

THE PROPOSED GUIDELINES FOR CLOUD COMPUTING MIGRATION FOR SOUTH AFRICAN RURAL HOSPITALS

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ABSTRACT

It is now overdue for the hospitals in South African rural areas to implement cloud computing technologies in order to access patient data quickly in an emergency. Sometimes medical practitioners take time to attend patients due to the unavailability of kept records, leading to either a loss of time or the reassembling of processes to recapture lost patient files. However, there are few studies that highlight challenges faced by rural hospitals but they do not recommend strategies on how they can migrate to cloud computing. The purpose of this paper was to review recent papers about the critical factors that influence South African hospitals in adopting cloud computing. The contribution of the study is to lay out the importance of cloud computing in the health sectors and to suggest guidelines that South African rural hospitals can follow in order to successfully relocate into cloud computing. The existing literature revealed that Hospitals may enhance their record-keeping procedures and conduct business more effectively with the help of the cloud computing. In conclusion, if hospitals in South African rural areas is to fully benefit from cloud-based records management systems, challenges relating to data storage, privacy, security, and the digital divide must be overcome.

KEYWORDS

Cloud computing guidelines, rural hospitals, Cloud computing migration, e-health

1. INTRODUCTION

Recently, as the cloud application age evolves, it has become more viable than conventional IT systems to build electronic medical records (EMR) [1, 2, 3]. Masana, [4] stressed the crucial role of IT capabilities in the success of cloud computing (management, technology and relations). Due to the present procedures used for keeping files, hospitals in South Africa's rural areas are failing to provide patients with high-quality health care facilities in need of medical support [4]. South African rural hospitals have been left out on cloud computing potential that have previously been explored in the developed countries and South African private. Medical practitioners at healthcare facilities must constantly have access to medical information in order to give timely services to patients. Records that have been adequately kept should always be guarded and categorised, with access regulated and gained only with the requisite authorization and/or privileges [5].

Existing e-health initiatives and solutions in the public healthcare sector face issues that provide the groundwork for the rural healthcare sector move to cloud computing. Rural hospitals that deploy cloud-based medical applications will be able to transfer some of their workload to cloud computing service providers, especially in a public cloud environment [6]. Cloud computing is a

network access method that provides ubiquitous, practical, on-demand network access to a pool of shared reconfigurable computing resources that may be quickly built and withdrawn. Rural hospitals frequently struggle to obtain the Information Technology (IT) infrastructure required to perform their everyday operations. The hospital administration frequently struggles with maintaining, hosting, obtaining, and supporting the necessary IT systems. Given the complexity of IT services at a rural South African hospital, it is critical to shift to cloud computing and utilize a solution that can improve their services [4].

Adoption of cloud computing services will result in significant organizational transformation, affecting work styles [7]. According to Al-rawahna et al. [7], hospitals must examine many factors before switching to cloud computing services on an organizational level. Hospitals in rural South Africa will benefit from cloud computing services in terms of cost savings, improved performance, increased agility, adaptability, and stability of services, and a more sustainable climate [8]. While cloud computing and related services are not a new phenomenon in the IT business and are viewed as a technology that might be utilized to offer services more efficiently by many organizations, it is still not widely employed in the public healthcare sector. The junction of government cloud facilities and cloud computing is a new transition between e-government and cloud computing that carries the capability administration services more operational and effective [7]. According to Mosweu, [1], cloud computing technology reduces the likelihood of data and application loss by ensuring that data, records, and information are constantly accessible since they are backed up on several computers.

According to the existing literature, migration to cloud computing and other initiatives such as mobile health care applications pose significant obstacles in various health care industries [9, 10]. The contribution of the study is to lay out the importance of cloud computing in the health sectors and to suggest strategies that South African public health sectors can follow in order to successfully relocate their ICT services into cloud computing.

