Review of Developing Country Health Information Systems

A high level review to identify Health Enterprise Architecture assets in ten African countries

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This report records the results of a review of eHealth and health information systems in Africa in order to identify architecture assets in these countries.

Methodology

The review collected information about eHealth and health information systems from the following sources:

1. Published literature – searching on Science Direct for all publications in 2008 or later where Title, Abstract or Keywords contained either the <country name> AND "health information" or the <country name> AND "eHealth".

2. Grey literature – PDFs, Word documents, Power Point presentations and web pages found on the internet via a Google search which contained either the <country name> AND "health information" or the <country name> AND "eHealth". Some information published prior to 2008 was also accepted.

3. Web-sites of country ministries of health.

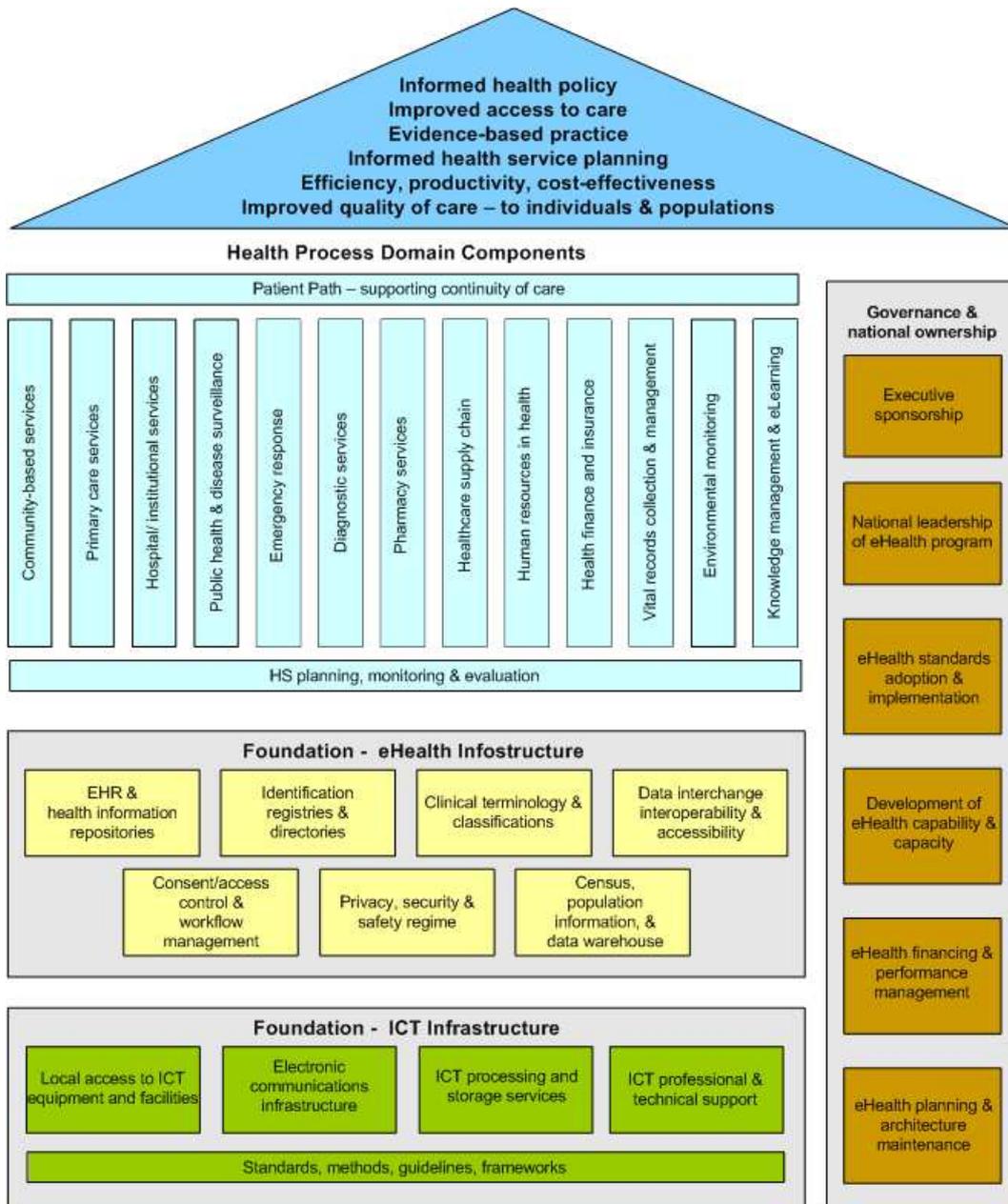4. Communication from individuals exposed to health information systems in the countries.

