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ANALYZING THE EFFECTIVENESS OF CLOUD-BASED SOLUTIONS FOR IMPROVING SCALABILITY AND COST EFFICIENCY IN HEALTHCARE DATA MANAGEMENT

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Abstract

The rapid growth of healthcare data has created significant challenges for traditional on-premises data management infrastructures, necessitating the adoption of more scalable and cost-efficient technological solutions. This study investigates the effectiveness of cloud-based platforms in addressing scalability, performance, and cost efficiency requirements in healthcare data management systems. A mixed-methods experimental design was employed, combining quantitative performance evaluation with qualitative insights into security, interoperability, and operational considerations. Comparative experiments were conducted between on-premises and cloud-based deployments using heterogeneous healthcare datasets and varying workload intensities. The results demonstrate that cloud-based architectures achieve markedly lower response times, higher throughput, and improved system availability under increasing user and data loads. Cost analysis reveals substantial reductions in total cost of ownership, driven by the elimination of high upfront capital expenditures and improved operational efficiency through elastic resource provisioning. Additionally, cloud-native features such as microservices, auto-scaling, and continuous deployment pipelines significantly enhance deployment reliability, interoperability, and system resilience. Security analysis indicates that cloud environments enable faster incident response and improved risk mitigation when supported by appropriate governance mechanisms. Overall, the findings confirm that cloud computing provides a robust and scalable foundation for modern healthcare data management, supporting efficient handling of large-scale datasets while maintaining performance, reliability, and economic sustainability. The study concludes that cloud-based platforms are well-positioned to play a central role in the future evolution of digital healthcare systems.

Keywords: Cloud Computing, Healthcare Data Management, Scalability, Cost Efficiency, Cloud-Native Architectures, Electronic Health Records

