The Current Healthcare Industry in South Africa

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ABSTRACT*: The current South African Healthcare (SAHC) system remains a dual healthcare system, consisting of the public and private healthcare sector. Albeit it unevenly distributed from a gross budget perspective, the gross national spend leans disproportionately towards the private sector coverage of healthcare. This equates to R 243Bn serving approximately 20% of the population as opposed to a similar public budgeted spend of R 247Bn serving approximately 80% of the population. In effect, the private sector serves a minority of the employed population. The SA Government has historically made large government Information and Communication Technology (ICT) investments within the public health sector, regionally based, where the return on capital investments have not been realised. The SAHC sector remains siloed. Health technology is advancing globally, and being propagated by the World Health Organisation (WHO) resulting in a global digital health strategy adopted by many countries. The South African National Department of Health (NDoH) has recently subscribed to its own local version of a 'Digital Health Strategy', in accordance with the WHO. The South African Public Healthcare technological infrastructure, in its current state, is deficient with many challenges needing urgent upgrading. The proposed digital or ehealth strategy and the proposed National Health Insurance (NHI) will require the reengineering of a national infrastructural and technological (ICT) environment from the ground upwards. Furthermore, this can only be achieved by reengineering the current state of the public healthcare technological infrastructure including the building infrastructure. This will include a transformation of national legislation. These projects and initiatives must be nationally managed within the ambit of improving the management capacity across all regions and districts that needs to be nationally coordinated. This effort can only be achieved by performing synchronised and well-coordinated implementations of such projects nationally across the SA Public Healthcare sector. This includes the integration of healthcare technologies, or national assets, from district to national level. This study provides further insights into these opportunities and challenges currently facing the South African Public Healthcare sector in preparation for the National Health Insurance (NHI) reform currently in review by the President. It further aims to assist in an approach to a solution addressing this national healthcare crisis.*

Keywords*:* Public healthcare, Private healthcare, healthcare information technology, National Health Insurance (NHI), public health informatics, healthcare data analytics, eHealth strategy, healthcare modernisation*.*

INTRODUCTION

The SA Healthcare system primarily consists of the private sector (privately funded) and the public health sector (state funded), servicing the total population of 60 million plus citizens. Both private and public come with different budgets and funding mechanisms (Mayosi & Benatar , 2014) (Mayosi, et al., 2012) (Coovadia, et al., 2009). Whereby the access to healthcare is hindered by this imbalance of state funding mechanisms versus the private healthcare funding addressing a minority of the population. The private and public sector remain polarised in nature with inherent inequities (Coovadia et al., 2009; A Jeffery, 2023; Ngobeni et al., 2020).

The dual system is problematic for the South African Government in addressing Universal Healthcare (UHC) for all citizens, on an equal footing. Bringing access to quality healthcare for the greater population is key, and not only the affluent having access to quality healthcare(Anthea Jeffery, 2023; National Department of Health SA, 2015; Sandoz, 2020). The SA Government is undertaking an eHealth strategy, including the NHI health plan in the hope of bridging this gap, albeit only a funding model(South African National Department of Health, 2019).

Both private and public healthcare require ambitious reengineering efforts whereby the current public platform needs upgrading and modernising across all technology platforms including basic infrastructure. The private sector is relatively modernised and digitally transformed to a large degree in comparison to the public sector. The population will benefit immensely from such basic upgrades to clinics and buildings bringing quality healthcare to the rural areas in dire need of such upgrades(Dhingra and Dabas, 2020; Maina and Singh, 2020; Mayosi et al., 2014; South African National Department of Health, 2019; Wiley and Mathews, 2017). Historically there have been attempts to address isolated challenges with custom project and budget led initiatives, at regional level. However, these have not produced the long-lasting results originally needed as they often lack strategic vision within a greater vision of integration and standardisation of technology platforms(Abbott and Ade-Ibijola, 2018).

The solution lies partly in the modernisation of the current healthcare platforms through ambitious digital transformations and modernisations of all current systems within in the public health sector landscape. The public and private healthcare landscapes are complex where both sectors consist of multiple nodes of data points of "knowledge" or information: patient data, transactional data, analytical data (metadata), clinical notes, genetic data, lab results data, Business Intelligence (BI) data, spatial or Geographic Information Systems (GIS) management information data and patient data trends or information (Coovadia, et al., 2009) (Telkom Business, 2015). The construct of this vision in healthcare knowledge management is widely promulgated through the eHealth policies and tools of the World Health Organisation (WHO) (World Health Oganisation, 2016) (Health Systems Trust, 2016) (Heatlh-e-News, 2012).

South Africa needs to modernise its public healthcare system by aligning to these global trends through the newly introduced National Healthcare Insurance (NHI) model of 2018, which is currently in a pilot phase (Heatlh-e-News, 2012) (Minister of Health, 2016). The NHI program is hoping to be fully operational by 2030 through a phased approach over the next 10 to 14 years(Dhingra and Dabas, 2020; South African National Department of Health, 2019).

This study serves to bring deeper insights to the needs of a digital transformation and upgrading of all technologies within the public healthcare sector through its eHealth strategy, inclusive of building structures and equipment. It will further shed more light on the dynamics of the lead-up to the digital eHealth strategies being prescribed by the World Health Organisation (WHO) and the NDOH of SA. This includes an economic analysis of the SA healthcare landscape and its encompassing legislatures governing the imperatives of an eHealth strategy for digital transformation.

The study will follow the standard format of the methodology used and the results of the findings will be presented. The analysis and discussion will ensue giving insights into the solutions and alternatives to such eHealth strategies enabling and enforcing a digital roadmap of technologies across the healthcare landscape of South Africa.

METHODOLOGY

A systematic literature review was conducted from various leading specialist medical sources including corporate literature studies and models undertaken (Medline, PubMed and Scopus) for articles published in the last 15 years. They were then reviewed by two reviewers who performed independent screening, full-text inclusion, data extraction, and appraisal. The Consolidated Health Economic Evaluation Reporting Standards checklist was mainly used for the quality assessment (Gould R, 2021).

Thus, in addition gaining an insightful and interpretive approach heard from experts in the field of healthcare and technology. The study and methodology propose a strategy to further enhance the objective of access to quality public healthcare for the SA population, including the insured population through the national roll out of the NHI (National Department of Health (NDoH), 2016) (NDOH, 2012) in conjunction with the eHealth Strategy and the adoption of the Fourth Industrial Revolution (4iR) (South African National Department of Health, 2019) (Health Management Technology, 2017) .

The literature research follows the interpretive approach in addressing the SA public healthcare challenges(Hevner et al., 2004; Higman et al., 2019). The solutions and strategies are presented been gleaned from the findings that were primarily based on the logical design approach of a new system, making logical sense namely the Design Science Research method (DSR) (Gould R, 2021)(Hevner et al., 2004).