2. PROBLEM STATEMENT

South African rural hospitals face significant challenges when considering the migration to cloud computing. These hospitals are often run by limited staff and operate with limited budgets, making it difficult to access the resources necessary to transition to cloud-based solutions [6]. Additionally, many hospitals lack access to reliable traditional ICT infrastructure, making the process of implementing cloud computing more difficult and costly. Furthermore, there is a lack of training and support available to rural hospitals in order to understand the benefits of cloud computing and to learn how to use the technology effectively. Most of the hospital are still relying on the paper filing as their trusted backup that will not let them down in time of emergencies [1, 4]. At each rural hospital, a file clerk is responsible for managing the patient files. The clerk is also responsible for printing out the necessary forms and documents for each patient, entering patient information into the printed file, and filing them in the appropriate filing cabinets. Therefore, there is an urgent need to provide support and resources that can help rural hospitals in South Africa migrate to cloud computing. This paper provides awareness support by examining a literature that will help government and hospitals in successfully adopting cloud computing. The paper provides best practices for cloud computing adoption that can help the South African government assess the readiness of hospitals in rural areas up until the implementation phase.

3. OBJECTIVES

- To analyse the potential benefits of cloud computing migration for South African rural hospitals
- To ascertain the challenges in adoption of cloud computing for South African rural hospitals.
- To develop best practices for cloud computing adoption for South African rural hospitals.

4. DATA COLLECTION METHOD

The study followed a literature review method to gather the information that will assist in achieving the study objectives. Literature review method used to gather and analyze data from written material. It involves reading and studying books, articles, journals, and other written sources to gain an understanding of a particular topic [11]. It also involves analyzing these written sources for patterns, connections, and insights. Literature research is an important tool for gaining knowledge and understanding of a variety of topics, from the humanities and social sciences, to the sciences [12].

For the purpose of this research, The following online electronic databases were examined for previously published studies: Google Scholar a, MDPI journals, SAJIM, JISfTeH, IEEE Xplore Digital Library, Science Direct, ACM Digital Library, researchgate and Springers PubMed. The literature search was based on the following search terms: "South African health sectors" OR "Cloud computing in South African health sectors" OR "filing system in South African health sectors" OR "implementation of cloud computing in South African health sectors" AND "benefits of cloud computing in healthcare services." The researcher created the following steps to identify relevant papers that helped in develop best practices for cloud computing adoption for South African rural hospitals. This steps will also help other researchers to use when they using literature review as the method to gather information [11, 12].

Steps	process
Step 1: Identifying and selecting relevant sources:	To begin the literature review process, the researcher firstly identified and selected sources that are relevant and appropriate to the research topic. Sources included scholarly journals, books, websites, articles, and other materials.
Step 2: Reading and analysing sources	Once the sources have been identified and selected, the researcher read and analysed the sources to identify any potential gaps or areas for further exploration.
Step 3: Synthesizing sources:	The researcher synthesized the sources by looking for patterns, themes, and relationships between them. This process involves finding common themes or ideas among the sources, comparing and contrasting them, and noting any contradictions or inconsistencies. This has helped in getting the themes that could be suggested as a strategies that can be implemented for adoption of could computing in South African rural hospitals.

Step 4: Drawing conclusions:	Once all of the sources have been analysed and synthesized, the researcher drawn conclusions based on the evidence presented by other authors. This included forming an argument, making a recommended guidelines, and proposing further research.
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5. OVERVIEW OF CLOUD COMPUTING IN SOUTH AFRICAN HEALTH SERVICES

Cloud computing is becoming increasingly popular in the South African health services sector [3]. The cloud offers a range of advantages, such as cost savings, increased scalability, improved data security, and enhanced collaboration. It also provides a platform for health professionals to access patient data and services from any location, at any time. The South African Department of Health is actively promoting the adoption of cloud computing in the health services sector [4]. The department has developed a cloud-based system, called the National Health Information System (NHIS), which provides health professionals with access to patient data and services [3]. The NHIS enables health professionals to access patient information from any location, at any time. The South African Government is also funding the development of an Integrated Health Information System, which is designed to link all health services in the country and provide a single view of patient information. This system was implemented in 2021.