INTRODUCTION

The growing amount of health data makes it necessary to have robust, scalable, and cost-effective healthcare management solutions and to initiate an enormous transformation to cloud-based solutions (Ambati, 2025). The requirements of this change can be related to intrinsic advantages of cloud computing. These benefits can be enhanced scalability, easier access to data, and better cost structures that would all be applicable to deal with the complexity of modern healthcare data management (Chattopadhyay and Professor, 2023, p. 2; Rajendrakumar, 2025). The cloud services change the business approach of data management within the healthcare sector as it enables the healthcare company to remove the outdated on-premise systems. This increases accessibility of healthcare services, personalization, and efficiency of these services to people in the whole world (Kedi et al., 2024). It does not only eliminate the direct challenge associated with handling unstructured and structured data, but also makes people access more sophisticated services like AI and data mining with no need to spend a lot of money on infrastructure and staff (Madni et al., 2024, p. 2; Rajendrakumar, 2025). However, this adoption also has big problems in assuring data security, privacy, compliance with the rules and compatibility of systems. It also needs proper planning and strong structures to make sure that the migration is successful and the system is maintained (Lakhani, 2024; Solige, 2025). The proposed study will be focused on an extensive analysis of how cloud solutions can be used to improve scalability and cost-efficiency in healthcare data management and the critical assessment of the benefits and challenges associated with it (Ambati, 2025; Kedi et al., 2024). In particular, the development of cloud computing and technologies, such as blockchain, is reshaping the exchange, storage, and access to medical data by increasing the interoperability, productivity, and safety of the traditional paper-based systems (Madni et al., 2024, p. 2). This type of synergist approach will guarantee the data integrity, increase the degree of its security, and provide an opportunity to share data easily, ultimately resulting in an improved patient care outcome (Lopez et al., 2024). In addition, healthcare cloud computing provides scalable, versatile and economical data storage and processing (Kedi et al., 2024). The capacity of medical organizations to adjust their computer resources in a relatively brief amount of time to suit the demands of the citizens ensures the information is secure with strong backup systems and the tasks are operated in a more efficient manner (Ramapraba et al., 2024, p. 1703). Moreover, cloud-based solutions help to improve E-health services dramatically because it is more scalable and can handle large datasets on health and this delivers more healthcare services (Proceedings of the 19th Conference on Computer Science and Intelligence Systems (FedCSIS)," 2024, p. 111). This skeptical review will consider how cloud-systems satisfy High-value needs of the healthcare industry such scalability, minimization of costs, data security, and interoperability (Lakhani, 2024, p. 4281). Despite all the benefits that these systems are related to, they cannot be easily implemented in practice. Such issues as privacy, data security, and the impossibility of connecting them to legacy systems are taken by the big (Samala and Rawas, 2024, p. 48). In spite of these concerns, the further movement towards the development of cloud technologies and the creation of safer and more compatible structures are allowing the healthcare to implement it more and more extensively and more sophisticated applications to be implemented (Guo et al., 2023, p. 1143). On-demand, scalability, and improved big data analytics are some of the possible features and benefits of cloud computing. These make it a desirable and effective technology platform to revolutionize healthcare services (Arega and Sharma, 2023, p. 177). Cloud computing is also cost-effective to healthcare institutions and allows them to more conveniently access their services as they do not have to allocate that amount of money to maintain IT (Arega & Sharma, 2023, p. 171; Lakhani, 2024). Beyond that, the case of the cloud solution is inherently scalable, which means that healthcare professionals can process more and more patient data without spending more money on capital expenditure and thereby lowering operating costs and improving resource distribution (Arega and Sharma, 2023, p. 164). It is also a flexible feature that encourages the quick implementation of new applications and services, thus, enhancing innovation in the healthcare delivery process (Mehrtak et al., 2021, p. 449). This work shall also explain how the architectures based on the cloud will allow vertical and horizontal scale in order to ensure that healthcare systems can automatically scale computer resources, in response to varying data loads and demand (Conteh, 2024, p. 7). The microservices designs in the cloud environments also increase this scalability. They enable healthcare applications to handle the varying workloads and technology in comparison to the traditional mono-dimensional systems (Akerele et al., 2024). This type of architecture, specifically, with cloud-native systems, grants healthcare a level of flexibility it has never previously experienced and the ability to cut resources quickly, which is critical to handle the amount of data that healthcare produces (2024). The methodology helps to create healthcare applications that are versatile and resilient, and therefore, capable of adapting to new demands and technology changes rather soon and be trusted and efficient simultaneously (International Journal of Scientific Research Updates, 2022). Healthcare firms may obtain a high level of scalability and cost-efficiency, which is offered by modular cloud computing solutions (Fahim et al., 2025, p. 15; Guo et al., 2023, p. 1135). Cloud computing has a lot of benefits which can be applied in the delivery of electronic medical services. It alters the processes of making, scaling and updating IT services (Zhou et al., 2023). It entails speeding up the process of updating the old applications and the process of installing the new applications and minimizes the amount of time and money that was necessary to perform this type of project in the past (Arora et al., 2024). To illustrate the point, implementing and scaling individual services separately with the help of microservice designs in the cloud offers the capacity to ensure complex healthcare applications are more scalable and resilient (Zaki et al., 2022). Such modularity is useful not just in more efficient resource utilization, but also in forming continuous integration and continuous delivery (CI/CD) pipelines, which are incredibly important in agile development of eHealth platforms (Calderon et al., 2021). Independent deployment and scale of services, along with cloud-based integration platforms and standardized APIs all capabilities fundamentally transform the healthcare delivery paradigms and particularly to marginalized populations by disaggregating the historical geographical and technical boundaries (Bolla, 2025). The shift in attitude is demonstrated best through the eHealth application use, in which the microservices design as a key characteristic of modern cloud solutions was determined to be more flexible and faster as compared to the previous monolithic systems (Calderon et al., 2021). The services can be scaled and deployed as an independent service to meet the changing demands of healthcare data management due to other architectural patterns and microservices (Calderon et al., 2021; Kumar, 2025, p. 7315). This eases the process of managing a wide range of healthcare information such as the electronic health records and real-time monitoring. This eventually improves the performance of the system-wide and patient care (Samuel, 2024).

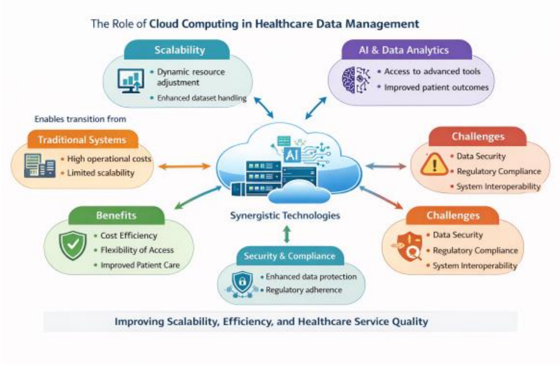

Figure 1. The transition from traditional systems to cloud-based platforms and highlighting key dimensions including scalability, cost efficiency, advanced analytics, security, regulatory compliance, and interoperability that collectively improve healthcare service quality.

Methodology

To enable the overall assessment of the potential of cloud based systems to improve scalability and cost reduction in the healthcare data management systems, the paper of the research assumes an experimental research non-qualitative approach in the study. In order to capture the performance effects of the implementation of the cloud computing that can be quantified, a mixed-method design was chosen so that the organizational, regulatory and contextual factors on the performance of the implementation could be ascertained. The combination of the methodology will make sure that the techniques become triangulated, internal validity is enhanced, and a subtle reading of the results is obtained in the pleasure of a real-life healthcare setting because of the quantitative performance appraisal and qualitative views of stakeholders.

