NHIS DESK REVIEW OF PREVIOUS ASSESSMENTS

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Ministry of Medical Services
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AfyaInfo

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The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

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Abbreviations

CHIS	Community Health Information System
CHW	Community Health Worker
CHEW	Community Health Extension Worker
DHIS	District Health Information System
DSL	Data Services Layer
HIS	Health Information System
HMIS	Health Management Information System
HSSF	Health Sector Services Fund
ICT	Information and Communication Technologies
KePMS	Kenya HIV/AIDS Programme Monitoring System
KEMSA	Kenya Medical Supplies Agency
LAN	Local Area Network
MOH	Ministry of Health
NHIS	National Health Information System
ODS	Operational Data Store
USG	United States Government
WHO	World Health Organization

Definitions

For consistency of use, the following technology definitions are provided below and used throughout this document:

Archiving – Archiving is a process for backing up data that may not be routinely accessed, but to which an organisation wants to retain the ability to access should the need arise. By archiving data, database queries become faster and more efficient, translating into faster, more responsive experiences for the end users. For example, "*I want to store large amounts of data for long periods of time and might never query any of it.*" For the AfyaInfo project, we will consider archiving as a means to keep critical data available to the Ministry of Health (MOH) but not drag down the performance of real-time and recurring analysis activities.

Data dictionary – A data dictionary, or metadata repository, as defined in the IBM Dictionary of Computing, is a "centralised repository of information about data such as meaning, relationships to other data, origin, usage, and format." In other words, a data dictionary helps describe the data in the system, and helps translate the data of one system into terms acceptable in another system. This can be a document, a stand-alone piece of software positioned between two other pieces of software (often referred to a "middleware"), and/or a design component of an existing piece of software. AfyaInfo will need to produce a data dictionary to help systems (e.g. District Health Information Software (DHIS), Health Sector Service Fund (HSSF), and Integrated Disease Surveillance Report (IDSR)) translate their data fields into a common language.

Data dissemination – Once data have been integrated into the National Health Information Systems (NHIS), stored in the data warehouse, and sent to the various data marts for data mining and visualization, the "results" should be disseminated to decision-makers. The method of dissemination depends on what the results look like and who needs them; however, data dissemination could occur by web page, email, Rich Site Summary (RSS), SMS text message, paper report, voice phone call, a briefing, or another method.

Data governance – Data governance embodies a convergence of data quality, data management, data policies, business process management, and risk management surrounding the handling of data in an organization. Through data governance, organizations are looking to exercise positive control over the processes and methods used by their data stewards and data custodians to handle data. AfyaInfo will need to create good data governance structures because, as systems join the NHIS and build new applications using integrated health information system (HIS) data, small changes in one system's database design will have ripple effects on the whole NHIS. A simple change in a field's definitions in system A, might render irrelevant the mashups built using that data field in systems B, C, and D.

Data mart – A data mart is the access layer of the data warehouse environment that is used to get data out to the users. The data mart is a subset of the data warehouse, usually oriented to a specific business line or team. There can be multiple data marts inside a single HIS system; each one relevant to one or more business units for which it was designed. Data marts may or may not be dependent or related to other data marts in the same HIS. For AfyaInfo, this could mean creating separate data marts for each system (e.g. DHIS, HSSF, ISDR) and/or stakeholder (e.g. World Bank, United Nations, Centers for Disease Control and Prevention, Clinton Foundation), and/or government constituency (e.g. Department of Standards and Quality Assurance, Kenya National Bureau of Statistics, Kenya ICT Board) or hierarchy level (e.g. facility, county, national).

As such, these data marts would allow focused groups of users to interact with equally focused groups of information to mine and visualise, without being overwhelmed by the entire national dataset.

Data mining – Data mining is the process of extracting patterns from large data sets by combining methods from statistics and artificial intelligence with database management. Data mining is a process of inspecting, cleaning, transforming, and modeling data with the goal of highlighting useful information, suggesting conclusions, and supporting decision making. For example, *"I'm accumulating tons of data daily and I know there's valuable information in there, but I don't know what it is."* For AfyaInfo, we will want to provide some tools or capability for the MOH to mine and explore the data once it starts populating the national data warehouse.

Data services layer (DSL) – The DSL provides a layer for data access that is independent of the physical schema. The purpose is to provide a consistent interface for accessing data, independent of the structure of the databases attempting to make the connection. For AfyaInfo, the DSL will be the component that each system (e.g. HSSF, DHIS, MFL) will connect with to submit and retrieve data from the NHIS. Because each system is interfacing with the DSL and not each other directly, it does not require that each participating system reconfigure its own database to be in compliance with a national standard; it only requires the each participating system build a connection string that translates the native system's database into the terms defined in the DSL. As a result, systems can continue collecting and processing data as they have before, but now a new service will run "in the background" that translates key data into the DSL for submission or extraction.

Data warehouse – A data warehouse is a subset of the overall data available in a system, collected over large periods of time, and needed to process a relatively small number of very large data requests. It is an interim database that lies somewhere between the source databases (e.g. DHIS, HSSF, ISDR) and the reporting platform (e.g. a national indicators dashboard). Data warehousing is used for archiving, data mining, and analytics or some combination of all three. A data warehouse maintains its functions in three layers: staging, integration, and access. Staging is used to store raw data for use by developers (analysis and support). The integration layer is used to integrate data and to have a level of abstraction from users. The access layer is for getting data out for users.

Data visualization – Data visualization is the visual representation of data such as transforming tabular data into a picture, chart, graph, or physical model in order to communicate more clearly and stimulate viewer engagement and attention. Visualizations can also be helpful in data mining as trends may be more easily spotted using a line chart, for example, than by using a long tabular list of raw data. For AfyaInfo, we will want to provide some tools or capability for the MOH to create visualizations.

