URF PUBLISHERS
connect with research world

Journal of Artificial Intelligence, Machine Learning and Data Science

https://urfpublishers.com/journal/artificial-intelligence

Research Article

Data visualization in healthcare: Risks and Rewards

Gokul Ramadoss*

*Corresponding author:** Gokul Ramadoss, USA, E-mail: Gokul1248@gmail.com

A B S T R A C T

The present study examines healthcare businesses' use of Power BI, Tableau, Snowflake, and Amazon Redshift. The study stated that these tools allow real-time analysis and decision-making, changing healthcare data management. These technologies speed up on-premises and cloud big data processing, improving patient care and operations. The research uses a thematic analysis of academic articles to show that data visualization tools help physicians make decisions by simplifying practical insights from vast datasets. The study highlights rewards and risks that in order to effectively utilize these technologies.

Keywords: Data visualization, risks, rewards, healthcare system, data security, misunderstandings, and overreliance

1. Introduction

Data visualization has transformed healthcare by simplifying large, complicated datasets[1]. These visual representations help healthcare practitioners understand complex data patterns and make faster, more informed decisions[1,3]. Data visualization improves clinical decision-making, patient outcomes, and operational efficiency, making it a crucial tool in contemporary healthcare[5]. Data visualization has many benefits, but it also has dangers that must be handled to prevent problems. Power BI and Tableau can help healthcare professionals turn complicated on-premises or cloud data into useful insights[3]. Healthcare businesses can safely connect to and analyze massive datasets using Snowflake and Amazon Redshift. Patient care and decision-making improve. To use healthcare data securely and efficiently, this study address the data security and safety risks posed by the integration of these capabilities.

a. Significance of the study

Data visualization helps doctors make decisions, patients obtain better treatment, and healthcare operations run more smoothly. More healthcare practitioners are using visual analytics to evaluate large patient data sets, which improves patient outcomes and healthcare delivery[6]. This study examines the rewards and risks of data representation. Healthcare is a key

source of big data. Hospitals' massive data sets pose challenges for proper analysis and understanding. Data is easier to grasp with visualizations. The data may help the learn more and improve its service.

b. Problem statement

Data visualization enhance doctors' decisions, patient care, and healthcare efficiency. The literature hasn't adequately investigated its risks. Poor data interpretation is a serious concern. Incorrect data presentation lead to harmful healthcare choices[9,10]. Many are concerned about data security and privacy when healthcare providers use data visualization technology to handle patient data[11]. This study addresses that gap by examining how data visualization affects healthcare decisions, patient outcomes, and operational efficiency.

2. Literature review

People like healthcare data visualization because it helps them make choices, enhance patient outcomes, and streamline operations.

Rewards of data visualization

1. Better clinical choices

Data representation simplifies complex data, helping

clinicians make better decisions. Doctors use dashboards and graphs to identify patterns, monitor patients, and make wise choices[12]. Doctors can react swiftly to vital sign changes to avert issues and enhance patient outcomes[15]. Clinical decision-making technologies improve patient care and reduce errors by improving accuracy and speed[4]. Vellido[4] say data visualization tools enable healthcare personnel to uncover patterns, trends, and outliers to enhance patient outcomes and operations. Live visualizations and massive dataset management draw users to Power BI and Tableau.

2. Integration of on- premises and data sources

Healthcare organizations store and manage data on-premises and in the cloud. Enterprises need on-premises solutions to secure and comply with sensitive patient data[1]. Scalable and adaptable cloud technologies assist healthcare organizations handle growing data[7]. Power BI and Tableau can show comprehensive patient data from various data sources. These solutions integrate on-premises and cloud data for real-time analysis and visualization[9].
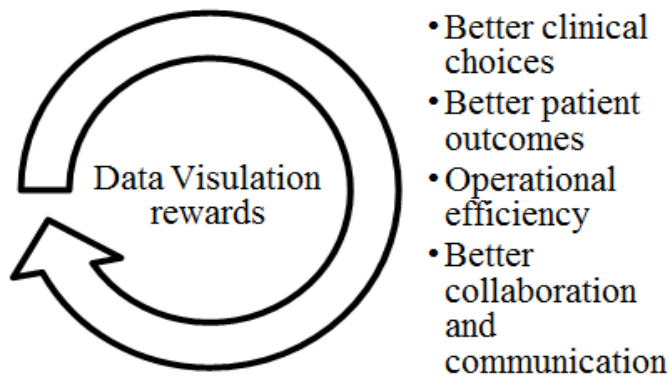

Figure 1: Data Visualization reward

3. Operational efficiency

Data representation improves healthcare organizations. Administrators may track patient flow, resource consumption, and staff performance[19]. Managers and planners may identify patient movement and resource utilization issues via heat maps and trend graphs. These tools enable facility administrators to choose people, equipment, and operations, improving efficiency and patient satisfaction[2].

