Proposals for a
Sudan eHealth Strategy

by

Salah Mandil, Ph.D.
Expert Consultant
to the ITU & WHO
on eHealth & eStrategies

and,

Former Director
Health Informatics & Telematics
World Health Organisation
Geneva, Switzerland

NOTICE

This entire report, and the technical specifications contained in Annexx III, were prepared by Dr S H Mandil, Senior Expert Consultant to the ITU and WHO, and former Director of Health Informatics and Telematics, WHO, Geneva, ***for use only by or for*** the Federal Ministry of Health, Sudan, and WHO EMRO, for the explicit purposes of this assignment, and that is the development of an "Sudan eHealth Strategy".

Parts of the material included and adapted herein stems from materials prepared by the author over several years of consultancy and support to similar endeavours by the national health authorities of several countries, between the mid-1990's until the present. As some of this material is to appear in a formal publication, ***no parts of this document, in total or in part, are to be used by any other party or any other purpose, without the explicit written consent of the author***.

May 2005

Proposals for a
Sudan eHealth Strategy

by

Salah Mandil, Ph.D.
Senior Expert Consultant
to the ITU & WHO on eHealth & eStrategies

Executive Summary

In response to a request by the Federal Ministry of Health (FMoH), the Eastern Mediterranean Regional Office of WHO sought the Author's consultancy services to study the requirements of the Sudan for eHealth Support, with particular priority for the improvement of the day-to-day management of the health care services. This is the Author's report on the study which was carried out in the second half of January 2005.

The study was assisted by, indeed in great part based on, the more extensive experience of the Author on the analysis, design and implementation of eHealth solutions in several countries. This study also builds on the Author's 2004 study of the Sudan requirements for TeleMedicine links, which was requested through and funded by the ITU, and which led to the actual operational start (in April 2005) of a Sudan National TeleMedicine Network with pilot links between four remote general hospitals and Khartoum University Teaching Hospital. The experience of building these TeleMedicine links – with which the Author was fully professionally engaged – has been most valuable in this broader study for nation-wide eHealth Solutions.

At present, the Sudan health sector, led by the FMoH and the State Ministries of Health, is in the middle of a major, ongoing ***reform*** of the managerial technical and clinical aspects of the health sector, including the delivery of the medical care services. The underlying theme of such reform is to increase the capacity of the health care institutions (hospitals, health centres, Laboratories, etc...) to deliver more and better quality medical care and to gradually strengthen these institutions to independently manage their own human, financial and other resources. These responsibilities were until hitherto the FMoH's responsibility; but the FMoH is gradually limiting its role to setting national health policy and strategy, monitoring their implementation and progress thereon, and conducting evaluation and audit.

One of the key features of the "ongoing reform", referred to above, is the concerted effort to explore more, and increase the current, uses of "Information & Communication Technologies (ICT)" support to the National Health Care Services, including its clinical, public health and managerial aspects – referred to briefly as "eHealth support". Cost-effective eHealth support is indeed the most worthwhile avenue for the Sudan.

This study started with a rigorous ***analysis of the requirements*** of a wide range of users in hospitals, health centres and their various technical and administrative support services, both in Khartoum and several other States. It also included an analysis of the capacities and potential for running and managing eHealth technological support.

The study established, and ***recommended***, the following Users Requirements to be adopted as the ***priorities*** for eHealth Support:

- Users require support to ***manage*** their day-to-day functions particularly to reduce the burden of reporting and search for and access to needed data and information;
- Users demand the means to ***network*** and communicate, over distance and substance, with other parts of the health sector, both as providers and requesters of information and related services;
- Users require updated and clear rules for ***information flow*** within the health sector and access to commonly needed ***data bases***, a few of which already exist but most need to be developed based on ***standards*** that are respected nation-wide;
- The recently launched ***TeleMedicine*** Network is apparently filling a major need, and more nation-wide TeleMedicine links are called for;
- Professionals require and demand access to the increasingly available courses and training opportunities accessible over the Internet, e.g. Continuous Professional Development/Continuous Medical Education (***CPD/CME***) courses;
- Institutions require that their minimum ***human resources*** requirements be verified and provided for;
- Professionals and patients alike require greater levels of ***security and confidentiality*** of personal data and related transactions;
- Professionals demand that the relevant ***legislation*** be updated; and
- All levels of users demand to be ***informed and truly involved*** in eHealth, as it is appreciated as a major development affecting the scope and quality of their work.

The report gives in sections 4 to 8, the ***Technical Specifications*** equivalent to the requirements cited above. Briefly the following priorities are specified:

1) The development of a National Health Information Platform that networks all the Sudan health sector institutions and supports all forms of communications between them; this could be referred to as “Aafya-Net” or “Shabakat Al-Aafya”;
2) The development of a National Health Care Management Information System, comprising mainly of MISs for hospitals and health centres, and aimed at the direct support of the day-to-day health care services. This NHC/MIS also sets the core for key services such as Electronic Medical Records;
3) The extension of the current National TeleMedicine Network to ensure at least one site in each of the remaining 22 states, and to launch the TeleEducation services;
4) The development of a National Health Data Dictionary to hold, and make publicly available, all the standards of data items and related procedures; and
5) The enforcement of a strict Digital Security on all eHealth support.

It is ***recommended*** to start the implementation of the above five priorities. Nation-wide implementation could take 5-15 years. It is ***recommended*** to start with the implementation of a core of the proposed NHC/MIS in as many health care institutions as possible, initially a pilot of 12 hospitals and 12 related health centres. An approximate budget of US$ 5.3 million is proposed (para 9.1). As explicitly requested by the FMoH, a near-complete Draft Request for Proposals, or Invitations to Bid, is given in Annex III.

Much of the actual development work should be outsourced to contractors and local service enterprises. But, it is necessary and ***recommended*** that the MoH IT Team be strengthened in calibre and in number of professionals, to be the necessary professional counterparts to such services providers.

Proposals for a
Sudan eHealth Strategy

by

Salah Mandil, Ph.D.
Expert Consultant
to the ITU & WHO
on eHealth & eStrategies

Table of Contents

Executive Summary ____ *2*

1. INTRODUCTION ____ *6*

2. THE CURRENT SITUATION ____ *7*

2.1 Overall Findings ____ 7

2.2 The National TeleMedicine Network ____ 8

2.3 The Out-patients Unit of Khartoum North Hospital ____ 9

2.4 Khartoum Teaching Hospital ____ 9

2.5 Khartoum State MoH ____ 10

2.6 Drug Information Centre ____ 11

2.7 The Other States ____ 12

2.7.1 Al-Gazeera State MoH ____ 12

2.7.2 Al-Hasaheisa General Hospital ____ 13

2.7.3 Abo-al-Ela Health Centre ____ 13

2.8 The National Information Centre ____ 14

2.9 Access to Internet Services ____ 15

2.10 Health & Biomedical Statistics ____ 15

2.11 Federal MoH ____ 16

2.12 SudaTel Networking & Communications Services ____ 16

3. USERS' MAIN REQUIREMENTS ____ *18*

3.1 Support to day-to-day Management ____ 18

3.2 Infra-structure for Networking & Communications ____ 18

3.3 Nation-wide Data Flow and Data Bases ____ 19

3.4 More TeleMedicine links ____ 19

3.5 Continuous Professional Development & Medical Education 19
3.6 Ascertaining the Minimum Human Resources 20
3.7 Security & Confidentiality 20
3.8 Up-to-date Legislation 21
3.9 To be Informed and truly Involved 21
3.10 Technical Support 21
3.10.1 Declared and Explained Standards 21
3.10.2 A National Health Data Dictionary 22
3.11 Ascertain the Minimum Funding required 22
4. NATIONAL HEALTH CARE MANAGEMENT INFORMATION SYSTEM 23
4.1 An Overview of The Requirements 23
4.2 The recommended Strategy to a Solution 24
5. Aafya-Net: A SUDAN HEALTH INTRANET 25
5.1 Infra-Structure 25
5.2 Relevant Developments to-date 26
5.3 The Proposed Aafya-Net 28
6. STANDARDS 30
7. DIGITAL SECURITY 31
8. HUMAN RESOURCES & RELATED ISSUES 32
8.1 Software Development 32
8.2 Staffing 33
8.3 Partners & Others to be Involved 33
9. BUDGETARY ESTIMATES & FUNDING 34
9.1 Budgetary Estimates 34
9.2 Funding 35
10. PROPOSED STRATEGY & WORK PLAN 35
11. EPILOGUE 39

Annex I - Terms of Reference of the Expert Consultant 40
Annex II - People Met & Institutions Visited on this Assignment 41
Annex III – Requirements & Specifications of eHealth solutions 43
SECTION A: Aafya-Net, or Shabakat Al-Aafya 44
SECTION B: The NHC/MIS 48
SECTION C: A National Health Data Dictionary 69
SECTION D: Expanding the existing Pilot TeleMedicine Network 70
SECTION E: Digital Security 72
Annex IV - Health Care Institutions in the Sudan 75

Proposals for a
Sudan eHealth Strategy

by

Salah Mandil, Ph.D.
Expert Consultant
to the ITU and WHO
on eHealth & eStrategies

1. INTRODUCTION

Through WHO/EMRO, the Ministry of Health, Sudan, requested the Author to advise on the development of a Sudan e-Health Strategy. The main objective of eHealth support would be the better management of the day-to-day health care services at the institutional level, the optimal uses of existing national resources and the improvement of information flow between the institutional, State and Federal levels. Thus, at this stage, the eHealth Strategy is to emphasise a National Health Care Management Information System; Terms of Reference are shown in **Annex I**.

