

Why National eHealth Strategies Matter - An Exploratory Study of eHealth Strategies of African Countries

Anthony M. Maina
Department of Information Technology
Dedan Kimathi University of Technology
Nyeri, Kenya
anthony.maina@dkut.ac.ke

Upasana G. Singh
School of Management, IT and Governance
University of KwaZulu-Natal
Durban, South Africa
singup@ukzna.ac.za

Abstract— National eHealth strategies have been with us for at least two decades. A majority of World Health Organization-member states have enacted eHealth strategies or policies. This study explores the national eHealth strategies of African countries and highlights examples of successful eHealth programmes. The objective is to demonstrate the importance of health IT strategies in the deployment of eHealth initiatives, including their significance in an evolving technology paradigm being shaped by Industry 4.0 technologies. The study observes that national eHealth strategies are not only instrumental in the establishment of a coherent approach to the deployment of digital health technologies but also anchor effective implementation, justify investments, and spur innovation in health informatics. Finally, important questions are raised about national strategies in the fourth industrial revolution (4IR) era.

Keywords— eHealth, national eHealth strategy, Industry 4.0, fourth industrial revolution (4IR), Internet of Things (IoT), big data

I. INTRODUCTION

National eHealth strategies are associated with the country-wide introduction of health information technologies and have a history dating back at least two decades. European countries were the frontrunners; countries such as San Marino, Finland, and Norway, formulated their strategies in the 1990s [1]. Pioneering African countries introduced theirs about a decade later, for example, Ghana (2010) and Kenya (2011). Globally, about 60% of WHO-member states have enacted national strategies, traditionally associated with their respective country's health goals and international priorities; for example, targets on universal health coverage [1].

But why are national eHealth strategies important? Responses to this question have not been addressed sufficiently, particularly from the context of low and middle-income countries in Africa. This study explores key aspects of national strategies from African countries and discusses examples of successful eHealth programmes. The objective is to demonstrate the importance of health IT strategies in the deployment of eHealth initiatives including their significance in evolving technology settings being shaped by Industry 4.0 technologies, notably, Internet of Things (IoT) and big data. The rest of the paper is organised as follows. Section 2 introduces the concepts of eHealth and national strategies. Next, we discuss the fundamental attributes of the national strategies of Kenya, Uganda, Tanzania, Ghana and South Africa in Section 3, and highlight examples of successful eHealth projects. Thereafter, we examine the importance of health IT strategies in Section 4 and close by evaluating their

context in the Industry 4.0 era in Section 5. Finally, conclusions and recommendations based on the study are discussed in Section 6.

II. eHEALTH AND NATIONAL STANDARDS

eHealth describes broadly the delivery of health services aided by computer-based applications and infrastructure. It incorporates technology-based services that include mHealth, telemedicine, electronic health records (EHR), and digital-mediated training. More recently, emergent ICT innovations have spawned new observations about eHealth. For example, big data technologies are used to analyse vast volumes of data and thus facilitate evidence-based health decisions. Social media has been deployed to promote accurate exchange of health information, for instance, Twitter being used to communicate accurate health information and dispel rumours on the Ebola virus [2]. These viewpoints are important to understand the recent developments in digital health technologies.

National eHealth strategies are introduced to guide countries on how best to integrate eHealth programs into health systems. They gained prominence after the enactment of WHA 58.28 resolution on eHealth in 2005 that advised member states to [3]:

“consider drawing up a long-term strategic plan for developing and implementing eHealth services in the various sectors of the health sector, including health administration, which would include an appropriate legal framework and infrastructure and encourage public and private partnerships.”

WHA 58.28 resolution is definitive in its recognition of the importance of digital technologies in healthcare. It advocates for the development of the technology infrastructure that will underpin ICT-mediated health services, particularly those considered vital in promoting affordable and equitable healthcare services. It also singles out the importance of partnerships in building sustainable eHealth systems, calling for “closer collaboration with private and non-profit sectors... so as to further public services for health and make use of eHealth services...” [3].

National eHealth strategies are framed as high level plans or detailed strategies. High level plans outline overarching strategies but lack implementation plans; detailed strategies comprise both [4]. The latter approach incorporates a monitoring and evaluation program to track progress on targets and to facilitate future planning. These strategies guide the planning, designing, and implementing of eHealth programs so as to attain targeted health objectives.

