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An Overview on Big Data in Healthcare Department

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ABSTRACT: ***The development of big data is mainly due to the fast growth in computing power, the number of internet-enabled data-generating devices, and the decreasing prices of data storage itself, which make data accessible to everyone for practically no cost. Health care is one of the main sectors where big data analytics has shown to be much more effective than traditional methods in delivering fruitful results. Big data is primarily concerned with the storage and processing of huge, complex data volumes for which conventional techniques are inadequate. A survey on the use of big data analytics in health care has been conducted in this article to give an overview of the technology, methodology, and algorithms utilized in big data for data management and decision making in healthcare. Academics, academics, and businesses interested in big data and healthcare in particular can benefit from the findings of this study report.***

KEYWORDS: ***Big Data, Healthcare Informatics, Stakeholders, Genomic Analytics, Opportunities.***

1. INTRODUCTION

Because of record keeping, compliance and regulatory obligations, and patient care, the healthcare sector has traditionally produced a large quantity of data. Historically, most unstructured data was produced at the point of care: office medical records, handwritten nurse and doctor notes, hospital admission and discharge records, paper prescriptions, and MRI, CT, and other imaging. The increased digitalization of data in the healthcare sector has begun to produce data that meets all of the characteristics and definitions of big data. Clinical practices, disease monitoring, population health administration, and management in the healthcare sector will all profit from the analyses of this digital data. Big data in healthcare is defined as electronic health data sets that are so vast and complicated that they are difficult (or impossible) to handle using conventional software and/or hardware, as well as with typical data management tools and techniques. Clinical data from CPOE (Computerized Physician Order Entry) and clinical decision support systems are included in this database[1]–[4].

V's of Big Data in Healthcare:

a) Volume:

Despite the real-time streams of online and social media data, healthcare companies with over 1,000 workers store over 400 terabytes of data per company, according to Health Catalyst, qualifying healthcare as a high-data volume sector. Various kinds of data, ranging from conventional personal medical records and clinical trial data to emerging forms of data such as sensor readings and 3D imaging, all contribute to the massive amount of healthcare data.

b) Variety:

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The diversity of sources and the complexity of various types of data may be used to describe healthcare data. Unstructured, structured, and semistructured data are the three types of healthcare data. Most unstructured data has traditionally originated from medical records, handwritten notes, paper prescriptions, MRI, CT scans, and other sources. Electronic accounting and billings, actuarial data, laboratory equipment readings, and EMR data translated from paper records are all examples of structured and semi structured data.

c) Velocity:

In comparison to relatively static data such as paper files, x-ray films, and scripts, processing a real-time stream, such as various monitoring data, accurately and in a timely manner is gradually becoming more important and challenging in order to provide the right treatment to the right patient at the right time. The ubiquity of wearable monitoring gadgets, which offer constant and ever-accumulating physiological data, is a real example. The ability to conduct real-time analytics on continuous monitoring data may aid in the early detection of life-threatening pathological alterations and the provision of appropriate therapy.

d) Veracity:

The enormous amount of healthcare data, which comes from a number of sources, varies in quality and complexity. Biases, noise, and anomalies in healthcare data are widespread, posing a risk to effective decision-making and treatment of patients. The most difficult task is to strike the right balance between safeguarding patient information and preserving data integrity and usefulness[5]–[8].

Stakeholders:

Different stakeholders in the healthcare sector anticipate different things from Big Data, which may be described as follows:

a. Patients:

They want to be able to effortlessly integrate their daily usage of technology into their medical treatment. Some people wish to compare shop for medical care in the same way they do for consumer goods. Everyone wants customer-friendly service, one-stop purchasing, and improved care coordination between themselves, carers, and other providers, with the ultimate aim of providing error-free, compassionate, and effective care.

b. Providers:

Providers desire real-time access to patient, clinical, and other pertinent data to help them make better decisions and provide safe, effective, and efficient treatment. They want technology to be a helpful tool rather than a hindrance.

c. Researchers:

They want new tools to improve the quality and quantity of workflow – for example, predictive modeling, statistical tools, and algorithms that improve the design and outcome of experiments and give them a better understanding of how to develop treatments that address unmet needs while navigating the regulatory approval and marketing process.

d. Pharmaceutical Firms:

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They aim to learn more about illness causes, identify more focused therapeutic candidates, and conduct more successful clinical trials in order to prevent late failures and bring safer and more effective medicines to market. They want precise formulary and reimbursement information once they're on the market so they can tailor their marketing efforts, as well as less expensive post-marketing monitoring.

e. Medical Equipment Manufacturers:

Many of them are starting to question what to do with data collected from hospital and home devices for safety monitoring and adverse event prediction, and how to combine it with old and new types of personal data.

Opportunities:

Healthcare companies ranging from single-physician offices and multi-provider groups to major hospital networks and accountable care organizations stand to gain substantial advantages by digitizing, integrating, and successfully utilizing big data. Early detection of diseases and ailments when they are in their early stages, when they can be controlled and treated more easily and efficiently; individual health management by providing patient-centric services; improving treatment methods; and detecting healthcare fraud more quickly and efficiently are all implicit benefits of big data analytics in healthcare. According to McKinsey, big data analytics may save the US healthcare system more than $300 billion per year, with two-thirds of it coming from cuts of around 8% in national healthcare spending.