The initial review included 48 African countries with information collected in English, French and Portuguese. An overview of this information indicated that the countries could be grouped into three broad groups:

- Countries where there was no evidence of eHealth planning or implementation. These countries may have had a health information systems assessment by the WHO Health Metrics Network (HMN)[1], and participated in surveys by the WHO Global Observatory on eHealth (GOe). [2,3]

- Countries where there was some evidence of eHealth planning but no evidence of significant implementation. These countries may have had a health information systems assessment by the WHO HMN [1], participated in surveys by the WHO GOe [2,3], and developed a national HIS plan with the assistance of the HMN [1].

- Countries where there was evidence of eHealth planning as well as some significant implementation. These countries may have had a health information systems assessment by the WHO HMN [1], participated in surveys by the WHO GOe [2,3], and developed a national HIS plan with the assistance of the HMN [1].

The intention was to present the findings of the review using RM-ODP viewpoints, i.e. Enterprise, Information and Computational Viewpoints. However, this high level review did not yield sufficient detail regarding elements and processes to present the findings about eHealth and health information systems in these countries using the viewpoints.

Instead, the eHealth architecture model proposed in ISO TR 14639 - Capacity Based eHealth Architecture Roadmap - Part 1 (below) was used to determine whether there was evidence of existing components within each of the key categories:

- Governance and National Ownership,
- Foundation – eHealth Infostructure,
- Foundation – ICT Infrastructure, and
- Health Process Domain Components.

Informed health policy
Improved access to care
Evidence-based practice
Informed health service planning
Efficiency, productivity, cost-effectiveness
Improved quality of care – to individuals & populations

Health Process Domain Components

Patient Path – supporting continuity of care

| Community-based services | Primary care services | Hospital/ institutional services | Public health & disease surveillance | Emergency response | Diagnostic services | Pharmacy services | Healthcare supply chain | Human resources in health | Health finance and insurance | Vital records collection & management | Environmental monitoring | Knowledge management & eLearning |

HS planning, monitoring & evaluation

Governance & national ownership

Executive sponsorship

National leadership of eHealth program

eHealth standards adoption & implementation

Development of eHealth capability & capacity

eHealth financing & performance management

eHealth planning & architecture maintenance

Foundation - eHealth Infostructure

EHR & health information repositories

Identification registries & directories

Clinical terminology & classifications

Data interchange interoperability & accessibility

Consent/access control & workflow management

Privacy, security & safety regime

Census, population information, & data warehouse

Foundation - ICT Infrastructure

Local access to ICT equipment and facilities

Electronic communications infrastructure

ICT processing and storage services

ICT professional & technical support

Standards, methods, guidelines, frameworks

Figure 1. eHealth architecture model according to ISO TR 14639 - Capacity Based eHealth Architecture Roadmap - Part 1

Within each of the components, an attempt was made to determine whether for that component there was:

1. No evidence of planning or implementation;
2. Some evidence of planning but none of implementation; or
3. Evidence of planning and evidence of implementation.

This was done for ten countries and the summarized results are illustrated in Table 1. A more detailed report is provided for each of these ten countries.

Table 1. Evidence of eHealth planning and implementation in ten African countries.

Legend:
- No planning or implementation (white)
- Planning but no implementation (dotted)
- Planning and some implementation (black)

	Angola	Botswana	Ethiopia	Ghana	Kenya	Nigeria	Tanzania	Uganda	Zambia	Zimbabwe
Governance and national ownership	dotted	black	dotted	black	black	dotted	black	black	dotted	black
Foundation eHealth infostructure	white	dotted	black	black	dotted	white	white	white	white	dotted
Foundation ICT infrastructure	dotted	black	dotted	dotted	dotted	white	black	black	white	black
Health process domain components	black	black	black	black	black	black	black	black	black	black

Angola

Country and National Ownership

In 2005, Angola implemented a national plan for the development of ICT in health, which set targets for health sector connectivity. [2]

Within the Ministry of Health, the *"Gabinete de Estudos, Planeamento e Estatística"* (GEPE) is responsible for health information systems. With the WHO and HMN, GEPE developed a national plan for Health Information Systems for 2011 – 2015. [4]

The ministry is developing capacity in health workers for data use for decision-making and planning. [5]

Evidence of planning, some implementation and capacity development.

Foundations: Infostructure

Since 2001, GEPE has been trying to establish a single health information system and database. The ministry's district health system strategy calls for a unified health information system that harmonizes the requirements across vertical programs and integrates the process of data collection and aggregation. [5]

Some evidence of planning for harmonization but no evidence of implementation.

Foundations: Infrastructure

There is no information on ICT infrastructure for health facilities. Angola's ICT tariffs remain above the Sub-Saharan African averages, partly due to Angola Telecom's monopoly over the SAT-3 cable. The first phase of a national fiber-optic backbone linking 18 provincial capitals through 6,000 km of fiber-optic cable was scheduled to be completed in 2011. [6]

No evidence of planning and implementation that is specific to health facilities.