THE SOUTH AFRICAN HEALTHCARE SECTOR

The South African healthcare system comprises of a dual public and private system. The private healthcare system has undergone an investigation by the Competition Board of the SA government. Primarily investigating the reasons for the rampant escalation of medical costs outstripping the accepted industrial sector indices (Serfontein, 2016) (Archer, 2016) (Health Systems Trust, 2016) (Minister of Health, 2016) (South African National Department of Health, 2019). Thereby, making healthcare practically unaffordable for the majority of the SA population, at large. Currently, only the higher income brackets can afford private healthcare, thus healthcare is perceived as a luxury for a privileged few (Minister of Health, 2016) (Abbott & Ade-Ibijola, 2018)(Sandoz, 2020).

To understand this better, when the United Nations (UN) Millennium Development Goals (MDG's) were signed by 189 UN Member States in 2000, consisting of 8 major goals (United Nations, 2015) (World Health Organisation SDG's, 2016). They all committed to eradicating or alleviating poverty, disease, hunger, environmental degradation, illiteracy, and discrimination to women (Mayosi, et al., 2012). These MDG's were subsequently superseded by the Sustainable Development Goals by 17 integrated objectives or goals based on the MDG's but are broader in scope (United Nations, 2015) (World Health Organisation SDG's, 2016)The SDG's were signed by all its member countries in 2015. The South African National Department of Health (NDoH) have subsequently adopted these goals for its own public healthcare strategy (Coovadia, et al., 2009) (Piotti & Macome , 2007) (Mohlameane & Ruxwana, 2016). The universal access to healthcare (UHC), for all South African (SA) citizens, is the most significant of the Strategic Development Goals (SDG's) where the National Health Insurance (NHI) plan, sits at its core (Mayosi & Benatar , 2014) (Mayosi, et al., 2012) (Mohlameane & Ruxwana, 2016).

Further to this initiative, is the World Health Organisation (WHO) eHealth strategy which has also placed itself on the SA (NDoH) strategic plan of development, whereby the eHealth strategy will take precedence across all future developments (Health Systems Trust, 2016) (Katuu, 2016) (World Health Organisation-eHealth, 2012). This eHealth strategy has been adopted and applied by the SA (NDoH) in conjunction with the South African National Development Plan (NDP) as a strategic plan of governance currently being implemented (Mayosi, 2012) (NDOH, 2012) (South African Government, 2012)(Abbott and Ade-Ibijola, 2018).

The private health sector originated from the mining corporations in the late 1800's and early 1900's where they established their own in-house medical healthcare financing schemes and hospital facility and systems, primarily as a supported benefit function. The mining hospitals served black and white labour forces which then spawned their own non-profit medical aid structures supporting their own in-house medical and financing structures per se. These medical aids later departed from the mines and proliferated into mainstream business (Health Systems Trust, 2016) (Serfontein, 2016). Today the medical aid industry is a multi-Billion-rand industry, serving approximately 25% of the population, including insurance products currently

gaining traction in the market (AWS, 2021; National Department of Health SA, 2015; Sandoz, 2020; Sidel, 2018).

The private healthcare system addresses approximately 14% of the population, with a budget of 243 Billion Rand plus per annum, which is self-funded by a network of 220 private hospitals and 75 medical aids, giving cover to approximately 7.3 million people out of approximately 60 million (Coovadia, et al., 2009) (Mayosi & Benatar , 2014) (Minister of Health, 2016)(Fig 1,). The public healthcare sector addresses approximately 86% of the population with a budget of 247 Billion Rand per annum through a network of approximately 4200 public hospitals and clinics(Fig 1,) (South African Government, 2012) (Telkom Business, 2015) (Jeffery, 2016)(A Jeffery, 2023; Sandoz, 2020).

The figure of the "Out of Pocket Costs" (OPC), approximately 34 billion Rand in the 2022 financial year, amounts to personal private money being spent on unpaid benefits, from medical aids (Fig 1,) (Archer, 2016) (Jeffery, 2016). This figure is increasing as costs escalate and the corresponding benefits are similarly curtailed by medical aids. Those that can't afford the medical costs are dropping out into the public system which inevitably have to be carried by the public healthcare budget which already finds itself under strain (Archer, 2016). Hence, drastic measures are called upon across the board. This posits the figures of the stated healthcare cover in question, as the Private Healthcare budget spend is not covering 16% but a much higher percentage of population than the original figure stated, due to these escalating OPC costs. 'Healthman Consultants' (2023) place this figure around the 38% mark, where the budget-spend is much higher, as a result (Archer, 2016) (Jeffery, 2016)(Anthea Jeffery, 2023). Further, the analysts state that approximately 37% of the SA population utilise private Doctors. Approximate 29% of the SA population make use of private hospitals, due to the "creep" of these OPC costs. Simply stated: the private health funding utilisation is increasing due to the inadequacies of the medical aids in meeting all the members' healthcare needs due to these decreasing benefits by the medical aids (Haywood, 2016)(Sharma and Kshetri, 2020; South African National Department of Health, 2019).
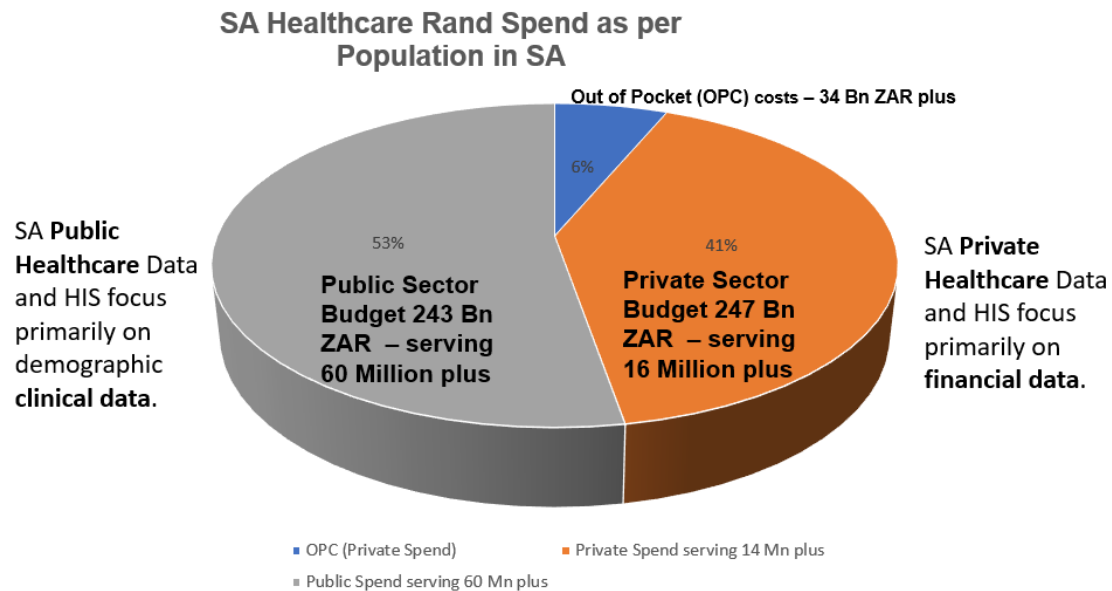
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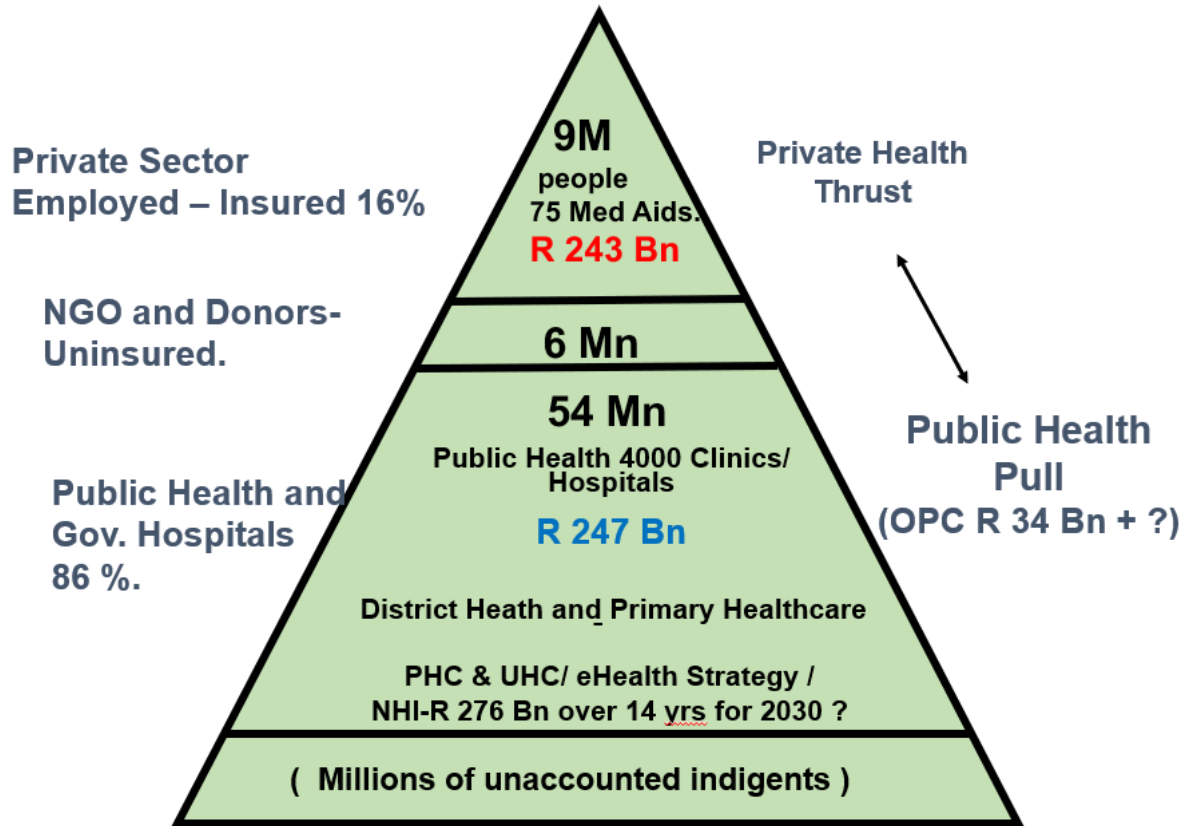
Figure 1 : The Economic overview of the SA Healthcare Landscape. With permission from: (Abbott & Ade-Ibijola, 2018) (Source: http://www.hst.org.za/healthstats/index.php).