Scott and Mars [5] argue that poorly designed or vague strategies are significant barriers to the growth and maturity of eHealth programs. Development frameworks are introduced to assist policymakers craft well-defined strategies that correspond to the health needs of a particular environment. Two design approaches are predominant. The first one is the National eHealth Strategy Toolkit (NeST) [6]. Initiated as a collaboration between the WHO and the International Telecommunications Union (ITU), NeST has three strategic pillars: the national eHealth vision, the action plan, and the monitoring and evaluation framework. The vision defines the validity of an eHealth agenda by identifying the health priorities, and demonstrates the significance of digital technologies in addressing those needs. The action plan corresponds to an “implementation roadmap” of how eHealth initiatives will contribute to the realization of health objectives. Lastly, the monitoring and evaluation framework is a feedback mechanism that facilitates assessment and provides input for future planning.

Another development approach was proposed by Scott and Mars [5]. It outlines eight key steps in the planning and design of an eHealth strategy. The first four steps (1 to 4) are a situational analysis of the environment relevant to the strategy. These steps clarify the health issues to be addressed by health technologies based on internal and external factors. Since not every health issue can be pursued, the fifth step (5) identifies the key priorities using factors such as disease burden, resources, level of knowledge, and economic cost. Nature and quality information available influences the outcome of this stage. Next, stakeholder engagement is covered by steps 5 and 6 and the objective here is to define the optimum solutions to the needs identified as the most critical. Stakeholders are drawn from government, private sector, academic experts, and eHealth specialists. In the last stage, (steps 7 and 8) decisions are made on the eHealth solutions to be pursued and the strategy document drafted.

III. NATIONAL eHEALTH STRATEGIES IN AFRICA

National eHealth strategies of Kenya, Uganda, Tanzania, Ghana and South Africa (Fig 1) are reviewed in this section.



Fig 1: National eHealth Strategies – Countries in Focus (highlighted)

A. Kenya

With a population of more than 48 million, Kenya has a healthcare expenditure accounting for 5.7% of GDP and spends about \$169 per resident annually on health [7]. Main

health issues are associated with reproductive, maternal and child health, communicable diseases, for example, HIV/AIDS and tuberculosis, and rising challenges of non-communicable diseases such as cancer [8]. Kenya National eHealth Strategy (KNES) was first enacted in 2011. Its vision is “to develop efficient, accessible, equitable, secure, and consumer-friendly health services enabled by ICT” with a focus on 5 domains: telemedicine, health information systems, information for citizens, mHealth, and eLearning [9].

During the life cycle of KNES – the period between 2011 and 2017 - there has been significant progress in the establishment of eHealth standards and adoption of health information technologies. District Health Information Systems (DHIS) version 2, a software used for aggregation of health data from the local to the national level, was implemented beginning 2011, replacing the use of error-prone spreadsheet files [10]. Its application offers various benefits. First, because it is based on a free and open-source license, it offers economic benefits compared to commercial alternatives. Secondly, the system is a decentralized application with utilities for data collection at the primary facilities, and thus it suits flexibility and robust use. Lastly, DHIS2 relies on a web-based interface and hence guarantees platform and device independence. By early 2012, DHIS2 was available nationally in all the districts and had more than 1,300 unique registered users [11].

B. Uganda

Uganda has a population of over 40 million. Its public health expenditure as a proportion of GDP is 7.2% and spends approximately \$133 per resident annually on health services [12]. Shortages of key health personnel, epidemics of HIV/AIDS, tuberculosis and malaria, and inefficiencies in health service delivery are among the key challenges that motivate the introduction of eHealth [13]. Covering the period 2017 to 2021, the country’s national strategy has the objective of creating “an enabling environment for the development, deployment and utilization of sustainable, ethically sound and harmonized eHealth initiatives at all levels” [13].