Health Process Domain Components

Angola's national health information system consists of routine information generated by the service delivery system, vital statistics, population surveys and special surveys. The routine health information is called SIS (*Sistema de Informação Sanitaria*) and produces reliable data in some provinces. Individual patient records are a rarity at the primary care level. [5]

Angola has established a Health Information System (HIS) that focuses on surveillance and basic services. [7] The following has been reported on, although the extent of computerization is unknown:
- A health worker database.
- A drug inventory management system
- A Rapid Alert System (*Sistema de Alerta Rápida*) recording suspected cases of polio, measles, neonatal tetanus, meningitis and malaria.
- Detailed health maps for 11 provinces.
- Several vertical surveillance systems.

- A routine surveillance system that functions with external support.
- The National Institute for the Fight Against AIDS (INLS) HIV data collection. [5]

In early 2009 the ministry introduced a computerized Spanish health management information system. [5]

Reports of isolated pilot projects have been published, e.g. describing the use of handheld computers to collect information about HIV/AIDS. [8]

While there has been some progress with the monitoring and evaluation of HIV/AIDS treatment, routine data collection and health information systems are weak and need support. [6]

Evidence of routine data collection and surveillance systems. Isolated systems supporting patient care.

BOTSWANA

Country and National Ownership

A national plan for the development of ICT in health, which sets targets for health sector connectivity, was implemented in 2003. [2,3]

The Department of Health Policy, Development, Monitoring and Evaluation (HPDME) became functional in April 2010 as a result of a restructuring exercise and aims to provide strategic direction and support on issues including information management. [9]

Botswana reports that the majority of the listed actions to promote an enabling environment for information and communication technologies (ICT) in the health sector have been taken and are likely to continue. [2,3]

The country has a well-conceived eGovernment strategy and ICT Policy (known as 'Maitlamo') and a special healthcare task force has been appointed to address the aspects of the policy impacting healthcare. Community Access Centres will be established, providing easy access to information and services including healthcare. [10,11,12]

The eHealth Botswana programme aims to introduce a number of ICT initiatives to improve the health of Batswana and improving the overall efficiency and effectiveness of the healthcare system. eHealth Botswana targets included:
- All health facilities operational for more than ten days per month to be connected.
- All Batswana have appropriate access to health information on-line. [11]

Strong evidence of planning and sponsorship, and some implementation.

Foundations: Infostructure

The Ministry of Health currently uses 20 separate information systems which are not integrated. The goal of the PING Health Systems Post Office project is to integrate all health information systems in Botswana resulting in a more efficient and effective use of resources. [13,14]

A Health Professionals Registration System is under development in order to maintain a database of all health practitioners and professionals in the country. [15]

Evidence of planning for integration and developing registry for health professionals.

Foundations: Infrastructure

eHealth activities include the installation of local area network (LAN) and Wide Area Network (WAN) in 22 facilities. [12,16]

Evidence of providing ICT infrastructure to health facilities.

Health Process Domain Components

There are several on-going eHealth initiatives in the country, including:

- Integrated Patient Management System (IPMS) at four sites including the only referral hospital.
- Warehouse Management System (WMS) at Central Medical Stores to manage the procurement and distribution of drug supply.
- MASA system in some hospitals and clinics to manage HIV/AIDS patient information where IPMS has not been implemented.
- Blood management System (BMS) in the two cities to manage inventory and distribution of blood.
- District Health Information System to provide aggregated health information from health districts [16] [17]

The PING Patient Referral Project has built a system that assists HIV testing centers with the referral and tracking of clients that get tested for HIV. [18]

Evidence of implementation of systems to support patient care.

ETHIOPIA

Country and National Ownership

The country has had a national eGovernment policy since 2009. [3]

The Federal Ministry of Health (FMOH) has implemented the Ethiopian Health Management Information System (HMIS) while the Central Statistical Agency (CSA), a division of the Ethiopian government, manages population–based health information sources, i.e. censuses, ad hoc surveys, and registering vital events. [19]

Evidence of a national structure for health information management. Some evidence of planning but not specific to health.

Foundations: Infostructure

In 2011 the Health Ministry organized an eHealth workshop in order to begin developing appropriate health informatics standards and an architectural framework for interoperability and scalability of the various eHealth initiatives in the country. [20]

The HIS unit at national level is running an integrated "data warehouse" containing data from all data sources (both population-based and facility-based sources including all key health programs) [21]

Evidence of planning for standards, interoperability and integration.

Foundations: Infrastructure

Although the score assigned by the HMN HIS Assessment for HIS infrastructure in 2007 was 47.2% [21], "Cyberethiopia" is a high profile project to connect public sector facilities such as schools, hospitals and clinics. [22].