The imbalance is evident from the figures which are widely published by the National Department of Health (NDOH) and Health Systems Trust (HST) of SA. This gap is growing, much to the despair of the Ministry of Health (South African Government, 2012)(Coovadia et al., 2009; Sidel, 2018). This has led to the recent signing in of the National Health Insurance legislation by the President of South Africa in 2024. It remains to be seen of the health outcomes it has promised to the population of South Africa.

SA Healthcare Rand Spend as per Population in SA

Out of Pocket (OPC) costs – 34 Bn ZAR plus

SA **Public Healthcare** Data and HIS focus primarily on demographic **clinical data**.

53% Public Sector Budget 243 Bn ZAR – serving 60 Million plus

6%

41% Private Sector Budget 247 Bn ZAR – serving 16 Million plus

SA **Private Healthcare** Data and HIS focus primarily on **financial data**.

■ OPC (Private Spend) ■ Private Spend serving 14 Mn plus
■ Public Spend serving 60 Mn plus

The NDoH often fails to mention that the SA Public Health care Spend rose from 16 Bn ZAR in 94/95 to 243 Bn in 2022 – 1 394 % increase.

Source : http://www.hst.org.za/healthstats/index.php.

Figure 2: The Economic overview of the SA Healthcare Landscape.

While huge improvements have been achieved regarding to improved access to healthcare for all, within the public sector, since the 1994 elections, such efforts have been eroded by the 'burden of diseases', related to HIV/AIDS, weak health systems management, bad management and very low staff morale(Maphumulo and Bhengu, 2019; National Department of Health SA, 2019; Sandoz, 2020).

Looking closer at Fig 2, it remains evident that the populations being addressed are not similar according to similar budget spend. Bearing in mind the private healthcare sector is solely privately funded and remains a privately subsidised self-driven open ecosystem or private industry(Sidel, 2018). The private healthcare also provides in excess of R 100Bn tax revenue back into and supportive of the public healthcare sector. In addition, private health is supported by 80% of the high-end taxpayers making the most contributions to the tax revenue. Thus, financially supporting and aiding the public healthcare sector regarding the tax base of the total healthcare industry in South Africa. However, it also remains a fact that Government does offer tax credits back into the private healthcare system in the region of R 30Bn (A Jeffery, 2023; Sandoz, 2020; Sidel, 2018; Wiley and Mathews, 2017).

The result being a dire picture of poor health outcomes relative to the total health expenditure in the SA public health sector (Harrison, 2010)(Mayosi et al., 2014). It is now of utmost strategic importance for government to establish clear service structures, or mechanisms in order to retain medical personnel and make better use of private sector personnel, academics

and Non-Governmental Organisations (NGO) (Heatlh-e-News, 2012) (Section 27, 2012). This includes the establishments of private-public partnerships in the service delivery of public health (Harrison, 2010)(Maphumulo and Bhengu, 2019). This is yet to be exploited on a wider scale.

The public healthcare financial model termed the National Healthcare Insurance (NHI) model, will ultimately give universal access to public healthcare for all its citizens(National Department of Health SA, 2015). The key objective of the SA NHI is in providing access to Universal Healthcare (UHC) across all population sectors of the South African population (Minister of Health, 2016) (Health Systems Trust, 2016)(National Department of Health SA, 2019, 2016a).

THE SA PUBLIC HEALTHCARE SECTOR

The NHI is primarily a financial model proposed by government which is designed to pool and fund the medical services for all, irrespective of socio-economic class(National Department of Health SA, 2015). This will be a single master fund: publicly managed and administered by central government. This fund will operate on a pre-payment system ensuring cross subsidisation across all the services within healthcare system. The implementation phase will be performed in various phases over the future years i.e. 14-year plan with a projected budget of 256 Billion Rand, which is a total under estimation according to most analysts (Minister of Health, 2016). Further, the NHI is aligned with the Bill of Rights, embedded in the South African National Constitution: Section 27 states universal access to healthcare for the entire SA population(Abbott and Ade-Ibijola, 2018; Coovadia et al., 2009; National Department of Health SA, 2016b, 2015).