The eHealth framework is anchored under 12 pillars, notably eHealth services, infrastructure, and stakeholder engagement. Each pillar is then associated with strategic objectives which define the core action plans or programs. The eHealth services pillar, for example, has one of its objectives as the establishment of “a unique, standardized, comprehensive and compatible electronic medical record (EMR), electronic health record (EHR) and personal health record (PHR)” [13].

mTrac is a highly successful mobile health platform launched in 2011 by the Ministry of Health. It is anchored by the country’s rapidly expanding mobile telephony infrastructure. Reaching national scale-up in 2013, it has more than 62,000 registered health staff drawn from 4,431 health facilities, including all district health offices. mTrac is used to submit weekly health surveillance data via SMS using a basic mobile phone. The tool is part of the national electronic health management information system (eHMIS), which also incorporates DHIS2 [14].

C. Tanzania

With a population exceeding 55 million people, Tanzania is one of the most populous countries in Africa. Its health expenditure as a percentage of GDP stands at 5.6% while the annual per capita expenditure is \$137 [15]. The drive to introduce digital health technologies is influenced by the limited number of well-equipped health facilities, including shortages of qualified staff, the high disease burden of HIV/AIDS, tuberculosis and malaria, as well the need to improve efficiencies in health systems [16]. The country's national strategy covers the period 2013 to 2018 and its vision is "to enable a safe, high-quality, equitable, efficient, and sustainable health systems" for all residents [16].

Its eHealth policy framework has 4 pillars: eHealth foundations, eHealth solutions, change and adoption, and health governance. Strategic objectives cascade from each pillar and they are followed up by strategic initiatives or plans. Under the pillar of eHealth foundations, for example, the country identifies the improvement of ICT infrastructure as one of the strategic initiatives.

Open Medical Record System (OpenMRS) is an example of a popular eHealth project first implemented in 2008 in Morogoro region, east of the country, to manage HIV/AIDS programs [17]. An open-source software platform which supports generic medical records, OpenMRS is "based on a conceptual database structure" that is delinked from the nature of health data or the specific data collection forms and hence can be customised for different uses [18]. Although initially tailored for developing countries, OpenMRS is also popular in many parts of the world including across Africa.

D. Ghana

The Ghana was one of the first African countries to enact a national health IT strategy. Introduced in 2010, the eHealth strategy had the aim of harnessing "the potential of information and communications technologies to improve the health status" of its residents (MoH, 2010). The country spends 3.6% of GDP on health and has an annual health per capita expenditure of \$145 [19]. Health priorities focus on tackling epidemics such as HIV/AIDS and tuberculosis, reducing infant and child mortality rates, and mitigating increased threats of non-communicable diseases such as cardiovascular disorders and diabetes [20].

Its strategy has 4 strategic pillars – the regulatory framework for data management, health capacity, health equity, and paperless records and reporting [20]. The framework expounds each strategy by defining specific aims and key actions to be implemented. On health equity, for instance, key actions focus on the deployment of mHealth for health services.

CommCare is a smartphone-based application used in Ghana to collect real-time maternal health data [21]. The initiative - a partnership between the Health Ministry and WHO's Millennium Villages Project - assists countries to monitor deaths among pregnant women and among those who recently gave birth. The project's aim is to initiate response and follow up measures in order to prevent future deaths. A specialist assists community health workers to conduct investigations into each death. Then, using a mobile phone, relevant health data is captured and uploaded to an electronic database that is available for review and analysis by a local medical team. The project hopes to contribute

towards reducing maternal mortality to less than 70 deaths per 100,000 live births by 2030, in line with the Sustainable Development Goals [22].

E. South Africa

South Africa has a population of at least 56 million. Its eHealth strategy covered the period 2012 to 2016 [23]. The country spends 8.8% of national GDP on health and has a health per capita expenditure of \$1,148, one of the highest in Africa [24]. While the country has made progress in reduction of child and maternal mortality and tackling diseases such as tuberculosis and malaria, it still has one of the highest rates of HIV/AIDS infections globally [24]. Its eHealth mission is to integrate digital health technologies so as to transform and improve healthcare services [23].

The eHealth framework comprises 10 strategic priorities, which are in turn linked to strategic activities. These main activities are then associated with target outputs, to be achieved within a specified time frame. Priority 8 on eHealth foundations, for example, identified implementation of a national electronic health record (EHR) by May 2013.