The "WoredaNet", the e-government communication backbone developed by the Ethiopian Telecommunication Corporation, promises to be a major enabler for rapid ICT development in the country. [16]

Healthnet is a major government sponsored project to link up regional hospitals and introduce telemedicine applications. [23]

Evidence of government support and planning for ICT infrastructure provision to health facilities.

Health Process Domain Components

There is a health services based information system that brings together data from all public and private facilities. [21]

Computerised applications for healthcare include:

- A national Health Resource Information System (HRIS). [24]
- The Health Integrated Financial Information System (HIFIS). [24]
- SMARTCARE Ethiopia – an electronic health record system that supports longitudinal record-keeping for a clinical care, especially for HIV/AIDS treatment, TB care, VCT, and antenatal care. The system is being rolled out nationally and provides clinical decision support and data portability via the use of smart cards. [25] Over 100 clinics and hospitals in the Dire Dawa region, covering the entire area, have successfully deployed this system. [19]

ARTISE, the antiretroviral therapy (ART) patient-monitoring system is based on the WHO ART patient-monitoring system. ARTISE was developed to capture the information documented on standard paper forms and is used to provide reports that are useful to clinicians, clinic managers, and public health officers. [26] [19]

The HMIS was established to "support informed strategic decision-making by providing quality data that help managers and health workers plan and manage the health service system." As of 2008, a comprehensive electronic HMIS has been developed in conjunction with doctors associated with Tulane University and is now being deployed to health facilities in several regions of the country, with an eventual nationwide rollout eventually slated to occur. [19]

Evidence of several systems to support patient care.

GHANA

Country and National Ownership

The country has had a national eHealth policy since 2003. [2,3]

In 2004 the ICT for Accelerated Development (ICT4AD) policy was passed and is currently at various stages of implementation. This policy represents the vision of Ghana in the information age and addresses 14 priority focus areas or pillars including health. [16]

The Ministry of Health has recently developed the Ghana Health Service (GHS) Enterprise Architecture. This comprehensive 162 page document includes a detailed roadmap for implementation of the future state architecture. [27]

Strong evidence of planning and policy development. Comprehensive Enterprise Architecture for Health.

Foundations: Infostructure

In 2009 the Enterprise Architecture documented that there is a need for robust Health Information Exchange (HIE) and Clinical Data Exchange (CDE) mechanisms to ensure timely and secure transfer of information between the GHS and the other agencies, within the GHS and with international bodies such as the WHO. [27]

Initiation of work on information exchange mechanisms.

Foundations: Infrastructure

In 2009 the Enterprise Architecture documented that there was limited Wide Area Network infrastructure providing connectivity for the stores and that there are plans to expand this infrastructure to the districts to connect all sites and offices. [27]

Plans to expand ICT infrastructure to all health facilities.

Health Process Domain Components

Mobile Technology for Community Health (MOTECH) in Ghana has developed two interrelated mobile health services, the "Mobile Midwife" application and the "Nurses' Application" which helps nurses and community health workers to record and track the care delivered to women and newborns in their area. [16] Mobile technology (PDAs) have been used successfully in Ghana for the collection of health data. [28]

In 2007 the GHS launched its automated system, the District-wide Health Information Management System (DHIMS). The DHIMS has been developed for use at districts in order to improve the use of health data for decision making at the level where data is produced. It is claimed that the system captures the data in the districts from "the community and public health services to the district hospitals" and provides support for hospital integration of electronic patient records, billing and hospital management system. The DHIMS attained full country coverage in 2007 after original piloting in 20 districts across the country. Data flows are vertical, with accumulated data from health facilities in districts flowing to the regional and national levels. [19]

Evidence of automated collection of routine health information. Some evidence of systems to support patient care.

<u>**KENYA**</u>

Country and National Ownership

Since 2006 Kenya has made progress putting in place an ICT policy framework and implementation strategy. [16] There is an eHealth Intersectoral Group under the Ministry of Health. [2,3]

In 2011 Kenya launched its national e-Health Strategy 2011-2017. The vision of the strategy is "*To develop efficient, accessible, equitable, secure and consumer friendly health care services enabled by ICT*". The mission of the strategy is to "*promote and deliver efficient healthcare services to Kenyans and consumers beyond our borders, using ICT*". [29]

The strategy isolates five key areas of intervention:
1. Telemedicine
2. Health Information Systems
3. Information for citizens
4. mHealth
5. eLearning

Strong evidence of national sponsorship, ownership and planning.

Foundations: Infostructure

The Kenyan Ministry of Health is represented at ISO TC 215 where Kenya is the only African country to have "P" membership and may vote on standards. [30]

The Ministry uses an electronic database to manage and track the nursing workforce. [31] There are many vertical programs creating their own program-specific databases which are not integrated with the national HIS. [19]

Evidence of prioritization of eHealth standards. No evidence of integration.