The Sudan has been undergoing a quiet but significant managerial reform of its health care services, particularly on three aspects. **First**, the actual delivery of the health care services, and their management, have been de-centralised to the State level, with the Federal Ministry responsible for the overall national policy, strategy, legislation, monitoring and audit. **Second**, the health care institutions, e.g. the hospitals, are having more authority to run their own affairs particularly their finances. **Third**, Health Insurance schemes are being rapidly introduced and developed as a complementary, and in some cases as an alternative, means of funding the health care of individuals and whole families.

A **fourth**, though different, point about the ongoing "reform" is that the health care institutions, and the Ministries of Health at the Federal and State levels, are consciously seeking to increase their uses of "Information & Communication Technologies (ICT)" support to the clinical, public health and managerial aspects of the health sector.

The Author visited Khartoum, Sudan, from 29 January to 07 February 2005, to meet with the MoH decision-makers and "Information Technology (IT) team", and representatives of the institutions providing the health care services – hospitals, health centres, laboratories, pharmacies, etc… The Author also visited the Management of the National Health Insurance Scheme; the National Information Centres; and SudaTel which is the main national Networking and Telecom operator. A list of the individuals met during this assignment is given in **Annex II**.

Some notable developments and progress have been achieved in the Information and Communication Technologies (ICT) services in the Sudan. However, there are many problems and impediments relating to eHealth for which, fortunately, excellent solutions exist; These are mostly strategic and technical issues, and predominantly on how to consolidate the various ideas and pockets of progress and work done so far, and to progress towards actual nation-wide solutions and their practical implementation.

Extensive discussions on the various aspects of the potential eHealth Support were held. These included outright statements of requirements. Some requirements were triggered by the Author citing an issue, or a problem, or a lack of progress and citing a likely solution, and obtaining reactions and often a chain of questions/answers. This led to better understanding of the Requirements and eventually to the articulation of the potential Solutions.

This report is organised such that chapter (2) briefly cites the overall findings upon which the eHealth Strategy proposed in this report largely rests. Then each of chapters (3) to (7) re-states key main requirements or issues, discusses their relevance to eHealth Support and recommends remedies or actions leading to their fulfilment. Chapters (8) and (9) deal with Human and Financial resources. And, finally chapter (10) draws the main recommendations into a Strategy and related step-by-step Work Plan.

A brief, oral report, highlighting the gist of the findings and recommendations cited in this report, was presented at a conclusive meeting, chaired by Dr Abdalla Sid-Ahmed, the Under Secretary of the Federal MoH, and attended by over 25 staff members representing a fine cross-section of the MoH departments.

2. THE CURRENT SITUATION

2.1 OVERALL FINDINGS

Several pockets of progress are worth noting because they have a direct impact on the subject-matter of this report. These are discussed in paragraphs 2.2 to 2.11 below.

In addition, there is a noticeable high level of awareness of the potential of eHealth, that is of computing, networking and communications (CNC) support to many aspects of the day-to-day services including health care. Such an awareness spreads across professionals as well as decision-makers.

The eHealth efforts enjoy strong and unequivocal support and endorsement by the decision-makers at the highest levels. The eHealth development rests on a competent but relatively small team who are stretched between their numerous MoH tasks. They need to be enriched in numbers, expertise and remuneration.

The health care institutions, especially hospitals, are anxious to make wide uses of eHealth support because they appreciate the positive impact it could make to the cost-effectiveness and efficacy of their health care work. They expect and believe in a nation-wide effort towards that aim.

Some standards that would apply nation-wide have been established, but there are still quite a few standards that need to be developed and agreed upon.

In brief, more progress could be achieved if there is a clear eHealth Strategy that is understood, respected, monitored and adhered to by all concerned. That is precisely what is behind the request of the Sudan FMoH to WHO EMRO for this Consultancy/Study.

2.2 The National TeleMedicine Network

The Sudan has just completed the installation of five pilot sites of a Sudan National TeleMedicine Network. The Network is to bridge the severe shortages of Experts and Specialists, and the lack of specialised diagnostic facilities in the States, with support from Khartoum. This Federal MoH-led network links the main hospitals in Kassala (Kassala State), Kosti (White Nile State), El-Damazien (Blue Nile State) and Niyala (South Darfur State) with the University of Khartoum Teaching Hospital in Khartoum, for support with Diagnosis and proposed Treatment using these services:

- **TeleRadiology**, whereby radiological images prepared in any of the above cited four sites, are sent for expert readings by Specialist Radiologists;

- **TelePathology**, whereby microscopic images of pathological samples, prepared in any of the above cited four sites, are sent for expert readings by Specialist Pathologists; and

- **TeleUltrasound**, whereby ultrasound images or even films, prepared in any of the above cited four sites, are sent for expert readings by Specialists, starting first with maternal and foetus images for examination by expert Obstetricians.

The installation and testing of this pilot Network had recently been completed, and its actual operation started (in April 2005). The same network will also serve to support:

- **TeleEducation**, whereby lectures and training courses will be provided, over the same TeleMedicine links, by Experts from either Khartoum or abroad. These courses could eventually be part of the Continuous Professional Development for all health care professions, including Continuous Medical Education (CME) for physicians.

A team of IT professionals in the Federal MoH, and counter-parts in each of the four sites mentioned above, are fully trained to provide trouble-shooting services,

preventive maintenance and training, and are backed up with a two-year Guarantee and Maintenance services by the original TeleMedicine equipment vendor.

2.3 The Out-patients Unit of Khartoum North Hospital

As part of the past few years to explore the uses of computing support, a simple system was developed to support the visibly over-worked and over-crowded "Emergencies and Accidents" Unit of Khartoum North Hospital. A home-made computerised application was programmed and installed to carry out the following day-to-day chores:

- to register an out-patient on arrival at the Unit;
- to trace his/her transfer and movements within the various sub-units;
- to trace requests for laboratory tests until results are returned;
- to maintain all the above in a simple "medical record" for reference and further uses within Khartoum North Hospital.

The above amounts to a simple computerised system for the Registration, Discharge and Transfer of a part of the Out-patients Unit of the hospital. All other activities of the hospital, whether administrative, financial or clinical, are totally manual. The system is based on the de facto "IT standards", but has no "Health Data Standards" such as coding schemes and codes. It has an elementary Password Protection system, but no other form of Digital Security to ascertain the Confidentiality of the personal health data it holds.

The two buildings of the many buildings within the complex of Khartoum North Hospital, which host the "Emergencies and Accidents" Unit, are actually wired with a Local Area Network (LAN) linking the humble computing facilities used for the above-cited system.

The above system has been running now for almost 3-years. The system is considered, and the Author stresses that it is, a success because of the notable improvement it has brought to the cost-effectiveness of the Registration, Discharge and Transfer functions of one of the busiest hospitals in the State. Since a year now, the hospital has become autonomous in running its administrative and financial affairs, even though it still depends on an Annual funding from the Federal MoH.

2.4 Khartoum Teaching Hospital

The Khartoum University Teaching Hospital (KUniTH) is the most important hospital in the Sudan health care services because of the vital role it plays – both clinically and managerially – even though this statement may be challenged by a few of the new private or semi-private hospitals. My visit to KUniTH was facilitated and coordinated by, and included meetings with its Director, Deputy Director, Manager of Administration, Manager of Finance and Manager of IT services, and several health

care and IT professionals.

KUniTH has numerous pockets of computerised and even networked services. For example, it has computer-supported applications for the following:

- Outpatients Registration, Discharge and Transfer system;
- a simple monitoring of requests for and responses to Laboratory tests;
- a basic Patient Billing application.

and,

- KUniTH hosts all the Receiver workstations for the Sudan National TeleMedicine Network briefly cited in para 2.2 above;

- KUniTH has a room, known as the eLibrary, which is equipped with workstations that are linked to a battery of CD-ROMs Medical Literature covering a variety of health domains, and other workstations that may used to link to internationally accessible library services such as Medline of the US National Library of Medicine.

- KUniTH has a Computer Training centre comprising of some 20 PC's connected to a Trainer's PC and conceived to host computerised training courses. The same facilities are connectable to the Internet.

- KUniTH has a Local Area Network linking selected buildings in its large complex; but many more buildings and potential users sites still remain to be wired for access to the LAN.

But KUniTH does not have an overall Hospital Management Information System, which is a major handicap felt and is most apparent in its operational service units, such as the Medical Records department. The Management of the IT services is competent and basically aware of these shortcomings.