South Africa was the regional leader in the introduction of health information systems. As early as 1996, the first version of DHIS was developed as a partnership between the University of Oslo, the University of Western Cape, and the Western Cape Department of Health [25]. However, the country grappled with the lack of an eHealth strategy framework, stark disparities in eHealth initiatives across and within provinces, inoperable systems, expensive broadband connectivity, inter alia [26]. By 2009, three years before the national eHealth strategy was formally approved, the country's National Health Council (NHC) had recommended halting implementation of all health digital technologies that were not interoperable [23].

After the development of the national eHealth strategy in 2012, there was significant progress in the state of eHealth. For instance, the eHealth policy framework was strengthened following the enactment of the mHealth strategy [27]. Designed for the five-year period between 2015 and 2019, the strategy leverages on the country's well-developed mobile and wireless infrastructure to "support priorities of the health sector" [27]. MomConnect is a flagship project in this domain. Initiated the National Department of Health, it is integrated into maternal and child health services [28]. It works as voluntary, free service, available via subscription using SMS codes to enable expectant mothers to receive promotional information about their health and that of their infants. By 2017, the cumulative total of clinic registrations using the service exceeded 1.5 million while the number of health facilities with at least one registration was about 4,700 [28]. It is used by more than 60% of the country's pregnant women to access antenatal services and has one of the highest global coverage rates of similar projects [29].

IV. WHY NATIONAL eHEALTH STRATEGIES MATTER

National eHealth strategies have become mainstream in many regions including in Africa. The five countries surveyed introduced their national eHealth strategies between the year 2010 and 2017 and a summary of their major eHealth projects is presented in Table 1. Planning of these strategies reflected both global and national health priorities, notably the focus on universal health coverage. In

addition, the design of the national strategies takes cognisance of the prevailing health challenges in their environment. The key priorities aim at improving child and maternal health outcomes, tackling epidemics of HIV/AIDS, tuberculosis, and malaria, and minimizing threats associated with non-communicable diseases such as cancer and diabetes. Overall, the decision on eHealth strategies by the five countries corresponded with advocacy by WHO for countries to draft for developing and implementing digital health technologies [3].

TABLE I. EXAMPLES OF eHEALTH PROJECTS IN AFRICA

eHealth program	Country	Details
District Health Information Systems (DHIS) Version 2	Kenya	<ul style="list-style-type: none"> Web-based health information system used for aggregation of health data Nationally available in all the districts in the country More than 1,300 unique registered users
mTrac	Uganda	<ul style="list-style-type: none"> Mobile platform used to capture weekly health surveillance data via SMS User base of at least 62,000 registered users drawn from more 4,000 health facilities Tool is a subset of the national electronic health management information system (eHMIS), which incorporates DHIS2
Open Medical Record System (OpenMRS)	Tanzania	<ul style="list-style-type: none"> Open source electronic medical records system Initially piloted for HIV/AIDS clinics First implemented in the country in Morogoro region in 2008, in three sites, and more than 11,000 patients enrolled. System also rolled out across Africa in South Africa, Kenya, Rwanda, Lesotho, Zimbabwe, Mozambique, and Uganda.
CommCare	Ghana	<ul style="list-style-type: none"> mHealth platform for capturing maternal and child health data Its use is instrumental in efforts by the country to reduce maternal mortality to less than 70 deaths per 100,000 live births
MomConnect	South Africa	<ul style="list-style-type: none"> A platform that used basic cell phone technologies to support maternal and child health services Used by more than 60% of the countries pregnant women to access antenatal services By 2017, the service had nearly two million registrations

Although the strategies - with the exception of Uganda's (2017) and Tanzania's (2013) - pre-date the WHO/ITU's NeST and Scott and Mars (2013) development frameworks, they generally conform to the suggested guidelines. For example, the frameworks emphasize the importance of stakeholders in health policymaking [5], [6]. The strategies surveyed pointed to the engagement of government ministries, government agencies and local/regional authorities; organisations such as faith-based groups, charities, and commercial enterprises; and occupational groups such as professional associations, staff unions, and employers. These entities have an interest in the progress of

eHealth and help shape the national policies. Additionally, the national strategies incorporate the three core elements of an eHealth vision, action plan, and the monitoring and evaluation framework. The eHealth vision is addressed by the strategy's vision and mission, while the action plan is covered by a generic cascade of pillars, strategic objectives and strategic activities, shown in Fig. 3. The monitoring and evaluation framework is anchored by the declared outputs and pre-defined completion dates for each activity.