Foundations: Infrastructure

Kenya has over 6150 health care facilities in 254 districts. In 2011 approximately 23% of these had neither computers nor internet services available to their health staff. The majority of districts reported that fewer than half of their facilities had uninterrupted access to electricity. [29]

Network strengthening activities have been initiated in Kenya in support of mHealth and other applications development. [32] At Kijabe Hospital in Kenya, Cisco and other collaborators installed a wireless network with an online medical reference tool called the Map of Medicine in order to provide medical professionals with relevant and up-to-date information needed to diagnose and treat patients. [33]

Evidence of plans to improve ICT infrastructure.

Health Process Domain Components

Electronic health records have been successfully implemented in several HIV clinics to manage patient care. [2,3,34,35,36] In addition, mobile devices (PDAs) have been used successfully in Kenya for the collection of health data, [28]

Kwale District is Kenya's first computerised district level HMIS. It is a joint effort between the Kenya MoH and the Community Health Department of the Aga Khan Health Services. The programme developed simple user-friendly software to collect and analyse data from local health facilities to provide more timely information for planning and decision-making, to give feedback to the clinics, and to encourage clinics to meet their targets and improve their performance. [7]

Kenya's HMIS systems have historically supported epidemiological data, explaining the lack of other subsystems of a comprehensive HMIS, such as drugs, lab services, logistics, finance, and human resources. [19]

Evidence of some systems to support patient care and strong system to collect routine information.

NIGERIA

Governance and Country Ownership

According to the progress report of the WHO Global Observatory for eHealth, between 2000 and 2005 Nigeria took actions to promote an enabling environment for information and communication technologies (ICT) in the health sector and was likely to continue doing so. This included the following:

- A health sector reform programme, which addressed the need to deploy ICT in the health sector;
- A national plan for the development of ICT in health which was implemented in 2005; and
- The launch of eHealth as part of eGovernment. [2,3]

Evidence of plans to make eHealth a priority.

Foundation: Infostructure

There is currently no integration of the multiple and wide variety of health information systems in the country. [37]

The National Malaria Control Programme is a vast project managed by the Ministry of Health.[38] In its early stages, it links data on climate, temperature and disease patterns. [33]
Little evidence of integration.

Foundation: Infrastructure

ICT infrastructure in the health sector is largely perceived as inadequate. (42)

Most of Nigeria does not have the infrastructure for internet connectivity. (43)
Indicates that ICT infrastructure for country is inadequate. No evidence of planning.

Health Process Domain Components

Health information systems are used extensively but implementation is vertical and fragmented. [37], for example OpenMRS is used in Northern Nigeria to provide digitized medical records [39] and DHIS is used in several provinces for routine data collection and reporting. [40] The Federal Capital Territory e-Health Web Portal initiative includes patient data management. [41]

Isolated systems to support patient care do exist.

TANZANIA

Country and National Ownership

The Government of Tanzania considers Health Information System to be one of the keystones for an efficient health system. [44] The Ministry of Health and Social Welfare (MoHSW) have a comprehensive current national eHealth Strategy [49] with roadmap and programmes for period 2009 – 2015 which includes plans for financing, governance, monitoring and evaluation, benefits realization, standards and interoperability. [49] The MoHSW has also published a proposal to strengthen Health Information Systems. [54]

Within the MoHSW's Health Information and Research (HIR) Section there is a unit called Health Management Information System (HMIS). There are also other sections contributing to eHealth, i.e. Health Research Systems and Surveys (HRS), National Sentinel Sites Systems (NSSS) and Information Technology and Communication (ITC). [44] [53]

Tanzania's health information system structure is divided into four levels, including the national, regional, district and health unit levels. [45]

There is government support for strategy development in eHealth, especially in the following areas:
- Strategy and Public Health 'Business' Alignment
- Policy and Governance
- Management: Organization of responsibilities and decision-making functions to coordinate people, processes, and technology
- Organization and Skills: Addressing structure, resources and facilities in the MoHSW
- Technology and Architecture: Infrastructure of eHealth and mHealth systems [51]

Strong evidence of country ownership and leadership. Well-developed structures for eHealth are in place.

Foundations: Infostructure

There is currently no integration of health data or a data warehouse for health information. [44] [52]

No evidence of planning for integration and interoperability.

Foundations: Infrastructure

The Afya Mtandao (Swahili for Health Network) was officially launched in January 2008 with funding provided by the International Institute for Communication and Development (IICD) of the Netherlands. This is now being expanded to include faith-based hospitals owned by Muslim Council (BAKWATA) and Private Hospitals. [49]

The Information and Communication Technology for Rural development project (ICT4RD) provides ICT access to the rural Tanzania and includes work to link dispensaries and Health centers. [16]

Mobile phone infrastructure is used for mobile solutions and mHealth initiatives, e.g. in the Integrated Disease Surveillance and Response (IDSR) system for recording priority diseases. [50]

Network strengthening activities have been initiated in support of mHealth and other applications development. [32]

Evidence of planning and implementation of ICT infrastructure for health facilities.

