

BIG DATA ANALYTICS IN HEALTHCARE

Shubham Mehla ^{*1}

^{*1}Research Scholar, Jagan Institute of Management Studies, Sec-5 Rohini, New Delhi, India.

ABSTRACT

In the current era of smart phones and wearable devices, vast amount of patient health data files and sensor data are being generated. Big data Analytics plays a major role in solving issues and challenges that arises in healthcare sector. Big data can handle huge explosion of data which is found in healthcare sector. Everyday petabytes of data are getting generated through various devices, which can be if analyzed can give useful data driven solutions and insights for patient treatment. This paper gives an overview of different application area of big data analytics in healthcare, challenges and the tools and technologies that could be used in healthcare clouds. Big data can change the healthcare industry and can improve the operational efficiencies, quality of monitoring the clinical trials.

Keywords: Big Data, Hadoop, Healthcare, Big Data Analytics, Framework.

I. INTRODUCTION

There is abundant of data generating everyday around the world and one of the major sectors contributing to data is healthcare. With the increase in use of Electronic Medical records (EMR), Healthcare Information Systems (HIS), wearable and smart devices, IOT. In today's era data is growing at an uncontrollable rate. Different variety of health-related data is being generated in form of digital data which includes clinical data, insurance claims etc.

Much of the healthcare data is in unstructured, structured form. So traditional database systems are not able to process healthcare data efficiently. So here comes the need to integrate big data analytics, tools, and techniques into healthcare industry to extract useful insights from abundant data that is being generated. Analytics has changed the way healthcare is practiced altogether, giving a new meaning to health.

Big Data analytics can analyze a variety of complex, generous characteristics of data and generate valuable insights. When applied to healthcare industry it has the potential to identify hidden patterns and trends which lead to improved healthcare quality and reduced costs enabling quick decision-making. Big data analytics in healthcare also provide an easy access to input and retrieval of healthcare information both for the doctors and for the hospital authorities.

There are various big-data sources in healthcare, some includes Drug Research and Lab Results, Social Media, Claims and patient records, Mobile Apps, Remote monitoring etc. Earlier healthcare industry uses to generate a lot of data driven in hard form by record-keeping, patient care. Current trend is towards rapid digitization of these large amounts of data. With emergence of big data, we can expect bigger opportunities in the field of healthcare. We can extract and turn data into useful insights using big data analytics. Useful insights can help in improving the healthcare to provide better care to patients by using high performance computing for healthcare and reducing healthcare cost. Another biggest challenge in healthcare is to investigate ways on how data can be processed in an efficient and secure manner.

In this research we would emphasize on application of big data analytics in healthcare, challenges involved and benefits of big data analytics also the requirement of high-performance computing in healthcare.

Background: Big data is generally called "Big" because of its volume, speed at which data is being generated, variety and veracity of complex data. Big Data Analytics in healthcare used to treat one patient can potentially be used to treat another patient with same illness. The various steps involved in the process would help in diagnosing the patient and patients coming up with same disease. According to the reports it could be stated that every year in US a total amount of around \$300 billion can be saved each year by using big data analytics in healthcare.

II. LITERATURE REVIEW

[1] Big data analytics is of paramount importance in healthcare aspects like patient diagnostics, fast epidemic recognition, and improvement of patient management. The target of this profiling study is to supply a summary of the big data analytics publication dynamics within the healthcare domain and to

debate this scientific field through related examples. To get the literature review, many papers have been analyzed and studied to mine knowledge.

Well-cited papers investigate the identification and management of high-risk cost patients, the utilization of massive data, implementation of Hadoop and cloud computing in genomics, and therefore the development of mobile applications for disease management. Important is additionally the research about improving disease prediction by investigating patients' medical results using advanced analysis (such as segmentation and predictive modelling, machine learning, visualization etc).

Application of big data analytics in healthcare is increasing day-by-day as the data that is being generated in the field of healthcare is tremendous. Due to this healthcare sector is moving towards deploying tools and technologies that must cope up with big data. Decision makers in healthcare organizations will be able to take meaningful actions according to the situation based on the insights derived from the big data analytics. Many research papers around 30% focused on and explained how big data analytics could be used in the field of healthcare to improve the hospital operations and treatment to patients.

[3] There are many opportunities in healthcare sector for big data analytics to enhance the quality of various aspects of healthcare with the implementation of analytical techniques like descriptive, predictive, and prescriptive.

- a) Medical diagnosis – Diagnosis of a disease by analyzing previous data may help in diagnosing the disease as an earlier stage and thus also reduce complications during treatment.
- b) Community healthcare – Preventive steps must be taken before hand against the predicted risks of chronic disease among population by making people aware about contagious disease outbreaks.
- c) Hospital Monitoring – Hospitals can be monitored in real-time that could help government to ensure optimal service quality.
- d) Patient care – Customized patient care services can be provided by the hospitals using big data analytics to provide rapid relief to the patients.

