Big Data Analytics For Healthcare Quality Improvement

Jharna Maiti[1],Prachi Gurudiwan[2],Abha Grover[3]

[1]Associate Professor, Department of Biochemistry Kalinga University, Raipur, India.

[2]Assistant Professor, Department of Pharmacy, Kalinga University, Raipur, India.
ku.prachigurudiwan@kalingauniversity.ac.in,0009-0008-0150-5250

[3]Assistant Professor, New Delhi Institute of Management, New Delhi, India., E-mail: abha.grover@ndimdelhi.org,
https://orcid.org/0009-0008-2828-2149

Abstract

The rise of Big Data Analytics (BDA) in the healthcare sector has the potential to revolutionize service management and patient care. This study looks at BDA's possibilities in the healthcare sector. The data we gather comes from a variety of sources, including patients, organizations, institutions, and a range of monitoring devices, sensors, or instruments. So far, the healthcare sector has accumulated a vast amount of data, which is stored in both paper and digital formats. This leads us to the crux of Big Data analysis, wherein firms encounter novel organizational and technological challenges. The healthcare sector has traditionally produced a significant volume of data, largely because of the necessity of keeping patient medical records. The difficulties with Big Data in healthcare, however, extend beyond its mere volume; they also include the astonishing diversity of data forms and types as well as the pace at which this data must be analysed in order to produce insights in a timely manner.

Keywords: *Big Data, Big Data Analytics, Data-driven healthcare*

INTRODUCTION

Over the years, healthcare systems around the world have had to deal with a number of issues pertaining to accessibility, affordability, and care quality [1]. As the COVID-19 pandemic has put further strain on health systems worldwide, these difficulties have only gotten worse. Healthcare organizations experienced a sharp increase in patients during the pandemic's height, as well as staff burnout and shortages of medical equipment, supplies, and personnel. A transition towards a patient-centered health ecosystem is also being brought about by the rising demand for convenience and accessibility from health seekers [9]. These factors taken together have forced healthcare institutions to use digital technologies. Technology's power resides not just in offering fresh solutions to healthcare issues, but also in giving customers unique experiences [2]. In addition to transforming healthcare operations throughout the system to support organizational growth, technology can revitalize the relationships between patients and healthcare providers [3]. Due to the potential of digital technology to revolutionize the healthcare ecosystem, the global healthcare business has witnessed a surge in digitization. Social distance during the epidemic really played a significant part in accelerating the digital revolution of the healthcare delivery model [4]. Clinically, digital health systems have also demonstrated the ability to accurately describe health and illnesses. [13]. However, digital solutions also assist in identifying unnecessary administrative procedures and activities that can be removed, hence saving money on operations. Thus, the emergence of digital ecosystems offers healthcare the opportunity to improve care quality, lower long-term costs, and increase and speed access to care. However, a vast volume of digital healthcare data is also a result of the global digitization of healthcare systems.

Review of literature

Many facets of healthcare delivery can be enhanced with the use of this data. Furthermore, evidence-based care has always been the foundation of the healthcare industry, and providing the appropriate information at the appropriate time and location is crucial to ensuring that the right care is provided. This is where more recent technologies that can extract medical data from

electronic devices and analyze it to give doctors pertinent information enter the picture. Healthcare organizations are incorporating big data and advanced analytics into their plans to boost the efficiency of their healthcare operations and improve the precision of diagnosis and treatment in personalized medicine. Healthcare institutions can improve clinical decision-making, track illnesses, and oversee public health campaigns by effectively utilizing this data. But analysing clinical data is difficult because of both the sheer amount and the complexity of trying to make sense of it all [5].

Big Data refers to the enormous and ever-growing digital datasets that come from our interactions with online technologies. Essentially, it's about data that's so vast that it creates hurdles for traditional storage and analysis methods. Ohlhorst shares a similar view, describing Big Data as exceptionally large datasets that are nearly impossible to manage or analyze using conventional data processing tools. He believes that as the dataset grows, extracting any meaningful insights becomes increasingly challenging. Jordan takes this a step further by viewing Big Data as a complex system that requires databases for storage, various programs and tools for management, and skilled personnel to extract valuable information and present it in a way that's easy to understand [10].