Health Process Domain Components

There is an array of information systems in place to collect data and report health status and service delivery. Although there is some automation, these are largely paper-based and include:

- Health Management Information Systems (HMIS) routine health collection from 5400 sites,
- Demographic Surveillance Systems (DSS),
- Health Systems Research under the MoHSW,
- Tanzania Demographic and Health Surveys (TDHS),
- Population Census and Housing,
- Household Surveys are coordinated by the National Bureau of Statistics (NBS) in collaboration with the MoHSW,
- Vital Registration System (VRS) (administered through the Ministry of Justice and Constitutional Affairs),
- National Health Accounts, managing financial resources for health,
- Health status records including:
  - Acute disease surveillance EPI programme (Expanded Programme for Immunisation)
  - Chronic disease surveillance like HIV/AIDS NACP, TB & Leprosy Programme [44]

The HMIS is computerized at the national and regional levels, remaining paper-based at the district and health unit levels the data handling is still manual at the district level. [45]

Recent eHealth projects include:

- The District HMIS (D-HMIS)which aims to improve the ability to collect, store and analyse health data, increase data accuracy, increase accountability, and improve tracking of health trends in the districts. Information on patient registrations, diagnoses, treatments, lab tests, billing and pharmacy records are being digitised. [47]
- Mennonite Economic Development Associates (MEDA) tracking mosquito net and voucher distribution. [46]
- PSI Tanzania system for logistics of supply and distribution of mosquito nets. [46]
- Implementation of OpenMRS has been implemented at 3 sites for the management of HIV/AIDS. [35]

Tanzania deployed DHIS 1 in five pilot districts between 200 and 2006, and begin deploying DHIS2 at the district level in 2008. Tanzania has configured DHIS2 to include data entry , analysis, and reporting of data for sexually transmitted infections [49], voluntary testing and counseling (for HIV) [50], and prevention of other to child transmission (PMTCT) of HIV/AIDS. DHIS 2 is the backbone of the HMIS technical strategy in Tanzania. [54]

Evidence of variety of systems for data collection and surveillance. Limited evidence of systems to support patient care.

<u>**UGANDA**</u>

Governance and Country Ownership

Several initiatives ensure that eHealth has support at a national level:

- A national plan for the development of ICT in health, which sets targets for health sector connectivity, was implemented in 2005. [2,3]
- The main goal of Uganda's Health Sector Information and Communication Policy is to "promote effective Development, Deployment and Exploration of ICT for quality healthcare".[55][56]
- In addition, the country has a HIS Strategic Plan 2009/11 - 2013/14 which includes setting up electronic networking (WAN and LAN) between national and district levels within the health sectors [57]
- HIS policy and planning is reported as adequate and there is substantial investment towards the development of routine facility-based health information systems [58]
- The scope of Uganda's National ICT Policy Framework looks at various categories of information from different sectors including health. [59] [16]
- National Health Policy includes the objective to facilitate the establishment and operation of a community based health information system. [60]
- Ministry has published standard operating procedures for HIS. [61]

Evidence of strong national leadership and planning.

Foundation: Infostructure

There are challenges harmonizing and streamlining data sources so that they are leveraged to provide a better impact measurement of health sector interventions. [58]

Limited integration of information.

Foundation: Infrastructure

Although there is basic ICT infrastructure in all districts that facilitates the transmission and feedback of data from the district level to the national level, HIS infrastructure is reported as present but not adequate [58]

The Government of Uganda through the Ministry of Information Communication Technology is spearheading the development of the National Data Transmission Backbone Infrastructure (NBI) and the Electronic Government Infrastructure (EGI) [62] [57]

The ICT infrastructure between the district and national levels is adequate enough for data transmission, whereas it is weak at the lower levels. ICT management is stronger at the national level, where the Resource Centre of the Ministry of Health coordinates HIS activities.

The Uganda Health Information Network (UHIN) was established in 2003 and links 175 remote facilities. [63]

Strong evidence of planning and implementation of adequate ICT infrastructure for health facilities.