2.5 Khartoum State MoH

This is by far the leading, better equipped and therefore most active State, as far as computerised health information and procedures are concerned. About 20 applications are in varying levels of operation, or operation-cum-development, including:

- eMail within and outside the Sudan,
- simple Accounting (expenditure against a stipulated budget),
- Personnel (mostly individual staff profiles),
- Salaries,
- Attendance (as a part of "incentives" payments),
- Fellowships (mostly covering study/training abroad),

- Voluntary Organisation (profiles of …),
- Form-Filling (for Surveillance reporting),
- National Health Statistics (the oldest & best organised family of applications),
- Documents Listing,
- Registry of Pharmaceutical Services, and
- Drugs Information Centre.

All the above applications are supported by a Network of some 110 PCs within the Khartoum MoH building, and approximately 150 PCs in 8 other locations. Five servers are in place including one dedicated for the Drug Information Centre (see para 2.6 below).

IT Standards are adopted and followed for the above uses, but there are few Data Standards and, a more serious, there is no common Data Dictionary.

A last but critical comment. The above applications, where operational, meet their simple objectives of providing periodic, pre-determined reports. Except for the National Health Statistics, none of these applications supports ad hoc queries or selective analysis because these applications were neither conceived and designed as generalised applications, nor as a family of related applications.

2.6 Drug Information Centre

This Drug Information Centre (DIC) is mainly a telephone information service on Medicaments/Drugs, their side effects and adverse reactions. Its users are mainly professionals, students and the public. DIC comprises of a computerised Knowledge Base and a number of Reference Textbooks, Pharmacopoeia and Compendia, in CDs and hard copy. It was established in 1998, and its Web site (www.dickhartoum.com) was introduced in 2004.

The oral requests for information/knowledge come over 4 telephone lines. Requests are received and registered; then the appropriate response(s) are investigated and prepared; and then the requester is called back with the response(s) usually within minutes or hours.

The recipient of the call is always a Pharmacist. DIC staffing includes three pharmacists for day-time queries, and one pharmacist for evening calls. The system was locally developed, and the original developer is its current administrator and she is backed by the Khartoum MoH IT team.

DIC also provides Training Courses on the what? And how? of its services, and publishes a 4-yearly journal. The latter is evaluated once a year through a Questionnaire to the readership.

The DIC information service is provided free of charge. The Khartoum State

MoH provides the main funding, and additional funding comes from advertisements in the DIC Journal by the Drug companies.

The DIC experience is a strong indicator that Knowledge Data Bases have an important role to play in the Sudan, and a national eHealth strategy must cover that.

2.7 The Other States

To propose a national eHealth strategy, it is important to gauge and establish the needs, interest and readiness of all parts of the national health care services. It was not possible to actually visit "all" states, but it was possible to visit parts of five different states.

Meetings were held with numerous individuals and professionals in different states. These included health care professionals and decision-makers in:

- Al-Gazeera State;
- Kassala State;
- Khartoum State
- South Darfur State; and
- White Nile State.

Some of these visits were whilst on another recent assignment for the installation of the TeleMedicine Network (see para 2.2 above). Discussions were also arranged with professionals from other States and cities including specialists and general practitioners working in a teaching hospital, general hospitals and health centres, and in relatively smaller cities and communities. A complete list is in **Annex II**, but by way of example, we summarise the gist of the findings in Al-Gazeera State.

2.7.1 Al-Gazeera State MoH

All the professionals and decision-makers I met at the Gazeera State MoH were quite familiar with the managerial and technical problems they are facing. They were also quite aware of the importance of information for management, and had ample data and information to back that. They described their manual systems of data collection, validation, analysis and presentation of results. This is based on a reporting system which included weekly, monthly and annual reporting. They prepared a few excellent examples for my visit and, when I requested a different demonstration and data, these were readily and quite efficiently presented. In brief, though predominantly manual methods of collection of data/information via forms, registers and even radio phones, these were well-organised and usable.

Equally important, these professionals and decision-makers were quite familiar with the potential of ICT support to overcome many of these problems. Indeed, they have already demonstrated some simple computer applications to

underline the issues.

I gave a lecture there on *"The Relevance of eHealth to health care services in the Sudan"*, in which I alluded to a National Strategy that may cover hospitals, health centres and communities of their state. The lecture, which was attended by 70+ professionals and all the senior decision-makers, was enthusiastically enriched with numerous constructive questions on some problems and possible related solutions of conceiving and implementing a National Strategy.

It can be reliably stated that the situation in Al-Gazeera State shows that the time is ripe and long due for the introduction of routine eHealth support on a nation-wide level because the institutions concerned need it, and the people in charge are anxious and ready to introduce and utilise these.

2.7.2 Al-Hasaheisa General Hospital

This is a 42+ years old general hospital, comprising of 5 service sections including one specifically for Children and one for Dental out-patients. It has 20/25 medical doctors. Its management is over-whelmed by the day-to-day provision of health care services, and rely on simple monthly and annual statistical reporting.

The hospital's management and clinical leaders firmly state that one of their key problems is the scope, quality and timeliness of data/information – both patients' clinical records and administrative and statistical data for planning and monitoring purposes. The maintenance of financial data has only recently become vital because some services have become chargeable and the income is pumped back into the hospital budget. Even though patients' data is supposed to be filed, stored and recoverable, there are many problems due to loss, duplication, inadequacy and the non-sharing of data resulting in doubtful quality and validity of patients data. This forces costly repetitions and wastes time. More seriously, medical staff started to simply neglect and not fill in patients data forms! This is despite a national law that requires patients data to be maintained for 5-years (Khartoum State 10-years).

There is one very simple use of computing support: the maintenance of accounts relating to patients payments. This is done on one PC running a simple and locally written program essentially to nicely layout the manually entered data. Colleagues in Al-Hasaheisa were unaware of what other PC programs were available from FMoH or any other state.

2.7.3 Abo-al-Ela Health Centre

This health centre serves a caption population area of 28,000, but in terms of patients visits it is one of the largest health centres in the State. It has 2 physicians and 30 other staff including nurses, a laboratory technician and a Nutritionist.

The leaders of the health centre stress that a most notable problem is the lack of a system for patients data acquisition, storage and updating; and that the absence of a systematic approach to patients data has significantly diminished the care to record essential data, such as a patient's initial diagnosis.

Other problems are the trouble that the staff, including the medical cadre, face with inadequacy of equipment and other materials as well as with transport and salary scales.

The financial income of this health centre has dropped in a significant way due to the shift of many patients to a newly established health centre of the National Health Insurance scheme (from about 2,000 to 700-800 patients per month).

In response to my direct question as to, given the necessary authority, what would they improve? The response, with no hesitation whatsoever, was to set up a proper "patients data system" and to retain the actual total income of the health centre (of which apparently 25% is transferred to the Local Government), employ only one-third of the current staff but improve the laboratory building and provide the staff with better medical equipment and facilities. That, they were confident, will enhance the types and improve the quality of the health care they currently provide.

2.8 The National Information Centre

This national institution is a part of the Headquarters of the Federal Ministerial Council and is charged, inter alia, with the responsibility of facilitating and maintaining the collection, storage and processing of national data on all sectors. In a recent initiative, the NIC developed, through a bidding process, three applications for adoption and uses by the government ministries to cater for their supposed requirements in these three areas:

- Personnel, mostly individual profiles and related processes;
- Accounting; and
- Stores Management.

Each interested user ministry is to pay a fee for the acquisition of each of these application packages. Apparently, only 4 of the 26 ministries have acquired the software, and their actual uses is not known but apparently not extensive. The FMoH is not one of the 4 user ministries and the following reasons were given:

- The FMoH was not consulted on the key features before these applications were actually developed;
- The NIC developments were simple "applications" and their features are lacking and are not complete systems with documented procedures; and
- The FMoH was already using its own developed applications and was engaged in its refinements;
- Other "competing" systems exist outside the MoH; e.g. two other different

Accounting Applications are in use in various ministries.

And, the general comment was made that the above does not address one of the main problems, and that is the development of a Strategy for developing the infra-structure that the computerised applications require.

2.9 Access to Internet Services

A few units and services of the hospitals and Ministries of health have access to the Internet. Where available, this is enthusiastically and well used. In order to avoid mis-use, and that is mainly personal non-MoH uses, there is a careful control over the Internet links.

There are justifiable calls for relaxing, and it is recommended to relax the rules on Internet access, particularly for the look-up of Knowledge Bases and for access to the Continuous Medical Education courses accessible over the Internet. This will be readily achieved and appropriately monitored with the development of the proposed Sudan Health Intranet, Aafya-Net (chapter 5 of this report).

2.10 Health & Biomedical Statistics

This is currently by far the largest "health data/information" operation in the Sudan. Such data is acquired through the State health directorates, primarily via periodically filled forms which are then keyed in. Increasingly, such data arrives on CDs or diskettes. Some direct downloading from the states has started but is severely limited by the lack of nation-wide networking of the health care institutions.

All data are fed into the National Health Statistics Data Base, after validation, and processed. A few applications process such data to produce periodic reports (e.g. with Health Indicators) and to serve Surveillance purpose. Sometimes, and when possible, it is used to respond to specific queries. These applications are mostly programmed on Access, the Microsoft data base management system. The resultant "reports" are usually shared back with the States also on CDs and diskettes.