Cloud computing is set to revolutionize the South African health services sector, and it is likely to become an essential part of the healthcare system in the near future. Cloud computing is a form of internet-based computing that enables shared access to applications, data, and resources from any remote location [13]. Cloud computing offers numerous advantages to healthcare organizations, including cost savings, improved communication, enhanced security and privacy, and streamlined operations. The South African government is taking steps to encourage the implementation of cloud computing in the health sector. The government has set up several initiatives to promote the use of cloud computing, such as the Cloud Computing in Health Care (CCHC) project and the National Health Information Platform (NHIP) [5]. These initiatives have been designed to help healthcare organizations make the transition to cloud-based solutions. The CCHC project is a collaboration between the South African Department of Health and the South African National Health IT Board to provide cloud computing solutions to the healthcare sector.

The NHIP is a platform that aims to connect healthcare organizations and provide access to secure data and resources. Cloud computing has the potential to drastically improve the efficiency and quality of healthcare delivery in South Africa [5]. It can help healthcare organizations reduce costs and improve patient care by streamlining operations and providing access to the latest medical technologies. Although South African National Health IT Board to provide cloud computing solutions to the healthcare sector, South African rural hospitals faced significant challenges adopting the recommended cloud computing solution or National Health Information Platform (NHIP) [4]. These hospitals are often run by limited staff and operate with limited budgets, making it difficult to access the resources necessary to transition to cloud-based solutions. Many of hospitals in South African rural area lack access to reliable traditional ICT infrastructure, making the process of implementing cloud computing more difficult and costly.

6. ADVANTAGES OF CLOUD BASED NATIONAL HOSPITAL MANAGEMENT SYSTEMS (NHMS)

HMS have been moved to and incorporated into the cloud environment in order to take advantage of the benefits of the cloud environment, such as greater accessibility, adaptability, and accuracy [14]. The cloud-based HMS improves the health system's efficiency, scalability, and overall performance by sharing resources with a large number of devices in the cloud [15]. Cloud-based HMS alters how doctors, medical staff, and hospitalist communicate patient information, improving overall hospital productivity and lowering expenses [16].

According to the Mosweu [1], HMS is a hospital management information system that encompasses several elements of hospital administration and patientcare. It is designed with certain flexibilities in each module that may be changed to match the needs of the individual hospital, and it provides a complete software solutions. According to Guimaraes, [17], HMS might operate successfully in places with enough ICT infrastructure, stable network access, and adequate bandwidth. This indicates that, in order to maintain equity in the delivery of medical care, the HMS needs to be installed in a cloud-based setting, allowing health institutions with poor ICT infrastructure to be served as well.

According to Katuu, [18], HMS is crucial in healthcare services because it helps to keep vital patient data by offering improved information systems, as well as standardizing the workflow, patient flow, and numerous activities that improve the hospital's overall performance. The duplication of data may be avoided by utilizing HMS since information received from multiple teams is kept on a single storage and can be shared with other network users without having to re-enter it. HMS lets several users to view data at the same time without interfering with each other. According to Adler-Milstein et al. [19], HMS offers significant promise for improving readability, minimizing medical mistakes, improving healthcare quality and service and lowering wasteful healthcare expenses. The HMS goes beyond modern healthcare technology, paperless techniques, or information standardization/sharing by making the medical history of a patient available whenever and wherever it is required for therapy [17].

Healthcare sectors may get a competitive edge and enhance their performance by implementing cloud computing. Cloud computing offers several advantages, including limitless storage, constant resource access, cost effectiveness, flexibility, and scalability [20]. According to a studies concluded by [1, 14, 15, 17] the following are the key Advantages of cloud based national hospital management systems:

- a. **Cost Savings:** Cloud-based hospital management systems are often more cost-effective than traditional on premise systems because the hosting, maintenance, and storage costs are reduced or eliminated. If hospitals in rural area migrate to cloud computing they do not need to acquire, deploy, or manage expensive IT infrastructure. They can instead use current cloud-based infrastructure to obtain the NHMS services they require. This can drastically minimize both upfront and ongoing expenses related with hardware and software maintenance.
- b. **Scalability:** Cloud-based hospital management systems are highly scalable, allowing hospitals to easily expand their systems as their needs grow. Cloud-based NHMS will enable hospitals in rural areas to increase resources fast and simply to meet demand. This enhances flexibility and enables hospitals to swiftly add more users or services as needed rather to investing in new IT infrastructure.