Metadata – Data providing information about one or more aspects of the data, such as:

- Means of creation of the data
- Purpose of the data
- Time and date of creation
- Creator or author of data
- Placement on a computer network where the data were created
- Standards used
- The basic information of a piece of music

For example, a digital image may include metadata that describe how large the picture is, the color depth, the image resolution, when the image was created, and other data. A text document's metadata may contain information about how long the document is, who the author is, when the

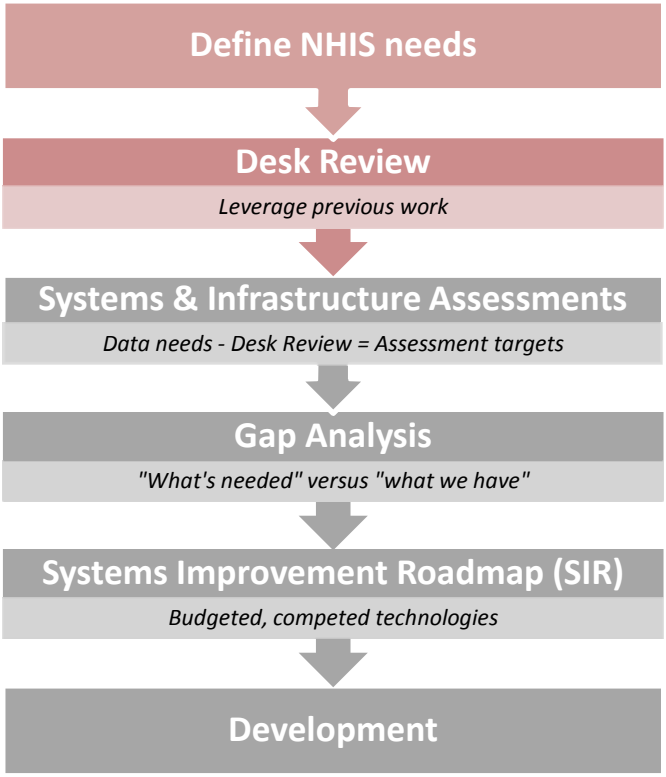
document was written, and a short summary of the document. Metadata can be stored and managed in a database, often called a registry or repository. AfyaInfo will store the metadata for each system's data that enters the national HIS in the *data dictionary*.

Operational data store (ODS) – The ODS is a database designed to integrate data from multiple sources for additional operations on the data. The data are then passed back to operational systems for further operations and to the data warehouse for reporting. Because the data originate from multiple sources, the integration often involves cleaning, resolving redundancy, and checking against business rules for integrity. The ODS comes after data passes through the *DSL* and before it is stored in the *data warehouse*, or parsed out into the various *data marts*.

Background and Justification

The objective for Output 1 is to establish an integrated web-based, host country-owned and managed, national health information system (NHIS) that generates quality data used at all levels to improve health service delivery. To achieve this goal, AfyaInfo employs these steps:

1. **Define NHIS needs** – Identifies "what *assets* we need" (systems, technology, and people)[1] and "what *processes* we must know" (change management, data fields, and standards) to establish a functioning NHIS enterprise architecture.
2. **Desk Review** – Leverages previously commissioned work to assess what assets and processes are already in place.
3. **Systems & Infrastructure Assessments** – Targets data not discovered during the desk review. These assessments complete our understanding of the existing assets and processes in place. Collectively this establishes the baseline for readiness of individual systems as well as the family of systems to join the NHIS.
4. **Gap Analysis** – Identifies the difference between the *necessary* assets and processes (Step 1) and the *existing* assets and processes (Steps 2 + 3).
5. **Systems Improvement Roadmap (SIR)** – Prioritises, plans for, and budgets for the assets and processes identified in the Gap Analysis. Puts them into a development timeline and assigns top-level responsibility.
6. **Development** – Iterative development of the SIR components.



Step 1 - Define NHIS Needs

An NHIS which creates interoperability among a family of systems consists of three main, and inseparable, parts. First, it consists of assets (e.g. hardware and software). Second, it consists of processes (e.g. standard protocols, definitions, and rules). Third, it consists of a governance and change management model.

In an ideal situation for the NHIS the desk review discovers:

- All systems would use the same **programming language**[2]
  - Can share web service code snippets

[1] Figure 1: Stepwise approach to systems development. Adapted from the ITIL software development methodology. For purposes of clarity, processes (which are deemed "assets" in ITIL) have been broken out to a separate category.

[2] This does not mean that all systems use the same software *system* (e.g. DHIS). In a perfect world, all individual software systems (e.g. DHIS, iHRIS, KEPMS, CHIS) would be built using the same programming language (e.g. PHP, .NET, ColdFusion, Ruby on Rails). This would simplify how to build connections among them. The AfyaInfo proposal and integration concept does not recommend using a single piece of software (e.g. DHIS) to solve problems in all HIS areas (Service Delivery, Logistics, Finance, and Human Resources).

- Simplifies quality control and troubleshooting
- Enables a clearer path for how to build admin interfaces for the DSL
- Makes it easier for the Ministry of Health (MOH) to establish internal (or local) programmers to maintain the NHIS because programmers only need proficiency on one language
    - Where this is not the case, the programmer support pool for building or maintaining dashboards, administrative panels, or application-specific interfaces to the data will rest at the system owner level, troubleshooting will be more difficult, and fewer cross-system efficiencies will exist on development efforts.

- All systems would use the same **database type**[3]
  - Avoids syntax issues with data structure and SQL commands across MySQL, PostGreSQL, and MS SQL, MS Access, Oracle, etc.
  - Enables the sharing of written queries into underlying databases
  - Simplifies decision for what database technology to use for the data warehouse
  - Increases the developer pool already involved in the NHIS who can contribute / pinch hit on NHIS development issues across the projects
  - Makes it easier for the MOH to build internal (or local) programmers to maintain the databases
    - Where this is not the case, we will need to build the data dictionary and data map for interoperability entirely from scratch—the task becomes more complicated and longer if the systems are all using different types of databases

- All systems would have web services built and enabled
  - Jump starts development; to the extent that systems are on different databases and use different programming languages, the web services will have to be custom built. To the extent these systems are built upon the same platforms, portions (or all) of a single web service may function across systems making development simpler and faster.
  - Simplifies defining web service standards becomes easier; it is a documentation exercise of what already exists, rather than a negotiation among system owners and programmers to create something from scratch.
  - Suggests that documentation has already begun or been finished on the web services for each system, which makes documentation on the central DSL easier.
    - Where this is not the case, we will need to work with each system's programmers individually to build a web service and connect to the DSL. Documentation will be a larger effort if building from scratch.

- All systems would have excellent **data quality**
  - Adds immediate value to the NHIS when system is joined.
  - Builds confidence among stakeholders when first dashboards are created and initial conclusions drawn from data mashups.
    - Where this is not the case, processes must be built to clean the data both one-time prior to entry in the NHIS and then systematically.