An important remark has to be added. Whereas the health care indicators are well-prepared and serve the needs of Surveillance, they also need to be related to indicators on Finances and Human Resources in order to provide the pointers for the Managerial actions that would influence the scope, quality and economy of the health care practice in the Sudan. This improvement is one of the first uses, that is ***recommended*** for the well-established and well-managed Health & Biomedical Statistics Unit, to explore when the new NHC/MIS (chapter 4) and the proposed Aafya-Net (chapter 5) are introduced.

2.11 Federal MoH

The past three years witnessed a noticeable increase in the introduction and uses of computing, networking and telecommunications, by the various departments and services of the FMoH. These uses may be grouped into these four groups:

a) Computer messaging, particularly eMail, is increasingly being used for routine internal correspondence. The MoH Local Area Network currently links 165 users PCs within the Ministry, and another 65 users PCs of several special programmes such as Malaria and Pharmacy.

b) Accounting applications: these support the conventional recording of a "Budget" and related "Expenditure", the issuance of the mandatory "Authorisation" prior to any acquisition, travel, etc… and eventually clearing the related "Payment".

c) Personnel applications: these also barely support the conventional recording of employees list, individual staff profiles, vacant and unfunded positions and retirements. The data validation is a major concern and, at present, takes time and thus slows the personnel operations.

d) Specialised administrative tasks such as the registration of graduate MDs and their distribution to vacant posts throughout the country. This data-intensive challenge organises the process of having approximately 1,700 graduate MDs from Sudan's 26 medical faculties, properly registered with their full personal profiles and then each assigned to a location for the 6-16 months obligatory service prior to being licensed to practice. The system assists with matching their profiles against vacant posts received from the directors of various health care institutions such as hospitals, laboratories, health centres, etc… This partly computerised system is indispensable to the responsible General Directorate, Training and Human Resources Development.

e) Medical programmes: a couple of applications are still being studied, one is for "curative medicine" and concerns the distribution of hospital equipment; and the other is for "preventive medicine" and concerns more current (daily and weekly) reporting for Public Health surveillance. Both are being developed but are severely hindered by the lack of reliable Network links to rural areas.

As mentioned above, some aspects of these applications are supported on the MoH LAN. Four small-scale servers, with 256-512 MB memory and 18-40 GB disk space, support the above operations: one server dedicated to hosting the eMail services, one for the Applications, one for the Remote Access Services and one for Internet services.

2.12 SudaTel Networking & Communications Services

This paragraph is a simple update of my report on the "Sudan National TeleMedicine Network" study which the Author carried through the ITU in 2004.

The Domestic telephone system is mainly based on a modern fibre-optic national backbone cable network, supported in certain geographic areas by microwave radio relays, radiotelephone communications, and a domestic satellite system with over 50 (VSAT and SUDOSAT) earth-stations. In addition, a Wireless GSM Network is fully operational in the great majority of the major cities and some of their neighbouring rural areas, and in interface with the international GSM network. The International links for the domestic telephone system are provided by satellite earth stations – Intelsat (Atlantic Ocean) and Arabsat.

For data communications, SudaTel offers Baseband and Broadband services that are quite adequate for the envisaged eHealth applications (e.g. hospitals and health centres management and information flow, and the already operational national TeleMedicine network (para 2.2), which can also support TeleEducation) including full colour video and other forms of dynamic imaging. Through its "Data Cloud" services, SudaTel clients are able to establish their own virtual Wide Area Networks or Intranets or Extranets or to merely rent dedicated lines with a range of speeds, from 64 Kbps to 2 Mbps (and 155 Mbps *"can be"* available if requested).

SudaTel actively encourages potential users, and promotes applications, by either demonstrating these or by offering pilot links and installations, or both. Indeed, SudaTel has offered its facilities free-of-charge for the TeleMedicine pilot links. Another broader study is taking place for the introduction of eForms, in collaboration with the National Information Centre and some government departments; this is viewed as the start of simple eGovernment applications. As part of its promoting the uses of networks, particularly the Internet, SudaTel has a *"Free Internet"* service in Khartoum State, and a similar offer for other states is expected.

SudaTel has over 500 major subscribers: banks, government departments, universities, petrol companies, public and private companies. The proposal made in chapter (5) of this report for the establishment of a health sector Intranet (which may be referred to as ***Aafya-Net***) is based on a technical certainty that the existing SudaTel services, and their practical experience with other sectors, are more than adequate to establish and operationally support a Sudan-wide Aafya-Net.

In this regard, we draw attention to, and stress, these **two additional issues,** which are neither unique to the health sector nor to the Sudan but which has to be considered when assessing the requirements to develop and acquire the necessary eHealth support:

i) the challenge and cost of the *"last mile":* These are the tasks and cost of connecting the actual end-user (e.g. the Admission unit) facilities of a health care institutions (e.g. a hospital) to the nearest point along the existing SudaTel backbone cable network.

ii) Digital Security: that is the need to secure all network-based transactions, and even eMail services. Certainly, all patient-related data transfers, storage or routine communications, must be totally secure. It can be argued, as is the case in some countries, that digital security may be better offered by a third-party other than the Telecom operator. That calls for a National, intra-Sectoral, policy and strategy on Digital Security chapter 7).

3. USERS' MAIN REQUIREMENTS

This chapter echoes the main requirements stated by users who were carefully selected as a representative cross-section of the health sector users and who were met, and their stated requirements verified, by the Author. Each of the following paragraphs covers a main requirement. The essential requirements that are recommended for priority implementation, are further detailed in chapters (3) to (7) of this report. In other words, chapters (3) to (7) include the Author's recommendations on "what to do?" about each of the requirements cited below.

3.1 Support to day-to-day Management

Information support for the day-to-day management of Health Care services is poor, archaic and requires a major modernisation such that:

- first and foremost, the health care services are cost-effectively delivered;
- the data to be periodically "reported" by the health care services are readily and automatically extracted instead of being a form-filling workload for the health care staff;
- the time of the professional health care staff is dedicated to patient care.

This is further covered in chapter (4) of this report.

3.2 Infra-structure for Networking & Communications

The existing network of the FMoH is largely used for eMail and access to the Internet. Whereas these are well appreciated improvements, the effective links between the various health institutions are still poor, manual, slow and prone to a great deal of losses and errors.

What is required is a Nation-wide platform for health information flow, exchange and uses by all levels of the health care services. Such a platform is also essential now that the health care delivery services are gradually encouraged to be autonomous.

It is ***recommended*** that a National Health Platform should be developed to be

the Health Intranet of Sudan and to be recognised, respected and trusted as the secure national platform for all Health Information activities. We propose that such a platform could be referred to a ***Aafya-Net***, and in Arabic as "Shabakat Al-Aafya", and this is further covered in chapter (5) of this report.

3.3 Nation-wide Data Flow and Data Bases

The existing "reporting system" is supposedly the core of data collection, flow, uses and feedback. In reality, it is not a single coherent system but a mix of long-standing reporting requirements, supplementary instructions and rules, and special reporting. Feedback is rare and drowned in aggregate reports that do not cover or reach all concerned. Access to past reports, indicators and other epidemiological information is manual, and is difficult for Khartoum-based staff and almost impossible for remote areas.

It is ***recommended*** that, as an integral part of the design and introduction of Aafya-Net (see para 3.2 and chapter 5 of this report), new revised procedures and rules be introduced for data and information flow. These should partly be a direct product of the proposed National Health Care Management Information System (NHC/MIS) covered in chapter 4 of this report.

3.4 More TeleMedicine links

As stated in para 2.2 above, the pilot of the Sudan National TeleMedicine Network was installed earlier this year, and the pilot operational services have started. The network was designed by and its installation monitored by the Author. This has started to satisfy a real need and stirred enthusiasm and demands for more such links, for both clinical and educational (see para 3.5 below) purposes.

It is ***recommended*** that,

a) consideration should be given for extending the TeleMedicine links to the many sites that need it, particularly in the rural, remote under-served areas; and,

b) when Aafya-Net is operational, the present point-to-point links (e.g. between Kosti General Hospital and Khartoum Teaching Hospital) should be replaced by the broadband links over Aafya-Net which cater for many-to-many links.

3.5 Continuous Professional Development & Medical Education

All health professionals, particularly the medical cadre, require and demand the opportunities for further professional training, development and education, particularly on new procedures, techniques and technologies. Indeed, over 50

countries today require proof of attendance of such CME courses as a pre-requisite for the re-Licensure of a medical practice. For the Sudanese, travel to courses abroad has decreased because of cost increases and travel inconvenience.

The Internet has acutely increased the awareness of the Sudan health care professional staff of the availability and sources of professional development and educational courses. They have repeatedly stressed their requirements for access to such courses.

It is ***recommended*** to:

a) Initiate a survey to solicit the extent and the relative priority of the subjects for which CPD/CME courses may be started;
b) start an active survey of the availability of relevant courses and the conditions for benefiting from these, noting that some of these courses are free-of-charge and some are at a charge; and
c) whereas the Aafya-Net links would be adequate for such CPD/CME courses, it is worthwhile to plan that certain sites cater for several trainees to simultaneously benefit from a course. The Khartoum University Teaching Hospital has already built and equipped such a facility.