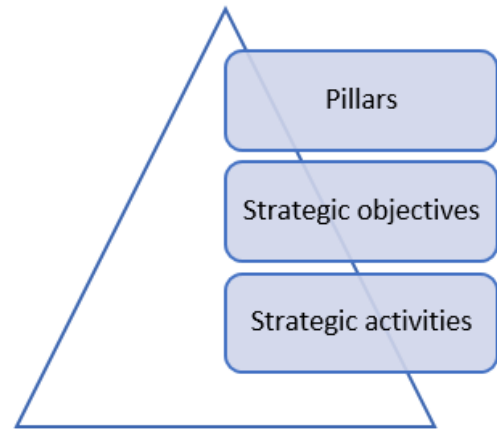


Fig. 2: Generic National eHealth Strategy Action Plan

The outcome of this investigation demonstrates the value of national eHealth strategies in the following ways: first, they are associated with the growth and maturity of the eHealth sector. Flagship eHealth projects discussed were introduced or further strengthened in the period after enactment of the national strategies; moreover, recent statistics from the global eHealth survey suggested a positive association between the introduction of national strategies and the steady rise in eHealth implementations [1] the EU region pioneered the introduction of regional and national strategies and it is also the region with the most robust developments in eHealth. Granted, other factors contributed to the success of eHealth programs, for instance, superior funding and an already existing technology infrastructure. Still, the impact of the strategies cannot be discounted. Luna et al. (2014) argue that there is limited focus on the policy agenda is a contributor to the eHealth adoption challenges confronted by developing countries [30]. National strategies not only identify such impediments but they also formulate measures to overcome or mitigate these concerns, hence enhancing the likelihood of successful eHealth deployment.

Next, national eHealth strategies contribute to the effectiveness of eHealth implementation. Prior to approval and passage of South Africa's national strategy, the health IT landscape was characterised by the lack of coordination, limited or no automation, and where information systems existed, they could not easily communicate or exchange data [23]. Inoperable and disjointed systems are a longstanding concern for many eHealth systems. Such systems end up as "data silos" which are unable to communicate and share data with other systems. A big part of this problem is the lack of standards to guarantee that established systems follow a common protocol so as to facilitate interoperability and streamlined data sharing. Strategies moderate the risk of fragmented systems.

Additionally, national strategies support the case for funding of eHealth solutions. In the EU, the rising cost of

public healthcare expenditure has contributed to technology-led initiatives to make healthcare more cost effective while delivering greater value in terms of health outcomes (EU, 2012). In Africa and other developing regions, the viability of eHealth solutions is harder to justify solely based on costs because of the already low annual health expenditure per capita. With the exception of South Africa, countries discussed have an annual health expenditure per capita of less than \$200. In such settings, therefore, strategies have to consider other factors besides economic reasons in making the case for eHealth solutions. For instance, telehealth offers opportunities for remote health facilities to utilize the expertise of doctors in major cities. mHealth projects, anchored by fast-expanding mobile telephone infrastructure in developing countries, offer opportunities for low-cost, superior health services in many of these regions. Since strategies clarify health priorities, Scott and Mars (2013) contend that they provide “evidence-based guidance” which justifies expenditure and investment in eHealth initiatives [5].

Finally, national eHealth policies promote innovation. Policies on digital health technologies are structured within a wider framework of national action plans to tackle the broader development agenda. For example, Kenya’s national eHealth strategy aligns to Vision 2030, a national social-economic blueprint powered largely by digital technologies to drive the country’s industrialization and economic development [31]. This creates technology ecosystems that spur innovations in multiple sectors including health. These four goals of national strategies are summarised in Fig. 4.