[3] If there are opportunities in big data analytics in healthcare, then there are few challenges too. The implementation of big data analytics in healthcare has few challenges. Some of the common challenges in the area include:

- (a) Initial Investment- It requires a lot of huge investment to deploy the infrastructure required to leverage the benefits of big data.
- (b) Quality of Data – As this is an emerging field, so there are less of big data experts.
- (c) Quality of insights – The medical healthcare data which is being generated is of poor quality and contains a lot of inconsistencies. So, yielding insights from that data may sometimes result into inadequate insights and misleading suggestions.
- (d) Privacy and Security – It is a serious issue to give access and exposure of patient's data to unauthorized third party such as government agencies, insurance companies.

Challenges faced by Healthcare Industry

Healthcare industry is now-a-days facing multiple challenges ranging from new disease outbreaks to maintaining an optimal operation efficiency. Healthcare sector is rapidly increasing and necessity to manage patient care and innovate medicines has increased. Big Data Analytics can solve these healthcare challenges through the vast amount of data available in the healthcare sector like financial, clinical, R&D, administration and operational data. Here are the few challenges faced by the healthcare industry and ways how Big data Analytics can help and change the scenario

1. Health Tracking – In the world of IOT, basic wearables can track and detect patients sleep, heart rate, exercise, distance walked etc. i.e., one can track daily reading of these factors. Apart from these there are new medical innovations that can monitor the patients blood pressure, pulse Oximeters and many more. The continuous monitoring of the body along with the sensor data collection allows healthcare organizations to keep people out of the hospital as they can identify the potential health issue and can provide care before the situation goes worse.

2. Reducing Cost – Hospitals do not get an idea how many staff members do they require, so they end up booking either over or less staff members. Big Data Analytics can help in saving costs for hospitals. Predictive Analytics can help resolve this issue by predicting the admission rates of patients and help with staff allocation. This will help hospital to utilize their investment to the maximum. Healthcare industry also believes that predictive analytics will save organizations 25% more in annual costs.

3. Assisting High-Risk Patients – If hospital records are digitized, then data can be accessed to understand the pattern of many patients. This would help in understanding the patients who visit the hospital repeatedly, frequently and their chronic issues. This understanding can help hospitals to give patient care better and provide insight into corrective measure to reduce patients frequent visit to the hospital. This can also help healthcare organizations to keep a list and check on high-risk patients and offer them customized care.

4. Preventing Human Errors – Many times it has been observed that health professionals tend to either prescribe a wrong medicine or dispatch a different medication by mistake to the patients. Big data analytics can help physicians who cater to many patients in a day. Big Data software analyze user data and the prescribed medicine. This can confirm the data and can approve the prescribed medication to reduce mistakes and save lives.

Big Data Analytics can contribute in these areas and can improve the operational efficiency of the industry.

Apart from the current scenario, Big data Analytics can also be a great advancement in the science and technology. In Healthcare Industry, Artificial Intelligence can be used to surf through numerous data being generated within seconds to find solutions of various diseases. This will not only provide the accurate solutions but also provide customized solutions to the patients for unique problems. In future Big Data Analytics advancement in healthcare industry is in progress. This could be fully utilized in the coming years to advance the evolving healthcare sector.

III. METHODOLOGY

[4] Healthcare data is generated from various devices and a group of Genomic data, clinical data. Data is in various form semi-structured, unstructured. To process the unstructured data, big data and cloud computing go hand in hand. We have various cloud computing platforms where data are being collected and processed with data-intensive programming paradigms such as MapReduce distributed storage system etc. Open-source Hadoop platform also have various cloud vendors like Cloudera, AWS (Amazon Web Services). All of these are cloud version, so they can be used to handle big data. Various NoSQL databases includes MongoDB, HBase. These are economically free and open source, but they offer less capabilities than cloud version of databases. Open-source cloud platforms like Hadoop, MapReduce are used for the application of big data analytics in healthcare. The healthcare applications operate on and uses terabytes of streamlining data, images, audio, video, textual data, sensor data generated and efficiently processed.

IV. RESULTS AND DISCUSSION

Much research has been conducted to verify the implementation of big data analytics in healthcare. Big data analytics in healthcare helps to discover the hidden potential and highlighting the challenges. Success of getting information depends on the organizations data quality, data privacy and security. It is also now possible to avail smart healthcare services with use of latest technologies like in-memory databases, artificial intelligence cloud computing to improve the overall performance of healthcare system. Here we will elaborate on various big data analytics capabilities in the healthcare. [2]

1. Clinical diagnosis and research

Clinical diagnosis refers to identification of cause and nature of a particular disease by observing the symptoms and signs of the patient. This is basically detected by examining the patient physically and reading his medical history.

Diagnosis of disease is the major area which need high attention in healthcare management. So much huge volume of data is being generated related to patient-illness details, medication, and treatment schedules etc, this data needs to be analyzed so that it could be transformed into value-added data for improved decision making by the doctors and health experts. Big data technologies such as Hadoop, spark is used to clean and process the huge amount of unstructured data collected and develop prediction models for decision- making.