4. Better collaboration and communication

To provide complete patient care, healthcare teams must collaborate. Data representation allows departments and specializations to exchange and comprehend data better. Teams from diverse areas may agree on treatment approaches using shared visual displays[5]. This collaboration improves care and integrates patient treatment programs.

b) Risks of data visualization

1. Data visualization may cause confusion.

Misunderstandings are a major danger in data presentation. Data visualization technology may simplify understanding, but a faulty design or decision can mislead. For instance, adopting improper chart styles or scales might obscure essential information or lead to incorrect conclusions, which could affect therapeutic choices[9]. To avoid misunderstandings, healthcare practitioners must learn to critically evaluate visual data and comprehend its boundaries.

2. Data security and privacy concerns

Visualizing data, particularly medical data, must be secure and confidential. In imaging, HIPAA necessitates the protection of a large amount of personal health data[19]. Hackers may easily access data without authorization using cloud-based viewing tools. Encryption and access constraints protect patient data and foster confidence[5].

3. Overuse of video tools

Healthcare personnel may overuse data visualization technologies and disregard other data or their clinical opinion[15]. While visualizations can enhance understanding, it's important not to rely solely on them. Doctors must utilize clinical and visual data to make educated judgments. Visual technology can obscure data analysis and clinical thinking, lowering care.

4. Integration issues

Hospital data display tools may be difficult to implement. Display tools may be difficult to utilize due to data standards, EHR interoperability, and user training[18]. Healthcare visualization tools must be well-planned and arranged to benefit people.
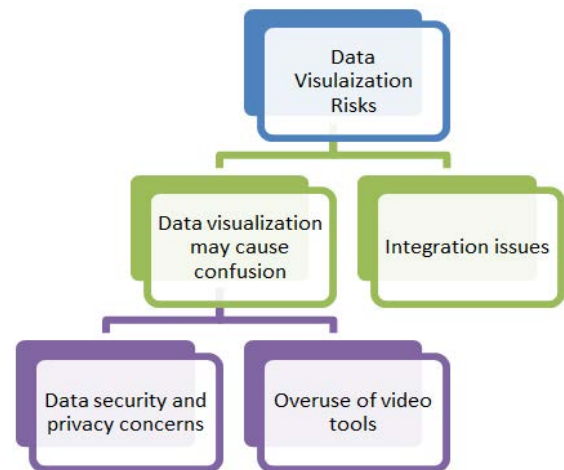

Figure 2: Data Visualization Risks.

3. Materials and Methods

This secondary study examines how data visualization influences clinical decision-making, patient care, and operational efficiency in healthcare. To achieve the research aims, secondary research involves reviewing articles. This strategy provides a complete picture by combining and evaluating data. The procedure is explained here.

Research Design

The research examined secondary data sources such as academic journal publications, company reports, case studies, and other works. Present study selected this method because it integrates existing knowledge and identifies key themes, trends, and gaps in the study to present a comprehensive view of the issue. Systematic reviews organize data collection, analysis.

Data Collection

Academic papers, are secondary data sources used in the study. Experts have examined healthcare computing, data visualization, and clinical decision-making articles in academic journals. Healthcare and consulting studies demonstrate real-world data display tool utilization. Well-documented articles demonstrate why healthcare firms utilize data visualization.

e. Search Strategy

The search strategy included Google Scholar for comprehensive literature searches. Key phrases were "data visualization in healthcare," "clinical decision-making," "patient care," "operational efficiency," "data security in healthcare," and "risks of data visualization, big data." To ensure the knowledge is current and beneficial for contemporary healthcare, present study searched for research within the past decade.

d) Data Analysis

Present study examined the selected data sources using thematic analysis. This involves identifying data patterns and themes. A thematic study revealed the positives and downsides of healthcare data visualization. This examined how data visualization technologies impact professional decision-making, patient outcomes, and operational efficiency, as well as their risks and limitations.

Research Methods	Secodary Research
	Research Aticles
	Search Strategy
	Thematics analysis

Figure 3: Research Methods.

