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Data-Driven Health Care: Present state and path forward

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Abstract:
In healthcare, data analytics is a promising new subject. Data integrity and semantic interpretation are more critical in therapeutic applications than in other contexts. Despite these challenges, healthcare is increasingly turning to big data as a source of evidence. Studying healthcare data is essential for controlling and reducing healthcare expenses, as well as improving patient outcomes. In what ways might big data analytics be used in healthcare? Before offering any ideas, the authors lay out a conceptual framework and specific design techniques. Big data analytics in healthcare are being introduced in this research. Final thoughts: healthcare big data analytics might be a way to improve results while also cutting expenses, according to the paper. Despite its great potential, this technology still has a long way to go.This paper discusses the use of big data analytics in healthcare. Finally, the paper suggests that big data analytics in healthcare represents an opportunity to improve outcomes while cutting costs. It has enormous potential, yet it is beset with difficulties.

Keyword : Health Care, Big Data, Artificial Intelligence, Machine Learning, Predictive Analytics

1.0 Introduction

The aging and demographic transition, greater demand for health services, higher societal expectations, and rising health expenses are all putting pressure on health systems throughout the world (Atun, 2015). These pressures include an increasing burden of illness, multi-morbidity, and disability. Inefficiency also contributes to poor output (Badawi et al., 2011). Fiscal conservatism and erroneous economic austerity policies are restricting investment in health systems as a result of the current challenges facing the healthcare sector. With these challenges in mind, a massive overhaul of health systems is needed to achieve universal health coverage (UHC) by the year 2030(Kocher and Sahni, 2014). Artificial intelligence (AI) and machine learning, the most visible expressions of this technology, provide the promise of achieving more with less and may act as the spark for a revolution in digital technology. But the promise's nature and breadth have not been adequately examined.

Healthcare organizations look for appropriate technology to simplify resources to enhance the patient experience and organizational performance (Tang et al., 2019). Now a -days technology has become a backbone of health care (Tandon et al.

2020).In order to improve the patient experience and organizational performance, healthcare companies search for suitable technologies to streamline resources (Wang, Kung, and Byrd,2018).Health care could benefit from new insights provided by data analytics, which is a fast-growing industry. The accuracy, integrity, and semantic interpretation of big data are critical in clinical applications, notwithstanding the difficulties associated with controlling their bulk, variety, velocity, veracity and value.Studying health history is thus necessary to keep healthcare costs under control, reduce waste, and uncover evidence that may improve patient outcomes.

2.0 Healthcare industry as source of valuable data.

The healthcare industry is comprised of several sectors, industries, and a diverse range of businesses. The healthcare sector encompasses all businesses engaged in goods and services connected to health and medical care and is further subdivided into six primary categories. Pharmaceuticals, biotechnology, equipment, distribution, and facilities, as well as managed health care, are among these industries. We will highlight each industry in further depth in this research, emphasizing the many components of the supply chain, as well as the healthcare sector and its relationship to the entire market. Our focus will be the understand the quantum of data exchange that happens within the sub-sector of this health care industry.

2.1 Pharmaceutical:A person's purchasing decisions are impacted by four major psychological aspects, which include perception, motivation, learning, attitude, and beliefs (Kotler, 1999). For the Pharma sector, we can identify each of the aspects is present in some shape or form. Many types of data are created or utilized in the pharmaceutical industry, making it a data-intensive organization. The quantity of data available expands exponentially as additional sources are added. Research, the R&D process, clinical trials, doctors and academics, medical equipment, and patients are all sources of raw data in the healthcare and pharmaceutical industries.Pharmaceutical firms will be able to find active ingredients that have the necessary therapeutic effect and turn them into successfully licensed medications more rapidly if they use and analyze this data properly. The creation of a new drug is a time-consuming and expensive undertaking. The ability to utilize Big Data at different phases is provided by its widespread adoption. In a review paper (Haleem et al., 2015) . Regulators are exploring the possibility of sifting through this vast amount of data in search of any possible medical mistake or bad impact signal. Improved patient safety and increased responsibility for medication manufacturers and distributors are possible outcomes of these data insights.