MATERIALS AND METHODS

Big Data refers to a massive collection of information characterized by its high volume, speed, and variety. To turn this data into something valuable, we need specific technologies and methods [6] . Essentially, Big Data encompasses information that is not just large in size but also highly dynamic or diverse, which means we need innovative ways to process it. We must rely on new technologies to efficiently gather, aggregate, and analyse Big Data since traditional data-processing equipment and software are unable to handle its scale and complexity [11]. This type of data is fundamentally different from what organizations have used in the past, which means they need to rethink their approach. For starters, organizations should view data as a continuous flow rather than a static stock, which calls for the implementation of streaming analytics. These characteristics highlight the necessity for new IT tools that can fully leverage the potential of this fresh data. The exponential growth of information accessible to different businesses and individuals is directly linked to the idea of "Big Data," which creates chances for insightful analysis and better decision-making [7].
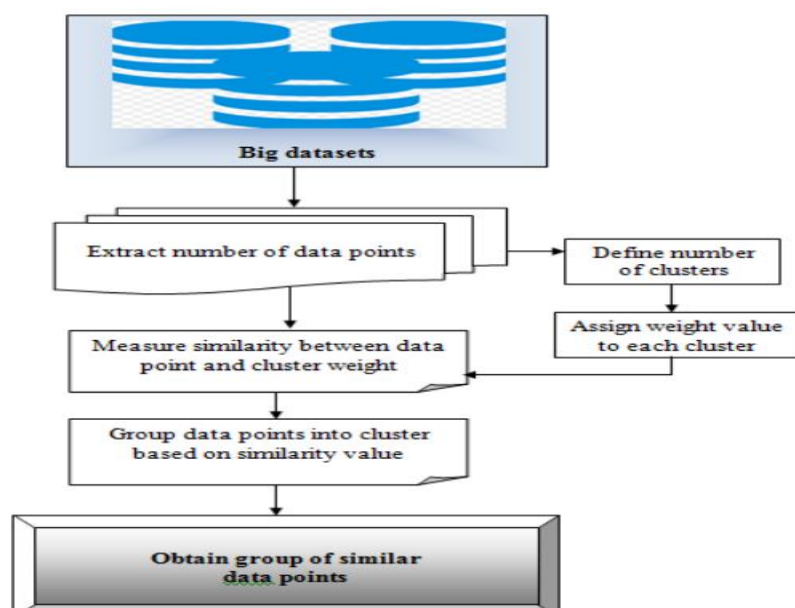

Figure 1: Proposed architecture

Effective management of unstructured data is frequently a challenge for traditional tools and approaches [8]. To handle healthcare data more efficiently than is now feasible due to the continuously growing variety and number of data sources, there is an urgent need for innovative Big Data analysis approaches as well as state-of-the-art analytical tools and technologies.