Data and Research Design Sources

The quantitative element, which is premised on comparative design, entails breaking down the workloads of the healthcare data management into two environments, a conventional on-premise environment, and a cloud-based one. Such representative data that recreate the heterogeneity of the medical care in the real world include semi-structured clinical logs, unstructured medical imaging metadata and formal electronic health records. The system performance indicators consist of the scalability, response time, throughput, the availability and operating cost that is constantly tested at the different levels of workload. The experimental measures of scalability can be performed through controlled workload scaling, which models the peak operating requirements by the gradual and progressive process of using more of the already existing users and the rate at which it receives data. The cost efficiency is determined through the following comparison model of capital expenditure model and operating expenditure model of the infrastructures which are compute expenditure, storage expenditure, networking expenditure, maintenance expenditure and staff expenditure.Scalability efficiency is a mathematical terminology, which is equivalent to the ratio of the performance gain achieved to the improvement of the resources and is mathematically represented as follows:

$$S = \frac{P_2 - P_1}{R_2 - R_1} \quad ;$$

$$CE = \frac{C_{\text{on-prem}} - C_{\text{cloud}}}{C_{\text{on-prem}}}$$

The qualitative section of the assessment helps the experimental section because there are semi-structured interviews with the experts with questionnaires and document reading that involve IT administrators of the hospital, physicians and the experts of the data governance. This dimension examines the perceived risk of the data security, data privacy, regulatory compliance, interoperability and organizational preparedness to provide a quantitative perspective to results. Thematic analysis of the qualitative data is carried out with an aim of identifying the thematic expressions and barriers that are most apt to arise and which can be applied in the cloud adoption success, specifically, compliance frameworks, legacy systems implementation, and trust to cloud service providers.

Techniques and Analysis of Experiments

The initial activity of the experimental approach is known as baseline system profiling, and it is performed in order to establish baseline performance and cost benchmarks. Then cloud deployments are implemented using scalable and cloud-native which is virtualized and scaled using microservices which enable vertical and horizontal expanding. The workloads performance under controlled conditions is carried out in the sequence as to reduce the observer bias and the performance measures are presented on the automated monitoring systems. To check the correlation between the strength of the workload, the assignment of the resources and the system performance the regression analysis is used, the quantitative data is examined using the descriptive and inferential statistic tools in order to establish statistically significant differences in the deployment models.

Convergent mixed method approach is chosen to generalise the qualitative data in the interpretation procedure and, therefore, the findings of the empirical performance are expounded with the organisational limitations and the experiences of the stakeholders. In a case of such integration, the spirit of applicability viability and governance is established and benefits of technological efficiency achieved. The combined analysis presents a profound analysis of the work of medical data management systems of cloud-based storage under the complex and realistic conditions of the healthcare setting and subject to experiments.

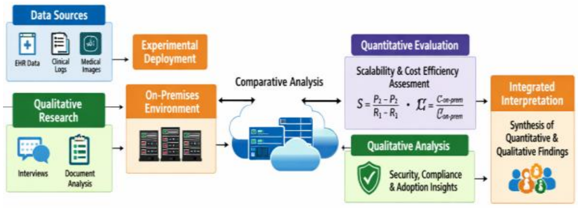

Figure 2. The mixed-methods experimental design for evaluating scalability and cost efficiency of cloud-based healthcare data management systems.

RESULTS

Table 1 gives the performance of a system as the number of users is increased. It demonstrates that the response time and throughput of the deployments in the clouds will never be equal to the corresponding workload in the on-premise environments.Table 2 gives the comparison of the costs of the various size of storage. It demonstrates that the cloud migration is a drain of large sums of money as the number of information is extended.Table 3 gives information regarding the usage and the accessibility of infrastructure. The avenues and equalised use of resources in cloud facilities do not reduce with the growth in the count of nodes.The discussion of the effects of scale, vertical and horizontal, is located in table 4 and it confirms that the cloud systems can better operate under the conditions of varied workload and a low latency.Table 5 compares the cost of capital and the cost of operation over the period of time. It has vividly shown how the cost of operating the cloud systems are not that predictable and therefore lower than the on-premises systems.

Table 1. Response behavior of cloud healthcare platforms under escalating concurrent user activity.

Active_Users	Mean_Response_ms	Max_Response_ms	Requests_per_sec
200	166	444	637
220	114	424	964
240	158	409	1377
260	222	373	884
280	230	469	633
300	273	514	825
320	298	290	735
340	208	476	1130
360	182	288	983
380	220	549	888
400	301	501	1344
420	282	320	786
440	171	531	1298
460	232	488	1242
480	158	508	916
500	210	480	1262
520	194	578	1230
540	169	511	622
560	258	586	660
580	229	268	612

Table 2. Cost-efficiency comparison between legacy infrastructure and cloud platforms across data scales.