"Everyone has the right to have access to healthcare services including reproductive healthcare. The State must take reasonable legislative and other measures within its available resources, to achieve the progressive realisation of each of these rights. No one shall be refused emergency medical treatment" (Section 27 of the SA Constitution 1995).

This is stated in the National Health Insurance (NHI) white paper which was released in December of 2015 and currently under further review, pending feedback from the industry. It is published on the (NDOH) website for the public to read (Health Systems Trust, 2016) (Minister of Health, 2016). The reasons for the high healthcare budget spend in South Africa, as being one of the highest in the world, is currently being debated widely. According to the National Department of Health (NDOH), the primary reasons are commonly known as the **'Quadruple Burden of Disease':**

1) **Communicable Diseases** – Human Immune Virus (HIV), Sexually Transmitted Infections (STI's), Tuberculosis (TB), Tropical diseases (Malaria) and others,
2) **Non-Communicable Diseases** – ("Western diseases" sweeping Africa) Cardiovascular diseases detailing High Blood Pressure, Diabetes, Cardiac Failures and Cancer,

3) **Maternal Pediatric or Mother Child diseases** - Mortality rates are abnormally high compared to other countries and,
4) **Trauma and injury related conditions -** all forms of violence including rape and motor accidents (Abbott & Ade-Ibijola, 2018) (Coovadia, et al., 2009) (National Department of Health (NDoH), 2016) (Theron, 2016) (Jeffery, 2016).

The above burdens of disease are the primary causes of rising costs, within the public healthcare and the private healthcare sector, according to the Minister of Health (Brand SouthAfrica, 2012). To address the burdens of these diseases the NDoH has developed a five-year macro plan for public health which is detailed in the "Outcome no 2" of the Negotiated Service Delivery Agreement (NSDA) (Minister of Health, 2016). This is all encompassing regarding their vision: "A long and healthy life for all South Africans". Inclusive of the NSDA document is the implementation of the National Health Insurance (NHI)(National Department of Health SA, 2019, 2016b, 2014).

Public Health Projects

Over the past years various projects were executed or currently underway through policies or strategic documents (White Papers) managed by the SA Government Information technology (IT) agencies and its partners (Telkom Business, 2015) (Harrison, 2010) (Mohlameane & Ruxwana, 2016) (National Department of Health/CSIR, 2014) (Minister of Health, 2016) (South African Government, 2012).

1) The Department of Health Strategic Plan document (2014).
2) The Department of Health 'eHealth Strategy' document adopted from the World Health Organisation (WHO) eHealth global strategy and toolkit (2012).
3) The National Health Information Systems strategic document (NHIS)
4) The National Development Plan program document (NDP).
5) The National Department of Home Affairs with CSIR and others in creating a national Health Patient Registration System (HPRS) currently being rolled out.
6) The National Health Insurance financial model (NHI) White Paper. Section 27: the 'Health Bill of Rights' ensuring universal access to healthcare across South Africa.
7) The Government Wide Enterprise Architecture (GWEA) forum and strategy document.
8) The World Health Organisation (WHO) six blocks of strategy document.
9) The United Nations (UN) consisting of 17 Strategic Development Goals (SDG's) and South Africa subscribes to these SDG's over a thirty year plus period.
10) The Negotiated Service Delivery Agreement (NSDA) document.

The policies or strategic white papers stated above are not all entirely focused on healthcare but do overlap into the public healthcare domains, besides the WHO, UN, NHI, NHIS and eHealth strategies which are purely health related (Mohlameane & Ruxwana, 2016) (Mayosi & Benatar , 2014) (Minister of Health, 2016) (National Department of Health (NDoH), 2016).

In accordance with the WHO eHealth strategy the SA Government has endeavored to drive the following solution-based projects - on its own eHealth strategy through its partners (NDOH, 2012) (World Health Organisation-eHealth, 2012):

1) a national patient master index (PMI) with a unique identifier – there is a system currently being rolled out as a medical indexing card system i.e. Health Patient Registration System (HPRS), as an initiative with Home Affairs.

2) IACT Project in Eastern Cape Province. HISP-SA has been contracted to develop an Anti-Retroviral Treatment (ART) module to capture the adult clinical record called Debo,

3) National Health Information Repository & Data Warehouse Project (NHIRD) is supporting the National Department of Health (NDoH) data quality across the country where many workshops and "data clean ups" are currently underway,

4) CDC Contract to Support NHIS Development in South Africa (2011-2016) which is a project in collaboration with Jembi, Health Partners SA, University of Pretoria (The aim of the project is to assist the Department of Health in strengthening the national health information system at national, provincial, district, sub-district, facility and community levels),

5) DHER – District Health Expenditure Review. HISP-SA is designing the District Health Information System (DHIS) being a primary source of data for this review,

6) web based surveillance facility management systems such as the TB Electronic Disease Registers (EDR) which is facilitated through Tier.Net software (HISP-SA has partnered with WamTechnology and University of Cape Town Center of Infectious Diseases and Epidemiology Research (CIDER) regarding this initiative),

7) facility based HIV management system involving the data collection and analysis software (Tier.Net) which is the data exchange between Tier.Net and third-party tools using a modified version of the HIV Cohorts Data Exchange Protocol (HICDEP) format (Tier.Net imports the data from the "Electronic Medical Record" (EMR) systems. HISP-SA has partnered with WamTechnology and CIDER regarding this initiative),

8) the vital registration of deaths and births across all areas including rural areas,

9) health knowledge management guidelines such as best practices - currently non-existent except for a few isolated areas of expertise within the landscape,

10) mHealth comprising the use of mobile devices where there are currently a few projects in flight in certain rural areas in conjunction with the NGO (HISP) (Health Information Systems Programme, 2012),

11) Telemedicine in providing care at distance (Telkom Business, 2015) (Mars & Seebregts, 2008),

12) the National Health Laboratory Services (NHLS) with its 'Gateway' project in progress,

13) virtual healthcare through collaborative health information and education,

14) health research such as gaining vast coverage while utilising large data sets,

15) real-time workflow of scheduling and dispatch,

16) the DHIS (Dep of Health Information Systems) of all SA information systems to be operating on a standardised operating protocol or system language namely HL 7 v 3 which is currently constantly upgrading the health systems across all provinces,

17) party to this project is the integration of national systems underway called HNSF (Healthcare Normative Standards and Functions) currently being managed and engineered by the CSIR, in conjunction with the NDOH (NDOH SA, 2014; Wiley and Mathews, 2017),

18) the recent establishment of the OHSF (Office of the Health Standards and Facilities) addressing the governance and quality services of all 4200 public healthcare facilities in anticipation of the NHI implementation,

19) remote monitoring, diagnostics and environmental monitoring (Telkom Business, 2015).