Clinical Procedures:

- To find more clinically relevant and cost-effective methods to diagnose and treat patients, researchers are doing comparative effectiveness research.
- Clinical decision support systems to improve operational efficiency and quality, such as providing real-time information to emergency technicians, nurses, and doctors to improve triage, diagnosis, treatment selection, prevent iatrogenic infections and readmissions, and prevent prescription and other medical errors.
- Increased openness regarding medical data, remote patient monitoring, and predictive analytics to identify people who might benefit from proactive treatment are some of the other topics being explored.

Research and Development:

Predictive modeling to reduce attrition and produce a leaner, faster, more targeted R & D pipeline in drugs and devices; statistical tools and algorithms to improve clinical trial design and patient recruitment to better match treatments to individual patients, reducing trial failures and speeding new treatments to market; and 3) analyzing clinical trials and patient data[9], [10].

Public health: 1) analyzing disease patterns and tracking disease outbreaks and transmission to improve public health surveillance and response time; 2) faster development of more precisely targeted vaccines, such as choosing the annual influenza strains; and 3) converting large amounts of data into actionable information that can be used to identify needs, provide services, and predict and prevent disease.

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Genomic analytics: By developing fast and effective gene sequencing technologies, genomic analysis may be added to the conventional healthcare decision-making process. Using high-throughput genetic sequences, collect organism DNA sequences and conduct genome-wide association studies (GWASs) for human illness and micro biome research.

Fraud detection: Use a distributed processing platform (e.g., Map Reduce for Hadoop) to quickly analyze a huge number of claim requests in order to minimize fraud, waste, and abuse, such as a hospital's overuse of services or identical prescriptions for the same patient filled in numerous places.

Device/remote monitoring: Capture and analyze massive quantities of continuous healthcare data from wearable medical devices in the hospital and at home for safety monitoring and incident prediction.

Issues and Difficulties:

Along with the benefits that healthcare has reaped from big data, there are certain problems and obstacles that serve as roadblocks to effective big data implementation in healthcare and obstruct appropriate and maximal extraction of the benefits that big data can really provide. Big data analytics not only offers enticing possibilities, but it also comes with a slew of difficulties. The difficulty begins with selecting a big data analytics platform. Some factors, including as availability, convenience of use, scalability, degree of security, and continuity, should be considered while selecting a platform. Incomplete data, scalability, and security are some of the major issues that big data analytics faces.

The following are some of the difficulties:

i. Data Security and Privacy:

Internet transactions, cloud storage, social media interactions, and associated data expose personal and private data to possible and implied abuse, making data privacy a serious problem that requires serious attention. Data privacy in the healthcare sector is governed by 1) the legal conventional doctor-patient confidentiality. 2) Patients' apprehensions about disclosing their health information to other parties 3) Conflicting data access demands of other parties (insurers, employers, etc.).

ii. Issues with Data Standardization and Data Structure:

The data in the healthcare sector is mostly in an unstructured format, such as graphs, prescription notes, and pictures. Aside from that, structured data is usually diverse in nature. In longitudinal records, taking advantage of patient/data relationships and being able to put unstructured clinical notes into perspective. Although EHRs inside the same company exchange data, intra-organizational EHR platforms are at best fragmented. Data is saved in formats that are incompatible with a wide range of applications and technologies. This lack of data standards also creates issues with data transmission.

iii. Data Transfers and Storage:

Data creation is less costly than data storage.nThe actual issue is effectively storing data so that various methods and technologies may be used to properly retrieve the required

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information. The expenses of protecting and keeping data remain high after it has been produced.

iv. Appropriate Abilities are required:

Handling, storing, retrieving, and implementing large data is difficult due to a lack of technological knowledge. According to the McKinsey Global Institute, there will be a shortage of more than 100,000 people by 2020. It implies that 50–60% of data scientist jobs may become empty. Data scientists need a high level of technical expertise. Soft talents such as communication, cooperation, leadership, creativity, and others are required.

2. DISCUSSION

Big data is a set of technologies for storing, analyzing, and managing huge quantities of data, as well as a macro-tool for seeing patterns in the chaos of this information explosion and developing intelligent solutions. It's currently used in a variety of applications, including medicine, agriculture, gaming, and environmental protection. Big data's three primary principles were originally connected to three key concepts: volume, variety, and velocity. Due to the difficulty of collecting huge amounts of data, only observations and samples were previously permitted. As a consequence, big data often includes large amounts of data that traditional software cannot process in a fair period of time or at a reasonable cost. Amazon, Netflix, and many more companies utilize big data to provide services to their customers.

3. CONCLUSION

This article provides an overview of big data in healthcare, as well as the characteristics of big data, data stakeholders, and difficulties in dealing with big data in healthcare informatics. Despite the numerous possibilities and methods for big data analytics in healthcare described in this study, there are many more areas to be investigated, such as the quality, privacy, timeliness, and other elements of healthcare data. In the era of big data, computational health informatics is an emerging and essential academic area with the potential to have a major effect on the traditional healthcare sector. The rapidly growing digital health data will help the future of health informatics.

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