Clinical research is also a branch of healthcare sector that identifies the safety and effectiveness of various medication for human use. Big data could be used to capture high data from clinical databases and to carry our clinical research on different diseases such as sleep disorders etc. Personalized healthcare is also a promising scope in healthcare.

2. Health Insurance – It covers the medical claims of a person incurring medical expenses. Predictive analytics is used to identify the need for having medical coverage. This also helps to understand the organizations the disparity that exists in the society in health coverage. Blockchain technology offers the traceability and offers a significant role in the health insurance domain.
3. Service delivery system – Various health workers are the input to the health system that determines the quality-of-service delivery. They ensure that the system must meet the minimum quality standards. It is essential to identify the most relevant quality indicator and monitor the efficiency of healthcare system.

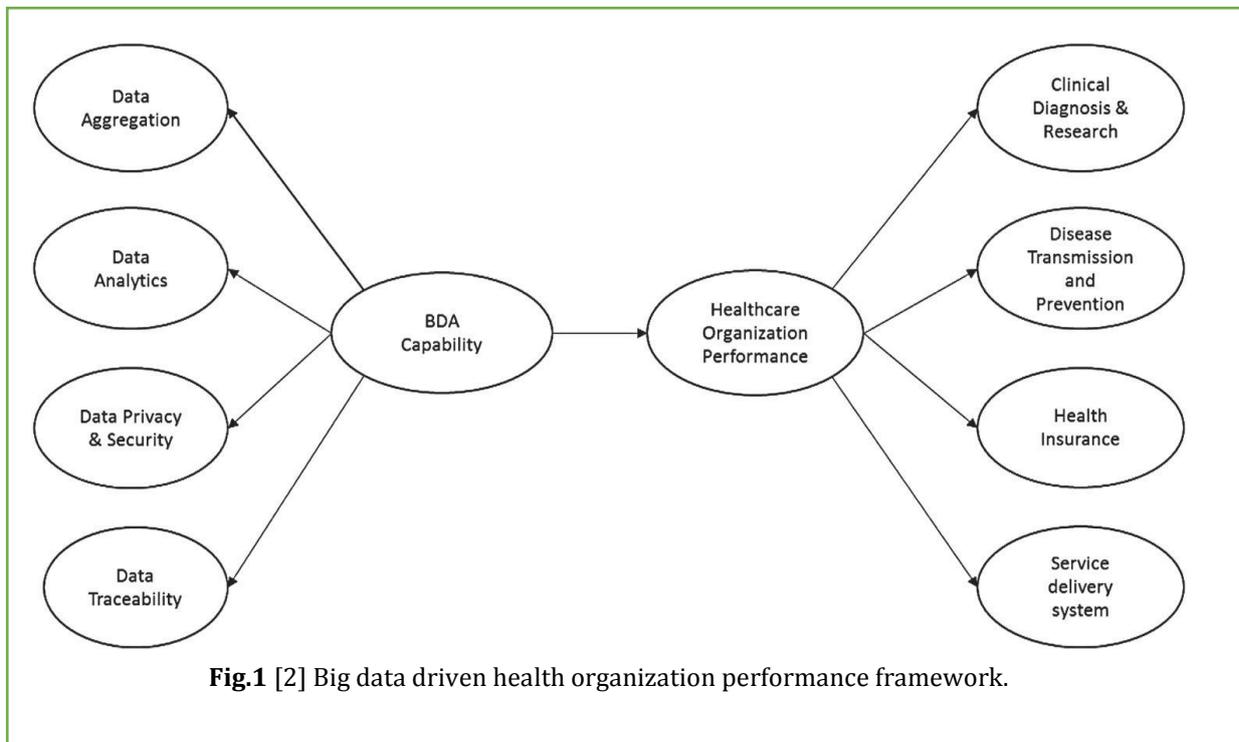


Fig.1 [2] Big data driven health organization performance framework.

V. CONCLUSION

A systematic review is aimed to investigate the applications, benefits, challenges of implementing big data analytics in healthcare. Many research articles are reviewed and analyzed thoroughly. The study highlighted that BDA plays a vital role in improving the performance of healthcare organization operations. Big data Analytics in healthcare is evolving as a promising field for providing insights from very large datasets and improving outcomes while reducing costs. Implementing healthcare analytics with efficient organizations, streamlining and analysis of big data will ensure accurate diagnosis of disease, reduction in cost and mistakes, appropriate Medicare treatment and would be very beneficial for the overall healthcare delivery. But the major challenge that hinders the implementation of big data in healthcare is the data privacy, data security concerns of data. BDA should look forward for removing these loopholes using more advanced tools and technologies. The basic aim of this paper is to discuss the role of big data tools and technologies in healthcare. Insights that we can get using Hadoop and Spark and how data-driven services can be provided to the people. Required tools and technologies of big data will accelerate the progress of health sector and will provide results for analyzing massive amount of data.

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