CLOUD COMPUTING IMPACT ON HEATHCARE IN SOUTH AFRICA

THEMBAYENA MGOZI

University of Pretoria, Graduate School of Technology Management, Department of Engineering and Technology Management, South Africa
mgozitn@gmail.com

RICHARDS WEEKS

University of Pretoria, Graduate School of Technology Management, Department of Engineering and Technology Management, South Africa

Presented by
LOUWRENCE ERASMUS

ABSTRACT

The emergence of cloud computing in the health sector is increasingly gaining acceptance as an effective means of improving healthcare delivery across the globe. In South Africa, the adoption of cloud computing may be hampered by persistent reliance on using traditional, disparate and unreliable Information and Communications Technology (ICT) platforms. This includes the implementation of the National Health Insurance (NHI) scheme to provide universal healthcare coverage supported by the use of ICT for health (eHealth) initiative in the country. This research study considered long-term strategic plans for the development and implementation of a value-based healthcare delivery system. This is in line with the National Development Plan (NDP) for 2030 vision on promoting health in South Africa. Correspondingly, this research study was conducted to leverage eHealth and propose a conceptual cloud computing model to improve healthcare delivery. The aim of this study was to describe the challenges and solutions necessary to enable cloud computing ecosystem within the health sector. The study employed a qualitative research methodology, using a narrative approach to obtain the findings with respect to the research objectives. The findings attest that the health information system is not meeting the requirements to strengthen healthcare system effectiveness. A key concern is the lack of well-coordinated regulatory frameworks for proper governance of eHealth standards implementation; including Patient Health Information (PHI) with respect to privacy and security. The recommendation is that the South African government should first address concerns of collaboration within the broader stakeholders to ensure coordinated healthcare delivery. Further investigation on eHealth may well be of value to improve the usefulness of the proposed model. Future research studies on eHealth will be driven by advancements in clinical standard practices, information management and medical technologies. This will lead to the development of new eHealth components essential to strengthen healthcare delivery through effective utilisation of the health outcomes in the future.

Key words: Cloud computing, Healthcare, Health Information System.

INTRODUCTION

"In the area of health, we will work harder to increase life expectancy at birth from 60 years in 2012 to 63 years in 2019. The campaign to reduce child and maternal mortality ratios will continue. This will require the implementation of the National Health Insurance and the improvement of the quality of care in the public sector. We will build on the success of our

HIV and AIDS treatment and support programme by expanding our mass HIV prevention communication campaigns". Presidency Republic of South African Government, 2014:14

The introductory citation attests to the current challenges facing the healthcare system in South Africa. In an attempt to overcome these identified challenges on healthcare, the Department of Health (2014:14) elucidates that "South Africa is at the brink of affecting significant and much needed changes to its health system financing mechanisms. The phase implementation of National Health Insurance (NHI) is intended to bring about these changes based on the principles of ensuring the right to health for all, enriching equity and social solidarity, and efficiency and effectiveness in the health system in order to realise universal health coverage. This is to ensure integrated financing mechanisms that draw from the capacity of the public and private sectors to the benefit of all South Africans".

The minister of health in his "forward-thinking", always seeking to bring modernity to his country similarly explains that in an attempt to remedy the healthcare crisis, the South African government has embarked on the NHI initiative (Focus Reports, 2012:9). Of crucial significance is that the NHI initiative is being envisaged by the minister of health to bring both public and private health sectors to operate in a collaborated and coordinated manner in changing the face of healthcare service delivery (Focus Reports, 2012:9). In a similar sense Weeks and Benade (2013:1) quite pertinently state that *"without doubt the project will be one of the most complex and multi-disciplinary in nature ever undertaken by the South African Department of Health"*. This citation attests to the implementation of a R300 billion NHI project, to be implemented over a 14 year period (Weeks and Benade, 2013:1).

The deputy minister of health provides more clarity and states that the "eHealth Strategy for South Africa 2012/13-2016/17" should provide a clear roadmap to an integrated and well-functioning national patient-based information system (Department of Health, 2012:5). This includes agreed scientific standards for interoperability, which improves the efficiency of clinical care, produces the indicators required by management, and facilitates patient mobility. The conclusion is that the architecture of this patient-based information system should also serves as a critical enabling factor for the implementation of the NHI scheme in South Africa (Department of Health, 2012:5).

According to the office of the Presidency Republic of South African Government (2011:343), the NHI initiative forms part of the "National Development Plan: 2030 vision" on promoting health. This includes the development and implementation of a national health system that works for everyone and produces positive health outcomes (Presidency Republic of South African Government, 2011:343).

HEALTHCARE DELIVERY SYSTEM PERSPECTIVE

"High and rising health care spending has created fiscal crises in countries around the world. Future demographic shifts and innovations in medical technology threaten to further accelerate spending and destabilize the system. Nearly every government is now asking: How can we design a health care system that produces better value for the money we spend"? Porter and Guth, 2012:1

Based on Porter and Guth's (2012:1) observation in relation to the healthcare system reform in countries around the world, it could well be argued that the healthcare challenges are universal

across the globe. However, Dal Poz, Kinfu, Drager and Kunjurnen (2007:3) contend that any attempt to compare the size and characteristics of the health system across countries or over time requires some level of harmonisation of the available information. This is because each disease or health concerns has its own sets of defining characteristics and affects different populations across different countries and settings (Dal Poz *et al.,* 2007:11). In a similar sense Mahundi, Kaasbøll and Twaakyondo (2011:3) point out that the health information systems in developing countries are characterised by fragmentation due to a number of subsystems operating separately, and in most cases vertically.