- c. **Improved Security:** Cloud-based NHMS offer hospitals improved security features to protect patient data because cloud providers are able to leverage dedicated resources to secure information stored in the cloud. This means that hospitals in rural area may benefit from advanced and dependable security processes like encryption without having to worry about acquiring and maintaining expensive security solutions.
- d. **Enhanced Data Accessibility:** Cloud-based hospital management systems allow authorised personnel to access critical patient information from any location, at any time. This implies that only authorised healthcare staff may rapidly and securely access patient information and other data from any place, allowing them to make better decisions and offer better treatment. Furthermore, cloud-based solutions eliminate the need to retain and manage backup files, allowing hospitals to run more effectively with less resources. Finally, cloud-based systems give a single source of data across all hospital departments, allowing for increased cooperation and quality of treatment.
- e. **Improved Collaboration:** Cloud-based hospital management systems offer secure sharing of patient information between different departments, improving collaboration and care coordination. By allowing healthcare workers to access NHMS on cloud, they are enabled to make faster, better decisions and communicate more effectively. This results in improved team work, better care coordination and increased patient satisfaction. Additionally, cloud-based collaboration tools are secure, cost efficient and provide a greater level of resources and flexibility, helping to reduce healthcare costs.
- f. **Automation:** Cloud-based hospital management systems enable automated processes for managing patient data, streamlining administrative tasks and freeing up staff time. Automation process enable recovery or processing controlled data during or after a disaster requires minimum effort. Additionally, cloud services offer solutions for automatic backups and data security. With IT issues resolved, physicians can concentrate on patient care and local recovery activities.

7. CHALLENGES OF CLOUD COMPUTING ADOPTION

Since cloud computing is in the early phases of development in South African hospitals, hospitals in rural area are facing several challenges in implementing it. According to Mgosoi and Weeks [21], healthcare cloud computing service providers are capable of delivering large-scale software systems. However, research participants are concerned about the primary obstacles limiting them from implementing cutting-edge ICT platforms in the South African health sector [21]. The key issues identified by Mgosoi and Weeks, [21] include high bandwidth costs, ICT infrastructure, and PHI system fragmentation diverse systems. On multiple occasions, respondents said that there is no underlying principle determining who owns the patient records. This includes a failure to accept local standard, EMR legislation, the integration of heterogeneous systems and fundamental interoperability standards. If the stated difficulties are fixed and managed, respondents believe cloud computing is a viable alternative for improving healthcare service delivery [21].

Maphumulo, and Bhengu [22] observed that services in public healthcare fail to satisfy fundamental standards of care and patient expectations, leading to public distrust in the healthcare system. Long waiting times, a lack of human resources, negative staff attitudes, unsanitary facilities, poor infection control measures, medicine stock-outs, a lack of safety and security for staff and patients, increased litigation, and poor record keeping have all been raised by the public [22, 23].

Kanwar et al. [24] investigated the barriers to telemedicine adoption and its status in a rural area called Himachal Pradesh, in India. To identify issues in distant healthcare institutions, a mixed-method approach was adopted. A survey was done utilizing a 20-item checklist to collect information about the area's infrastructure, telemedicine equipment, workforce, and population. During phone conversations, questions were utilized to assess the level of acceptance of telemedicine and the barriers to its implementation in the rural Indian state of Himachal Pradesh. The study by Kanwar et al. [24] identifies the challenges as lack of awareness (75.9%), patient level of education (44.8%) having primary education, patient age (17.2%), technically challenged staff (30%), resistance to change (80%), and high workload with manpower shortage (60%).

According to a survey done by [6, 17; 2, 22, 24,25]the following summarised key challenges of Cloud Computing adoption:

- a. **Security:** One of the biggest challenges with cloud computing is ensuring that data is secure and protected from unauthorized access. Cloud providers must build robust security protocols, such as encryption and authentication, to protect data in the cloud.
- b. **Infrastructure:** Hospitals need to ensure that their cloud infrastructure is properly configured and maintained in order to provide the best possible experience for their patients. This includes making sure that the proper security and compliance measures are in place and that the infrastructure is able to scale with the hospital's needs.
- c. **Compliance:** Rural hospitals must ensure that they are compliant with government regulations and industry standards when it comes to storing, accessing, and managing sensitive data in the cloud. This can be a challenge, as regulations can vary across regions and countries.
- d. **Cost:** Moving to the cloud can be expensive, especially for organizations with large amounts of data. The cost of migrating data and purchasing storage and computing resources can add up quickly.
- e. **Performance:** Performance issues can be a challenge with cloud computing, as data must be transferred over the internet, which can slow down applications. Additionally, cloud providers can experience outages and other performance issues that can affect an organization's ability to access their data.
- f. **Integration:** Organizations must ensure that their existing systems and applications can integrate with the cloud platform in order to maximize efficiency and productivity. This can be a challenge for organizations that have legacy systems or applications that are not cloud-compatible.

According to Mohlameane and Ruxwana, [26], the adoption of cloud computing services poses policy and legal challenges across the world, particularly in terms of data security and privacy, among other issues. Concerns have been raised about whether South African ICT legislation and regulatory frameworks are enough to manage developing cloud computing regulatory problems, particularly in South African healthcare sectors. This study argued that the South African government must create strong national eHealth policy standards and commit to implementing them within the agreed-upon policy frameworks. Collaboration among stakeholders is required to improve healthcare service delivery in South African hospitals using ICT. This provides a comprehensive approach for implementing the healthcare system in South African hospitals.

8. GUIDELINE FOR CLOUD COMPUTING MIGRATION FOR HOSPITALS IN THE RURAL AREAS

There are a number of private companies offering cloud-based health services in South Africa. These companies offer a range of services, such as cloud-based storage, electronic health records, telemedicine, and remote patient monitoring. When it comes to the cloud computing shift, one observer correctly advised IT directors that it is vital to remember that cloud computing is a tool, not a strategy [8]. Thus, government IT professionals should research the guidelines for how cloud computing might integrate into their overall IT strategy. Cloud computing offers a range of benefits to hospitals in rural areas, including improved access to data, increased agility and flexibility, and greater cost savings. To ensure a successful migration to the cloud, hospitals in rural areas should consider the following guideline [10, 14, 20, 24, 25, 27, 28].

- a. **Assess current systems and processes:** A thorough evaluation of existing systems and processes should be conducted to understand the needs of the organisation and to identify opportunities for improvement.
- b. **Assess Cloud Computing Readiness:** Following the pilot effort's internal evaluation and external communication, IT managers should perform an overall IT cloud-readiness assessment to determine whether their organization has data and applications that can be easily migrated to a cloud environment, as well as whether a public, private, or hybrid cloud would be suitable or usable for these purposes, and rank-order potential projects. As the study continues, IT decision makers must concentrate on defining the criteria to decide for which applications and data cannot or may be kept in any form of cloud computing storage. As a result, they will discover a different area of "cloud-eligible" and "cloud-ineligible" information, as well as applications.
- c. **Start Small:** Due to financial constraints, hospitals in rural areas should start with a small-scale cloud deployment. This can be done by integrating cloud-based software for tasks such as digital records management, patient scheduling, and telemedicine services.
- d. **Utilize Public Cloud Platforms:** Platforms, such as Azure, Salesforce, Google Cloud and AWS, offer cost-effective options for cloud deployment. Hospitals in rural areas should leverage these platforms to leverage their existing IT infrastructure and benefit from the scalability and reliability that the cloud offers.
- e. **Leverage Cloud-Based Services:** Cloud-based services such as AI-enabled medical diagnostics, remote access for medical staff, and virtual consultations can be used to improve patient care and reduce healthcare costs. Cloud computing can promote the transfer of artificial intelligence into mainstream healthcare operations and help customers handle huge volumes of data as more cloud platforms integrate AI and ML into their offerings.
- f. **Establish a Secure Network:** Establishing a secure network to warrant data privacy and safety of patient is key to successful cloud adoption. Hospitals in rural areas should ensure that all data is encrypted, and access to the cloud is only granted to authorize personnel.
- g. **Educate Staff:** Educate staff about why cloud computing is important, as well as the security measures in place to protect patient data. This can help alleviate any security concerns they may have. ICT department in hospitals can run awareness campaigns to educate employees about cloud computing and the possible benefits of migrating to the

cloud. Hospital administration may also play a role in ensuring that cloud computing is used for legitimate hospital business objectives by fostering a culture of responsible usage.