In addition to the challenges the SA Government follow a historically held idealogy of the National Democratic Revolution (NDR). This is relatively unheard of in mainstream media for specific reasons. It is found to be counter intuitive to the democratic and open market system currently adopted by the SA Constitution. This is widely written about and is not or appear to be of any conspiracy-based philosophy as a counter argument. It is a dedicated strategy held by the government in centralising control and governance emanating from the SACP mandate of communism led philosophies. This strategy is driving the AWC (Asset Acquisition Without Compensation) and now according to Jeffery A (2016; 2023) it is a fundamental milestone of bringing in the NHI for SA

Certain governing bodies have made progress in applying effective IT strategies, in the form of designing and developing new information structures called the National Health Information Systems (NHIS) (Health Information Systems Programme, 2012). This has been strategised in conjunction with Health Information Systems Program (HISP) (Health Information Systems Programme, 2012). The National Department of Health's (NDoH) National Health Information System (NHIS), has initiated a few programs such as the electronic health records (EHR) and the electronic medical record (EMR) with marginal success to date. Only a third of SA's provincial hospitals have embarked on some sort of electronic patient file to date. According to HISP there is a pilot study underway in the Eastern Cape, regarding EMHR operating on the district public health (DHiS) system, operating on the protocol HL 7 version 2.4/3.00, which is a global standard on healthcare informatics protocols.

Healthcare Technology in SA

The private sector ls largely silo'd in their own respective environments with many different systems addressing the private health sector, mostly operating on the Edifact protocol (Mars & Seebregts, 2008) (Health Information Systems Programme, 2012). Moreover, the private sector fails to integrate or share the same protocol with the public-sector ICT environment (National Department of Health/CSIR, 2014). This is a technological constraint of the private healthcare system. The Council for Medical Schemes (CMS) is addressing this integration problem with many projects (Telkom Business, 2015) (South African Government, 2012).

Public Healthcare utilise various systems, approximately 5 different systems across 9 provinces (Mars & Seebregts, 2008). SA is a member of the ISO/TC215 Health Informatics for data standards promoting more efficient data interchange. South Africa subscribes to the ICD-10 coding data system which is now the national diagnostic coding standard. The HL7 ver 2.4/3.00 is the national messaging standard within the public health sector but not yet fully adopted (Mars & Seebregts, 2008) (Coovadia, et al., 2009).

Mobile technologies have penetrated and proliferated across the business and the social sector within South Africa giving rise to mobile applications or mHealth technologies. The penetration of mobile handsets is estimated to be between 80% and 90% (Westphal & Biaxten, 1998). The analysts predict that this technology, consisting of mHealth, will further expand rapidly (Mars & Seebregts, 2008). Further, telemedicine, medical informatics, marketing, surveillance and healthcare education will experience similar growth (Health Information Systems Programme, 2012) (Health Management Technology, 2017) (Mars & Seebregts, 2008). While these initiatives are being closely aligned to the eHealth strategy, within government, they are currently facing challenges in the implementation of these technologies (Telkom Business, 2015) (NDOH, 2012). Furthermore, a great need arises to build capacity within mHealth Informatics at all levels (South African Medical Journal (SAMJ), 2017) (World Health Organisation-eHealth, 2012)(Herselman et al., 2016; Kapoor et al., 2020; Maina and Singh, 2020).

However, the eHealth strategy inherently has its own challenges and constraints, which is summed up by the Negotiated Service Delivery Agreement (NSDA) (Health Systems Trust, 2016) (South African Government, 2012). While there has been substantial spending to procure ICT and NHIS in the past, it has largely failed in meeting the basic requirements to support the business processes within the healthcare system. Thus, rendering the public healthcare system incapable of producing quality data information services for the effective management and evaluation of performance in general, largely due to the lack of governance and policies (Heatlh-e-News, 2012) (Mars & Seebregts, 2008)(AWS, 2021; Groenewald, 2017).

Besides these eHealth strategies, constraints and limitations, there are challenges in the system that currently restrict the effective implementation of the eHealth strategy rollout which needs reviewing (Mayosi, 2012) (Coovadia, et al., 2009). The eHealth strategy will form the main framework to the roll out of the NHI model, as stated by the Minister of Health, where the model will dictate the eHealth strategy as the roadmap in achieving an effective national health information system revolving around the patient (Mayosi & Benatar , 2014) (Minister of Health, 2016) (South African Government, 2012).

CURRENT CHALLENGES WITHIN THE SA PUBLIC HEALTH SECTOR:

The main challenges within the public healthcare system are the following (Jeffery, 2016) (Serfontein, 2016) (Health Systems Trust, 2016) (Abbott & Ade-Ibijola, 2018)(Higman et al., 2019; Kapoor et al., 2020; Sharma and Kshetri, 2020):

1) healthcare data islands of data across various divisions with no integration or interoperability,
2) hospitals and clinics lack interconnectivity and interoperability structures on a common platform, minimal to absent inter-departmental collaboration or basic interoperability across major public health and governmental departments,
3) the centralisation of the Relational Database Management Systems (RDBMS) for effective Business Intelligence (BI) and Data Mining techniques (there are projects in early phases).
4) a lack of standardisation across heterogeneous systems is the main obstacle to interoperability,
5) a huge gap in the skills development in support of these systems where key skills are being bled to the private sector,
6) differing stages of system maturity regarding eHealth environments,
7) too many islands of uncoordinated projects with no national or global project management at a higher level,
8) differing levels of organisational structures requiring authorisation and jurisdiction down to district clinic level to execute independent managerial functions at a local level i.e. procurement of medicines and recruitment of competent healthcare workers,
9) the centralisation of procurement and the allocation of infrastructure development ie Dpt of Works to fix critical infrastructure needed at the community clinic level, and
10) the lack of high-level coordination between the national eHealth strategy and corresponding Enterprise Architecture (EA). Whereby this should be based upon common standards evolving towards standardisation on a local and a global template which requires a high level of management commitment, especially with the NHI rollout.

THE NATIONAL HEALTH INSURANCE (NHI)

The following questions, regarding the latest white paper of the NHI (2015/2016), need to be considered for the implementation of such technology programs.

A. Will the proposed NHI model function within the current state of the Public Healthcare infrastructure?
B. Which governing body is overseeing the big picture of implementation and coordination of these respective programs answering to the overarching strategic objective of the Department of Health (NDOH) and the wider National Health Information System (NHIS)? and,

C. Has the government made provision for these portfolios of programs to be managed under a "Mega Project" banner requiring specialist skills which South Africa doesn't currently have in abundance?,

D. What are the funding mechanisms involved to support such a system ? Is this affordable to the South African population? and,

E. Is the SA Government not merely establishing a third healthcare sector - under the current private and public healthcare sector? What happens to all the legislated laws surrounding the CMS (Council for Medical Schemes Act and division? What happens to them in the greater scheme of NHI? Would it not incur certain repealing of older healthcare laws?