Correspondingly, the minister of health (Department of Health, 2012:5) notes that historically, health information systems in South Africa have been characterised by fragmentation and lack of interoperability between disparate systems. This includes considerable resources that were invested in these systems, which did not generate the expected returns on investment (Department of Health, 2012:5). This situation described by the minister of health is not problematic only in South Africa but even in the United States (U.S.) these identified healthcare challenges are common. As Porter (2009:1) enlightens that "Despite many waves of debate and piecemeal reforms, the U.S. healthcare system remains largely the same as it was decades ago. We have seen no convincing approach to changing the unsustainable trajectory of the system, much less to offsetting the rising costs of an aging population and new medical advances".

RATIONALE OF THE RESEARCH STUDY

As noted by Teperi, Porter, Vuorenkoski and Baron (2009:35) today's healthcare systems consist of numerous incompatible applications for departments, functions and administration. A truly integrated medical review system combines all disparate healthcare applications into a holistic system view, which enable easy tracking of the health outcomes over the full cycle of care (Teperi *et al.*, 2009:35). In a similar view Zhang and Liu (2010:2) agree that the electronic health records (EHRs) effectiveness depends exclusively on a robust and stable implementation of electronic medical records (EMRs). This is to ensure interoperability, seamless integration and interconnectivity of all healthcare data records across care delivery organisations (Rowley, 2009:3).

Furthermore, the Department of Health (2012:5) notes that globally, ICT has emerged as a critical enabling mechanism to develop HIS capable of strengthening health system effectiveness. Of further relevance is the argument by Teperi *et al.* (2009:35) who maintain that information technology (IT) alone cannot fix a broken healthcare system but it can enable a new value-based approach to care delivery and measurement outcomes. Porter (2010:7) concurs with the statement by Teperi *et al.* (2009:35) in the sense that part of the six fundamentals strategic agendas to reform healthcare delivery is to "Create an Enabling Information Technology Platform" in the health sector.

Enthoven and Tollen (2012:2) also agree that the evidence based healthcare system can be supported by the state-of-the-art information technology platforms. It is also contended by Kshetri (2010:2) that the state-of-the-art ICT platforms are beginning to make a sustainable and positive impact on the delivery of healthcare services to the developing economies.

Following a similar line of thought, perhaps, with further insights, it can be argued that the myriad ways of the state-of-the-art and emerging technologies including cloud computing can also be deployed to improve healthcare delivery in South Africa. Frank and Moore (2010:12) elucidate that the cloud architecture enables platforms of collaboration combined with rich abilities of

communications and coordination, and thus opening up new and significantly more efficient business models. Frank and Moore (2010:12) make an observation that cloud computing adoption models have a velocity, which have not been witnessed in technology space before. The argument by Frank and Moore (2010:12) is based on the adoptions rate, performance and costs. For example: Salesforce.com services 75,000-plus of its clients with 15 billion quarterly transactions, and reliability is at 99.99999% with transaction times of 300 milliseconds (Frank & Moore, 2010:13).

Therefore, it is perhaps not so surprising that Frank and Moore (2010:12) are of the views that cloud computing is inevitable and the future resides in the cloud (Frank & Moore, 2010:19). This assertion by Frank and Moore (2010:12) also holds true in the sense that Chang, Chou and Ramakrishnan (2009:2) are also of the view that the emergence of cloud computing is observed as driving the need for better collaboration, coordination and interaction in the health sector. This includes the delivery of a secured and quality of healthcare services across different parts of the health sector. For example, figure 1 depicts such collaborative and coordinated health systems viewpoint as articulated by Chang *et al*. (2009:2). This strategic approach suggests that patient centric and evidence value-based healthcare system requires interaction between all key role players with patients located at the centre as envisioned by the Department of Health (2012:5).
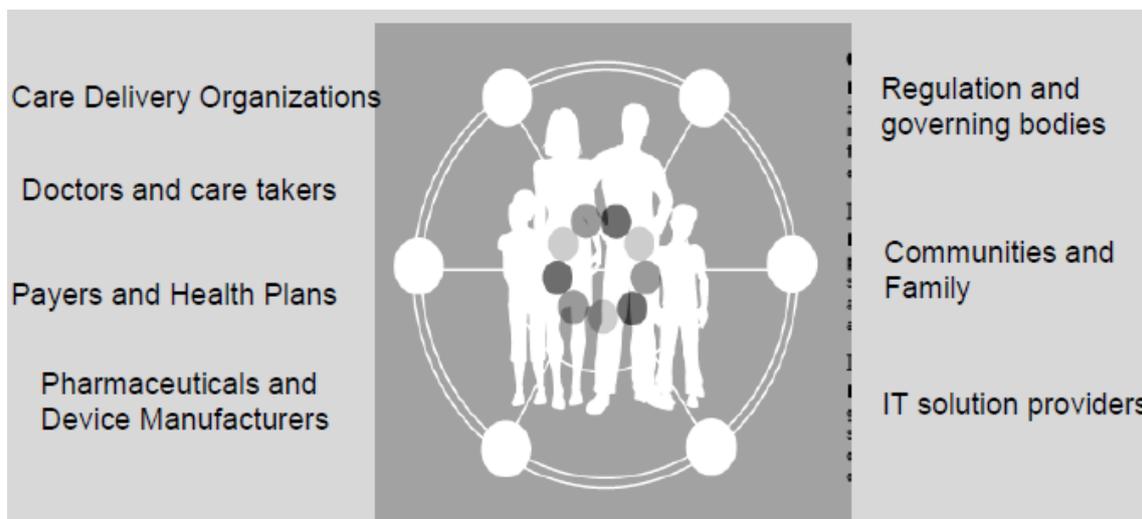

Figure 1: Collaborative, coordinated and interactive health systems (Chang et al., 2009:2)

Following a similar trend of supported arguments, it is important to note that the healthcare service quality, accessibility, reliability and affordability should be sustainable throughout the health system life-cycle.