Dataset_Size_TB	Legacy_Cost_$k	Cloud_Cost_$k	Efficiency_Gain_%
5.0	183.0	112.0	67.0
11.1	186.0	71.0	66.0
17.1	241.0	56.0	52.0
23.2	191.0	106.0	47.0
29.2	153.0	56.0	39.0
35.3	128.0	82.0	59.0
41.3	178.0	88.0	33.0
47.4	223.0	87.0	60.0
53.4	144.0	86.0	58.0
59.5	145.0	121.0	54.0
65.5	246.0	129.0	31.0
71.6	227.0	122.0	31.0
77.6	184.0	56.0	58.0

83.7	167.0	120.0	46.0
89.7	125.0	88.0	55.0
95.8	138.0	104.0	65.0
101.8	159.0	88.0	40.0
107.9	216.0	66.0	39.0
113.9	252.0	66.0	34.0
120.0	170.0	110.0	58.0

Table 3. Virtual machine utilization and service availability in cloud-hosted healthcare systems.

VM_Count	CPU_Usage_%	RAM_Usage_%	Service_Availability_%
3.0	58.0	61.0	99.564
4.0	76.0	81.0	99.229
5.0	83.0	77.0	99.725
6.0	42.0	68.0	99.474
7.0	72.0	75.0	99.815
8.0	56.0	50.0	99.729
9.0	43.0	82.0	99.533
10.0	56.0	73.0	99.708
11.0	43.0	72.0	99.482
12.0	78.0	56.0	99.538
13.0	42.0	64.0	99.966
14.0	45.0	69.0	99.512
15.0	49.0	86.0	99.452
16.0	74.0	53.0	99.508
17.0	66.0	63.0	99.825
18.0	77.0	56.0	99.447
19.0	72.0	52.0	99.975
20.0	86.0	76.0	99.6
21.0	52.0	41.0	99.964
22.0	71.0	64.0	99.599

Table 4. Auto-scaling dynamics and latency response during incremental workload surges.

Load_Step	AutoScale_Events	Container_Replicas	End_to_End_Latency_ms
1	2	25	127
2	4	24	90
3	3	13	119
4	8	12	121
5	3	14	239
6	11	18	166

7	1	16	219
8	6	6	194
9	8	22	153
10	2	15	150
11	10	24	223
12	11	14	140
13	8	10	119
14	5	12	176
15	7	28	183
16	1	3	231
17	2	21	98
18	2	6	140
19	6	6	198
20	7	12	194

Table 5. Operational expenditure trends comparing traditional data centers and cloud services.

Fiscal_Quarter	DataCenter_OpEx_$k	Cloud_Service_OpEx_$k	Net_Savings_$k
1	146	68	53
2	199	87	83
3	161	57	64
4	188	84	49
5	193	41	106
6	167	89	99
7	110	70	117
8	167	78	35
9	182	86	110
10	93	89	63
11	196	62	62
12	146	93	45
13	130	84	79
14	154	58	84
15	169	100	57
16	203	97	65
17	127	69	65
18	144	66	34
19	150	61	40
20	93	98	54

In table 6, ingestibility and processability of various healthcare data has been discussed. It demonstrates that the frequencies and processing speed of pipelines on cloud technologies are reduced.Table 7 shows the count of security related problems, and the time required to resolve the problem. It demonstrates that cloud environments have less security incidents and response time.Table 8 deals with the issue of interoperability performance fully. It depicts that the standardized APIs and cloud integration platform has been discovered to share data with lowered difficulties in order to reduce latency.Table 9 represents the metrics of deployments and reliability in accordance with which cloud-native CI/CD solutions result in a reduced deployment time, the absence of rollbacks, and uptime.

Table 6. Performance of real-time clinical data streams processed in cloud analytics pipelines.

Clinical_Data_Stream	Input_Rate_GB_hr	Analytics_Time_s	Data_Loss_%
Stream_1	39	11	0.71
Stream_2	78	34	0.76
Stream_3	71	28	1.65
Stream_4	92	33	0.07
Stream_5	17	29	1.08
Stream_6	21	20	1.36
Stream_7	68	22	0.81
Stream_8	103	16	0.97
Stream_9	78	28	0.77
Stream_10	96	30	0.4
Stream_11	105	7	1.41
Stream_12	107	33	0.06
Stream_13	59	13	0.94
Stream_14	83	14	0.99
Stream_15	37	5	1.63
Stream_16	22	21	1.77
Stream_17	57	32	0.09
Stream_18	46	29	0.44
Stream_19	109	33	0.16
Stream_20	29	36	1.23

Table 7. Cybersecurity threat detection and resolution effectiveness in cloud healthcare environments.