3.6 Ascertaining the Minimum Human Resources

One of the most basic requirements that have to be met for improvements to eHealth support are those related to the human expertise. These mainly concern "staffing" in health centres and hospitals, at both the Federal and State levels.

These are covered in chapter (8) of this report.

3.7 Security & Confidentiality

Security and confidentiality is the health sector is as old as the Medicine field. The present manual practices are subject to strict rules, regulation and legislation.

In the proposed eHealth support, the "security and confidentiality" issue is best addressed at two levels, the physical and the digital. The physical is that concerned with the physical safety of the hardware of the proposed network against theft, malicious damage, etc… Such hardware includes the servers, that is the hosts of data bases and services, and all the users peripheral equipment.

Digital security is concerned with the transactions and related data flow within users computers and over network links. Digital activities are in fact far more secure than the traditional manual practices, but the harm that could result from a digital

security breach could quickly spread and multiply, and it is for this reason that it is viewed as potentially more damaging.

My interviews with the current and potential eHealth users revealed little awareness of the importance of Digital Security, or even of the fact that “Passwords” are an inadequate safeguard to the security of computing facilities, applications and their information content. It is ***recommended*** that Digital Security be ascertained prior to initiating formal, operational eHealth services. This is further covered in chapter (7) of this report.

3.8 Up-to-date Legislation

Experience to-date in a number of countries shows that the development, drafting and passage of the Legislation necessary for eHealth support always lags behind the actual development of the relevant support.

For the Sudan to avoid future delays it is ***recommended*** to involve and engage, from the outset, the services of a dedicated legal person to review existing Legislation and Regulations, and to verify which of these would still apply for eTransactions and which would require updating or replacement. Particular attention is drawn to these two related issues:

- Electronic Medical Records: their content, who has the right to update, who has the right to access, and who is its ultimate owner?

- What ´Medical Data´ is accessible by third parties, e.g. Health Insurance schemes? At what stage of the relevant insurance claim? How? And for how long?

3.9 To be Informed and truly Involved

The eHealth support influences, and thus its development should involve, a wide range of units and individuals, from within and outside the MoH at the local, State and Federal levels, and indeed from outside the health sector.

It is therefore quite important and is ***recommended*** to carefully inform and involve, and be seen to involve, all known and anticipated collaborators and particularly the eventual Users of the emerging systems and services. This is covered in para (8.3) of this report.

3.10 Technical Support

3.10.1 Declared and Explained Standards

In the Sudan health sector, there is ample awareness on the need to base health systems and services, including the proposed eHealth support, on international **Standards** which cater for national needs and which are recognised and accepted nation-wide.

Furthermore, it is ***recommended*** that a concerted effort must be made to explain the national standards and the benefits for adhering to these, and to even stress that funding is only provided for activities that respect Nation-wide Compatibility. This is further discussed in chapter (6) below.

3.10.2 A National Health Data Dictionary

One of the most important ingredients for Nation-wide Compatibility is the uses of common data definitions, coding schemes and actual codes. These should be technically agreed to, and then widely and readily availed in a National Health Data Dictionary - both a look-up service and as a data base to which suggested additions or changes made be submitted.

In practice, there are already data items that are commonly adopted and used, and these are mostly in the administration and finance areas. The eHealth support will involve a major information system development taking place, and part of the software needed is known as a Data Base Management System (DBMS). Any of the best DBMSs come with what is known as a "data dictionary system" which is steadily parameterised and developed as an integral part of the required information system.

It is ***recommended*** that, with the development of the NHC/MIS (see chapter 4), a National Health Data Dictionary (NHDD) be conceived and based on that specifically related to the NHC/MIS. In other words, it is ***recommended*** that the eventual Request for Proposals for the NHC/MIS, includes an explicit requirements to develop the NHDD. The NHDD would comprise initially of the data items and entities of the NHC/MIS, and would be gradually enriched with those of other needs and applications.

3.11 Ascertain the Minimum Funding required

Another commonly expressed concern is that of the routine disappointment of *"no funding"* to enthusiastically drawn plans and designs. Sometimes this appears to have led to a *"go it alone"* attitude on the development of solutions that should be, and are technically and cost-effectively best, conceived nationally. This should be avoided, and the minimum funding must be guaranteed for the basic building blocks of the priority eHealth solutions identified and ***recommended*** in this report, namely:

- Aafya-Net (chapter 5);
- NHC/MIS (chapter 4);
- NHDD (para 3.10.2);
- the extended of the TeleMedicine Network (para 2.2); and
- the CPD/CME services(para 3.5).

4. NATIONAL HEALTH CARE MANAGEMENT INFORMATION SYSTEM (NHC/MIS)

4.1 An Overview of The Requirements

Government and private hospitals and clinics in Sudan have either very little or no computing support to their administrative or clinical work. Many government hospitals benefit from computing support to their accounting, specifically for Patient Billing, and these are actually run by designated "director of accounts" who is actually staff of the Ministry of Finance. Nearly all other data/information activities are manual. That is, data is collected on a wide range of forms, validated visually, stored in files or records or registers, and communicated in parts or in total to various destinations within and outside the health sector (e.g. the National Information Centre) and outside the Sudan (e.g. to WHO).

In contrast, all the health care institutions have the obligation to "report" on a regular basis, mostly monthly and annually. The reporting is also carried out manually even when they may be contained in a report or table prepared on an office desktop Word Processor. These manual practices are widely plagued by delays, losses and errors which are often noticed much later. There is a broadly expressed need for the introduction of computer-support to replace much of the current manual procedures for data recording, validation, processing and reporting.

Nearly all the users consulted during this study stress, and their actual technical requirements confirm, the need to give priority to the following solutions:

- Aafya-Net (chapter 5);
- NHC/MIS (chapter 4);
- NHDD (para 3.10.2);
- the extended of the TeleMedicine Network (para 2.2); and
- the CPD/CME services(para 3.5).

Equally important, the majority of all levels of staff in the National Health Care Services are reasonably aware of the existence and potential of improvements with the *"uses of computing, networking and communications"*.

Many staff members readily comment on how such improvements could improve the quality, efficiency and economy of their and their institutions' technical

duties and the direct benefits to their patients. Also, these staff appear to appreciate the importance of basing such developments on international standards and on the highest extent of Nation-wide Compatibility.

4.2 The recommended Strategy to a Solution

As stated above, the top priority immediately after Aafya-Net, is the concrete improvement of management information systems in the health care institutions of the Sudan. The totality of these MISs comprise what is referred to, by this Author, as the National Health Care Management Information System (NHC/MIS).

In its totality, such an NHC/MIS could be a massive, complex and costly system, which the Sudan needs but for which the available infra-structure is inadequate at present. A sensible strategy is to acquire and install the affordable, essential first, and gradually build onto that. Hence, the ***recommended strategy*** for the conception, acquisition and development of the NHC/MIS, is as follows; these strategic steps could be carried out in parallel with the development of Aafya-Net (chapter 5 below):

a) To avoid initially installing "complete" Hospital systems and, instead, to acquire and install only the core modules (point (c) below) of a Hospital MIS that is selected through open, international competitive bidding.

b) To install the core modules of the selected solution in as many hospitals and health clinics as possible And, in the shortest time possible so that these institutions are brought up in unison.

c) The ***recommended core modules*** are:

- Admissions, Discharge & Transfers;
- Minimum Data Set of Patient Records;
- Order Entry;
- Laboratory;
- Pharmacy; and
- Patient Billing.

It should be noted that these six recommended core modules (out of a total of approximately 25 modules) are chosen such that they cater for the key chores of Patients Registration and demographic data; Patients' essential clinical data; Physicians' orders regarding patients and their follow-up, with initial emphasis on Laboratory and Pharmacy related orders; and Patient Billing.

d) The "health centre core modules" would be a sub-set of those for hospitals. For example, it would have a Patient Registration function, but not a Patient Admission function. That is why the Hospital MIS has to be selected carefully and according to the technical criteria cited in point (e) below.

e) The selected solution must have, as a minimum, the following basic features:
- Modular and Scalable, that is could be reduced to a version suitable and optimised for installation in smaller hospitals and in Health Clinics;
- Exists and actually operational somewhere, that is the Sudan will not be an experiment for an untested or new system;
- Based on international and de facto Standards;
- Runs in a wide range of facilities, from a PC to an IP-Network; and
- Totally independent of any proprietary hardware.

f) To install and start the operation of the common data bases and services of the selected solution on Aafya-Net (see chapter 5 above) at the same time as the installation of the core modules in the first few hospitals. The common data bases include the Electronic Patient Records, and the common services include Appointments and Scheduling of patients visits, laboratory tests, etc.

The above recommended strategy is meant to speedily lead to an essential minimum number of health care institutions that are MIS-supported in their essential day-to-day activities. And, from whose MISs, relevant data could be extracted and communicated ("reported") periodically to satisfy other need – notably to the Health Statistics, Epidemiological Surveillance, Public Health and Planning services.

