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The Power Behind Cloud Adoption in Healthcare Digital Government

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Abstract: In recent years, Malaysia has witnessed a significant shift towards cloud adoption, driven by various factors including the need for greater efficiency, scalability, and cost-effectiveness in delivering public services. This paper provides an in-depth analysis of the key drivers, challenges, and opportunities associated with cloud adoption in Malaysia's digital government landscape. Drawing upon empirical research and case studies, it examines the strategic considerations guiding government agencies in their migration to cloud-based solutions. Furthermore, the paper discusses the potential benefits of cloud adoption, such as enhanced agility, improved service delivery, and increased innovation in public service provision. It also addresses concerns related to data security, privacy, and regulatory compliance, highlighting the importance of robust governance frameworks in mitigating risks associated with cloud deployment. Through a comprehensive review of current trends and best practices, this paper aims to shed light on the power behind cloud adoption in Malaysia's Healthcare digital government, offering valuable insights for policymakers, IT professionals, and stakeholders involved in the country's digital transformation journey.

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1. Introduction

Governments make every effort to meet citizens' expectations for simple, cost-effective digital experiences that improve service. Both productivity and efficiency are impacted by the combination of rapid data expansion and information propagation across heterogeneous systems. Additionally, government entities struggle to innovate with existing systems and infrastructure due to a lack of technological resources. For the benefit of all government organizations, Malaysia's government has transformed its Public Sector Data Centre (PDSA) into a unique cloud computing service.

Therefore, MyGovCloud, a new hybrid cloud solution for the government, will combine both private cloud services from PDSA and public cloud solutions from cloud service providers (CSP). Government Cloud Solutions facilitate a smooth transition to digital modernization that transforms how agencies cooperate and work, driving to more dynamic and sustainable operations. The government has also established a Cloud Framework Agreement (CFA) with the CSP businesses and the managed service providers that the CSP has hired in order to strengthen the MyGovCloud even more and to roll out the public cloud service in particular (MSP). Public sector organizations will not only receive a collective discount, but also a number of value-added services to improve the human resource capabilities within their own organizations, including training, certification programs, technology transfer, and more.

The cloud offers public sector organizations innovative ways to cut costs and deliver services, quickly pivot to new business models, create engaging customer experiences, enable remote work, learning and automate business processes. Most public sector organizations are

exploring ways of leveraging the cloud to accelerate the achievement of their goals. Many have adopted a cloud transformation strategy based on replacement of physical data centers with Infrastructure as a Service (IaaS) and the migration of on-premises workloads onto the organization's managed cloud environment.

2. Related Work

This literature review aims to examine existing research on cloud adoption in healthcare, focusing on the factors influencing adoption decisions, benefits and challenges associated with cloud implementation, and future trends in cloud adoption strategies. Healthcare organizations' decisions on adopting cloud computing are heavily influenced by organizational considerations. Research has revealed that important variables influencing cloud adoption include perceived benefits, leadership support, and company culture (Alshehri et al., 2020). Shaker et al.'s research from 2022, for example, indicated that cloud computing technologies were more likely to be adopted by healthcare companies that had a culture of innovation and strong leadership support. Furthermore, Mafouta et al. (2021) have identified organizational preparedness as a crucial element impacting the adoption of cloud-based solutions in the healthcare industry. This includes the availability of IT infrastructure and technical competence.

Cloud computing has become a disruptive technology in recent years, with the potential to completely change a number of industries, including healthcare. The adoption of cloud computing in healthcare holds the promise of improving efficiency, accessibility, and cost-effectiveness of healthcare services (Mohebbi and Moghaddasi, 2017). Cloud computing offers a scalable and adaptable approach to handle these complex concerns as healthcare organizations struggle to manage enormous volumes of data, ensure data security and privacy, and provide high-quality patient care (Kuo et al., 2016).Cloud computing adoption in the healthcare industry is not without difficulties, though. Cloud adoption in healthcare settings is significantly hampered by worries about privacy, data security, and regulatory compliance (Alshehri et al., 2020). Robust data protection measures and strict adherence to regulatory guidelines are necessary to ensure compliance with healthcare regulations, such as the Personal Data Protection Act (PDPA) in Malaysia and the Health Insurance Portability and Accountability Act (HIPAA) in the United States (Moghaddasi & Mohebbi, 2017).