- All systems would use state-of-the-art **hardware**
  - Increases frequency with which data can be updated and amount of data that can be updated within a given time period
  - Improves ability to leverage cutting-edge and world-class data visualisation and collaboration software and utilities
  - Improves ability to support the additional overhead incurred when a system incorporates external data via web services

[3] E.g. Microsoft SQL Server, MySQL, PostGreSQL, Oracle, Access, or other database type. The AfyaInfo proposal and integration concept does not recommend that all software systems (e.g. DHIS, iHRIS, KEPMS, CHIS) use the same literal database.

- Where this is not the case, system data may not be updated in real-time or may be limited in the amount of data it can share/consumer to/from the NHIS.

- All systems would be built to **the same data standard**
  - Jump starts development because data field *types* (e.g. text, integer, bit), *characteristics* (e.g. 32 characters long), *naming conventions* (e.g. "first_name" vs. "fname"), and *values/unique identifiers* (e.g. "Kenyatta National Hospital" vs. "Kenyatta Hospital" or similar for town names, provinces, etc.) are already in sync.
    - Where this is not the case, each data field to be exchanged must be negotiated among the stakeholders who will use the data field to agree and define the data type, characteristics, naming conventions, and values. Infers that determination of which system is the "authoritative source" of a specific data field has not yet been decided; doing so is a prerequisite for a DSL. Will lead to higher error rate among initial interoperability efforts as we discover nuanced differences in data across systems.

- All systems would use strong governance and change management mechanisms
  - Once intertwined, these systems will more efficiently communicate changes from their system to others', or deal with how changes in other systems will affect their own.
    - Where this is not the case, these mechanisms must be built and system owners must participate actively or the NHIS data quality will suffer.

The extent to which these conditions do not reflect reality, AfyaInfo will need to build a network that can accommodate the deviation. The greater the deviation from these ideal standards, the more complex the solution, the more programmers and people must be involved, and the slower the development will proceed.

<u>Assets (e.g. Hardware and Software)</u>

The data flow model for the proposed NHIS architecture is represented in Figure 1:

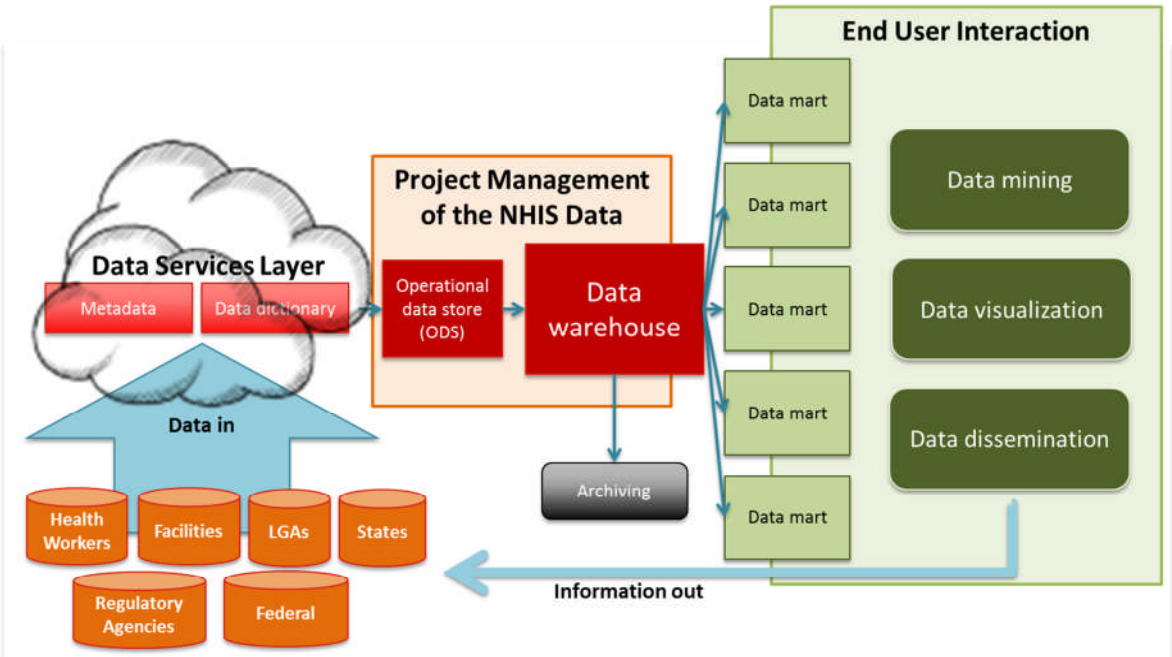


Figure 1: Data Flow Model and Major Components of the NHIS

In addition to the "ideal" criteria listed above, which focuses on the software systems in their current state and function, the NHIS will require that new functionalities be added to facilitate and govern this exchange of data. Existing HIS in Kenya may be capable of providing one or more of the

following needed software components. The resident **software components** needed for the new NHIS are[4]:

- Web services (to move data in/out of the Data Services Layer (DSL))
- Security software, virus scanning, firewalls
- Database software (for the Operational Data Store, data warehouse, and data marts)
- Scripting and/or application software to run processes on the data as it comes in (security checks, normalisation of the data, de-duplication of records, etc.)
- Administrative software to monitor the status of each DSL connection, system data, and the NHIS software and hardware components
- Archival software to manage infrequently accessed data from the data warehouse
- Application software to create or extract data marts for various stakeholders
- Data visualisation software to explore the data in a data mart
- Data dissemination software to share the results of a visualisation (web link, Excel, PDF, embed code, web services, etc.)
- Website(s) to engage NHIS system owners with information about standards, configuration, help desk support, etc.
- Website(s) to engage the private community to interact with subsets of NHIS data (optional)
- Dashboard software to share data visualisations, reports, and other administrative data for the DivHIS and stakeholders
- Wireless and Internet connectivity software (depending on how end users connect)

There are dozens or hundreds of options for any individual component of software described above. The decision on "which is best" should only be made once an adequate survey of "what exists" and "what are people capable of handling, e.g. training, sophistication, cost" are completed as part of the desk review and Systems & Infrastructure Assessments[5].