5. Aafya-Net: A SUDAN HEALTH INTRANET

5.1 Infra-Structure

The term "Infra-structure" is used here to refer to the computing, networking and telecommunications facilities and services which link numerous, varied and geographically spread organisational units and peripheral and common equipment, into a cohesive whole. With such links, and with pre-set procedures, protocols and standards, the infra-structure enables the flow of transactions and information, and the sharing of common resources, between all those linked to such an infra-structure and authorised to use its services. This is referred to as a "private Network", and a private network that uses the same communication protocols as the Internet, is referred to as an "Intranet".

In most countries, the physical parts of such Intranets, including the cabling, are usually owned and run by Telecom operators. This way, the private network, or Intranet, is essentially a logical network that is based and run over the physical network of the Telecom operator. This is also the case of the Sudan and the proposed Intranet: SudaTel, the Sudan Telecom services provider, owns the networking and communications backbone which links all the main regions and cities throughout the Sudan and upon other logical networks may be based.

It is ***recommended*** that the FMoH builds, upon the SudaTel networking and

communications backbone, a national health network linking all the Sudan health institutions, to support the systems and services recommended in this report. As mentioned in para (3.2), we propose to refer to such a Sudan health sector Intranet as ***Aafya-Net*** or, in Arabic, ***Shabakat Al-Aafya***.

5.2 Relevant Developments to-date

How to go about developing Aafya-Net? To understand the recommendations that follow, we need first to understand the traditional and present-day links of the Sudan health sector.

Fig.1 gives a schematic diagram of the main means of health data and information flow in the Sudan. Hospital and health centres periodically report to their State MoH, who process and consolidate the data in a variety of ways and present aggregates and summaries to the FMoH. The special programmes, such as HIV/AIDS, School Health, Nutrition, etc…, also report in nearly the same way. In addition, the Federal and State MoH require and obtain other data from, for example the National Statistics Bureau and the Ministry of Interior, required as the national baseline information. All this information is kept either in files or, as shown in Fig.1, stored into the relevant computerised data bases, particularly that of the National Health Statistics data base. The contents of these files and data bases are selectively retrieved, processed and used by a wide range of users, particularly for Planning, Monitoring and Evaluation.

Fig.2 is the same as Fig.1 except that it also shows the FMoH Local Area Network (LAN) which the most relevant development of the past couple of years which relates to the subject-matter of this report. This LAN is a network internal to the FMoH and is an important beginning to the modernisation of the communications and the sharing of data and data handling facilities between several units of the FMoH. This LAN is used for connecting the various FMoH users with the applications developed for various functions (briefly described in para 2.11 of this report). In addition, the LAN is used to avail a few common services to the users who have access to the 165 PCs currently connected to the LAN, such as eMail within the FMoH and with numerous health institutions in the rest of the Sudan and internationally. The LAN also hosts the gateway for access to the Internet.

In addition, there are the existing point-to-point connections for the National TeleMedicine Network described in para (2.2) of this report.

The main **weakness of the current links** is that most are essentially point-to-point, that is every line of communication between any two locations is specifically set for a particular service. Whereas this approach works, it is in fact quite limited, more costly in the long-term and certainly inefficient. It is limited in connectivity and costly and inefficient because a communication line is needed between each and every two points that need to communicate.

Fig.1

Traditional Sudan National Health Information Flow

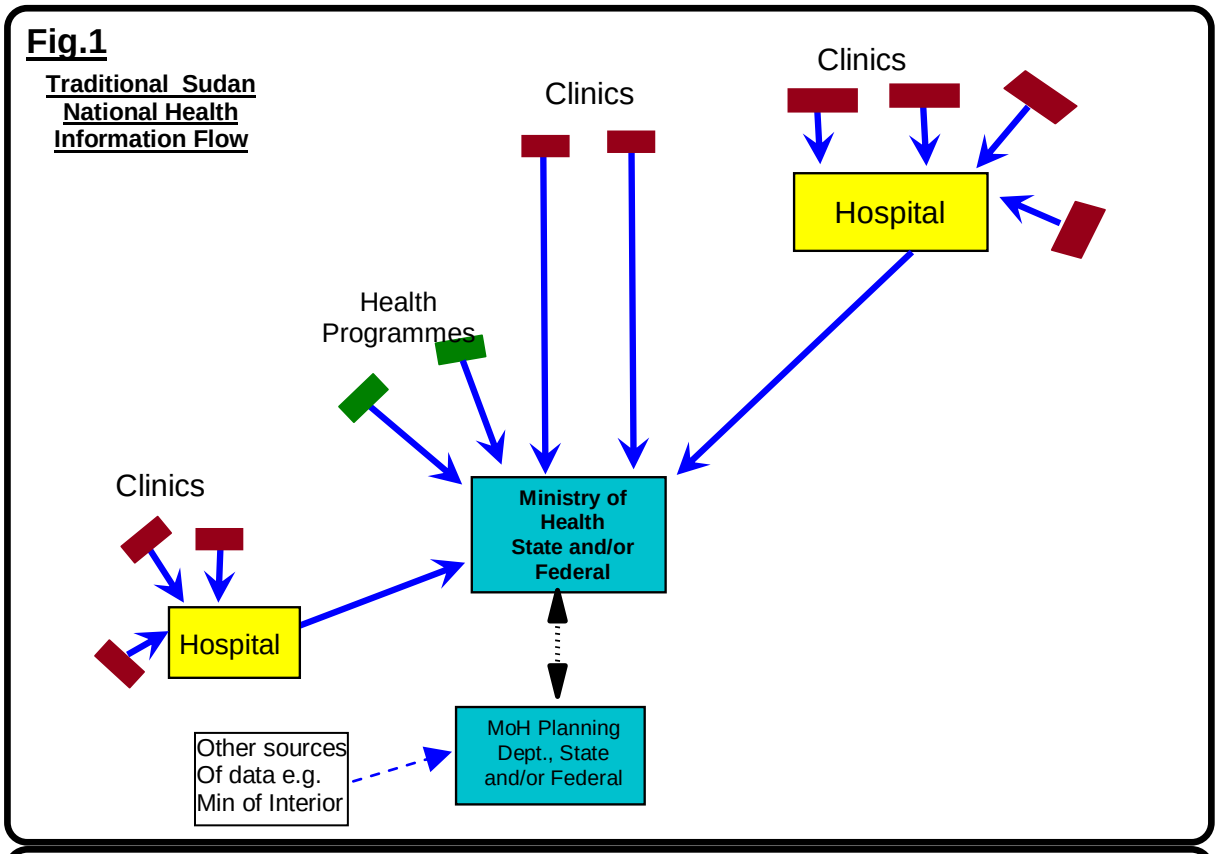
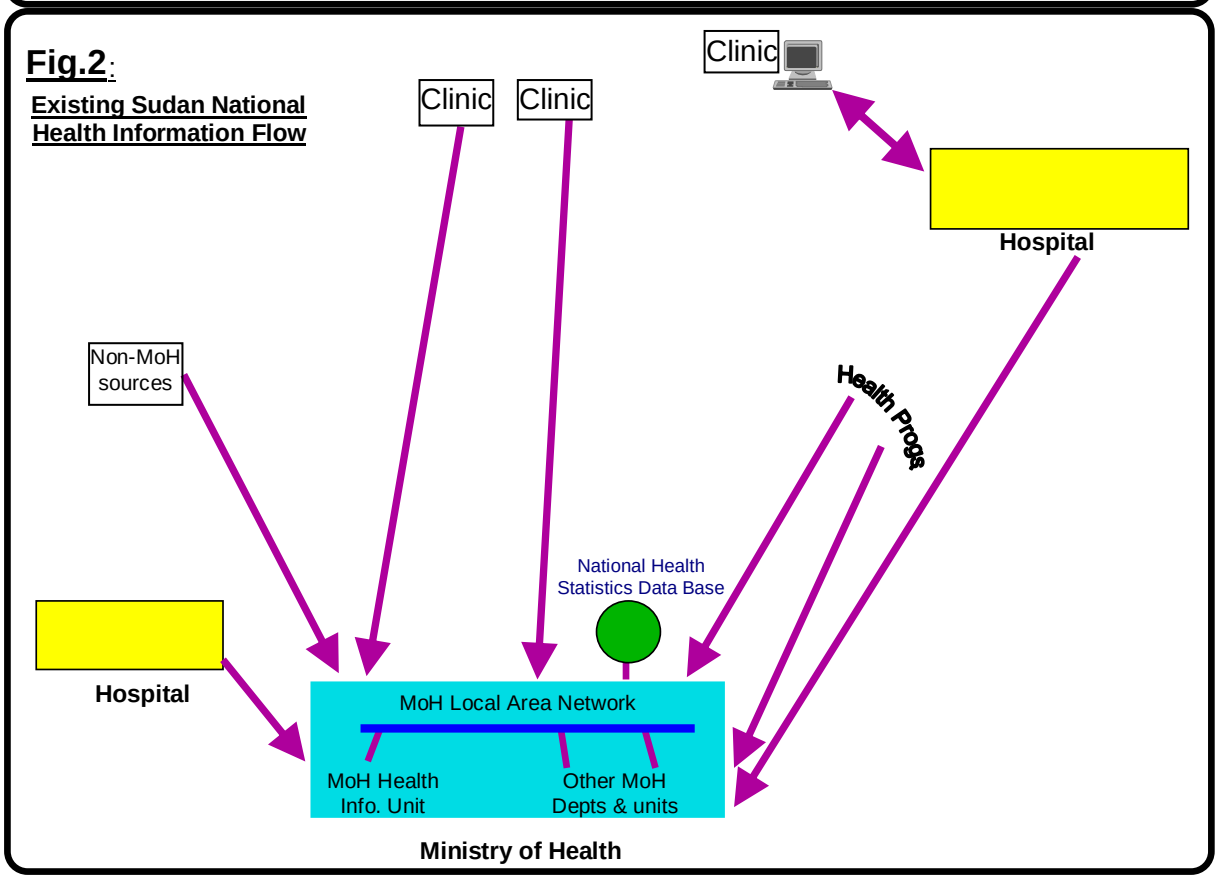