Future developments in cloud adoption techniques for healthcare are probably going to concentrate on meeting new healthcare objectives and demands, like patient-centered care, population health management, and customized medicine (Shaker et al., 2022). Advancements in cloud technology, such as edge computing, artificial intelligence (AI), and Internet of Things (IoT), are expected to play a significant role in shaping the future of healthcare delivery (Mafouta et al., 2021). By enabling real-time data analytics, predictive modeling, and individualized treatment plans, cloud-based platforms that incorporate these technologies have the potential to completely transform healthcare services (Mohebbi & Moghaddasi, 2017).

Cloud adoption in healthcare therefore has the potential to revolutionize the way healthcare services are delivered by increasing efficiency, accessibility, and cost-effectiveness. However, cloud adoption requires careful consideration of organizational factors, regulatory compliance requirements, and data security considerations. Future trends in cloud adoption strategies are likely to center on utilizing emerging technologies to address changing healthcare needs and priorities. Healthcare organizations can create effective strategies to fully utilize the benefits of cloud computing in improving patient care and outcomes by knowing the factors influencing cloud adoption decisions.

3. Challenges faced by public healthcare service in Malaysia

Numerous obstacles affect the Malaysian public healthcare system's capacity to deliver thorough and effective healthcare services. These difficulties affect several facets of the healthcare system, including staff shortages and infrastructure. The following are some of the main obstacles that the public healthcare system in Malaysia must overcome:

3.1 Overcapacity Facilities:

Problem: Overcrowding in public hospitals and healthcare institutions frequently results in longer wait times and worse patient satisfaction. Impact: Packed facilities put a burden on resources, jeopardize patient care, and increase the risk of burnout among medical staff.

3.2 Unequal Allocation of Medical Resources:

Problem: Healthcare resources are not evenly distributed throughout the country, with urban areas having better access to hospitals than rural ones.

Impact: Disparities in health outcomes may result from rural communities' difficulty receiving prompt, high-quality healthcare treatments.

3.3 Population Aging:

Problem: As Malaysia's population ages, there is a greater need for healthcare services due to changes in the country's demographics.

Impact: As the population ages, more demands are placed on healthcare facilities and staff, necessitating a review of healthcare plans to better meet the unique requirements of senior citizens.

3.4 Technology Shortfalls and Infrastructure Difficulties:

Problem: Some healthcare institutions could struggle with antiquated infrastructure, a lack of access to cutting-edge medical technology, and technological gaps.

Impact: Inadequate technology can reduce the effectiveness of healthcare delivery, obstruct telemedicine acceptance, and restrict the application of contemporary medical procedures.

3.5 Patient Awareness and Education:

Problem: Patients need to be better informed about early detection, preventative healthcare practices, and other related topics.

Impact: Insufficient patient education may exacerbate the burden on the healthcare system by increasing the frequency of avoidable illnesses and late-stage presentations.

3.6 Data security and management for health information:

Problem: Maintaining data security and managing health information are difficult tasks, particularly in light of the growing prevalence of electronic health records.

Impact: Poor handling of health information might jeopardize patient privacy and impede the smooth sharing of data between healthcare providers.

3.7 Combining Primary and Secondary Healthcare:

Problem: To guarantee seamless patient care, primary and secondary healthcare services need to be better integrated.

Impact: Patients may experience difficulties navigating the healthcare system and receiving timely referrals as a result of fragmented care brought on by a lack of integration.

Addressing these challenges requires a multi-faceted approach, involving strategic planning, investment in healthcare infrastructure and technology, workforce development, and ongoing efforts to enhance the efficiency and accessibility of healthcare services across the country.

4. Strategic Planning and Analysis

Creating a strategy plan for cloud adoption in. Malaysian healthcare services necessitate a thorough comprehension of the country's healthcare system, legal and regulatory environments, technology infrastructure, and the unique requirements of patients and healthcare providers.