In addition to the hardware needed in the "ideal" situation above, new hardware will be necessary to house the NHIS data warehouse, data marts, and other software components. The resident **hardware components** needed for the NHIS are[6]:

- Web server(s)
- Database server(s)
- Client-facing hardware to access the NHIS (PC, laptop, mobile)
- Wireless and Internet connectivity hardware (modems, routers, repeaters)
- Firewall hardware

The numbers of each component needed, models and specifications, will be driven by the results of the desk review and Systems & Infrastructure Assessments. For example, how many servers are needed is contingent upon how much real data exist in the targeted NHIS systems and how ready each system is to join the NHIS.

Processes (e.g. Standard Protocols, Definitions, and Rules)

For systems to achieve interoperability, they must all "speak the same language" and abide by agreed upon rules for how and when to exchange data, how to interpret the data received, and how to negotiate differences among systems. These include[7]:

- Data dictionary

[4] This list is representative, not exhaustive.
[5] In addition to insights gained from the Output 2 and Output 3 assessments on training needs and organisational capability.
[6] This list is representative, not exhaustive.
[7] This list is representative, not exhaustive.

- Data map
- Data exchange standard (e.g. SDMX-HD, HL-7, or DXF)
- Rules on which systems hold authoritative data
- Rules on reconciling closely related data
- Rules on removing duplicate records
- Backup and failover policies
- Service-level agreements (SLA) for uptime, service provisioning, response times, etc.
- Acceptable programming languages
- Acceptable database languages or design
- Procedure for notification of changes in underlying data
- Requirements for
    - Frequency of data updates by each system
    - Data quality, minimum specifications
    - Uptime or availability of a system's data
- Scope – See Figure 2 for the list of systems to be included in Year 1 for the NHIS[8]

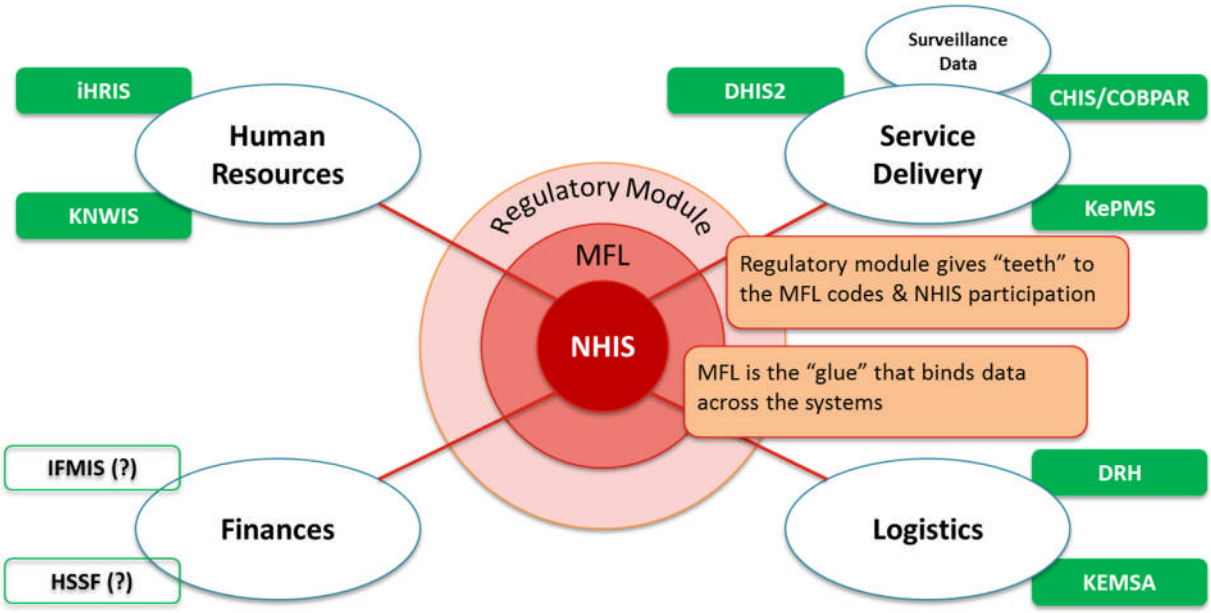


Figure 2: Information Systems Included in the Year 1 Proposed Scope of NHIS Development

<u>Governance & Change Management</u>

These requirements are being informed by work done through Output 2 and Output 3 of the AfyaInfo project. They are noted here only to stress their importance and to reinforce that they are inseparable from the asset and process requirements for a well-functioning NHIS.

Step 2 - Desk Review

The desk review aims to review all related assessments and interviews on these subjects that were completed by another entity, funding mechanism, or government organisation. The intent is to reduce duplication of effort and speed deployment time of the NHIS. The remainder of this

[8] System integration criteria proposed by AfyaInfo: 1) System fits cleaning into one of the following categories: Service Delivery, Logistics, Human Resources, or Finance; 2) System owners are willing and eager to participate immediately; 3) System already has Master Facility List (MFL) codes integrated (or soon will); and 4) Maximum of three systems per category. Inclusion in the Year 1 scope does NOT mean endorsement of one system over another, or that a system cannot be integrated in Years 2+. The intent of a narrow Year 1 scope is to build the mechanisms (assets and processes) necessary to add systems into the NHIS. The purpose is to build the infrastructure and processes in Year 1, not to build the complete NHIS family of systems.

document describes what sources were consulted and what information was extracted, relevant to the NHIS.

Steps 3–6 - To Be Addressed After the Desk Review is Complete

Follow on steps will build upon the results of the desk review.

Sources Consulted

While many previous assessments have been completed on the health facilities, networks, and systems, very few were focused on the critical data elements necessary to build an NHIS. However, we would like to acknowledge the excellent efforts and astute findings of the previous works listed below, which we leveraged to the maximum extent possible, and to whom we owe a great deal of gratitude.

A desk review is not a static process; if you are aware of a previously completed work whose findings are directly relevant to how the systems will connect their assets, processes, and governance models into the NHIS, please remit to: jeff_takle@abtassoc.com.