- h. **Develop a Plan:** Hospitals in rural areas should develop a plan to transition to the cloud and define the timeline, budget, and objectives. Make sure to include any necessary changes to operational processes and procedures. The start rollout plan should be supported by both ICT personnel and Healthcare leadership. Communicate the goals, progress, and costs/benefits of each cloud project to both external and internal stakeholders. This is the point at which the cloud computing migration transitions from being a tested endeavour to becoming newconventional in how the hospital manages its patience records and computational operations.
- i. **Select a service provider:** Select a reputable cloud provider that is experienced in working with hospitals. Make sure to review the terms of service and ask questions about the provider's security protocols. It is important to select a cloud provider that can meet the hospital's needs. The hospital should evaluate the security measures, storage capacity, scalability, and cost of the provider before making a decision.
- j. **Test the System:** Before deploying the technology to the full hospital, it should be tested in a controlled setting. This will allow the hospital to ensure that the system is functioning properly and securely.
- k. **Monitor Performance:** Monitor the performance of the cloud system to identify any issues or problems that may arise. This will ensure that the system is running smoothly and efficiently.
- l. **Backup Data:** Make sure to backup data on a regular basis to prevent data loss in the event of an outage or other issue. Cloud services offer solutions for automatic backups and data security. With automated backs on cloud computing, recovery or processing controlled data during or after a disaster requires minimum effort.
- m. **Train Staff:** Train staff on how to use the new system and any new processes or procedures that come with it. This will help ensure a smooth transition. Cloud computing project managers may create a complete training program adapted to the needs of the hospital and ensure that all employees have access to it. They should also collect lessons gained and share them with staff.

9. CONTRIBUTION OF THE STUDY

The contribution of this study is based on addressing the following three study objectives. The study provide both practical and theoretical contribution.

- To analyse the potential benefits of cloud computing migration for South African rural hospitals

The study found that the potential benefits of cloud computing migration for South African rural hospitals are immense. By leveraging the scalability, reliability, and cost-effectiveness of cloud solutions, rural hospitals can reduce their IT infrastructure costs, increase their ability to store and access data, and improve their overall efficiency [18]. Cloud computing can also enable rural hospitals to access advanced medical technologies, such as telehealth services, that would otherwise be out of reach due to the lack of resources. By providing access to these services, rural

hospitals can increase their ability to provide quality care to their patients. Additionally, cloud computing can also enable rural hospitals to take advantage of big data analytics and artificial intelligence (AI) technologies to make better decisions regarding patient care [28].

- To ascertain the challenges in adoption of cloud computing for South African rural hospitals.

This study contributes to the literature on cloud computing adoption by exploring the challenges encountered by South African rural hospitals in their adoption of cloud computing. Specifically, this study identified four key challenges: (1) lack of awareness and technical expertise, (2) high cost of infrastructure and implementation, (3) lack of reliable internet connectivity, and (4) security and privacy concerns [10]. These findings are important for informing policy makers and healthcare sectors on potential strategies that could be implemented to enable rural hospitals to implement cloud computing solutions. Findings from this study also provide an opportunity for further research to explore in more detail the factors that influence cloud computing adoption in rural settings.

- To develop best practices for cloud computing adoption for South African rural hospitals.

The study contributes to the development of best practices for cloud computing adoption in South African rural hospitals. The study offers a comprehensive review of the current state of the cloud computing landscape in South Africa, discusses the challenges faced by rural hospitals in implementing cloud services, and identifies potential solutions for overcoming these challenges. The study also identifies potential risks associated with cloud computing adoption and provides recommendations for mitigating these risks. Finally, the study offers a set of best practices for successful cloud adoption in South African rural hospitals, including an evaluation of the costs and benefits of cloud adoption, an analysis of the security and privacy requirements, and the development of a comprehensive cloud adoption strategy. The study's findings provide a valuable resource for healthcare professionals and stakeholders in the South African healthcare system as they strive to make the most of cloud computing technologies.

