becomes a complex and challenging task and, the decision process must be accelerated further.

VI. CONCLUSION

This work has focused on the big data and its features. Moreover, a detailed analysis of the implementation of big data analytics in healthcare has been discussed. This work also has discussed earlier research works of implantation and the impact of enormous information in human services enterprises. It is understood that the implementation of cognitive computing machines could make machines to act like a human with reasoning abilities. Thus, it leads them to handle any uncertain situations and to manage the problems for which needs vigorous computing tasks. Cognitive computing is entitled by state-of-the-art networking infrastructures, and thus it facilitates machine learning techniques to react efficiently. Hence, the capability of solving the solutions is based on the past data. From these special characteristics, it is appreciable that cognitive computing could provide more benefits in healthcare.

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