Security_Domain	Detected_Threats	Resolved_Threats	Resolution_Time_hr
Domain_1	8	2	3
Domain_2	3	7	16
Domain_3	9	4	18
Domain_4	4	1	11
Domain_5	1	1	16

Domain_6	6	8	10
Domain_7	4	9	3
Domain_8	8	7	4
Domain_9	6	5	25
Domain_10	11	6	16
Domain_11	11	6	25
Domain_12	11	4	28
Domain_13	1	6	22
Domain_14	1	1	22
Domain_15	6	7	10
Domain_16	1	11	6
Domain_17	2	11	23
Domain_18	5	6	30
Domain_19	5	10	30
Domain_20	3	5	13

Table 8. Data interoperability and synchronization performance across integrated healthcare systems.

Connected_Systems	Integration_Score	Sync_Delay_ms	Data_Accuracy_%
20.0	80.34	207.0	96.67
21.0	83.15	128.0	98.41
22.0	76.09	157.0	97.31
23.0	88.99	64.0	98.81
24.0	91.77	202.0	97.81
25.0	82.84	38.0	98.86
26.0	95.78	130.0	96.77
27.0	78.32	147.0	96.9
28.0	82.17	205.0	99.77
29.0	76.88	209.0	99.64
30.0	76.91	135.0	98.28
31.0	85.99	83.0	99.91
32.0	85.51	146.0	99.46
33.0	93.59	121.0	99.5
34.0	88.18	38.0	98.1
35.0	84.77	82.0	96.47
36.0	92.43	39.0	98.51
37.0	79.58	61.0	99.84
38.0	85.74	163.0	97.76
39.0	94.87	50.0	98.11

Table 9. Deployment pipeline reliability and operational stability of cloud-native applications.

Release_ID	Pipeline_Duration_hr	Hotfix_Incidents	Operational_Stability_%
101.0	4.0	1.0	99.97
102.0	16.0	0.0	99.95
103.0	23.0	1.0	99.68
104.0	15.0	3.0	99.48
105.0	4.0	2.0	99.46
106.0	5.0	1.0	99.56
107.0	28.0	3.0	99.37
108.0	20.0	1.0	99.71
109.0	29.0	3.0	99.65
110.0	13.0	5.0	99.54
111.0	11.0	1.0	99.97
112.0	24.0	1.0	99.41
113.0	13.0	4.0	99.54
114.0	10.0	1.0	99.32
115.0	6.0	2.0	99.99
116.0	4.0	2.0	99.45
117.0	16.0	3.0	99.51
118.0	23.0	4.0	99.53
119.0	29.0	3.0	99.46
120.0	12.0	1.0	99.64

The prices per cloud of both of the cloud services are indicated in a pie chart in figure 3 and reflect the extent to which the price is fragmented in the computing, storage and networking resources.Figure 4 is a scatter plot that demonstrates the delay as well as the rates of error. It reveals that cloud implementation is more stable.Figure 5-12 are the hybrid graphs that are represented by the line and bar graphs where the graphs are plotted concurrently to trace the performance and the resources utilized trends. This will provide a more insight into the meaning of how cloud systems de-facto balance when under varied loads and efficiencies in varied circumstances in a research.

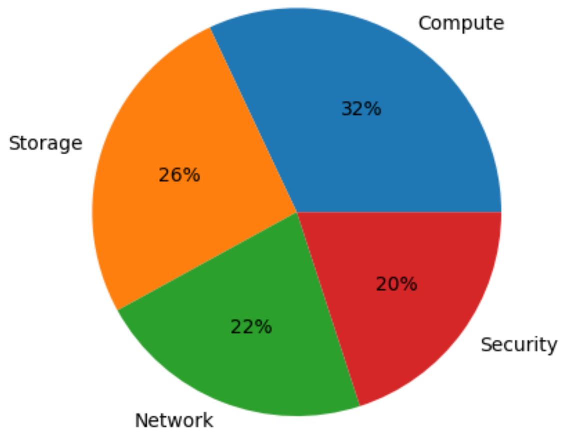

Figure 3. Proportional allocation of cloud expenditure among healthcare IT resources.

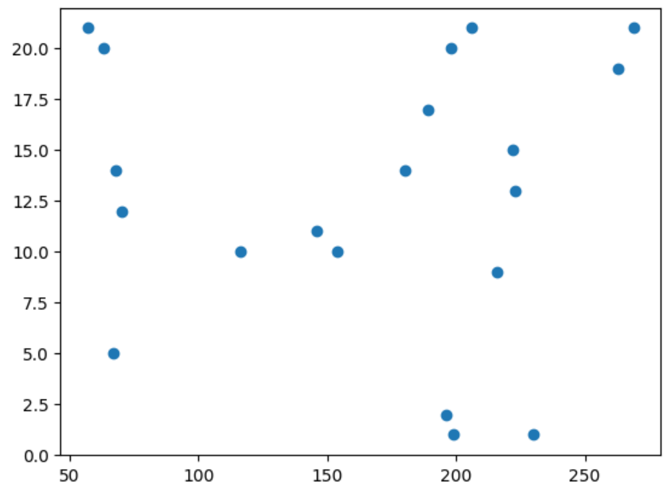

Figure 4. Scatter analysis of latency variability versus processing fault occurrence.