Of critical importance is that Kshetri (2010:2) also observed that the state-of-the-art ICT platforms are beginning to make a sustainable and positive impact on the delivery of healthcare services to the developing economies. In a similar view the Department of Health (2012:21) accentuates that the eHealth initiative can be seen as an investment in the health sector to secure benefits that exceed costs over time. This includes adopting an appropriate architecture coupled with comprehensive and rigorous interoperability standards in order to ensure sustainability over the long term as required by the Department of Health (2012:21). In same light Wyld (2010:8) similarly notes that the European nations are beginning to explore the use of cloud-based computing for the delivery of health services.

In fact Wyld (2010:15) further argue that cloud computing will greatly impacts organisations that are involved in a vast array of IT equipment, software, support, and services. Notable in this regard is the observation also attributed by Deloitte (2008:15) on the basis that the responsive and sustainable health system should be able to address future healthcare needs. Following the same line of thought Deloitte (2008:4) describes the Australian healthcare system as one of the best in the world in terms of producing good health outcomes for its citizens. A case in point Deloitte (2008:94) explains that the healthcare system is comprised of many distinct physical and human resources. Therefore, in order to avoid some of the healthcare challenges as described previously by both the minister of health (Department of Health, 2012:5) and Porter (2009:1) respectively, Deloitte (2008:94) suggests that the invested resources need to be effectively procured, allocated and scheduled to ensure proper implementation of a sustainable healthcare system.

PROBLEM STATEMENT

The preliminary investigation suggests that the HIS is not meeting the requirements capable of strengthening health system effectiveness in South Africa. As cloud computing continues to gain acceptance as an effective means of improving healthcare service delivery across the globe. In South Africa, the adoption of cloud computing may be hampered by persistent reliance on using traditional, disparate and unreliable Information and Communications Technology (ICT) platforms. A key concern is a lack of well-coordinated regulatory frameworks for proper governance of eHealth standards implementation. This includes PHI services with respect to privacy and security.

The following list of formulated questions gives more insight into the problem statement:

i. What are the main challenges facing the successful adoption and implementation of the national eHealth strategy within the healthcare environment in South Africa?

ii. How has the lack of collaboration, coordination and interaction affected the implementation and adoption of the state-of-the-art ICT solutions within the healthcare environment in South Africa?

iii. How has the evolution of healthcare ICT infrastructure changed the nature of healthcare service delivery in South Africa compare to other developing countries?

iv. What are the primary concerns for healthcare IT executives have about implementing emerging information technology platforms especially one that may not be entirely familiar with including cloud computing solutions?

v. What are the key challenges in embracing cloud computing in the health sector and how can service providers overcome such challenges?

vi. What is cloud computing's real potential in the health sector?

vii. What are the challenges associated with acquiring and implementing large software applications, such as EMRs and EHRs?

viii. What would be the biggest challenge in integrating public and private health sectors in South Africa?

RESEARCH OBJECTIVES

In order to address the research problem appropriately, the primary objective of the study is to describe the challenges and solutions that are associated with enabling cloud computing ecosystem and defines how cloud networking is likely to evolve in the near future. This is because proper implementation of cloud computing requires state-of-the-art ICT platforms, which are dynamic in nature, more agile and cost effective than traditional IT architectures. The key question is: given the breadth of cloud networking paradigm shifts that are impacting the adoption of cloud computing today, how likely is it to have South African healthcare system benefitting from such developments in the near future?

The secondary objective is to explore how other countries are approaching cloud computing challenges within the health sector and also learn from their best practices moving forward.

PROPOSED MODEL

"Government is committed to forge ahead with the implementation of the National Health Insurance (NHI) scheme. However for this to happen, a certain levels of health quality standards need to be adhered to by the country's hospitals and clinics. Quality has to be the precondition for health care. It is evident from the findings of the Health Facility Audit conducted in 2011 and 2012 that a lot of investment for improved quality is needed. The first initial steps to address this were the establishment of facility improvement teams in the NHI Pilot Districts. In order to ensure long term sustainability of these improvements, dedicated effort is required in partnership with the community, private sector and development partners". Department of Health, 2014:8

The citation by the Department of Health (2014:8) is in agreement with Van Dyk, Groenewald and Abrahams (2010:3) who are of the view that a single organisation cannot provide all the expertise necessary to address healthcare system challenges in South Africa. Of further significance is the connection of views that seem to coexist between different authors. For instance, Chan and Touré (2012:63-74) also agree with the views expressed by Van Dyk *et al*. (2010:3) in the sense that governments should encourage collaboration during the development of the national eHealth vision (Chan and Touré, 2012:18).