4. Results

The study examines how data visualization has impacted healthcare, as well as its advantages and disadvantages. Data visualization helps healthcare personnel make better choices, treat patients better, and manage facilities more effectively. Clear data visualization helps clinicians make better judgments, which is fantastic. Dashboards, graphs, and charts assist healthcare workers in rapidly and accurately interpreting complex statistics. This highlights patterns, quirks, and linkages in raw data to improve decision-making. EHR images enable clinicians to monitor patients and adjust treatment approaches, resulting in better patient outcomes. Visualizing real-time patient data enables early identification of health issues for faster, better treatment[1,3]. Seeing data clearly helps physicians the study found that Snowflake and Amazon Redshift improve healthcare data management when coupled with Power BI and Tableau[5]. They analyze massive on-premises and cloud datasets in real time. These technologies, with live panels, facilitate communication and decision-making[7]. They also signal data security and safety risks that need repair. These tools entail risks, yet they improve patient outcomes and operations, making them vital to contemporary healthcare[22].

5. Findings and Discussion

Healthcare practitioners get massive volumes of patient data, including medical histories, lab findings, imaging tests, and real-time monitoring. Dashboards, charts, and graphs help physicians see patterns and abnormalities that could go missed in raw data[21]. Power BI, Tableau, Snowflake, and Amazon Redshift ease healthcare data management and analysis[8]. These tools allow healthcare personnel to analyze huge amounts of data from several sources, improving patient care and operations. Healthcare increasingly relies on this technology, necessitating strong precautions[4].

Theme 1: Improved Clinical Decision Making

Data visualization simplifies healthcare choices by simplifying complex information into understandable graphs, charts, and displays. This enhancement helps physicians and nurses uncover patient data patterns, trends, and outliers rapidly. They can make better, more educated judgments[1,5]. A well-designed screen may provide clinicians real-time vital sign information to respond immediately. By simplifying data, visualization tools help clinicians make better judgments. They reduce the risk of missing crucial information.

Figure 4: Improved Clinical Decision Making.

Theme 2: Better Patient Care

Visualization technologies assist identify health issues early and provide individualized treatment programs. By tracking health measurements over time, clinicians may identify issues, adjust therapies, and follow patient improvement[12]. Graphic data may illustrate when a patient's health isn't going well, allowing early intervention to enhance outcomes. Making patient information easier to read helps clinicians concentrate treatment plans and better manage patients.
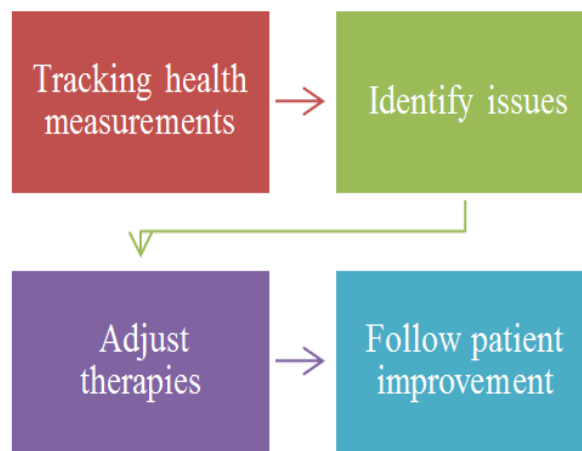

Figure 5: Better Patient Care.

Theme 3: Better operational efficiency

Data visualization clarifies success metrics and resource utilization in healthcare. Visual tools let management monitor patient flow, bed occupancy, and staff performance. This streamlines workflow and resource management[23]. Visualizing data on patient admissions and discharges may assist manage hospital beds, reduce wait times, and move more patients quicker. Graphics technologies increase healthcare quality and efficiency, lowering costs.

Data Security Issues

Data visualization provides advantages, but healthcare data security and privacy are issues. If not adequately safeguarded, hackers may access visual representations of confidential medical data and trigger data breaches[21]. Encryption, access restrictions,

and HIPAA compliance reduce these threats. Keeping patient data secure while utilizing rendering tools is crucial for trust and privacy.

6. Conclusion

This study examined data presentation in healthcare and discovered risks and rewards. Data visualization simplifies complex data into actionable insights for rapid actions and individualized treatment plans, thereby improving healthcare choices and patient care. The present study demonstrated that hospital data visualization using Power BI, Tableau, Snowflake, and Amazon Redshift improved data management. These technologies speed real-time analysis and decision-making by managing massive amounts of data from several sources. It enhances patient care and efficiency. This research also reveals that optimizing these technologies requires data security and safety.

7. Research Limitations and Future Work

This research shows how data presentation tools may enhance healthcare and reduce hazards. Future studies should concentrate on developing rendering tools that are safe, simple to use, and compatible with clinical practices. More study on how visualization influences professional judgment and decision-making is needed to improve healthcare tool utilization.

8. References

1. Alghamdi, T. Alsubait, A. Baz, and H. Alhakami, "Healthcare analytics: A comprehensive review," Eng. Technol. Appl. Sci. Res., vol. 11, no. 1, pp. 6650-6655, 2021.