2.2 Biotechnology&Bioinformatics: In thebiotechnology sectors, as well as many other fields, data may be utilized to analyze genomes and prescribe medications. "Big Data" and "Analytics and Data Science" are two new fields of study that have emerged

as a result of this transformation. The cost of genomic structure analysis dropped from $10 million in 2007 to only $1,000 thanks to analytics.As per S&P 500, the biotech business has grown significantly during the past year. When the NASDAQ Biotechnology Index (NBI) is compared to the S&P 500 ETF Trust (SPY), the biotechnology sector outperforms the S&P 500 by 60.20 percent as per Yahoo Finance.

Bioinformatics is an interdisciplinary subject involved with the use of statistical and computational techniques to the management and interpretation of biological data (Luscombe et al., 2001). As reported in a study (Nagara, Sharvani and Sridhar, 2018)on a daily basis, bioinformatics generates an enormous quantity of data from healthcare, genetics, and biomedical research. Clinical reports, genomic sequences, gene expression profiles, biomedical literature reviews, medical photographs, and sensor data are just a few examples of this kind of data.

2.3 Medical Equipment's and devices : According to a recent Bain assessment, Medtech (Medical Technology) leaders identified big data and analytics as the technology that would have the largest influence on the business over the next five years. "As the Medtech (Medical Technology) sector grows more competitive, leadership teams are rethinking their business strategies to meet changing client expectations. A critical component of that process is distinguishing the sales approach and portfolio value proposition in order to increase the likelihood of success as providers lessen their reliance on suppliers. Senor data in the clinical trials, Clinical data monitoring, Response monitoring systems generate massive data that can be analyzed further to understand the area better (Medidata, 2016)

2.4 Distribution:The supply chain network relies heavily on distribution. It represents the interests of the whole health care supply chain. Pharmacies, equipment wholesalers, and other similar businesses all fall within this category. The distribution sector is booming as more and more pharmaceuticals and medical equipment are being manufactured. Over the last five years, the stock price of AmerisourceBergen, one of America's major distribution corporations, has increased by 485 percent (AmerisourceBergen Corp). Pharmaceutical and medical equipment firms can more easily deliver their goods to hospitals and other healthcare institutions thanks to a well-functioning distribution system.Data-driven supply networks have had to adjust to the COVID-19 pandemic's high demand and supply limitations (McKesson, 2021). The supply chain grew more agile, collaborative, and inventive in order to assist their physicians in delivering treatment. Non-acute care environments are becoming more important, and health systems are scrambling to purchase items and diversify their sources. Clinicians were able to offer high-quality treatment in the face of the pandemic because to the supply chain's resiliency and flexibility.

2.5 Facilities and Managed Health care services : Healthcare facilities are the

sector's health care providers. It is where medications are supplied to individuals in need and physicians conduct medicine. Through hospitals, physicians' offices, nursing homes, outpatient surgical centers, and other institutions, this subindustry provides a broad variety of health care and social services. The industry has grown at a slower rate than the average for the healthcare sector during the previous two years. Revenue growth is a significant challenge for the healthcare facilities business.According to one study (Ledesma et al., 2015), the hospital business generates a combined $ 700 billion in sales each year, yet the top 50 firms produce less than 30% of revenue (first research inc.). Costs are quite high in this market due to the fact that hospitals need costly equipment like as CT and MRI scanners to function. Another cost issue is labor, which may account for up to 40% of total income. These facilities generate a great amount of direct and in-direct data to analyze and further study.

2.6 Other Related sector :There are other related sectors which are not directly involved in Health care services, but they are critical to the health care services eco-systems. They can be supplier of trained staff, Accounting and bookkeeping software packages, medical grade distilled water, Oxygen supply cylinders and many others which certainly provide a data insight to this the health care services.