The NHI propagates access for all, to Universal Healthcare (UHC), which has been legislated under 'section 27' of the SA National Constitution which also applies to the private sector in part (Section 27, 2012) (Minister of Health, 2016). The Private Healthcare sector has an obligation to fulfill this right to the SA Government and its people of South Africa (Minister of Health, 2016) by:

A. the implementation of an effective technological strategy that will enable the architectural changes to facilitate the structural improvements in the current public health model, ultimately facilitating access for all to universal healthcare as explicitly stated in the National Health Insurance (NHI) Bill of Rights (Minister of Health, 2016) (National Department of Health (NDoH), 2016), and

B. employing instruments and methods to measure disease outcomes and management protocols, which will continue to be critical to the understanding of the effectiveness of future knowledge-related public health strategies.

The ability to engineer a culture of change, learning with innovation will play a major role in health care. The evolving nature of knowledge-related strategies will dominate the public and private healthcare domains for many years, giving continued impetus to the digital healthcare revolution.

THE SA PRIVATE HEALTHCARE SECTOR

To facilitate an effective integration of the private sector with the public sector, varying degrees of entities called Public Private Partnerships (PPP's) need to be negotiated (Health Systems Trust, 2016) (NDOH, 2012). The technological expertise and platforms of the private sector need to be shared, by means of close collaboration, with public health which will enhance the public health sector in every respect, long-term.

The technology platforms consist primarily of network topology houses, facilitating the switching of transactions. The private health sector network architectures follow the Edifact or EDI protocol, in switching such data, which is a different protocol to the public health protocol of HL 7 ver 2/3 and the Health Information System (HIS) 2.00, currently being supported by the NGO called HISP-SA (Health Information Systems Programme, 2012) (NDOH, 2012). These private network switching houses are: HealthBridge, MediSwitch, DH Switch, MEDiPrax, MEDIKREDIT, Mediscor, InterPharm, Med EDI, iTrack, Panacea and DataMax.

These are the main contenders in the private healthcare switching space, for patient and transactional data, from service provider to funder, and vice versa. However, there are many more actively involved in the private health sector (Sandoz, 2020; Sidel, 2018).

Further, there are 3 main hospital groups in SA i.e.LifeCare Hospital Group, Netcare Hospitals and the Mediclinic Hosp Gp, all utilising the stated technologies for transactional financial systems and more – 270 private hospitals in total (Sandoz, 2020; Sidel, 2018). All are currently embarking upon the electronic healthcare record software interventions with varying degrees of success. The private groups are managed and governed independently with Government regulations in place but profitable and digitally transformed with good infrastructure across the board(Aceto et al., 2020; Sandoz, 2020; Swartz et al., 2021).

DISCUSSION

The SA Public Healthcare sector is in dire need of transformation, both legislatively and technologically. This can possibly be achieved through the development of a solid platform by implementing a few basic technologies within the public sector with well-structured ICT technologies, laying a solid foundation for effective collaborative knowledge management (Abbott & Ade-Ibijola, 2018) (Gentry, 1996; Mayosi, et al., 2012). This approach will encompass the public hospital/clinic networks and data architectures that need to be re-engineered comprising of over 4000 hospitals and clinics laying the foundation for Primary Health Care – community patient data structures (Health Systems Trust, 2016) (Ruxwana, 2010).

In order for the healthcare system to evolve into an effective and efficient system, healthcare risk management companies must align the needs of the three major actors in the market — the consumer, the healthcare provider, and the healthcare funder, through well-developed structured risk models, based on accurate historical clinical and financial data (Prather , et al., 1997; Ruxwana, 2010). This new NHI healthcare system can succeed if the necessary infrastructures are in place, and if adequate government legislature is reviewed in support of this initiative (Kleynhans, 2011) (Mars & Seebregts, 2008). The South African Minister of Health has produced a structured plan where these legislated initiatives are currently in mainstream political thought (Brand SouthAfrica, 2012) (South African Government, 2012). The most notable of these strategic initiatives is the National Development Plan (NDP), a blue print of development, placing the public health care focus on Chapter 10, "Healthcare for all" (South African Government, 2012) (Minister of Health, 2016). Emanating from the NDP '2030 Vision document', it produced "Nine Health Goals", namely:

   I.   life expectancy to be aimed at 70yrs. old (currently its 63),
  II.   Tuberculosis (TB) prevention and cure,
 III.   to decrease and prevent Non-Communicable Diseases (NCD),
 IV.   to decrease and prevent Maternal child mortality rates,

International Journal of Health and Psychology Research

Vol.12, No.3, pp.11-41 2024

Print ISSN: ISSN 2055-0057(Print)

Online ISSN: ISSN 20065(Online)

Website: https://www.eajournals.org/

Publication of the European Centre for Research Training and Development -UK

V.   to reduce and prevent violent trauma,
VI.   complete health systems reforms,
VII.   improve Primary Health Care (PHC),
VIII. Universal Access to Health Care (UAC), and
IX.   resources and HR management to be improved drastically.

Emanating from these nine strategic health goals the NDoH has subsequently produced six important 'Strategic Programs':

I.   administration and Patient Files,
II.   health Systems – encompassing the NHI,
III. HIV/TB – Maternal child infections,
IV.   improving Primary Health Care (PHC),
V.   developing hospital services workforce, and
VI.   health regulation and compliance.

From these programs a "Five-year Strategic Plan" was drawn up and set out by the NDoH namely:

I.   decreasing the Burden of Disease and its Prevention,
II.   Universal Health Care (UHC) through the NHI,
III.   reengineering of the Primary Healthcare (PHC),
IV.   improvement of Health Facilities,
V.   improvement of Capacity Planning, revenue collections, HR capacity within the supply chain of public health,
VI.   develop an efficient Health Management System for improved decision making,
VII.   improve the quality of care regarding norms and standards, and
VIII. improve the HR through effective training and accountability measures.

Currently, special attention has been given to the second program, the enhancing of the health systems platform and the NHI to be developed, which is in pilot phase (National Department of Health (NDoH), 2016) (Minister of Health, 2016) (Mars & Seebregts, 2008). Legislative issues are increasing the uncertainty in the private sector with new changes being promulgated. In response to these challenges, a proposed reengineering of the health industry legislature in South Africa is required, concerning the private hospitals countrywide(NDOH SA, 2014; Ngobeni et al., 2020; Swartz et al., 2021; Wiley and Mathews, 2017).