Health Process Domain Components

There are several HIS applications in use, including:

- The Health Management Information System and Integrated Diseases Surveillance and Response System (IDSR).
- Population-based data provided through periodic surveys such as the Uganda Demographic and Health Survey (UDHS), census and Living Condition Monitoring Surveys (LCMS).
- The Vital Registration, Management Information System (VSR-MIS). However, computerized registration data captured at the district Population Office in the VSR-MIS is difficult to analyze. [57]
- The Health Management Information System (HMIS) of the MoH has evolved over more than 15 years, encompassing data from all levels of the health system: the village or grass roots health unit, parish, sub-county, HSD, district, and national level. Data are captured using a hybrid of paper forms, registers, and tally sheets at the health unit level. The kind of data collected is primarily patient data and mortality but also includes health care facilities, staffing, drug supplies, family planning, and population. Uganda has invested heavily to develop the HMIS and the Integrated Diseases Surveillance and Response System (IDSR). [all vital wave] However the HMIS has been made more or less dysfunctional by partners setting up their own separate systems for monitoring and evaluation of their programs. This affects data availability and accuracy useful for planning. [64]
- Several vertical systems exist for the monitoring and evaluation of antiretroviral treatment for HIV/AIDS. [65] One of these is OpenMRS which is used at three sites to manage HIV patients. [66][67] These fragmented and parallel data collection systems lack coordination. [58]
- The electronic Human Resource Information System (HRIS) has improved the Uganda Nurses and Midwives Council's (UNMC) business processes by tracking health worker data. [68] HRIS provides quick answers for planning, training needs, service delivery, staff retention and productivity. [7]
- mTrac is used nationwide to track medication stocks and patient information at the country's 5000 health facilities and 8000 local medication distribution centers. [69]
- UHIN enables the sending of disease surveillance data, reports related to HIV/AIDS, TB, malaria, and data monitoring drug usage and stocks. [UHIN link 14] Health workers in two districts, Mbale and Rakai, use Personal Digital Assistants (PDAs), which allow them to communicate with each other, exchange information and provide better patient care. [33][28] The community-based Sample Vital Registration cum Verbal Autopsy (SAVVY) tool has been developed through a rigorous process in Uganda as an effective tool to aid in health planning. [26]

Evidence of wide variety of systems for routine data collection and surveillance but little evidence of systems to support individual patient care.

ZAMBIA

Governance and Country Ownership

In 2007 the Zambian government launched its national ICT policy. [16] That year the country's policy and planning for health information systems was described as "adequate". [70] Currently Zambia has a Health Information Systems strategy for 2009 – 2015 which includes plans to design system for electronic patient records and upgrading ICT equipment. [71] [72]

In addition, a national eGovernance initiative includes an integrated Health Management Information System. [73]

ICT skills training is provided for healthcare professionals. [74]

Some evidence of planning and policy development for eHealth.

Foundation: Infostructure

There is currently no integration of health information systems. [70]

No evidence of planning for integration and interoperability of systems.

Foundation: Infrastructure

In 2007 Zambia's Health Information System infrastructure was described as "adequate". All key national and regional managers had access to computers and basic ICT infrastructure, although many district level facilities did not. [70]

Evidence for adequate ICT infrastructure for health is limited.

Health Process Domain Components

- The Health Management Information System (HMIS) is used to collect aggregate routine data on service delivery, as well as data on disease morbidity and mortality. [70][82]
- In addition, sub-systems of HMIS include the National Health Accounts system (NHA), the Financial and Administration System (FAMS), the Health Resource Information System (HRIS) and the District Logistics Self Assessment tool (DILSAT)   and the Integrated Disease Surveillance and Response system (IDSR). [80]
- Other health information systems not included in the HMIS are the Drug Logistics Management Information System (DLMIS), Smartcare, a portable integrated electronic health record system currently implemented in more than 550 facilities and the routine reporting system for Antiretroviral Therapy and HIV drug resistance (ARTIS). [77] [78][80] SmartCare aims to provide "continuity of care" in preserving a longitudinal data view. Specifically designed for areas with no telecommunication, it uses patient carried smart card to record information and, on a monthly basis, merges the data in a large and robust base. [33] [19]
- There is a Perinatal Record System used in clinics and the University Teaching Hospital (ZEPRS). [75][79][81] ZEPRS is an eGovernment project targeting prenatal care to women and postnatal care to neonates. [33] The goal is to reduce the very high maternal and infant mortality rate by reminding clinicians of best care practices and by keeping track of important patient information that affects outcome. [26]

- There are several vertical, donor-specific monitoring and evaluation systems especially for HIV/AIDS. [80]
- Zambian National Blood Transfusion Service (ZNBTS) has an integrated database for tracking donors [83] and uses mobile phones to send reminders to donors. [76]
- Projects using EMR to monitor ART. [84]

There is evidence of use of eHealth used on a wide scale to support patient care, although predominantly focused on HIV.