1. APHIA II Evaluation. 2011 Case Study Review of the Community Health Information System (CHIS) in Kenya. Nairobi : USAID, 2011.
2. Health Metrics Network. *Health Information System Assessment Report.* Nairobi : Ministry of Health, 2008.
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7. Investment Climate Advisory Service, World Bank Group. *Kenya National eHealth Strategy.* Nairobi : MOH, 2011.
8. MOH. Community Health Information System (CHIS) Tools Feedback. Nairobi : MOH, 2009.
9. Unk. Health Information System Policy. Nairobi : MOH, Unk.
10. Child Survival Technical Support Project. *On the Design of Community-Based Health Information Systems.* Calverton : USAID, 2003. Produced by the Child Survival Technical Support Project. www.childsurvival.com.
11. Unk. *Community Strategy.* Nairobi : MOH, 2006.
12. Unk. Community Strategy Implementation Guide. Nairobi : MOH, 2006.
13. APHIA II Evaluation. *2011 Case Study Review of the REV.* Nairobi : s.n., 2010.

Key Questions[9]

The minimum requirements for systems in the NHIS are:

- Data that are of value to another system, the MOH, or a key stakeholder. Tertiary information or that which is only of interest to the system owner/user does not need to be shared amongst the NHIS community. Fundamentally, each system must understand and demonstrate how its data are useful to others in the NHIS community.

[9] These are the general questions. Survey instruments were created in much greater detail. To request access or review of those instruments, please contact the AfyaInfo project.

- Programming language and programmer support for each system that is capable of adapting the system's user interface, back-end processing, and database structures to accommodate additional data fields from/to the DSL.
- Database type, structure, and programming support to enable push/pull of data to/from the DSL.
- Web service mechanism for automated or semi-automated push/pull of data in/out of the DSL.
- Sufficient data quality and stability to render analysis as trustworthy and actionable.
- Sufficient hardware to accommodate increased load levied by web services, application and database changes, and increased use via the DSL.
- Use or adoption of a data standard within the web service to effectively interoperate with data from other systems.
- Sufficient governance and change management to communicate to the NHIS community when system data or definitions are added, updated, or deleted from their system; ability to adapt to changes from other systems.

The question categories below aim to establish whether each system has met the minimum requirements. Where shortfalls exist, they will be evaluated in the Gap Analysis and Systems Improvement Roadmap for future development. Question categories include:

Systems – For each software system:

- What assets, processes, and governance do they currently have?
- How do the nodes of this system communicate with one another (if applicable)?
- Are they supported with a programming or development resource?
- What is the system's state of readiness (uptime, quality of data, depth of data)?
- What is the system owner's interest and willingness to participate in the NHIS?

Infrastructure – For each user group(Data Entry, Manager, Government Official) at various levels (Community > Facility > District > State > National):

- On what hardware and software do they access the systems listed above?
- How critical are these systems to their daily jobs? (Output 2)
- How proficient are they in the use of these systems? (Output 2)
- How do they aggregate the data in these systems (Internet, courier, email, etc.)?
- How reliable is the infrastructure upon which they access these systems (power, connectivity)?

Methodology

The overall assessment methodology is as follows:

1. Identify the "ideal" conditions for all systems (referenced above in section titled "Define NHIS Needs").
2. Measure the current systems in reference to the ideal conditions via a desk review and—where necessary—primary data collection (outputs = **Desk Review; Systems** & **Infrastructure Assessments**).
3. Define the gaps between "actual" and "ideal" (output = **Gap Analysis**).
4. Decide which gaps are achievable, prepare strategic and cost options, and prepare a development plan (output = **SIR**).
5. Develop solutions on a timetable.

The desk review methodology consisted of a thorough analysis and review of all the previous assessment documents shared through Basecamp. The documents were sourced from relevant

individuals and entities. AfyaInfo will record the baseline data for each system and the overall infrastructure into the same Systems & Infrastructure Assessment tools that will be used to close any known knowledge gaps remaining after the desk review. In this way, AfyaInfo first establishes what is known from review of previous work before going to collect new data, there is minimal duplication of effort in any new data collection, and interviewers focus only on answering the questions within the assessment tools that have not been previously completed via the desk review.

Review Findings

Human Resources

Kenya Nursing Workforce Information System

The Department of Nursing deals with planning, supervising, and directing nursing services, overseeing nursing education, monitoring and evaluating nursing services, developing and reviewing nursing policies, standards, and guidelines, planning, deploying, and reviewing deployment of nursing staff, overseeing procurement and managing distribution of non-pharmaceuticals supplies and medical instruments, and conducting and disseminating operational research findings on nursing.

The CDC-EMORY project has assisted the Department of Nursing by designing and implementing a health workforce management system to assist in managing the deployment exercise, and providing reports for evidence-based decision-making and accurate data for research and analysis.

The Kenya Health Workforce Information System at the Department of Nursing was established in 2005 and its active use began in 2007. The department has managed the system since then, with the assistance of the CDC-EMORY project.

The system was developed using VB.Net 2002 - 2010, running on a MSSQLSERVER 2000 database. The department hosts the system on a Windows server 2003. The technology available in Kenya at the initial stages of system development greatly influenced the methodology used to develop the system. That is, it was developed as a Windows desktop system and a Citrix link was used to enable multiuser logins.

Eight Citrix licenses were procured and are maintained to enable the co-coordinators from the eight provinces to log in and post the staff returns from their respective provinces.