Dr. Anthea Jeffreys (2016), who is from the Institute or Race Relations (IRR) and a strong advocate for access to Universal Health Care (UHC) suggested a review of the current healthcare legislature, at a recent seminar held at the Free Market Foundation (FMF). Dr. Jeffries (2016) suggested the following changes to current legislature (Jeffery, 2016)(A Jeffery, 2023; Sidel, 2018):

a) public hospitals are in desperate need of experienced and qualified managers,
b) private hospitals need to be allowed to employ Doctors as salaried workers as this is not allowed currently, which completely negates the "Peer Review" process within

    Private Hospitals – many of the overseas hospital groups employ 'Resident Doctors' as formal employees of the hospital and not as independent practitioners,

c) presently private hospitals are prevented from training local doctors where the local Medical Schools are way behind in meeting the demand of the population - despite the current arrangement with the Cuban student exchange programs - this needs to be further reviewed by government,

d) 'Low Cost Medical Schemes' need to be reconsidered to cover the Prescribed Minimum Benefits (PMB's) which is currently throttling all private medical aids locally,

e) the government ban on medical insurance needs to be lifted and addressed accordingly,

f) the Set Exit Pricing (SEP) of drugs which disallows bulk discount negotiation must be reviewed as this could possibly bring down the cost of medicines,

g) the very poor standards of public healthcare and hospitals are shifting patients into the private hospitals in desperation which is increasing monthly,

h) the Medicines Control Council (MCC), now called the SAHPRA (The SA Health Products Regulatory Board), needs to review their lengthy process (5years) for drug approvals, and

i) Government doesn't pay or takes months to pay its suppliers. The Supply Chain needs to be seriously re-engineered which results in 'stock outs' leaving patients with no medications (Jeffery, 2016) (Section 27, 2012).

The proposed new NHI model is loosely based on the American "capitation" model but tailored to suit the unique South African environment. The NHI, fundamentally a financial model or framework, seeing to the health care needs of the country by means of collecting or pooling all funds and giving access to Universal Health Care (UHC) (Mars & Seebregts, 2008) (Minister of Health, 2016) (Health Systems Trust, 2016) (Jeffery, 2016).

While the financing of the NHI remains a questionable subject giving projections of R 256 Billion over the next 14 years, based on a projected growth of 3.5%, the economists fail to see how this will be achieved as the current growth is roughly 1%. The analysts are showing their own calculated projections in excess of R 550 Bn. Moreover, it remains unclear as to who will ultimately fund this huge figure, which is loosely based on a local tax base of less than 10% (Archer, 2016) (Serfontein, 2016) (Jeffery, 2016)(A Jeffery, 2023). Many challenges and unanswered questions lay ahead, concerning the actual support and financing of the NHI. The fact remains, from the studies conducted that the necessary Information Technology platform, in addition to the collaborative sharing of information within the ambit of Knowledge Management, is imperative for healthcare efficiency (Witten , 2000) (Calhoun, 1997) (Nonaki, 1991) (Blumenfeld, 1997). This is and remains key to the success of the future NHI system.

This review, has a bearing on the technology alignment process: specifically on the topics of Alignment of IT with strategy, the use of IT in a re-engineering exercise, IT advances in the health industry worldwide and the transforming of the health industry in South Africa by effective collaborative knowledge management (Prather , et al., 1997) (Gentry, 1996) (Westphal & Biaxten, 1998). It is therefore most important that a strategy for the NHI and public health care sector is formulated and positioned at a ministerial or executive committee level.

However, a few building blocks of the envisaged foundation need to be laid down which has been highlighted, such as a robust and solid national technological (ICT) platform, within the SA public healthcare network: currently operating below capacity for the demand (Abbott & Ade-Ibijola, 2018).

DATA ANALYSIS CAPABILITIES WITHIN PUBLIC HEALTH

Further, to addressing the data analysis capabilities within the SA Public healthcare one cannot ignore the technology platforms currently in place across the landscape. Healthcare Systems need to integrate seamlessly with a patient identity or hospital ID moving across the landscape from the Community clinic to the Hospital which is currently not possible as the data capturing is mostly paper based data sets, starting at the clinical visit which is further stifled by low maturities of systems and poor interoperability of such systems (National Department of Health/CSIR, 2014).

A plethora of disparate systems exists across the public healthcare landscape which simply don't talk to each other. The NDoH has laid down certain criterion addressing the possible stacks of standards across these systems namely the HL7 V3 incorporating the CDA and CCD, the ISO 13606, MIOS v4.1 and the IHE suite, essentially interoperable standards currently residing within the public healthcare architecture of SA. In addition to the ICD-10 codes, procedure codes are also used in a variety systems which adds to the complexity of such an environment (National Department of Health/CSIR, 2014).

Data Analysis requires a seamless integrated platform in order to produce reliable data structures from a well-structured stack of standards across the landscape. Many do see this as lost opportunities to exploit critical clinical value; from improved clinical outcomes to basic managerial operational data(Ngobeni et al., 2020; Saripalle et al., 2019; Swartz et al., 2021).
The NDoH is currently addressing this issue with the advance of the eHealth strategy laying down such foundations for effective interoperability across all systems within the SA Public Healthcare landscape. This is currently being performed by the implementation of certain clinical scenario's being performed across clinical settings where the sharing of healthcare information is monitored whereby actual demographic data is being used (National Department of Health/CSIR, 2014).

However, this will require the NDoH in addressing the following:
- A National eHealth standards board instilling the governance policies and processes.
- Review current policy decisions on security, data management and privacy of clinical data within the clinical environment.
- Architectural standards, policies and processes to be developed and deployed.
- A data dictionary for the eHealth and data analytical capabilities within the context of the SA public healthcare. A data dictionary creates the uniformity, validity, availability, reliability and the consistency of such data.

Furthermore, it is critical that this collaborative infrastructure be developed with a high priority as it paves the way for effective data management and eventually data mining: from the basic retrieval of a patient records, to the updating of such files in the system and then retrieving such data sets from an analytical perspective(Ćwiklicki et al., 2020; Kapoor et al., 2020; Monti and Rasmussen, 2017; Sharma and Kshetri, 2020).

RECOMMENDATIONS FOR SA PUBLIC HEALTHCARE:

The world of evolving global technology has reached unprecedented reach across all industries which could be exploited in the healthcare sector thus unlocking further value. The following technologies are experiencing explosive growth:

a) SA Government needs to utilise high end technologies such as cloud technology for standardisation of technologies that could be utilised as an outsourced option, with very little infrastructure needed,

b) broadband connectivity should be a basic human right, but it remains unattainable - especially in the rural areas- where this could be exploited on a large scale,

c) internet platform 3.0 – new current modernised internet platform consisting collectively of the SMAC technologies (social media, Mobile technologies, analytics and Cloud),

d) the effective use of ICT in improving data analytics and the operational use of Governments healthcare supply chain,

e) the interconnectivity of public health hospitals with centralised databases with good governance principles in place,

f) the need for fair peer review systems within the public and the private healthcare sectors, collaborating on effective clinical outcomes,

g) the need to upskill – the development of professional and administrative staff within the public healthcare setting,

h) big data analytics (data modelling) and Business Intelligence/Datamining (BI), and

i) knowledge management strategies and frameworks for Enterprise Information Management systems (EIM).

Medical biomedical informatics can identify early indicators of chronic diseases, enabling health workers and medical aid companies to begin addressing healthcare needs at early onset (Health Information Systems Programme, 2012) (Theron, 2016). Data analytics can score and explore healthcare transactional data and identify which members are at risk for a range of illnesses - including diabetes, asthma, congestive heart failure and coronary artery disease (Minister of Health, 2016)(Marwala, 2019; South African National Department of Health, 2019; Voets et al., 2022). These categories of diseases are all falling within the four main burdens of disease, as an example. Business Intelligence (BI) identifies the most relevant variables, including those high-risk patients developing chronic conditions. BI can construct patterns, enabling early recognition of such disease trends (Polanyi, 1997) (Perry, 1998).