ZIMBABWE

Governance and Country Ownership

The National Health Strategy for 2009-2013 contains a section on health information with the objectives of strengthening and harmonizing health information and surveillance systems, increasing the use of information in decision-making, training health informatics resources and developing an eHealth strategy . [85]

A National Health Information System Technical Committee has been established in order to coordinate eHealth initiatives. The committee has five technical workgroups with the following focus areas:

1. Guiding further development and use of the District Health Information System (DHIS).
2. Developing a digital communication solution for health.
3. Developing a national eHealth policy and coordinate architecture development, inter-ministerial coordination and public-private partnerships.
4. Managing report production and follow-up.
5. Coordinating human resource development and training. [86]

The national Child Survival Strategy 2010 – 2015 includes an objective to strengthen supervision, monitoring, evaluation and the Health Management Information system (HMIS) to report on progress towards the relevant MDGs. [87]

Six international donors are assisting in strengthening the HIS in Zimbabwe, mainly by providing computers, training, and technical assistance. [88]

The country's National Health Information and Surveillance System (NHIS) has been doing well and now has a strategy for the future, but it continues to suffer from limited computerization, communication system especially at facility level and the resultant inadequate analysis and use of information. [89]

Good evidence of country leadership in planning and working towards a national eHealth strategy and related enterprise architecture.

Foundation: Infostructure

There is currently no integration of health information systems. In order to harmonize health information systems, the National Health Strategy for 2009-2013 plans for the establishment of a central health information repository. [85]

Evidence of planning for harmonization

Foundation: Infrastructure

For over two decades Zimbabwe has been using ICT tools for electronic messaging in the districts through HealthNet. By 2007, HealthNet covered 51% of the public health facilities. [94] However a USAID assessment done in 2010 reported limited Internet access (including at the district level), limited computerization at the facility level, and inadequate analysis and use of information as key challenges of the NHIS. Only 57% of facilities were found to have functioning computers and only 20% had internet access. [88]

The main offices of the Ministry of Health and Child Welfare (MOHCW) are connected by a fiber optic link. [85]

Evidence of planning and implementation for ICT infrastructure in health facilities.

Health Process Domain Components

Zimbabwe has deployed the DHIS nationally. RTI is working with the U.S. Centers for Disease Control and Prevention (CDC) and the Zimbabwe Ministry of Health and Child Welfare to strengthen the capacity to use the DHIS effectively to improve health care management and policy at all levels. Monthly reports on malaria cases and deaths from all public health facilities and some NGO clinics are reported through the DHIS. [93] [90]

There is limited capturing of morbidity and mortality data at central hospitals. [87] Health providers at the facility and district levels submit different types of summary, paper-based reports to the MOHCW, providing information on disease outbreaks, hospital utilization, workload and human resources. [93] There is an Integrated Disease Surveillance and Response system (IDSR) which is also largely paper-based. [91]

HIV/AIDS care centres have a variety of electronic databases [89] and vertical programs maintain their own reporting systems. [85] There are initiatives for mobile data collection of healthcare indicators and for disease surveillance. [92]

Systems in place for routine data collection and surveillance, Little evidence of systems to support patient care.

This very high level survey cannot provide the level of accuracy or detail that could be achieved by visits to individual countries and interviews with key officials. However, it is clear from **Table 1** (duplicated here) that the survey does illustrate certain broad trends.

Legend			Angola	Botswana	Ethiopia	Ghana	Kenya	Nigeria	Tanzania	Uganda	Zambia	Zimbabwe
No planning or implementation	(white)											
Planning but no implementation	(light hatch)											
Planning and some implementation	(dark hatch)											
Governance and national ownership												
Foundation eHealth infostructure												
Foundation ICT infrastructure												
Health process domain components												

Table 1. Evidence of eHealth planning and implementation in ten African countries.

Governance and national ownership.

There is evidence that for all ten countries there is some leadership and sponsorship for eHealth, either shown by the fact that some structures are in place or that national ICT policies include the health domain. Six of the ten countries show evidence of active planning and work towards an eHealth strategy and/or enterprise architecture.

Foundation eHealth infostructure

Of the four key categories of the Architecture Roadmap, this category shows the least evidence of planning and implementation. Significantly Kenya is the only African country to have "P" membership on the ISO technical committee for Health Informatics, ISO TC 215. Five of the ten countries show no evidence that issues of standards, interoperability, national registries, health information exchanges and data warehouses are being addressed at all.

Foundation ICT infrastructure

In Africa, this category is challenging as ICT infrastructure is closely linked to economic development. The initial capital outlay is generally significant and requires long term planning on the part of the ministries of health. It is worth noting that the five countries where there is some planning and implementation are also countries where the leadership has recognized the need for an eHealth plan or some form of eHealth policy.

Health process domain components

All of the countries show at least some evidence of implementation in this category. It is assumed that there is some planning related to this, even if it is fragmented. There is limited evidence of electronic health records used to support patient care and the implementation effort in this category is largely in public health, disease surveillance and vital registration. Support of patient care appears to be largely program-specific, e.g. for the care of HIV patients.

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