Following on similar observations presented by the World Health Organisation (2008a:76) and supported revelations by the Department of Health (2012:17), it can therefore be argued that the regulatory frameworks serves as the core foundation for the renewal of the health system in South Africa. The deputy minister of health (Department of Health, 2012:5) also validates this statement to be true by stressing that *"in August 2009, the National Health Council (NHC), chaired by myself and comprising of the 9 Provincial MECs for Health, resolved that the acquisition of software solutions which were not interoperable should be halted until the eHealth Strategy for South Africa is finalised"*.

The Department of Health (2011b:15) similarly clarifies that the purpose of the regulatory framework is designed to place emphasis on the inter-linkages between quality assurance (through regulation) and quality improvement in the implementation of quality standards. These observations are also consistent with the Department of Health (2010:170) on the commitment to develop a framework for a comprehensive and integrated monitoring and evaluation system. This includes

Health and Management Information System (HMIS) followed by the development and enforcement of common standards, norms and systems across the country.

Whereas acknowledging the significance of implementing quality standards in the health sector, the World Health Organisation (2008a:12) further confesses that there is a need to coordinate and align partners on an agreed framework for the development of an efficient HIS as illustrated in figure 2. This will improve the efficiency and effectiveness of the healthcare system in the country as anticipated by the Department of Health (2014:7).
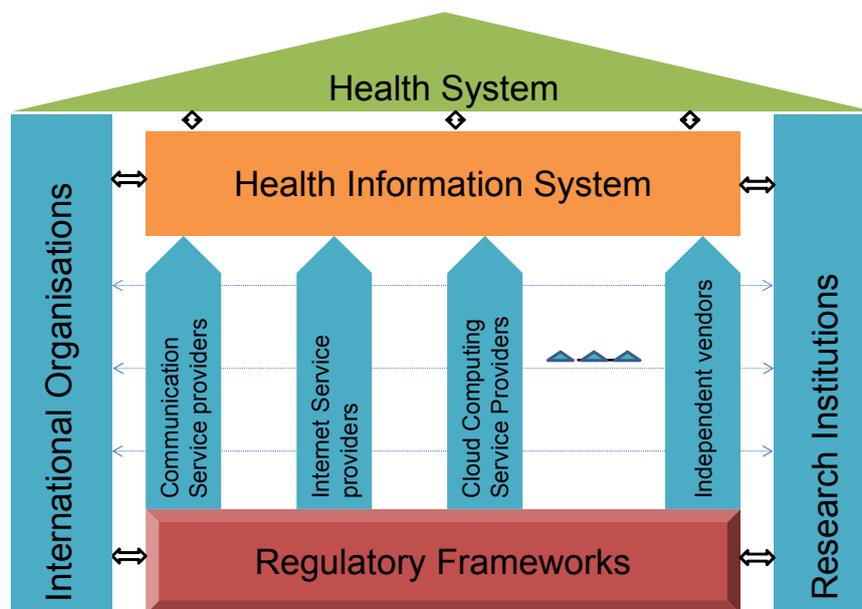
Figure 2: Proposed cloud computing model for health sector in South Africa

RESEACRH METHODOLOGY

The importance of cloud computing technologies to address the IT needs for future collaborative and coordinated healthcare is well articulated by Chang *et al* (2009:2). Frank and Moore (2010:12) also admit that cloud computing architecture enables platforms of collaboration combined with rich abilities of communications and coordination. This includes opening up new and significantly more efficient business models. As a matter of fact, Frank and Moore (2010:19) attest that cloud computing is inevitable and the future resides in the cloud.

As alluded to previously, the study aims to explore the myriad ways in which the state-of-the-art and emerging technologies such as cloud computing can be deployed as part of eHealth initiatives in creating a value-based healthcare delivery system in South Africa.

Deloitte (2008:72) quite pertinently points out that the eHealth architecture is structured into three segments that contain related components necessary to delivery eHealth vision in the health sector, namely:

i. **The eHealth Solutions** including systems and tools that consumers, care providers and healthcare managers will use to interact with the health system

    ii.   **The eHealth Infrastructure** including specific eHealth computing infrastructure components necessary to support the collection and sharing of structured and meaningful use of electronic information across the health system

    iii.   **The eHealth Enablers** including ICT components that must be in place or should be addressed to support the delivery of the overall eHealth strategy

Through the analysis of the stakeholder role perspectives, Deloitte (2008:72) notes that it is possible to define an eHealth architecture that identifies all the ICT components needed to deliver eHealth vision in the health sector. Chan and Touré (2012:125) also reiterated that other stakeholders from beyond the health sector play an important role in developing and implementing the national eHealth vision.

Correspondingly, following the consolidation of views as part of the literature review analysis in supporting the proposed conceptual model in figure 2, the research subjects are identified as per table 1. The identified stakeholders are referred to as participants and consist of Managing Directors (MDs), Chief Technology Officers (TCOs), Senior Executives, Subject Matter Experts and Specialists in their respective companies and institution based in South Africa.

Table 1: Research Subjects

Research Subjects	Participants Role	Description	Example
Health system in South Africa	Decision-makers	Strategic direction for eHealth (Department of Health, 2012:6)	National eHealth Steering Council
Health information system	Subject matter expects	Delivery of HIS software (Mars and Seebregts, 2008:17)	Health ICT Service Provider
Cloud networking platform	Key enablers	Enables ICT infrastructure (Shen et al. 2012:3)	Internet Service Providers
Cloud computing ecosystem	Key influencers	Provides utility computing (Winans and Brown, 2009:2)	Cloud Computing Service Providers
Enabling cloud computing ecosystem	Health IT innovators	Enhances ICT infrastructure performance (Calyam, 2011:2)	Technology Specialist Company

Cooper and Schindler (2011:143) alluded to the fact the objective of the exploratory study is usually to develop hypotheses or questions and discover further research tasks. In a similar sense the research study employed a qualitative research methodology using narrative enquiry whilst understanding and addressing the desirable circumstances and effects. This is to achieve the findings with respect to the research objectives. This research approach was undertaken taking into account the complexity and limitations of this area under investigation.