Furthermore, within the SA public health care sector, the need for effectively managing patient data remains critical. This will unlock tremendous value and knowledge which will benefit the

International Journal of Health and Psychology Research

Vol.12, No.3, pp.11-41 2024

Print ISSN: ISSN 2055-0057(Print)

Online ISSN: ISSN 20065(Online)

Website: https://www.eajournals.org/

Publication of the European Centre for Research Training and Development -UK

local populace provided that the following suggested initiatives within the public sector takes place (Kotze P, 2014) (South African Government, 2012) (South African Government, 2012):

1) Primary Health Care (PHC) must be implemented along robust sustainable business architectures with measurable outcomes - Universal access to Healthcare (UHC) (Mars & Seebregts, 2008).

2) The need for Public Health to embrace technology to take full advantage such as the standardisation of technologies across the landscape. This will include data analytics and supply chain technologies incorporating good operational governance over current process (South African Medical Journal (SAMJ), 2017) (Gentry, 1996).

3) To seek guidance and consult with the Private Sector Healthcare leaders in developing standardized technologies to collaborate on joint integrations with Public Private Partnerships (PPP's). The idea is to leverage off theses sophisticated environments (NDOH, 2012). Whereby the focal areas of collaboration be in:
   a) Pharmaceutical coding
   b) Diagnostic Related Groups
   c) Diagnostic Coding Schema
   d) Procedural Coding Schema
   e) Standards of Clinical Content (NDOH, 2012).

4) Critical need in upgrading Hospitals/Colleges to acceptable standards - focused need on large projects or Megaproject; across SA for approximately 4200 Hospitals and Clinics at provincial and district level and primary level.

5) Increased use of Technology to improve administration and operational aspects of procurement within the National Supply Chain (Arndt & Bigelow, 1998).

6) Education and development of the Human Resource issue in Public Health (Mars & Seebregts, 2008).

7) Interconnectivity of Public Hospitals with encompassing networks ensuring the centralisation of the Relational Data Base Management systems (RDBMs) (Fayad , 1996) (Blumenfeld, 1997) .

8) Establish Ethical boundaries for Risk-sharing with better analytics through established interconnectivity and Big Data analytics (Blumenfeld, 1997) (Hastie, et al., 2001) (Grossman, 2002).

9) Fair peer review systems to monitor standards in Private and Public healthcare through managing and monitoring effective treatment outcomes.

10) The most critical need currently is the effective development and training of Nursing and Medical personnel across the board within the Public healthcare sector.
   a) Nursing Colleges to be upgraded and integrated.
   b) Doctors /Interns/ nursing shortages to be addressed.
   c) Review of the whole Remuneration or grading system for health - needs an overhaul.

POSSIBLE OUTCOMES

A very large geographical coverage can offer very affordable convergence across fixed, mobile, data and cloud (Telkom Business, 2015). This would fill the immediate need for high-speed interconnectivity between public hospitals as a primary initiative in the form of a Wide Area Network (WAN) and Virtual Private Networks (VPNS) providing high speed fibre optics coupled to data centre hosting services as a solution (Telkom Business, 2015).

In implementing such measures, the expected benefits would be:

1) Synergistic platforms with Private Public Partnerships necessary for collaborative knowledge sharing.
2) Robust transactional platform across the public-sector network in support of all relevant business processes of the proposed NHI model i.e. the primary healthcare network being the backbone.
3) Standardising of data structures and protocols across such platforms and including the supply chain transactional hubs. This will include a massive reengineering of its core processes and data analytical capabilities.
4) The further development and enhancement of the Electronic Medical Record (EMR) within a clinic or Hospital (Khalifa, 2013). This medical/health record being centralised within architecture of digitalisation and centralisation of data reading to the national Health Patient Registration System (HPRS) with a national patient index record data base structure enabling effective Business Intelligence (BI) tools to be deployed (Kleynhans, 2011).
5) Centralisation of patient Databases within the public sector creating a central repository for a national patient index system (ID index file currently being rolled out with Home Affairs National Identity System (HANIS)), with unique identifiers and tags which could be interoperable with an Electronic Medical Record (EMR) for a patient history following the patient from primary clinic to the hospital (NDOH, 2012).
6) Collaborative interoperability of all relevant transactional platforms within the Public Healthcare Sector.
7) This all-inclusive "pervasive connectivity" would include the SMAC technologies. This is commonly referred to as the "Third Platform" where Gartner calls it the "Nexus of Forces", but "SMAC" is more commonly used to represent this technology stack (Weisinger , 2016) (Mgudiwa & Lyamu, 2018).
8) Further, to cloud computing, is 'Big Data' technology which caters for massive volumes of data which will need to be analysed and mined for trends and the tracking of patient performances and statuses regarding patient care (Westphal & Biaxten, 1998) (Grossman, 2002).
9) The importance of the creation of 'Data Stewards' or 'Knowledge Workers', within the public sector. The importance or emphasis of assigning designated qualified people, being accountable, for a system and its data structures.

10) The high-level coordination of such large projects and programs, under the banner of Program or Portfolio management, need to be effectively managed on a large scale.

11) The establishment of such a project practice within the SA NDoH public health structure encompassing large projects or Mega Project Management, as described above. This has huge relevance to the on-going NHI project over the next 14 years which will require judicious high-level program and portfolio management at the highest degree regarding National, District and Primary healthcare strategic objectives and milestones to be fulfilled on time and on budget (Oracle Press, 2014).

Further, to this concept of Mega Project methodology, it must be noted that the NHI architectural/technological platform requirements must blend or merge with the NHIS wider strategy, and national implementation on a grand scale.

CONCLUSION

The South African healthcare industry is rich in data, but poor in information or the interpretation of such knowledge from the data. This information is then transformed into better disease management practices and trends, thus ultimately reducing the ever-expanding burden of the Healthcare spend in this country. The focus must shift to preventative medicine, as opposed to curative medicine. The SA public health sector should strive in formulating a design or framework in establishing an efficient technology ICT platform, paving the way for an effective NHI healthcare model. This will require a serious review of the current status quo of the public hospital networks and data structures. Primary Healthcare is currently at the focal point of government which sets the stage for patient data structures and architecture's. The transactional data lies within the procurement and finance structure which need to be strategically aligned to all future developments within the public healthcare sector.

The impact of the knowledge evolution will instil a culture of change; learning and innovation which is party to this evolution of knowledge. The triple objectives of the SA government in improving the quality and access to public healthcare whilst reducing costs need to be matched in applying technologies through improving the capabilities of healthcare information systems, overall efficiencies and processes. Access to universal health care will be realised through the collaborative sharing of patient and bio medical information, ultimately creating a greater reach and lessening the spiralling costs of healthcare. This complex public health initiative can only be managed as a dedicated mega-project, which will ultimately increase the efficiency of the future NHI.

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The listed authors - no conflicts of interest. It remains an academic exercise which is funded by the DaVinci Institute of Johannesburg in South Africa.

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