Integrated Human Resource Information System iHRIS

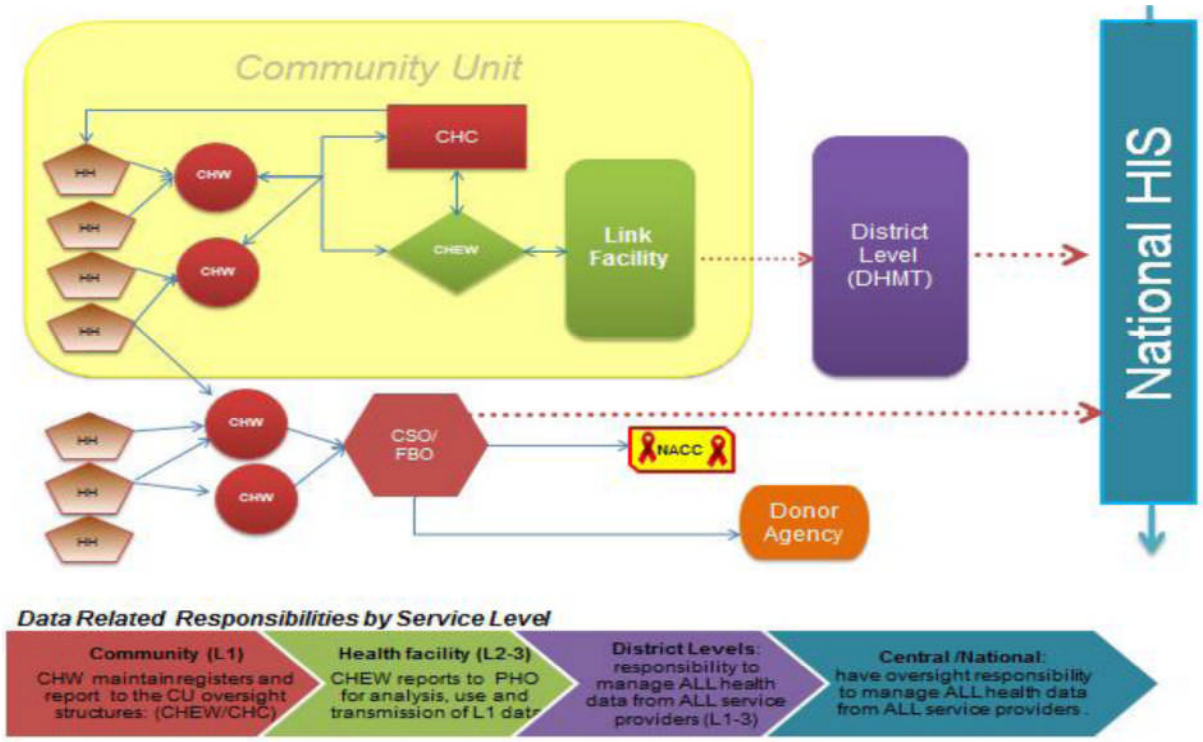
iHRIS is a web-based open-source human resource information system developed and supported by www.capacityplus.org/hris. The system was developed and customised to enable human resource management functions like transfers, vacant posts, current pay stations, and performance appraisal management functions.

iHRIS is based on the first floor of Afya House. Development is ongoing and iHRIS has been populated with data for all employees from Integrated Personnel Payroll Database (IPPD). The team is also implementing MFL codes in the definition of their health facility lists. iHRIS runs on Apache Webserver, uses MySQL as the database, and was developed using PHP.

Service Delivery

Community Health Information System (CHIS)

Figure 3 was extracted from the "*Kenya CHIS status Review Report*". It shows data flows from the different components of the CHIS.



Note: HH=household, CHC= community health committee, CSO=civil society organisation, FBO=faith-based organisation, NACC= National AIDS Control Council, DHMT=district health management team

Figure 3 - Data flow CHIS

Community health workers (CHWs) are responsible for collecting data from households. They transmit the data to the link (health) facility though community health extension workers (CHEWs). Each community unit is established under a link facility, which acts as a supervisory organ to the unit. HIV service data are captured through the Community-Based AIDS Reporting system (COBPAR) by the National AIDS Control Council as a separate reporting mechanism for civil society organisations implementing community HIV services. The MOH has four data collection tools for CHIS and reporting occurs at two levels. CHWs submit monthly reports to the CHEWs, who consolidate all the CHW reports as per the MOH514 or in substituted notebooks. The CHEWs also report monthly, through the MOH515. This report is submitted beyond the unit and the link facility to either the District Community Strategy Coordinator or the District Public Health Officer. Reports usually are submitted manually as few CHEWs have access to e-mail.

The CHEW, or in some cases the community health committee (CHC), also transfers the data from the MOH515 to the MOH516 for feedback reporting to the community, although this is done only rarely.

Printing and distribution of tools has been a challenge hence the poor reporting. Data storage was also mentioned as a problem. All tools are retained by the CHEW and limited to the link facility's capacity. At the time of review, there was no existing electronic data collection tool.

Kenya Program Monitoring System (KePMS)

KePMS is a Microsoft Access-based indicators monitoring database that over 90 U.S. government (USG) implementing partners use for the management of HIV/AIDS prevention, care, and treatment programme data based on indicators of the President's Emergency Plan for AIDS Relief (PEPFAR).

The system has four main modules; data entry, reports, decision support, and system utilities. Facility data are collected using government forms and entered into the system either monthly or quarterly.

Collected data are usually uploaded semi-annually securely to http://snisnet.net/KePMS.php website for access by the USG. Collation of the data from the USG agencies is done by the database administrator, who creates one national file. USG activity managers download the data, clean them, and give feedback to the programs. The Strategic Information team compiles final country report for reporting to the Office of the Global AIDS Coordinator. The following are the key KePMS components;

- Data management
- Indicator management
- Indicator targets management
- Training data management
- National programme indicator management
- Community-based programme indicator management
- Partner and activity sites master list and attribute maintenance
- Built-in data validation and logic checking for data quality.

The following system requirements have to be met for the application to run;

- Windows 200/xp/Server 2003/Vista
- Microsoft Access 200 and above
- Windows compatible PC w/100 MB disk space
- Microsoft Data Access Components 2.8
- Screen resolution of 800*600 or higher
- Administrator level privileges for windows.

District Health Information System (DHIS2)

The government of Kenya, through DANIDA and the University of Oslo, rolled out DHIS 2 as a key tool for service delivery data needs. DHIS 2 is a tool for collection, validation, analysis, and presentation of aggregate statistical data, tailored (but not limited) to integrated health information management activities. It is a generic tool rather than a pre-configured database application, with an open metadata model and a flexible user interface that allows the user to design the contents of a specific information system without the need for programming. DHIS 2 and upwards is a modular web-based software package built with free and open-source Java frameworks. DHIS 2 is open-source software released under the BSD license and can be used at no cost. It runs on any platform with a JRE 6 installed. The DHIS 2 is developed by the Health Information Systems Programme (HISP) as an open and globally distributed process with developers currently in India, Vietnam, Tanzania, Ireland, and Norway. The software is implemented at the national level in many countries in Africa and Asia, such as India, Vietnam, Kenya, Sierra Leone, Tanzania mainland, and Zanzibar.