As indicated by Bharadwaj and Lal (2012: 5) a similar approach was also considered in India whilst weighing benefits and challenges of cloud computing and also studying market trends. In the sections that follow, the research findings are summarised, discussed and interpreted in order to address the research objectives and arrive at the conclusions and recommendations.

RESULTS

This section discusses the findings with respect to the research objectives. The results provide in-depth insights to the challenges, solution and possible opportunities within the health sector in South Africa. The research participants in table 1 are referred to as respondents from this section

going forward. The interpretation of the results follows certain pattern as per the research subjects presented in table 1.

Research subject 1: health system in South Africa

The proposed conceptual model anticipated that the main pillars of the health system in South Africa consist of the research institutions and international organisations. Chan and Touré (2012:125) similarly confessed that other stakeholders from beyond health sector play an important role in developing and implementing national eHealth vision. This includes professional education agencies and academic institutions.

Table 1 illustrated the role of stakeholders henceforth referred to as respondents expected to play significant role on eHealth action plan in the health sector. Similarly, respondents come from the research institution and part of the decision-makers for the transformation of the health system in South Africa. In a similar sense the World Health Organisation (2012a:20) on Global Observatory for eHealth series attest that researchers usually make several broad conclusions about the adoption of ICTs in health sector. This includes keeping the technology simple, relevant, and local. The results indicated that the current challenges facing the health system are synonymous with eHealth strategy stumbling blocks in South Africa. These stumbling blocks are defined as "challenges" by the Department of Health (2012:7) within the South African context.

However Marston, Zhi, Bandyopadhyay and Ghalsasi (2010:9) argued by contending that to realise the full potential of cloud computing services means removing the roadblocks and overcoming the challenges of security, quality of experience and governance. The findings point towards security and privacy as some of the key inhibiting factors for the adoption of cloud computing within the health sector in South Africa.

It is worth mentioning that the respondents recognise that other countries have started implementing cloud computing platforms in the health sector. It is for instance noted by respondents that the countries that are getting it right are implementing interoperability standard frameworks that are closely monitored. This includes addressing concerns around security and sharing of data. The challenges around privacy and security are the biggest concerns to the adoption of cloud computing within the health sector in South Africa. This is according to the results obtained from the respondents underpinning the development of the health system in South Africa.

The results obtained indicate that if the security and privacy can be addressed and controlled, cloud computing is described as a good solution within the health sector in South Africa.

Bojanova and Samba (2011:4) quite pertinently agree that cloud computing services are the enabling fabric of the health information technology platform. This includes reducing barriers to entry for the developing economies, and transforming the cost base, agility and mobility of a well-developed HIS. Rashid Al Masud (2012:8) also described EMRs and EHRs platforms as crucial parts of cloud computing based models in medical sectors.

Research subject 2: health information system perspective

Following a similar trend of supported arguments previously presented for the proposed conceptual model in figure 2, the World Health Organisation (2008b:103) quite pertinently stresses that: *"the boundaries of a national HIS are not confined to the health sector alone and overlap with information*

systems in other fields. In addition, data is required for various needs, including information for improving the provision of services to individual clients, statistics for planning and managing health services, and measurements for formulating and assessing health policy".

Similarly, table 1 illustrated key stakeholder roles on eHealth action plan. The respondents in this study are part of the global or international communities and regarded as subject matter experts and leaders in the health ICT industry. These subject matter experts and leaders conduct businesses with public and private health sectors in South Africa and abroad. Although there are various challenges identified by the respondents, the main critical concern is enabling ICT infrastructure within the health sector in South Africa. The findings pointed towards high bandwidth costs and fragmentation of patient health information systems as part of the inhibiting factors for improving health system effectiveness in South Africa. The Department of Health (2012:8) attest that in order to best overcome the identified challenges, the eHealth strategy will have to be underpinned by certain key principles. The key principles include getting the basic rights such as addressing concerns around ICT infrastructure, network connectivity, basic ICT literacy, human resources and affordability planning.

The Department of Health (2012:11) further argued that part of the "Requirements for the eHealth strategy" is to develop ICT infrastructure for health. The Department of Health (2012:11) describes this initiative as appropriate to promote equitable, affordable, and universal access within the health sector in South Africa. This includes working with information telecommunication agencies and other partners to reduce costs for proper implementation of eHealth initiatives.

Van Dyk *et al*. (2010:3) also came to an agreement that a single organisation cannot provide all the technologies necessary to address healthcare system challenges in South Africa. The findings listed ICT infrastructure as a key enabler to strengthen HIS capable of improving health system effectiveness in South Africa.

In a similar sense, Porter (2010:7) echoed that part of the six fundamentals strategic agendas to reform healthcare delivery is to create an "Enabling Information Technology Platform" in the health sector. Schaay, Sanders, Kruger and Olver (2011:26) confessed that ICT is a key enabler for designing efficient HIS to improve health system effectiveness in South Africa. The findings indicate that cloud computing cannot be adopted within the health sector unless the ICT infrastructure is enabled in South Africa.