4.1 SWOT analysis

Performing a SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) for cloud adoption in healthcare services in Malaysia helps in understanding the internal and external factors that may impact the adoption and utilization of cloud technology in this sector. Figure 1 explains the key points delivered from the SWOT analysis:

4.1.1 Strength

i. Cloud adoption can reduce capital expenditure on IT infrastructure, allowing healthcare providers to allocate resources more efficiently.
ii. Cloud services offer scalability, allowing healthcare organizations to adjust resources based on demand, ensuring optimal performance.
iii. Cloud-based solutions enable remote access to patient data and healthcare applications, facilitating telemedicine and remote patient monitoring.
iv. Cloud platforms enable seamless integration of disparate healthcare systems and data sources, improving interoperability and data sharing.
v. Cloud services offer robust disaster recovery capabilities, ensuring data resilience and business continuity in case of emergencies.

4.1.2 Weakness

i. Healthcare data stored in the cloud may be susceptible to security breaches, raising concerns about data privacy and compliance with regulations.
ii. Integrating cloud solutions with existing legacy systems and infrastructure may pose technical challenges and require additional resources.
iii. Reliance on internet connectivity for accessing cloud-based services may

pose challenges in areas with limited or unstable internet access.

iv. Dependence on cloud service providers may result in vendor lock-in, limiting flexibility and increasing long-term costs.

v. Compliance with healthcare data regulations and privacy laws, such as PDPA, may require additional measures and monitoring in cloud environments.

4.1.3 Opportunity

i. Cloud technology facilitates the expansion of telemedicine services, enabling remote consultations, diagnostics, and treatment options.

ii. Cloud platforms enable healthcare organizations to leverage big data analytics for insights into patient outcomes, population health, and personalized medicine

iii. Cloud-based platforms foster innovation and collaboration among healthcare providers, researchers, and technology developers.

iv. Cloud adoption supports the development of mobile healthcare applications and solutions, enhancing patient engagement and care delivery.

v. Cloud-based platforms facilitate health information exchange (HIE) initiatives, improving care coordination and interoperability among healthcare providers.

4.1.4 Threats

i. Cloud-based healthcare systems are vulnerable to cyber threats and data breaches, posing risks to patient data security and confidentiality.

ii. Ensuring compliance with evolving healthcare regulations and data privacy laws may pose challenges for cloud adoption in Malaysia.

iii. Dependence on cloud service providers exposes healthcare organizations to the risk of service outages and disruptions, impacting patient care and operations.

iv. Issues related to data sovereignty and jurisdiction may arise when storing healthcare data in the cloud, particularly concerning cross-border data transfers.

v. Resistance from healthcare professionals and stakeholders to adopt cloud technology due to concerns about data security, privacy, and workflow disruptions.

Strengths	Weaknesses
▪ Cost Efficiency ▪ Scalability ▪ Accessibility ▪ Data Integration ▪ Disaster Recovery	• Data Security Concerns • Legacy Systems Integration • Internet Dependency • Vendor Lock-in • Regulatory Compliance
Opportunity	**Threats**
• Telemedicine Expansion • Big Data Analytics • Innovation and Collaboration • Mobile Healthcare Solutions • Health Information Exchange	• Data Breaches and Cybersecurity Risks • Regulatory Compliance Challenges • Service Outages • Data Sovereignty Concerns • Resistance to Change

Figure 1: SWOT Strategic Analysis Cloud Adoption in Healthcare Services

5.0 Way Forward Adopting Cloud with HealthCare System in Ministry of Health

Embarking on a journey to develop and deploy nationwide a cloud native application.The Malaysia Government is trying to continuously improve healthcare services by computerizing the hospitals' whole system through their Ministry of Health. A patient management system called Sistem Pengurusan Pesakit (SPP), a fundamental Hospital Information System (HIS), was first developed by MOH in 2007. It underwent various changes eventually attaining version 3.5 in 2017. As early as 2011, work on a new core HIS from SPP with Clinical Documentation (CD), namely HIS@KKM and clinical support modules began in order to equip SPP with Electronic Medical Record (EMR) to become a comprehensive HIS.

Due to the lack of adequate technology, high cost of development as well as maintenance associated with these independent monolithic standalones HIS systems, information sharing has become a serious issue in some government hospitals, leading to the creation of independent and standalone HIS systems. Adding on with challenges with integration of other systems such as Laboratory Information System (LIS), Radiology Information System (RIS) & Pictures Archiving and Communication System (PACS), Critical Care Information System (CCIS), Pharmacy Information System (Phis), Operating Theatre Management System (OTMS), Central Sterile Supply Services Information System (CenSSIS) and Blood Bank Information System (BBIS).