Features of DHIS2

- Web enabled based on Java technology.
- Platform independent – Runs on any platform for which there exists a Java Runtime Environment, in practice all popular platforms including Windows, Linux, Mac OS X, and Solaris.
- DHIS 2 is written according to the W3C standard for HTML and CSS and runs on any standard compliant web browser like Firefox, Chrome, Opera, Safari 4, and Internet Explorer 8+. The DHIS 2 team recommends Chrome as it provides excellent performance and runs on Windows, Linux, and Mac OS X.

- DHIS2 runs on most relational databases. It currently runs on PostgreSQL, MySQL, H2, and Derby. DHIS 2 is built with Hibernate and only minor development efforts are needed to make it run on any major relational database.
- DHIS 2 is released as free and open software under the BSD license.
- DHIS 2 has a modular architecture
- DHIS 2 supports the official format for health data exchange developed by the World Health Organisation (WHO) called SDMX-HD.
- DHIS 2 is currently available in English, French, Spanish, Hindi, Vietnamese, and Norwegian.

Logistics

Kenya Medical Supplies Agency (KEMSA)

KEMSA is a specialised medical logistics provider for health facilities and programmes supported by the Ministries of Medical Services and of Public Health and Sanitation (which together constitute the MOH). The agency was formed on February 11, 2000, in response to recommendations of a health stakeholders' forum, "Strategies for Reforming the Drug and Medical Supplies Systems in Kenya," held June 7-10, 1998. A State Corporation established by a legal notice issued under CAP 466 of the Laws of Kenya, KEMSA replaced successive medical stores administrations that had existed since 1901 under various names. KEMSA works to support the National Health Strategic Plan and the Kenya Essential Package for Health in providing public health facilities with the "right quantity and quality of drugs and medical supplies at the best market value".

KEMSA is currently running two applications;

- Logistic Management Information System – a web-based system
- Navision – A desktop windows-based Enterprise Resource Planning (ERP)

Finance

Integrated Financial Management Information System (IFMIS)

The desk review could find no concrete information about this application.

Health Sector Services Fund (HSSF)

HSSF is responsible for direct funding for health services by the government of Kenya, a strategy geared towards removing financial barriers to access to care. There was no concrete information on the implementation and or environment information about the system.

Refer to Appendix 1 for other software systems assessed during the desk review.

Existing Infrastructure and Use

Information and Communication Technologies (ICT) Equipment

The review showed that currently, about 149 districts now have PCs at health records and Information offices. These are used for the health information management system (HMIS) function of collating data at the district level and reporting. During the follow-up interviews, approximately 34% of the respondents indicated that the number of PCs was inadequate, more so at the facilities level (Figure 4).

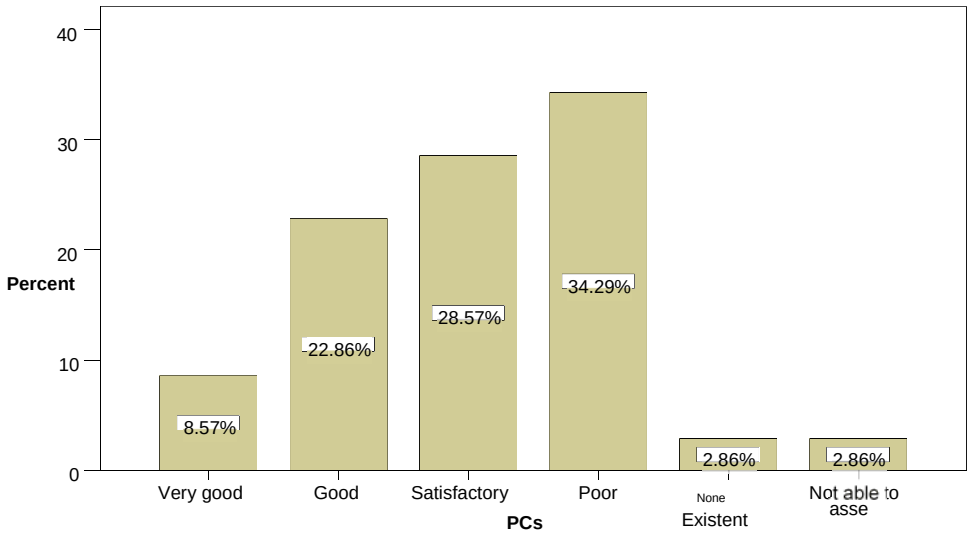


Figure 4: Adequacy of PCs at facility level

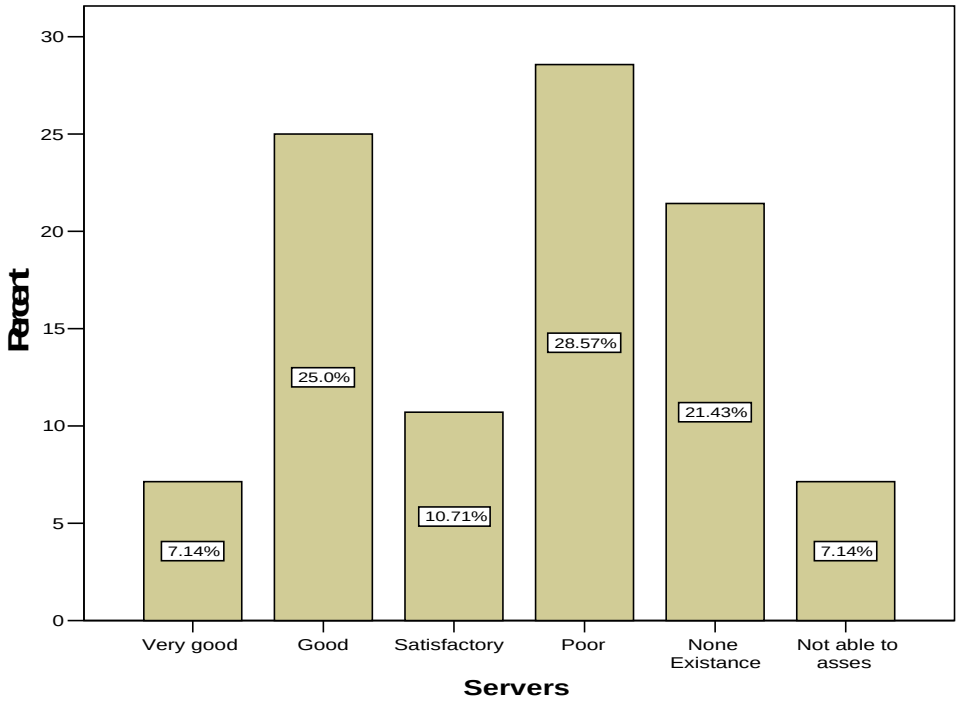


Figure 5: Adequacy of Servers

About a third of the respondents (32%) perceive that the number of servers is adequate for data management, whereas 29% do not (Figure 5). Another 7% of respondents were unable to assess.