RESULT AND DISCUSSION

Adapting the storage, processing, and presentation of results and drawing conclusions in a clinical setting presents an additional barrier when it comes to healthcare data. Healthcare data analytics solutions are designed to simplify complex data by integrating, describing, and presenting it in an understandable manner. In the healthcare industry, this method can greatly increase the effectiveness of gathering, storing, analysing, and visualizing huge data [12].
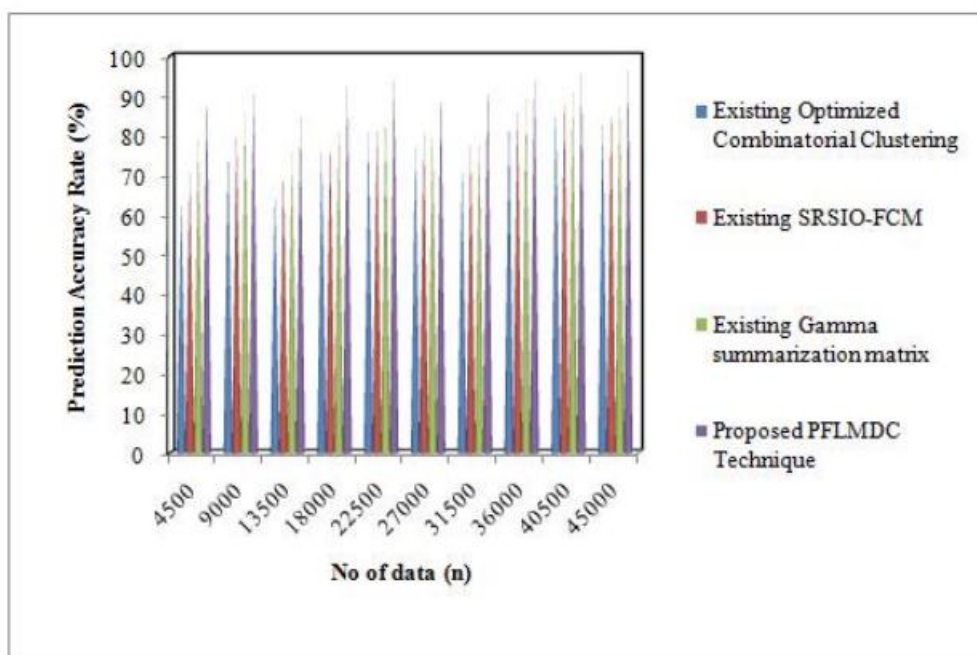
(a)
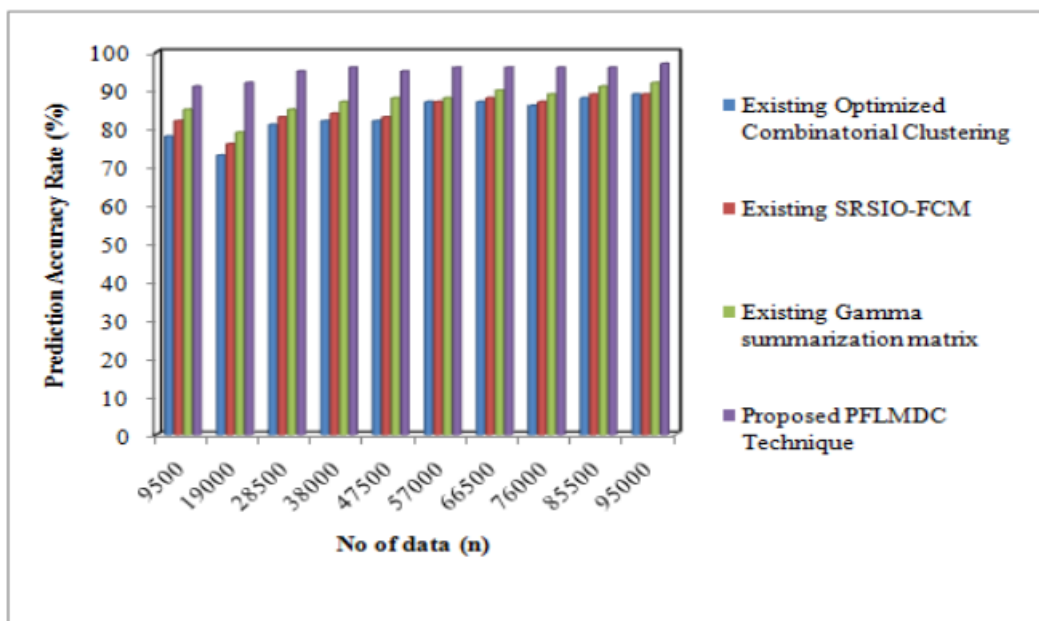
(b)

Figure 2: Measurement of PAR using Historical Hourly Weather Data

When we process data using Big Data Analytics, we create compelling data stories that can help make decisions with less risk and solid data backing. This approach can really benefit everyone involved in healthcare [14]. Making sure the appropriate therapy reaches the right patient at the right time is essential to utilizing the enormous amounts of data accessible in the healthcare industry. All stakeholders in the healthcare system, including payers, patients, and managers, may benefit from this individualized approach. We can uncover the insights concealed in massive datasets by bringing together the communities involved in data analytics and healthcare informatics. Clinical data can be clarified by Big Data Analytics, which facilitates well-informed judgments about patient diagnosis, treatment, and illness prevention [15] .