3.0 Application of Data Analytics into Health care sector

3.1 Big Data Analytics (BDA):In the digital age, decision makers now have access to massive volumes of data. Big data is a term that refers to datasets that are not only large, but also diverse and dynamic, making them challenging to manage using standard tools and procedures (Elgendy, 2014).The phrase "Big Data" was used lately to refer to datasets that have become so vast that they become difficult to handle using typical database management systems. They are data sets that are too large for frequently used software tools and storage systems to acquire, store, manage, and analyze in a reasonable amount of time (Kubick, 2012).According to research published in 2012, healthcare data was expected to account for 30 percent of the world's electronic data storage (Brown, 2015). From an EMC and IDC analysis, digital healthcare data is growing at a rate of 48 percent per year, compared to a 40 percent annual growth rate for the whole digital universe (IDC, 2014).Previously, the hospital was responsible for the whole treatment and care of the patient, but with the arrival of Big Data, therapy has become more simpler and more focused (Raghupathi &Raghupathi, 2014).One of the challenges in Big data to handle massive amount of health care data which is generally a high dimensional data. One of the most frequently applied multivariate statistical method to reduce the dimensionality of the data is Principal Component Analysis (PCA).

It has been used in analyzing multi-dimensional data (Sumit Kumar, 2022). PCA has been applied in the dimensional analysis of heath care data (Roland et al., 2021).In particular research Big data

analytics was applied to understand the behavioral aspects of patient towards the health care approach overall (Katki et al., 2021). Health care is a part of overall market microstructure of a country which is essential for the economics development of that country (Almahirah et al., 2021) and big data gives a clear but concise view to it.

3.2 Machine Learning application to Health care: Machine learning algorithms make a significant contribution to disease prediction. The overarching objective of this study is to assist academics and practitioners in selecting a suitable machine learning algorithm for use in health care.Arthur Samuel, an American computer scientist and pioneer in the fields of artificial intelligence and computer games, invented the phrase machine learning in 1959. He described machine learning as a field of research that focuses on the capacity of computers to learn without explicit programming. It entails building or using algorithms capable of self-learning and self-training. Using one of the Machine learning technique a study (Nayak, et al., 2021) revealed the prediction of occupational hazards. In a literature survey (Ferdous et al., 2021) provided a comprehensiveinsight to the machine learning algorithm being used in Health care sector. In an another related survey (Bakyarani, Srimathi and Bagavandas, 2019) provided various types and machine learning models that are making rounds in examining the health care data and providing an interpretation which is helpful in further development of the sector and provide direct benefit to the user of the health care sector. More research is underway applying the machine learning technique to make best use of data from the health care service providers.

3.3 Artificial Intelligence in Health Care:Artificial intelligence (AI) is a broad term that refers to computer technologies that mimic human intelligence-assisted systems such as cognition, deep learning, adaptability, engagement, and sensory comprehension (Tagliaferri, 2020). It is a computer science that train the computers to take certain decisions based on the information provided previously to the computer system (Tran et al., 2019). In a comprehensive review (Silvana et al., 2021) provided an exhaustive account of how AI (Artificial Intelligence) is changing the landscape of health care and providing more insight to the health care services related data.

3.4 Other data analytics techniques in Health care: There are many other techniques being developed to better understand the health care data and make a good interpretation of the data for the benefit of direct and as well as indirect users of the health care services and infrastructure.

4.0 Conclusion

Data analytics is a rapidly expanding field that has the potential to deliver valuable insight in healthcare. While several elements of big data continue to pose challenges in their usage and acceptance, such as managing their volume, diversity, velocity, veracity, and value, clinical applications place a premium on correctness, integrity, and semantic interpretation. Such obstacles,

however, have not stopped the use and investigation of big data as a source of evidence in healthcare. This necessitates the investigation of healthcare data in order to contain and minimize the rapidly increasing expense of healthcare, as well as to discover evidence to enhance patient outcomes. The purpose of this article is to discuss the potential and promise of big data analytics in healthcare. This article introduces the emerging topic of big data analytics in healthcare, explains the advantages, defines an architectural framework and methodology, reviews examples from the literature, addresses the problems briefly, and concludes. The purpose of this article is to offer a high-level overview of big data analytics in healthcare. Finally, the article concludes that big data analytics in healthcare is maturing into a viable discipline for extracting insights from massive data sets and optimizing outcomes while minimizing expenditures. Its potential is enormous; nonetheless, obstacles persist.

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