Research subject 3: cloud networking platform

The Department of Communications (2013:10) explained that internet service providers (ISPs) in South Africa operate under the legislative framework of the Electronic Communications Act (ECA) 36 of (2005). The legislator provides the legal framework for the convergence of communication technologies in South Africa.

The Independent Communications Authority of South Africa (ICASA) Act 13 of (2000) as amended, enables effective and independent regulation of the ICT sector in South Africa (Department of Communications, 2013:10). This is partly a 2020 vision as gazetted by the Department of Communications (2013:10) to achieve 100% broadband coverage in South Africa. The overall findings overwhelmingly indicated that indeed the legislative policy frameworks in the ICT and health sectors are missing in South Africa. This was relatively the argument with almost all

respondents participated in the study. Additionally, the respondents further argued that enrolling the ICT infrastructure is not a major challenge. The deductive reasoning points toward the fact that network connectivity alone cannot resolve the problems in the health sector. The respondents argued that without proper devices and tools designated at providing specific diagnostic or treatment, or care; the ICT infrastructure alone will not serve any purpose in the health sector.

Teperi *et al*. (2009:84) articulated that an inability to communicate undermine the ability of information technology to enable value measurement and to restructure care delivery around the integrated care for medical conditions. This was also in agreement with Porter (2010:5) who concluded that the fundamental problem in health care is "value for patients", not access, volume, convenience, or cost containment. It is for instance argued by Porter (2010:2) that the failures to adopt value-based in healthcare are arguably the most serious failures of the medical community. Porter (2010:2) similarly stresses that this result in hobbling innovation, which leads to slow diffusion of innovation with no meaningful value benefits in the health sector. The key findings placed collaboration as part of the missing link amongst key players in the ICT and health sectors.

It was evident that the coordinated care is missing within the health sector in South Africa. There was an identifiable gap to bring the strategy and policy documents from both ICT and health sectors in a coordinated and holistic manner to improve health outcomes in South Africa. The eHealth strategy for South Africa (Department of Health, 2012:1) should be coordinated with the broadband policy discussion document for 2010 vision (Department of Communications: 2013:1). This coordinated initiate on eHealth should reflects a shared vision and goal, and responding to the needs of improving healthcare delivery. The collaboration between the ICT and health sectors is central to improve health outcomes within the health sector in South Africa. The end goal is to bring the sectors of health and ICT much closer and encourage collaboration as recommended by Chan and Touré (2012:17).

Research subject 4: cloud computing ecosystem

Chang *et al* (2009:2) clarified the previous concerns on collaboration by reiterating that the emerging cloud computing provides a promising approach to address the IT needs of integrated care delivery structures. Bojanova and Samba (2011:6) note that the use of ICT for health (eHealth) is being adopted around the world including countries such as United State of America, United Kingdom and Japan, to name just a few.

The respondents alluded to the fact that these countries that are getting it right are implementing interoperability standard frameworks, which are closely monitored. The findings suggest that the legislative frameworks and unwillingness for the companies to share information are some of the main concerns inhibiting the adoption of cloud computing within the health sector in South Africa.

Although cloud computing service providers have found success globally, in South Africa the same cannot be said due to legislative frameworks and unwillingness for healthcare organisations to share information. The concerns point towards the sensitivity nature of PHI services. The privacy and security concerns make the organisations reluctant to move to the cloud computing platforms. It can be concluded that the legislative policy frameworks is the critical enabling factor to resolve key concerns inhibiting the adoption of cloud computing in the health sector. However, it is worth mentioning that in terms of Section 74 of the National Health Act No. 61 of 2003, the Department of Health (2012:10) has responded positively to this dilemma. This includes tackling in of "Policies and

Regulations affecting eHealth" as defined by the Department of Health (2012:17). Satzger *et al*. (2013:69) conclude that the use of eHealth standards resolves interoperability, fragmentation, and improves systems agility.

Research subject 5: enabling cloud computing ecosystem

The prospects of cloud computing are well illustrated by Shen, Keskin and Yang. (2012:3). This includes cloud networking elements and impacts on cloud computing ecosystem to "Create an Enabling Information Technology Platform" in the health sector as recommended by Porter (2010:7). Pretorius and de Wet (2000:2) indicated that the impact of a new technology should be measured against the requirements similar to the ones found in modern world markets. The associated technology impact parameters are clarified in detail by Pretorius and de Wet (2000:2). The overall findings indicated that the health system is not meeting the requirements capable of improving the "value for patients" in South Africa. Therefore, it could be argued that it may seem counterintuitive for the Department of Health to adopt and implement cloud computing platforms if the mandate to improve health system effectiveness is not met.

The respondent interviewed is based in the United Kingdom (UK) and works for a technology company based in California, United States of America (USA). This technology company has over 70 offices across 40 countries including its presence in South Africa. The respondent indicated that it is possible to meet some of the key requirements of the health system capable of improving the "value for patients" within the health sector in South Africa. This includes applying technological tools and techniques to enable the entire cloud computing ecosystem as explained by Shen *et al*. (2012:3). The ideas of having network connectivity being tightly coupled with applications are also clarified by Calyam, Sridharan, Yingxiao, Kunpeng, Berryman, Patali and Venkataraman (2011:2).