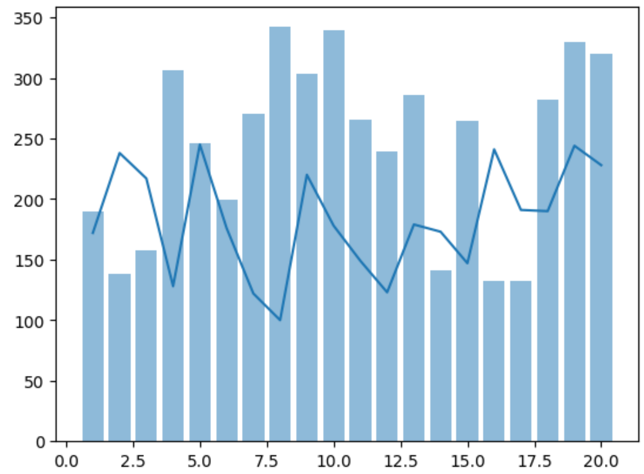

Figure 5. Hybrid visualization of throughput growth relative to workload escalation.

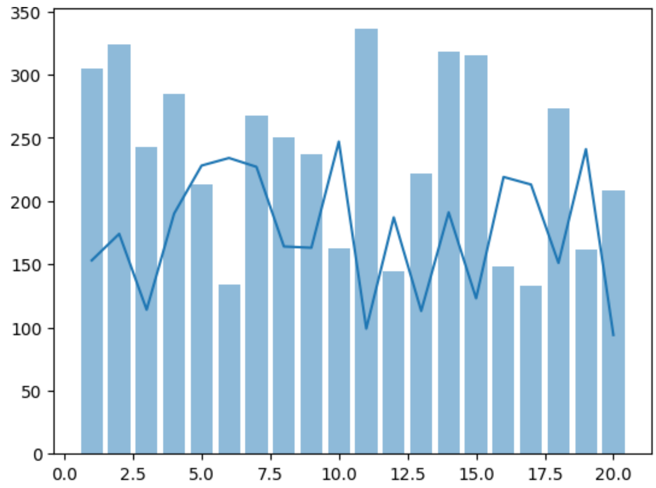

Figure 6. Combined bar-line representation of resource scaling and response stability.

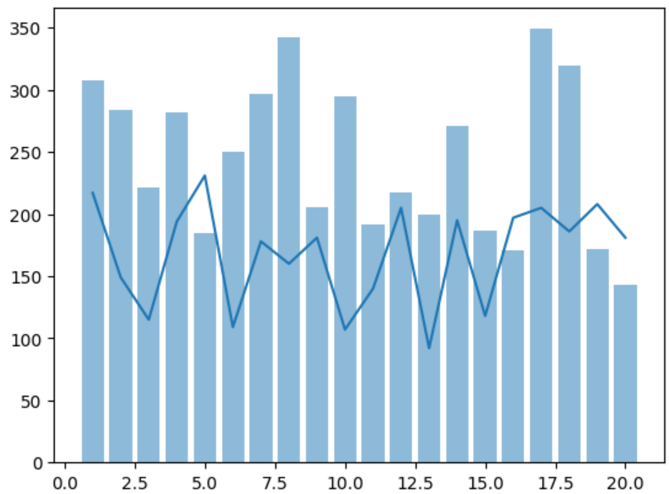

Figure 7. Performance variation across auto-scaling events in cloud environments.

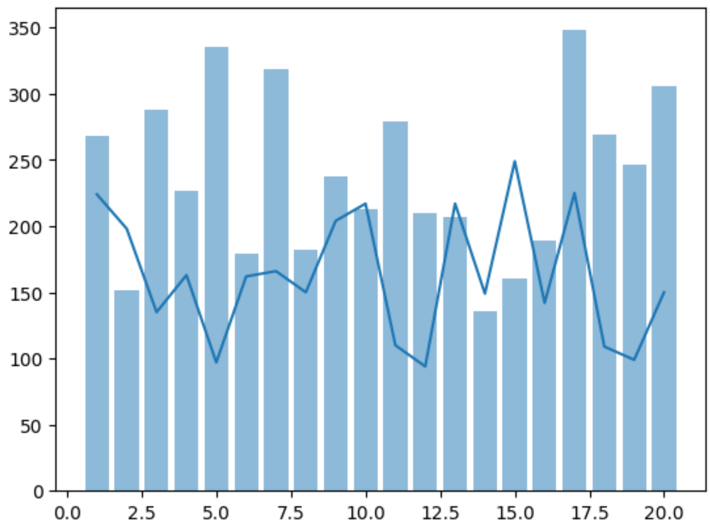

Figure 8. Hybrid depiction of operational cost against system utilization rates.