Fig.2:

Existing Sudan National Health Information Flow



5.3 The Proposed Aafya-Net

What is really **required** is a network that does for all the Sudan health sector what the FMoH LAN has started to do for the FMoH, and that is a network to link any and all health institutions and individuals together. Such a network is to be what the Sudan most requires, and that is a "national platform" for Health Information that connects and facilitates communications between all the institutions that make up the Sudan Health sector. Such a platform, or ***Aafya-Net*** as we propose to call it, will be a cost-effective and efficient means of availing all the existing available but impractical to access common data bases, references and look-up services, such as:

- The national repository of Health Statistics and Epidemiological data bases;
- The national Standards (those agreed to and under consideration);
- The national directories and registers; and
- The national Health Legislation reference manuals.

And, Aafya-Net would stimulate the further development and nation-wide uses of the above services as well as necessary new common data bases, references and look-up services, that would all be accessed by all authorised to do so, and would be cost-effectively managed. Examples are:

- The national repository of Electronic Medical Records; and
- The common eHealth tools needed to promote and practically enable N*ation-wide Compatibility*, such as the vital "National Health Data Dictionary".

In addition, with the development of a reliable and secure ***Aafya-Net***, today's hospitals and health centres, and tomorrow's "autonomous" hospitals and health centres, would be encouraged and tangibly supported to collaborate, to contribute and to share information, services and facilities, through a single national platform that specifies and maintains Nation-wide Compatibility.

All authorised users could securely link to such a platform and use it:

- to benefit from its services and resources;
- to use it as the direct means by which to honour their obligations of reporting and contribution to "epidemiological surveillance" and the assessment of the national health services;
- to plan the improvements to, and future enhancements of their health care services based on, the nation-wide standards that are inherent in Aafya-Net; for example TeleEducation links for CPD/CME (para 3.5 above).

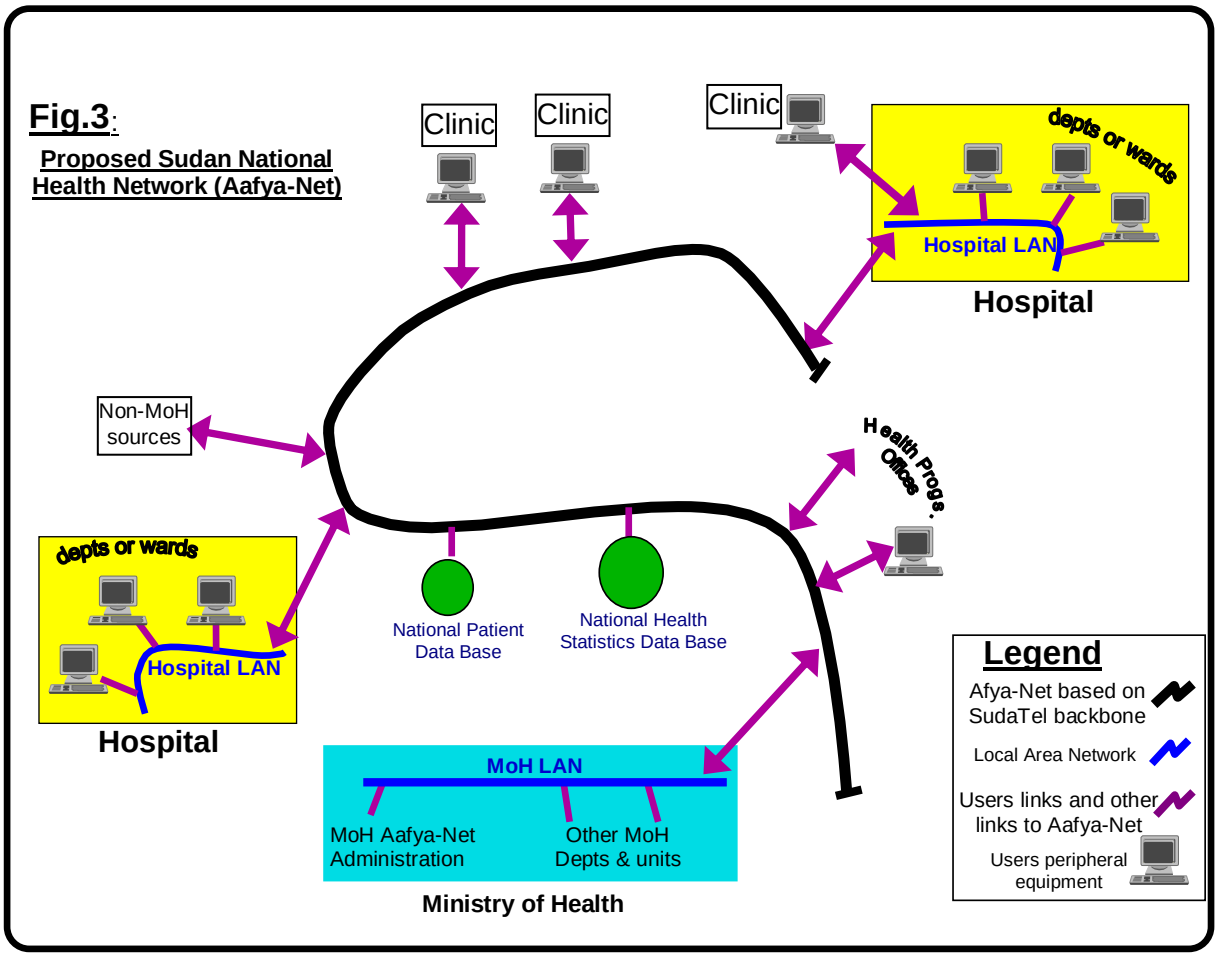


Fig. 3 shows an approximate schema of the proposed national health information platform, or "***Aafya-Net"***, and also hints at these examples of the types of systems, services and information flow that will be enabled by and over Aafya-Net:

- The National Health Care Management Information System (NHC/MIS), discussed in chapter (4) and detailed in Annex III of this report, comprising of and linking hospital and health centres MISs and eventually usable by all the authorised health care institutions of the Sudan;

- The potential support to a nation-wide expansion of the existing National TeleMedicine Network, briefly described in para (2.2), to cover the many other under-served areas in the country;

- The access to courses for Continuous Professional Development (CPD) and Continuous Medical Education (CME), discussed in para (3.5) of this report;

- The expansion of the current eMail services to all health care institutions of the Sudan;

- The improved, and potentially nation-wide, access to and support of the main MoH legacy systems (e.g. Personnel, Finance, Health Statistics, …); and

- An Aafya-Net Operations Centre that manages the Aafya-Net day-to-day operations, integrity and security; provides help and trouble-shooting support to its users; and manages its gradual geographic and functional development.

Aafya-Net will also have this other indirect by critical and vitally important advantage: ***Nation-wide Compatibility***. According to the ongoing Health Sector Reform, an increasing level of autonomy will be given to the institutions in charge of the actual Delivery of Health Care services, especially hospitals, to earn and manage their own resources. The MoH role, both Federal and State, is gradually shifting towards the setting of Policy, Legislation and Regulations, the monitoring of adherence to these, and evaluation and cost/effectiveness audit. These require and include the all important "*Nation-wide Compatibility"* of health data, information and related procedures and protocols, upon which a cost-effective and efficient national health service depends.

6. STANDARDS

In para (3.10.2) above, a National Health Data Dictionary was discussed and recommended. Furthermore, the importance of such an NHDD was emphasised as the readily-accessible central repository of all the standards and of the standard definitions of all data items and entities used throughout the health sector. This chapter points out which standards are already in use in the health sector of the Sudan, and stresses which other standards need to be considered and adopted for Nation-wide uses.

At present, there are national standards for the following:

- Disease Coding
- Clinical Procedures Coding
  and,
- Network communications, which is Internet Protocol (IP).