The requirements by the Department of Health (2011b:34) for data synchronisation and regular backups can also be achieved using the identified techniques on cloud computing as discussed by Fan, Wang and Chang (2011:2). The typical cloud computing architecture including application performance management technique is also discussed by Zhu and Agrawal (2012:7). The identified cloud computing architecture ensures that the performance objectives of "Typical Healthcare Applications Matrices" described by Alinejad, Nada and Istepanian (2012:3) are met throughout the healthcare life-cycle.

CONCLUSION

Following the interpretation of the findings and supported arguments using existing literature review analysis, it can be concluded that the stated research objectives were achieved. Of further significance in this regard is the connection that existed between the results obtained and literature review analysis.

This noteworthy correlation was demonstrated by discussing the findings with respect to the research objectives. The conclusive finding is that the HIS is not meeting the requirements capable of strengthening health system effectiveness in South Africa. Although cloud computing is being adopted within the health sector in other countries, it was found that the South African health system is not yet ready for this emerging technology. The findings attest to the fact that the ICT infrastructure is not enabled for cloud computing platforms within the health sector. This includes resolving privacy and security concerns throughout cloud computing ecosystem. A key concern is a

lack of well-coordinated regulatory frameworks for proper governance of eHealth standards implementation including PHI services with respect to privacy and security.

The Department of Health (2012:16) admitted that the use of ICT for health (eHealth) is still facing many cavities including the lack of clearly defined eHealth standards in South Africa. The study investigated the research subjects derived using the proposed model illustrated in figure 2. This model has been proposed based on the arguments presented by Van Dyk *et al*. (2010:2-3), (Chan & Touré, 2012:63-74), and Deloitte (2008:34-75). This proved to be a useful model to identify key inhibiting factors on the use of the state-of-the-art ICT platforms for health within the South African context.

RECOMMENDATION

There were conflicting views identified emerging from different stakeholders in the field of ICT and health sectors respectively. For example, the healthcare IT service providers pointed towards the ICT infrastructure as one of the major challenges for health information systems in the health sector. Although the ISPs are acknowledging the challenges within the ICT sector, however, providing network connectivity in the health sector was not their main concern. According to the ISPs, proper devices and tools designed for specific diagnostic and treatments are lacking in the health sector.

This lack of proper devices is identified as the main concern hindering the progress of enrolling ICT infrastructure within the health sector in South Africa. Furthermore, respondents made significant recommendations, which reflect major concerns associated with strengthening health system effectiveness. However, these concerns are already identified and well documented by the Department of Health (2012:7). Although both the Department of Health (2012:17) and Department of Communications (2013:28) have identified and documented the required policies and regulations; the coordinated message is lacking to the broader communities in the ICT and health sectors respectively.

The recommendation is that the South African government should first address concerns around collaboration within the broader stakeholders to ensure coordinated healthcare delivery. This will enable the country to move forward in a coordinated manner as envisioned by the respondents. Chang *et al* (2009:2) attest to the fact that this strategic approach is essential to create evidence value-based healthcare system (Porter 2010:5). This includes interaction between patients, providers, payers, policy makers and regulators as illustrated in figure 1 (Chang *et al*, 2009:2).

The minister of health clarifies that the aim of the NHI is to bring public and private health sector to operate in a collaborated and coordinated manner in changing the face of the healthcare delivery (Focus Reports, 2012:9).

Chang *et al* (2009:2) conclude that the emergence of cloud computing is observed as driving the need for better collaboration, coordination and interaction in the health sector. This includes creating a value-base healthcare delivery system with patients located at the centre as envisioned by the Department of Health (2012:5).

FUTURE RESEARCH STUDY

The study employed the qualitative research methodology using narrative enquiry whilst understanding and addressing desirable circumstances and effects to achieve the stated research

objectives. This approach was undertaken taking into account the complexity and limitations of this area under investigation. Bharadwaj and Lal (2012:5) indicated that a similar approach was also considered in India whilst weighing benefits and challenges of cloud computing and also studying market trends.

Cooper and Schindler (2011:143) also alluded to the fact that the objective of exploratory study is usually to develop hypotheses or questions and discover further research tasks. Therefore, it could be suggested that further investigation on eHealth may well be of value to improve the usefulness of the proposed model in figure 2. This can be achieved using the quantitative method as described by Marzuki, Ismail, Mohsein and Ehsan (2012:46).

In a similar sense Deloitte (2008:72) quite pertinently states that the eHealth architecture is not static. Future research studies on eHealth will undoubtedly be driven by advancements in information management technologies, medical technologies and clinical standard practices. This will inevitably lead to the development of new eHealth components essential to strengthen healthcare delivery through effective utilisation of the health outcomes in the future. In a similar view Deloitte's (2008:72) observation in relation to eHealth architecture attests that future research studies will likely to facilitate continuous improvement of the health system. This includes effective utilisation of the health outcomes as proclaimed by Chan and Touré (2012:52).

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REFERENCES

Alinejad, A., Philip, N.Y., and Istepanian, R.S. H., (2012), Cross-Layer Ultrasound Video Streaming Over Mobile WiMAX and HSUPA Networks, IEEE Transactions, 16(1):31-39, January.

Bharadwaj, S.S., and Lal, P., (2012), Exploring the impact of Cloud Computing adoption on organizational flexibility: A client perspective. *2012 International Conference*, 8-10 December.

Bojanova, I., and Samba, A., 2010, Analysis of Cloud Computing Delivery Architecture Models. *2011 IEEE Workshops of International Conference*, 22-25 March.