CONCLUSION

The study described in this article offers a comprehensive quantitative analysis that clarifies if Polish medical facilities are using Big Data Analytics and, if so, in what ways. We are able to draw some important conclusions from the results. These facilities manage both structured and unstructured data from a range of sources, including databases, transactions, emails, documents, devices, and sensors. They are using these findings in clinical, business, and administrative contexts, according to the analytics. This demonstrates unequivocally that data plays a significant role in many decisions being made. The study's findings are consistent with previous research, demonstrating that healthcare institutions are adopting data-driven healthcare and all of its advantages. In conclusion, big data analytics holds great promise for enhancing the healthcare sector and making a significant difference. Future studies will probably concentrate on how healthcare facilities formulate their plans to advertise and apply these solutions, the advantages they experience from using Big Data analysis, and their perspectives on this developing area.

REFERENCES

1. Belle, Ashwin, Raghuram Thiagarajan, SM Reza Soroushmehr, Fatemeh Navidi, Daniel A. Beard, and Kayvan Najarian. "Big data analytics in healthcare." *BioMed research international* 2015, no. 1 (2015): 370194.
2. Rajan, A., & Srinivasan, K. (2025). Automated Incident Response Systems for Cybersecurity. In Essentials in Cyber Defence (pp. 1-15). Periodic Series in Multidisciplinary Studies.
3. Kalema, Billy Mathias, and Viola Vivian Busobozi. "Big data analytics for data quality improvement to enhance evidence-based health care in developing countries." Performance Management of Integrated Systems and its Applications in Software Engineering (2020): 29-42.
4. Gupta, A., & Joshi, T. (2025). Frame Work of Sustainable Wastewater Treatment Methods and Technologies. International Journal of SDG's Prospects and Breakthroughs, 3(1), 1-7.
5. Srinivas, Titte R., David J. Taber, Zemin Su, Jingwen Zhang, Girish Mour, David Northrup, Arun Tripathi, Justin E. Marsden, William P. Moran, and Patrick D. Mauldin. "Big data, predictive analytics, and quality improvement in kidney transplantation: a proof of concept." American Journal of Transplantation 17, no. 3 (2017): 671-681.
6. Gowtham, D., S. Nandhini, R. Prasanth, J. Sureendhar, & E. Madhorubagan. (2023). IOT Service Improvement Through Hybrid Fog-Cloud Offloading. International Journal of Advances in Engineering and Emerging Technology, 14(1), 103–111.
7. Macias, Charles G., and Kathleen E. Carberry. "Data analytics for the improvement of healthcare quality." Medical Quality Management: Theory and Practice (2021): 121-138.
8. Suresh, G., & Lenine, D. (2024). Gaps of Indian Electrical Energy Sector and Its Optimal Mitigation by Using Optimal Utilization of Indian Renewable Energy Policy with the Help of the P&O MPPT Technique. Archives for Technical Sciences, 2(31), 94–115. https://doi.org/10.70102/afts.2024.1631.094
9. Rehman, Arshia, Saeeda Naz, and Imran Razzak. "Leveraging big data analytics in healthcare enhancement: trends, challenges and opportunities." Multimedia Systems 28, no. 4 (2022): 1339-1371.
10. Zamanpoore, M., Sedaghat, F., Sorbie, M. R., & Ashjar, N. (2024). Evaluation of the primary production and maximum fish production in Salman Farsi Reservoir, Fars Province, Iran. International Journal of Aquatic Research and Environmental Studies, 4(2), 19-36. http://doi.org/10.70102/IJARES/V4I2/2
11. Wang, Yichuan, LeeAnn Kung, Suraksha Gupta, and Sena Ozdemir. "Leveraging big data analytics to improve quality of care in healthcare organizations: A configurational perspective." British Journal of Management 30, no. 2 (2019): 362-388.
12. Batarseh, Feras A., and Eyad Abdel Latif. "Assessing the quality of service using big data analytics: with application to healthcare." Big Data Research 4 (2016): 13-24.

13. Vaitsis, Christos, Vasilis Hervatis, and Nabil Zary. "Introduction to big data in education and its contribution to the quality improvement processes." Big Data on Real-World Applications 113 (2016): 58.
14. Reddy, S., & Mohan, P. (2024). Optimizing Energy Efficiency in Wireless Power Transmission Systems for Industrial Applications. Association Journal of Interdisciplinary Technics in Engineering Mechanics, 2(2), 19-23.
15. Raghuram, G. (2024). Synthesis and Characterization of Novel Nanoparticles for Targeted Cancer Therapy. Clinical Journal for Medicine, Health and Pharmacy, 2(4), 21-30.