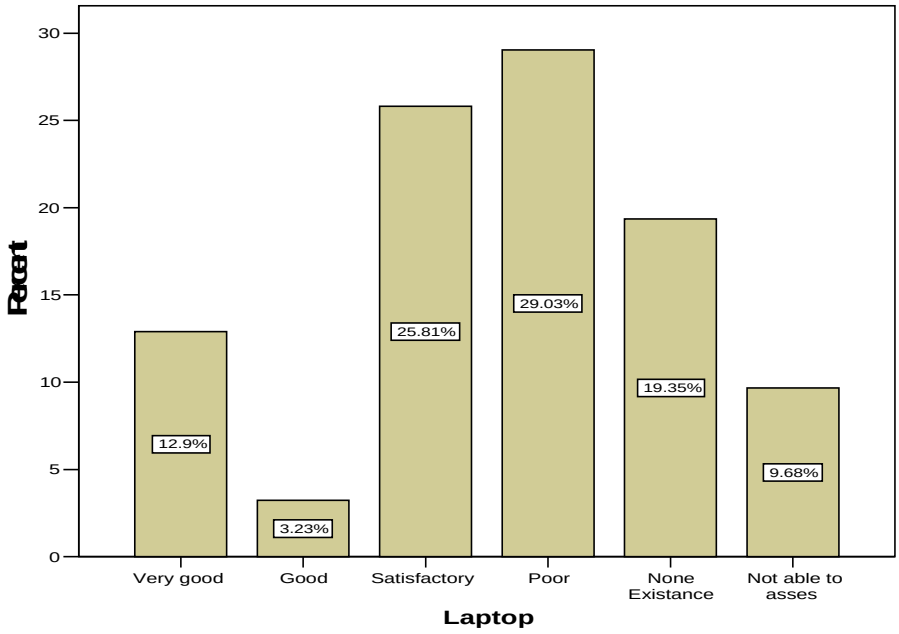


Figure 6: Adequate Availability and Use of Laptops

Just over 29% of the respondents rated the availability of laptops for data management as inadequate as opposed to 15% who found availability adequate (Figure 6). This 15% largely comprised respondents from Nairobi, and in particular from programmes and projects which are funded by development partners. Additionally, approximately 26% of the respondents are satisfied with the use of laptops while about 10% do not have access to them. Overall, numbers of PCs, laptops, and servers is poor and the equipment is unevenly distributed.

In some areas, electrical power, and connectivity are non-existent, making the provision of equipment needless.

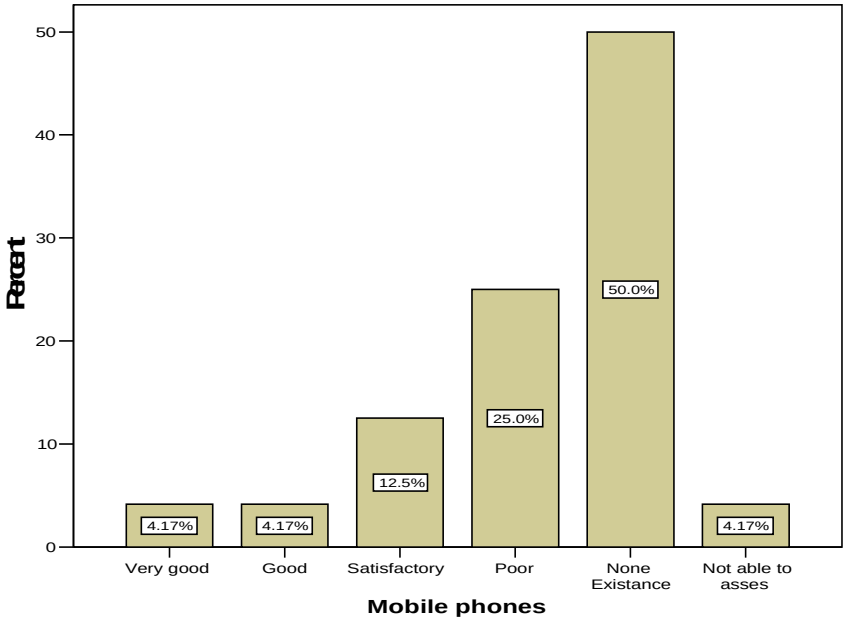


Figure 7: Use of Mobile Phones

The user of mobile phones for data connectivity was also minimal at the time of review (Figure 7).

Acquisition of ICT Equipment, Security, and Technical Support

A large percentage (over 75%) of the ICT equipment in use in the health sector and based on the sites visited were donated by health sector development partners. Only a small number were acquired through procurements funded directly by the responsible health ministry or, in the non-government sector, by a health facility.

The security in place for ICT resources refers largely to physical security—most of this equipment is located in burglar-proofed rooms. There was almost no electronic security.

There were three modes of technical support available for ICT equipment in the sites visited, namely;

- Internal – Users or internally employed staff provide support,
- Outsourced – A company or individual is either contracted or used on an as-needed basis.
- No support – No assistance is available. If the equipment breaks down, it is not repaired and consequently is discarded.

Table 1 shows support currently available.

Equipment	Support	Percentage
Laptops	Internal	55.0
	Outsourced	35.0
	No support	10.0
PCs	Internal	48.4
	Outsourced	48.4
	No support	3.2
Servers	Internal	60.0
	Outsourced	33.3
	No support	6.7
Printers	Internal	57.7
	Outsourced	42.3
PDAs	Internal	66.7
	Outsourced	33.3
Mobile phones	Outsourced	100

Table 1: Current Technical Support of ICT Equipment

The E-readiness report also outlined the following key observations:

- Hardware infrastructure across most of the health facilities at the time of report was not capable of serving the facilities efficiently.
- The local area network (LAN) in place in many facilities was not being effectively used.
- Internet connectivity was present within facilities but was unreliable.

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