Calyam, P., Sridharan, M., Yingxiao, X., Kunpeng, Z., Berryman, A., Patali, R., and Venkataraman, A., (2011), Enabling performance intelligence for application adaptation in the Future Internet. *Communications and Networks* 13(6):591-601, December.

Chan, M., and Touré, H.I., (2012), National eHealth Strategy Toolkit. White paper, World Health Organization and International Telecommunication Union 2012. Geneva 27, Switzerland. Accessed 02 February 2013. http://www.who.int/ehealth/publications/overview.pdf.

Chang, H.H., Chou, P.B., and Ramakrishnan, S., (2009), An Ecosystem Approach for Healthcare Services Cloud. *IEEE International Conference*, 21-23 October.

Cooper, D.R., and Schindler, P.S., (2011), *Business Research Methods*, Eleventh Edition, New York: McGraw-Hill.

Dal Poz, M.R., Kinfu, Y., Drager, S. and Kunjurnen, T., (2007), Counting health workers: Definitions, data, methods and global results. World Health Organisation. [Online] Available from: http://www.who.int/hrh/documents/counting_health_workers.pdf (Accessed on 22 January 2013).

Deloitte, (2008) National E-Health and Information Deloitte, Principal Committee, 30 September, Adelaide, Australia.

Department of Communications, (2013), Electronic Communications Act 2005. Consultation on the proposed National Broadband Policy for South Africa: National Gazette No 36332 of 03-April-2013, Volume 574. Accessed 26 April 2013. http://www.greengazette.co.za/documents/national-gazette-36332-of-03-april-2013-vol-574_20130403-GGN-36332.

Department of Health, (2010), National Service Delivery Agreement (NSDA) Report 2010-2014. Accessed 24 November 2012. http://www.doh.gov.za/docs/misc/2010/delivery_agreement.pdf.

Department of Health, (2011a), District Health Management Information System (DHMIS) Policy. Accessed January 2013. http://www.doh.gov.za/docs/policy/2012/dhmis.pdf.

Department of Health, (2011b), Towards Quality Care for Patients: National Core Standards for Health Establishments in South Africa. Accessed 26 July 2013. http://www.doh.gov.za/docs/notices/2013/NCS_for_Health_FINAL.pdf.

Department of Health, (2012), National eHealth Strategy: South Africa 2012/13-2016/17. Accessed 24 November 2012. http://www.doh.gov.za/docs/stratdocs/2012/eHealth_Strategy_South_Africa_2012-2016.pdf.

Department of Health, (2014), Strategic Plan 2014/15–2018/19. Accessed 26 November 2014. http://www.health-e.org.za/wp-content/uploads/2014/08/SA-DoH-Strategic-Plan-2014-to-2019.pdf

Enthoven, A.C., and Tollen, L.A., (2005), Competition In Health Care: It Takes Systems To Pursue Quality and Efficiency. White paper, Health Affairs. Accessed 15 January 2013. http://www.duurzaamcontracteren.nl/pdf/Enthoven_-_it_takes_systems_to_persue_quality_and_efficiency.pdf.

Fan, C., Wang, W., and Chang, Y., (2011), Agent-Based Service Migration Framework in Hybrid Cloud. *2011 IEEE 13th International Conference*, 2-4 September.

Focus Reports, (2012), Leading the Pharma Model for a Continent. White paper, Pharma Dynamics. Accessed 24 November 2012. http://www.pharmaboardroom.com/download?id=49.

Kachieng'a, M.O., (2011), Challenges in managing diffusion of telemedicine technology in South Africa. *2011 IEEE International*, 27-30 June.

Kshetri, N, (2010), Cloud Computing in Developing Economies. *Computer* 43(10):47-55, October.

Mahundi, M., Kaasboll, J. and Twaakyondo, H., (2011), Health Information Systems Integration in Tanzania: Tapping the contextual advantages, IST-Africa Conference Proceedings, 11-13 May.

Marston, S., Zhi, L., Bandyopadhyay, S., and Ghalsasi, A., (2011), Cloud Computing-The Business Perspective. *2011 44th Hawaii International Conference*, 4-7 January.

Weeks, R.V., and Benade, S., (2013), A service science and technology healthcare framework: A South African perspective. Prospective paper submitted for consideration. Graduate School of Technology Management, University of Pretoria.

World Health Organisation, (2008a), Health Metrics Network: Framework and Standards for Country Health Information Systems. Switzerland. Accessed 22 January 2013. http://www.who.int/healthmetrics/documents/hmn_framework200803.pdf.

World Health Organisation, (2008b), Health Metrics Network: Assessing the National Health Information System. Switzerland. Accessed 22 January 2013. http://www.who.int/healthmetrics/tools/Version_4.00_Assessment_Tool3.pdf.

World Health Organisation, (2012a), Management of patient information: Trends and challenges in Member States, Global Observatory for eHealth series, Switzerland. [Online] Available from: http://apps.who.int/iris/bitstream/10665/76794/1/9789241504645_eng.pdf (Accessed on 22 November 2013).

Wyld, D.C., (2010), The cloudy future of government it: Cloud computing and the public sector around the world. *International Journal of Web and Semantic Technology (IJWesT)* 1(1):1-20.

Zhang, R., and Liu, L., (2010), Security Models and Requirements for Healthcare Application Clouds. *2010 IEEE 3rd International Conference*, 5-10 July.

Zhu, Q., and Agrawal, G., (2012), Resource Provisioning with Budget Constraints for Adaptive Applications in Cloud Environments, IEEE Transactions, 5(4):497-511.