2. Ravishankar Rao, D. Clarke, and M. Vargas, "Building an open health data analytics platform: A case study examining relationships and trends in seniority and performance in healthcare providers," J. Healthc. Informatics Res., vol. 2, pp. 44-70, 2018.

3. Rehman, S. Naz, and I. Razzak, "Leveraging big data analytics in healthcare enhancement: trends, challenges and opportunities," Multimedia Syst., vol. 28, no. 4, pp. 1339-1371, 2022.

4. Vellido, "The importance of interpretability and visualization in machine learning for applications in medicine and health care," Neural Comput. Appl., vol. 32, no. 24, pp. 18069-18083, 2020.

5. G. Hester, T. Lang, L. Madsen, R. Tambyraja, and P. Zenker, "Timely data for targeted quality improvement interventions: use of a visual analytics dashboard for bronchiolitis," Appl. Clin. Inform., vol. 10, no. 01, pp. 168-174, 2019.

6. G. Thangarasu and K. Subramanian, "Big data analytics for improved care delivery in the healthcare industry," 2019.

7. H. C. Lim et al., "Toward a learning health care system: a systematic review and evidence-based conceptual framework for implementation of clinical analytics in a digital hospital," Appl. Clin. Inform., vol. 13, no. 02, pp. 339-354, 2022.

8. J. A. Chishtie et al., "Visual analytic tools and techniques in population health and health services research: scoping review," J. Med. Internet Res., vol. 22, no. 12, p. e17892, 2020.

9. J. A. Chishtie et al., "Visual analytic tools and techniques in population health and health services research: protocol for a scoping review," JMIR Res. Protoc., vol. 8, no. 10, p. e14019, 2019.

10. K. Y. Ngiam and W. Khor, "Big data and machine learning algorithms for health-care delivery," Lancet Oncol., vol. 20, no. 5, pp. e262-e273, 2019.

11. L. Wang and C. A. Alexander, "Big data analytics in medical engineering and healthcare: methods, advances and challenges," J. Med. Eng. Technol., vol. 44, no. 6, pp. 267-283, 2020.

12. M. S. Islam, M. M. Hasan, X. Wang, H. D. Germack, and M. Noor-E-Alam, "A systematic review on healthcare analytics: application and theoretical perspective of data mining," Healthcare, vol. 6, no. 2, p. 54, May 2018.

13. M. S. Islam, M. M. Hasan, X. Wang, H. D. Germack, and M. Noor-E-Alam, "A systematic review on healthcare analytics: application and theoretical perspective of data mining," Healthcare, vol. 6, no. 2, p. 54, May 2018.

14. N. Mehta and A. Pandit, "Concurrence of big data analytics and healthcare: A systematic review," Int. J. Med. Informatics, vol. 114, pp. 57-65, 2018.

15. N. Mehta, A. Pandit, and S. Shukla, "Transforming healthcare with big data analytics and artificial intelligence: A systematic mapping study," J. Biomed. Informatics, vol. 100, p. 103311, 2019.

16. S. A. Senthilkumar, B. K. Rai, A. A. Meshram, A. Gunasekaran, and S. Chandrakumarmangalam, "Big data in healthcare management: a review of literature," Am. J. Theor. Appl. Bus., vol. 4, no. 2, pp. 57-69, 2018.

17. S. Dash, S. K. Shakyawar, M. Sharma, and S. Kaushik, "Big data in healthcare: management, analysis and future prospects," J. Big Data, vol. 6, no. 1, pp. 1-25, 2019.

18. S. Nazir et al., "A comprehensive analysis of healthcare big data management, analytics and scientific programming," IEEE Access, vol. 8, pp. 95714-95733, 2020.

19. S. Shafqat, S. Kishwer, R. U. Rasool, J. Qadir, T. Amjad, and H. F. Ahmad, "Big data analytics enhanced healthcare systems: a review," J. Supercomput., vol. 76, pp. 1754-1799, 2020.

20. V. Palanisamy and R. Thirunavukarasu, "Implications of big data analytics in developing healthcare frameworks–A review," J. King Saud Univ.-Comput. Inf. Sci., vol. 31, no. 4, pp. 415-425, 2019.

21. Y. Wang, L. Kung, and T. A. Byrd, "Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations," Technol. Forecast. Soc. Change, vol. 126, pp. 3-13, 2018.

22. Y. Wang, L. Kung, S. Gupta, and S. Ozdemir, "Leveraging big data analytics to improve quality of care in healthcare organizations: A configurational perspective," Br. J. Manag., vol. 30, no. 2, pp. 362-388, 2019.

23. Z. Lv and L. Qiao, "Analysis of healthcare big data," Future Gener. Comput. Syst., vol. 109, pp. 103-110, 2020.