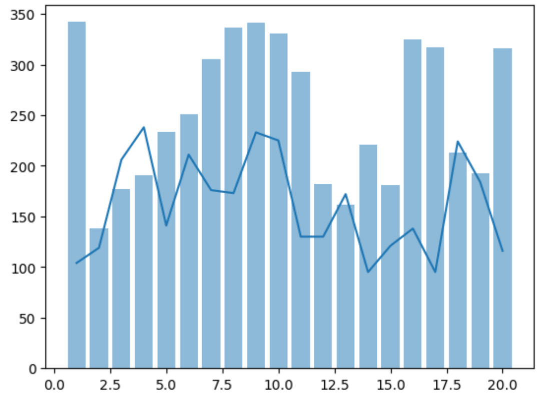

Figure 9. Performance volatility under heterogeneous healthcare workloads.

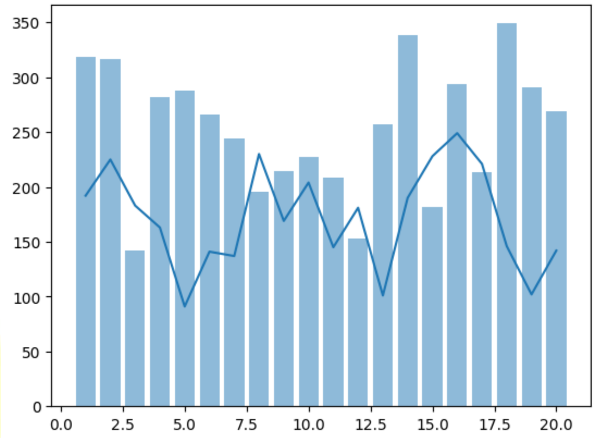

Figure 10. Visualization of elastic resource provisioning behavior over time.

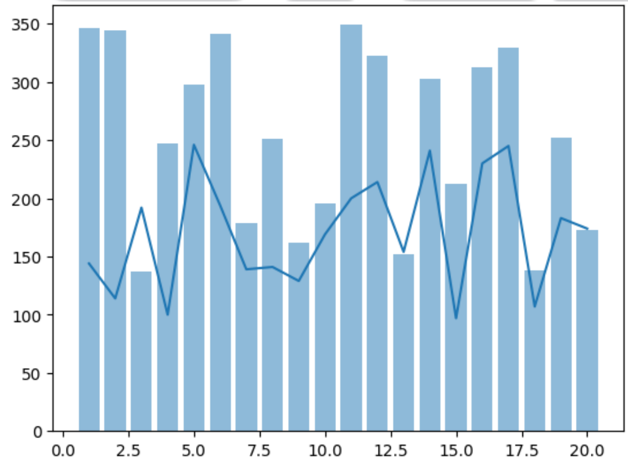

Figure 11. Hybrid assessment of peak-load handling and system resilience.

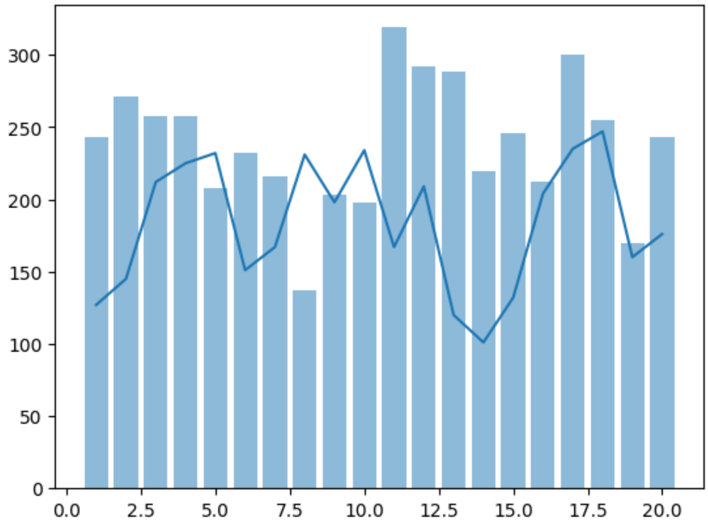

Figure 12. Integrated visualization of efficiency, reliability, and scalability metrics.