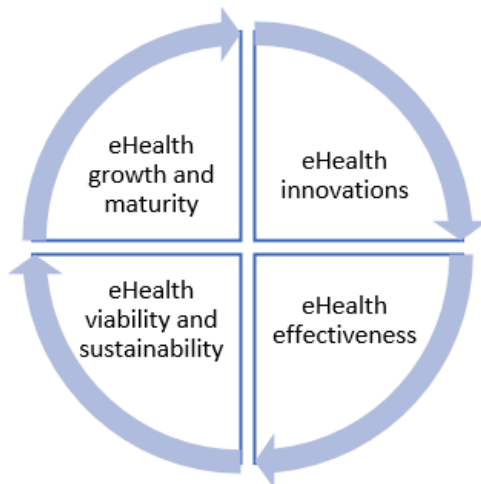


Fig. 3: Why National eHealth Strategies Matter

V. eHEALTH STRATEGIES IN THE INDUSTRY 4.0 ERA

eHealth as a concept has been closely connected with Internet technologies and continues to evolve as Internet innovations advance. The most recent developments are associated with the Industry 4.0 domain, the computing paradigm linked with emergent of technologies such as Internet of Things (IoT), big data analytics. IoT is about connectivity - the connectivity of anything [32]. Its vision is making physical objects – for example, cars, machines, medical equipment, hospital devices, and so on – connected to the digital world. Big data, on the other hand, describes a phenomenon characterized by increased volume and complexity of data in a manner that is difficult to manage using traditional information systems. At the same time, the value of such data can be unlocked via powerful algorithms

which can identify associations, patterns and trends in the data sets.

As a fast expanding domain, Industry 4.0 has sparked a new wave to digital automation building on the previous well established Internet technologies. For example, Google’s PageRank algorithm, Twitter’s trending topics, and targeted online advertisements, are based on big data analytics while facial recognition, a standard feature in social network platforms, is underpinned by machine learning algorithms. In addition, self-driving cars are no longer science fiction and technology is in existence to enable drones to make home deliveries of online purchases.

In healthcare, the Industry 4.0 era has the potential to transform and greatly improve the delivery of health services. IoT-enabled sensors connected to medical devices can be deployed to “remotely monitor patients” and real-time data relayed to health specialists [33]. IoT-based identification techniques can yield better results in terms of reduced medical errors such as patient mismatching, wrong dosages, and incorrect procedures [34]. Using big data algorithms, data from conventional health processes and external sources can be integrated and analysed to derive valuable insights useful for clinical decision making, management of disease outbreaks, logistics management, and prevention of insurance health fraud.

While growth in fourth industrial revolution (4IR) technologies is evident in many sectors, advances on this front lag behind in the health sector. Based on this study, national eHealth strategies will be pivotal in altering this narrative. At the same time, this raises a number of issues about existing eHealth frameworks. Are current eHealth strategies remodelled to acknowledge and leverage the capabilities of Industry 4.0 innovations? What direction, if any, are eHealth strategies and policies articulating in the fourth industrial revolution (4IR) era? What new concerns on governance, security and privacy are relevant to healthcare in the 4IR dispensation? Understanding and addressing these issues will be essential to revamping eHealth strategies and hence facilitate harnessing of these emergent ICTs for healthcare.

VI. CONCLUSION AND RECOMMENDATIONS

This study revisited the significance of eHealth strategies in modern health systems. We considered their importance in the introduction and maturity of eHealth initiatives, effectiveness of eHealth programs, justification of eHealth investments, and promotion of eHealth innovations. Accordingly, a national eHealth strategy is fundamental to articulating and shaping the direction a country follows so as to unlock the potential of digital health technologies, and in turn, delivery of better health outcomes.

While the formulation of national strategies is a significant step in the growth of health informatics, real progress depends “on the effective implementation of the strategy and the extent to which its implementation is monitored and evaluated” [26]. This study was limited to that extent because it discussed core elements of national strategies and examples of eHealth projects implemented in the countries sampled. Future studies could consider the extent to which the targets set in the national strategies were achieved, including what setbacks or challenges were faced.

Lastly, as the ICT era evolves - driven by 4IR technologies such as IoT, big data analytics, machine learning and artificial intelligence – it is not clear whether existing strategies address sufficiently the emerging concerns on privacy, security, and data governance associated with new technologies. These domains need to be understood better and future strategies realigned to meet the demands of the new technology dispensation.

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