9.1. Practical contribution

The study's practical contribution to South African ICT practitioners in rural hospitals is to provide an understanding of the adoption guidelines of cloud computing, which can be used to improve the hospital's healthcare services. The study provides a best guidelines for the adoption of cloud computing technology in rural hospitals that can be tailored to the specific needs of a South African hospitals. It outlines key steps for successful adoption, such as determining the level of cloud computing knowledge and skills of ICT staff and creating a cloud computing strategy. In addition, the study provides an understanding of the benefits and risks associated with cloud computing, as well as best practices for managing those risks. Finally, the study highlights the importance of monitoring and evaluating the implementation of cloud computing in the hospitals. By following these guidelines, ICT practitioners can ensure that the hospitals are making the most of cloud computing technology and providing their patients with the best possible healthcare services.

9.2. Theoretical contribution

The study contributes to the existing literature on cloud computing adoption strategies in South African rural hospitals by providing an in-depth analysis of the advantages influencing adoption decisions. Specifically, the study used a different research method to develop best practices for cloud computing adoption for South African rural hospitals. Moreover, the study identifies the key challenges and opportunities associated with cloud adoption in South African rural hospitals

and provides valuable insights into the implications of these findings for future research and practice.

10. RECOMMENDATION FOR FUTURE STUDIES

The migration of cloud-based services has several ramifications, exploring the perceived benefits of cloud computing, including improved access to data, scalability, improved patient care, and cost savings [10]. This means that in order to obtain a clear understanding and generalization of findings for the migration of South African rural hospitals to the cloud environment, the study about the adoption readiness need to be contacted. The study should include as many stakeholders as possible to understand technical knowledge and infrastructure, as well as cultural and organizational resistance to change. Other than a literature review study, a qualitative and quantitative survey should be conducted to use data from a sample of rural hospitals to analyse how different levels of cloud computing adoption and usage can affect cost savings for these hospitals. The future study should also investigate the cost savings associated with different levels of cloud computing adoption, such as the use of Infrastructure-as-a-Service, Platform-as-a-Service, and Software-as-a-Service.

Another future study should focus on the comparative analysis of the security risks of cloud computing in rural hospitals to those of hospitals in urban areas in South Africa. The study should investigate the security measures that should be taken when considering cloud computing adoption.

11. CONCLUSIONS

The implementation of cloud computing in healthcare services has both advantages and challenges. However, there are some challenges that should be taken into consideration, such as security risks, data privacy, and compliance with regulatory guidelines. South African rural hospitals should carefully evaluate their specific needs and potential risks before implementing a cloud-based, and they should be sure to invest in the security measures required to protect their data.

Additionally, South African hospitals must be aware of the potential costs associated with cloud computing, such as the need to purchase additional hardware and software, as well as the ongoing costs of maintenance and support. Overall, the advantages of cloud computing in healthcare services can be significant, but South African rural hospitals must be mindful of the challenges associated with implementation. Even though there is better eHealth infrastructure in some rural hospital, some existing study found that the eHealth systems were less commonly used which implies that even if they adopt cloud computing applications they might not use it. The main barriers to routine delivery of cloud computing services in rural area hospitals include a lack of understanding among the rural community, a lack of funds, lack of strong internet signal and health staff reluctance. Therefore, South African government need to provide more funding to support hospital in rural area and collaborate with telecommunication companies to build a robust internet infrastructure to support the adoption of eHealth in rural areas.

Implementing cloud computing in the hospitals can be a great way to streamline operations, improve scalability, and reduce costs for businesses. Depending on the cloud computing technology used, this might lead to better healthcare service delivery since medical records will be easier to monitor, find, control, and retrieve at any time and from any location. Cloud computing enables the health services to provide high-quality healthcare support at a low cost. Access to medical and patient data is accessible anywhere, at any time, thanks to the cloud,

allowing healthcare practitioners to monitor patient health status and make educated treatment decisions. Successful cloud computing adoption in healthcare, on the other hand, needs investments in information technology as well as understanding of the internal and external variables that impact technology acceptance. Overall, implementing cloud computing in the South African hospitals can be beneficial for moving their operations online and improve their scalability, performance, and cost-effectiveness.

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