For health care to continue to be cost-effective, quick, and efficient while still providing high-quality services, it needs constant and systematic innovation. Cloud computing is expected to transform the way information technology is used, improve health care services, and advance health care research, according to many managers and experts (IT)

According to Coughlin et al (2018), 30% of the world's data volume is produced by the healthcare sector, and this percentage will rise in the next years. The compound annual growth rate will surpass manufacturing, media & entertainment, and financing by 2025, reaching 36%.

These figures highlight the significance of healthcare data and demonstrate why medical data transfer is crucial for most businesses. Providers may extend their operations, use IT analytics, and implement more durable systems thanks to migration.

The cloud is the greatest alternative for the majority of Malaysian healthcare providers who are concentrating on the Ministry of Health Digital Transformation Plan. By moving to the cloud, we could automatically convert massive amounts of data, ensure backups, and do away with pricey in-house equipment. As a result, our health data management procedures become more efficient and quicker. Adherence to HIPAA and other rules governing the handling of healthcare data is the primary factor to take into account when choosing cloud technologies.

It is never simple to move the records of a whole business. Yet, by being aware of the difficulties involved with moving medical data in advance, you may prepare to prevent or reduce the hazards. Therefore, while relocating medical records, make careful to keep in mind these frequent data migration difficulties. It requires work and might be difficult to finish if you have never created a strategy for health data transfer. However, and you shouldn't begin shifting records without doing your research beforehand. The implications of not having a strategy are extensive.

As medical records are varied, interoperability is one of the biggest barriers to healthcare data transfer. They are produced by numerous tools in a variety of potentially incompatible forms. So, you must ensure data interoperability if you wish to transfer data to a more sophisticated system and use it for analytics and automation. In order to ensure seamless data sharing between system components using APIs, knowledge of interoperability standards like HL7 FHIR and is required.

Implementing a total solution for the hospital information system involves leveraging cloud-native architecture, modernizing applications, and adopting API-based integration. By embracing a cloud-native approach, can benefit from scalability, flexibility, and cost-efficiency offered by cloud platforms. Modernizing applications ensures that they are agile, modular, and easily maintainable, enabling faster updates and improved user experiences. API-based integration allows seamless connectivity and data exchange between hospital information system and other systems, promoting interoperability and facilitating a unified view of patient information. This comprehensive solution empowers healthcare providers with real-time access to accurate data, enhances collaboration, streamlines workflows, and ultimately leads to better patient care, operational efficiency, and data-driven decision-making within Malaysia's Ministry of Health.

6.0 Overall Action Steps and Proposed Solution

Leveraging on digital technologies will be the key imperative to enhance the healthcare service delivery. Here are proposed action plan and solution:

6.1 Create a Cloud Centre of Excellent

Establish a dedicated team responsible for guiding and overseeing the cloud adoption process, ensuring alignment with organizational goals

6.2 Prioritize Applications for Migration

Identify critical applications and services that will benefits the most from cloud migration. Prioritize based on impact, feasibility, and strategic goals.

6.3 Implement Pilot Projects

Begin with smaller-scale pilot projects to test cloud technologies, identify challenges, and gather feedback before full-scale implementation.

6.4 Establish Key Performance Indicators (KPIs)

Define measurable KPIs to access the success and impact of cloud adoption. This could include improvements in service delivery, cost savings, and enhanced data security.

6.5 Engage Stakeholders

Collaborate with healthcare professionals, IT staff and other stakeholders to ensure a collaborative and informed approach to cloud adoption. Address concerns and gather valuable insights.

6.5 Promote a Culture of Innovation

Encourage a culture of innovation with the organization, fostering an environment where healthcare professionals feel empowered to explore new technologies and approaches.

7.0 Conclusion

By implementing this way forward based on SWOT analysis, the Ministry of Health Malaysia can develop a robust action plan for adopting cloud-native solutions, addressing weaknesses, capitalizing on strengths, mitigating threats, and leveraging opportunities in the healthcare landscape.

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