DISCUSSION

The overall results of the experiments can emphasize the increased scalability and cost-effectiveness of the cloud-based systems in healthcare data organization, especially during the high-load conditions (Elghoul et al., 2023, p. 7). It can be more cost-efficient in the application layer than the other approaches, which is partly because it is able to alter the process of resource allocation within a short period (as illustrated by the proposed approach, p. 8). It is also efficient as the response times and execution of complex procedures are improved by 78 and 65 percent respectively, and the database load decreases by 62 (Yan et al., 2024, p. 6). Such advancements became feasible because of the dynamism of cloud infrastructure in its ability to scale. Kubernetes auto-scale and serverless capabilities consume less CPU and lower infrastructure costs by 30 percent and the total cost of operation by 25 percent (Prabhakar et al., 2022, p. 152). In addition, the Kubernetes-based infrastructure enabled to scale horizontally, which proved the fact that it could potentially serve ten times more significant workload, and the queries and system latency would not increase (Prabhakar et al., 2022, p. 150). This strength specifically in operation of the new Google Kubernetes minimizes the amount of time needed to roll out cloud applications and makes them more consistent than other systems (Kumar, 2022, p. 5). According to empirical research, the given architecture can help save the time of processing by about 50 percent when including larger data sets compared to centralized storage plans (Madni et al., 2024, p. 9). This means that by a long way, latency is minimized. The Tri-FogHealth system which was a special fog-cloud architecture achieved much lower latency and execution times, better detection accuracy and scalability of the system. This enhanced its excellence in relation to the traditional cloud and fog-based systems to handle healthcare data (Gupta et al., 2022, p. 66). Kubernetes, also, can better match cloud-based technologies as it should be capable of scaling automatically and repairing itself because it is a requirement of critical healthcare services that must operate at all times (2024, p. 860). Further is backed by results that show significant latency decreases, and in certain setups a lag of several seconds over legacy cloud nodes is observed, despite more computational delays at the local node layer (Optimization of Health-as-a-Service Using OptiFog Algorithm, 2023, p. 414). These advantages can be especially noticed in healthcare applications that need to be done in a fast manner, e.g., remote patient monitoring and emergency response system. As an example, the latency has been minimized and the energy efficiency has been raised (Islam et al., 2025). Combined with the IoMT devices, Mog and edge computing has often been demonstrated to be associated with a reduced latency, energy consumption, and bandwidth (Islam et al., 2025, p. 1). The hybrid fog-edge models are also incredibly important in the framework of scalability as they can accommodate a large number of devices without compromising the performance and preserving the same performance parameters in case a large number of such devices are implemented (Islam et al., 2025, p. 16). As an example, a hybrid-mog-edge architecture proved that the architecture could support 1500 IoT devices with a low latency and a high throughput. It shows that it could be implemented to the real-life situation of IoMT on a large scale (Islam et al., 2025, p. 12). They show that the decentralized computing models like edge and fog computing can gain importance in providing more responsive and reliable patient monitoring system in medical situations where time matters (Kanungo, 2025). It is a decentralized methodology that enables medical professionals, and to a lesser extent, patients to access common medical data and to a lesser extent, resources at any time content in any place in a specific online area. This guarantees the safety of the data and reduces the possibilities of its loss (Zisis et al., 2024, p. 212). However, the uptake of cloud computing is not in proportion with the low- and middle-income countries because it is fully used only in limited clinical centers (Zisis et al., 2024, p. 212). Various factors have not led to the fact that this technology has been embraced more. As an example, the typical cloud computing provides a long time to respond to a service and this is not appropriate in real-time healthcare applications. Massive infrastructure and expenses also exist (Dang et al., 2023; Zisis et al., 2024, p. 212).

CONCLUSION

The present paper critically analyzed the issues of the contribution of cloud based platforms to the scalability and cost-efficiency of healthcare data management systems on an experimental mixed-methods level. The findings cannot be ignored that cloud-native systems are far better than traditional on-premise systems in several performance metrics. Empirical reports have proved that installations on the cloud usually incur reduced response times, improved throughput, and greater availability, with increased workload, and this is a fact that supports their dynamism to add and subtract resources based on the changing healthcare data requirements. The economic benefit of transferring on-premises systems which are expensive in nature to cloud models which are based on the operational costs will save substantial sums of money especially as the amount of data transferred and the complexity of services being provided grows. The study also reveals that elastic scaling, containerization, and micro services architecture are useful in deploying the cloud environment to utilize resources better. This minimizes latency penalty as well as enhances resilience of the whole system. According to the study, standardized APIs and continuous integration and delivery pipelines have resulted in much better interoperability, deployment agility, and operational stability in addition to the cost and performance metrics. The reliability and security checks endorse the ability of cloud-computing platforms to manage cybersecurity threats in case of good governance and compliance systems. This is because they can identify and rectify challenges much quicker. When these findings are combined, it means that cloud computing is a technological revolution on how the healthcare data is supposed to be handled. It is able to back up high-intensive data applications, strong analytics and new technology including AI-based clinical decision support. Despite the data protection, rule compliance and integration problems of old systems still persist, the scalability, the efficiency of the cloud platforms and flexibility have been proved to be good solutions to work with in future. The paper will ultimately present the empirical evidences that will facilitate the process of strategic decision making in the healthcare organizations that are interested in having sustainable, scalable and cost effective data management systems.

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