But, there are no standards for the following categories; against each of these categories, we indicate the de facto international and vendor independent standard that is ***recommended*** for adoption and nation-wide uses in the Sudan:

- Drugs Coding (Anatomic, Therapeutic & Chemical Coding)
- Medical Devices (Global Medical Devices Nomenclature)
- Patient Discharge Summary: content and outline

It is also necessary to stress that, in the absence of clear-cut international standards for the following categories, it is important and ***recommended*** that the Sudan sets national standards for these:

- Locations, e.g. Hospitals, health centres, Laboratories, …
- Professional Groups (physicians, nurses, technicians, …)

and,

- The Arabic and Latin spelling of popular names and titles

The FMoH could re-approach the National Information Centre, Khartoum, regarding the above because the Author was informed that the NIC was "working on" such standards and would "soon" declare proposed standards. It is important and is ***recommended*** to speedily settle this issue and adopt actual codes of individual professionals (physicians, technicians, nurses, …), and locations, and agree on standards spellings for "Abdel", "Abdul", "El", "Al" and "..oud", "..ood", etc...because of the direct implications on the accuracy and efficiency of computations thereon.

7. DIGITAL SECURITY

As pointed out in para (3.7) above, the Author has found that there is little awareness that "Passwords" protection is most inadequate for security of digital facilities, transactions and their information content.

There is a strong need to appreciate unequivocal significance for "Digital Security" and to have thorough measures of such security. All data, information and transactions that are processed on computer applications and which flow through networks, must be secured through secure methodology, protocols, procedures and secure technological equipment. "Digital Security" is a critical part of eHealth Support.

Solutions to develop a secure computing, networking and communications operations are available. First, It is ***recommended*** to review the physical security of the existing MoH network (such as the gateways and routers), and the computing devices attached to it (the users' personal computers, the network servers, etc…). These should be behind locks when they are not in actual use by their authorised users.

Second, it must be clearly understood that "Digital Security" of transactions within applications and services, and over networks such as the proposed Aafya-Net, means that these FOUR measures must be strictly ascertained:

- **Authenticity:** to know and vet the identity of the specific sender of a message or initiator of a transaction, and the identity of its intended receiver. These are done via a unique digital certificate and signature for each user and server. Additionally, and very effectively, Biometric devices can be used to verify the uniqueness of an individual's fingers print, voice print, retina image, iris image, etc…

- **Integrity:** to be totally sure that the contents of the message or transaction have not been changed, either accidentally or maliciously, since it was sent or initiated and, if it had been somehow changed, to initiate the necessary warnings and as necessary re-transmission.

- **Confidentiality:** to ascertain that nobody, other than the sender and the intended recipient, has the ability to view, copy or otherwise know the contents of the message or transaction.

- **Non-repudiation:** to maintain an unequivocal record of a message or a transaction such that neither its initiator nor its recipient is able to later deny the message exchange or the transaction.

Thorough solutions are available for all the above four measures. These solutions are a mix of digital technologies and methodologies including the "Public Key Infra-structure (PKI)" solution. For certain transactions, such as ePayments, a "Trust Structure" is further used whereby a third party vets sender, recipient and type and extent of transaction before it is executed.

The Digital Security measures have to be in place and operational before any systems or services that handle computerised individual, medical data, are introduced. It is for these reasons that Digital Security is ***recommended*** as an integral part of the priorities in the proposed eHealth Strategy.

Chapter (9) on Budgetary Estimates and Funding includes the necessary provision for Digital Security.

8. HUMAN RESOURCES & RELATED ISSUES

8.1 Software Development

Whereas the current approach to *develop, rather than buy*, applications software appears initially to be cost-effective, this is certainly questionable on at least two grounds. First, it is contrary to another firmly applied policy of heavily relying on "consultants" (professionals recruited on the basis of one-year contracts) rather than on "permanent" staff positions. Second, actual experience asserts that this approach is barely acceptable for small scale ad hoc applications and has certainly failed for large-scale, critical applications. In the circumstances, it is ***recommended*** to avoid

the self-development of systems of the scale, variability and complexity of the proposed NHC/MIS. Such systems require 100s of person-years to develop, debug, optimise, document and continue to improve and modernise. The present market is a buyer's market, full of fine choices that can be commercially competitively acquired.

8.2 Staffing

The Federal and State MoH IT Teams, charged with the eHealth Support, are inadequate for the challenges ahead. Whilst well-motivated and have a fine theoretical basis, they are too few and lack practical experience. At present, there are only four professionals and their main workload is to support the operation and to trouble-shoot a few relatively simple applications cited in chapter (2) of this report.

It is not proposed that the FMoH or State MoH recruit its own staff to develop the nation-wide health information network, and the new nation-wide solutions cited in chapters (3) to (7) of this report. These are best, and certainly more economically and efficiently developed by international and local contractors selected through competitive bidding.

However, the FMoH and State MoH must have the staff with the capacity to manage the execution of the successful bids, to monitor their progress, to assess their outcome before acceptance and to manage the maintenance and support thereafter.

If the decision is taken to implement the main recommendations of this report, then it is ***recommended*** to immediately recruit 4 more professionals and re-structure the resulting 8-person Team as follows:

- Overall Manager of eHealth Support (1);
- Network Administrator & a Network Engineers (2);
- Data Base Administrator (1);
- Major Applications Development and Trouble-shooting (2); and
- Training, and Help Desk services (2).

It is also ***recommended*** that the bids, cited above, must include a thorough training on the relevant topics to the MoH IT Teams and, where feasible, this should include technical visits of 1-2 weeks to locations where similar solutions are already operational, e.g. Oman, South Africa and Turkey.

8.3 Partners & Others to be Involved

If the main recommendations of this report are accepted and approved for implementation, then these ***three further recommendations*** are necessary:

a) Set up an **"*eHealth Users Group"***, whose main role would be both advisory and promotional, and which comprises of representatives of the full spectrum of the health sector eHealth users; and

b) Give serious consideration to hold the ***"1st National eHealth Conference"*** in the Sudan, as a one or two-day event for all levels of the professional staff concerned. The conference should have two objectives. The first is educational, and thus it provides a general familiarisation with the eHealth Strategy, and the scope of the priority "eHealth Support" being developed, and why? The second is managerial, and thus it avails the opportunity to all interested to question or to obtain clarifications on the proposed/approved National eHealth Policy, Strategy and Work Plan. If the recommendations of this Report are approved for immediate implementation, then the proposed national conference could be held before the end of this year.

c) Regardless of having a national conference or not, establish a 2-3 person team to provide **travelling seminars** to all the States MoH, and to groups of hospital staff, on the specific solutions being introduced prior to actual implementation in their respective sites. This is apart from the actual training inherent in the contracts for the supply, installation, training and introduction of each of the solutions concerned.

9. BUDGETARY ESTIMATES & FUNDING

9.1 Budgetary Estimates

Here, the Author gives only the budgetary estimates for the core acquisition and installation of the main building blocks of the eHealth Support, their start of operation and annual support and maintenance. It is **stressed** that these are <u>not</u> budgetary estimates for a pilot or a few experimental applications, but ***estimates of the actual installation and operation*** of the:

- the proposed National Health Information Platform, or Aafya-Net, linking 12 pilot hospitals and 12 pilot health centres;

- the acquisition and installation of the NHC/MIS core modules (see point (c) in para 4.2 above), based on a competitively selected national solution, in 12 hospitals and 12 health centres, together with the creation of the relevant Data Dictionary and the Minimum Data Set of the Electronic Medical Records;

- The extension of the National TeleMedicine by another 22 workstations;

- the acquisition and installation of the PKI and Trust infra-structure needed for Digital Security, including a 100'000 digital certificates, 50'000 devices for physical storage, and 10'000 readers.

Priority Substantive Component (as per the above assumptions)	Reference in this Report	Estimate in US$
Aafya/Net: National Health Platform	chapter 5	1'900'000
National Solution for a Hospital MIS, Electronic Patient Records	chapter 4	1'400'000
Extending National TeleMedicine Network to 22 more sites	Para 2.2	1'100'000
National Health Data Dictionary	para 3.10.2	250'000
Digital Security	chapter 7	650'000

It **should be noted** that the estimates above are based on the Author's knowledge of the products and services in Today's eHealth market, and **(a)** do not include any taxes, VATs or the like; and **(b)** do not include any provision for local or foreign Consultancy services to guide the preparation of the Requirements and Technical Specifications for the Request for Proposals or Invitations for Bidding.

9.2 Funding

In the Sudan, as in many industrially developing countries, some major critical development work depends on and often awaits "external funding". The Author was informed that this is not the case for this "eHealth Pilot", and that a budgetary provision has been obtained from the Ministry of Finance for a practical initiation of the development and introduction of this pilot. This is sound national policy and is most commendable.

Whereas seed funding, from sources such as WHO and the World Bank, are often a great catalyst for improvements and change, the Sudan should be ready to invest its own resources for such a major need. We strongly support the efforts of the FMoH decision-makers and their counterparts at the States level. Thus, it is ***recommended*** to plan, as a matter of high priority, Federal and State resources, for funding eHealth Support - a vital, tangible contribution to the objective of equitable access to quality health care services.

10. PROPOSED STRATEGY & WORK PLAN

The overall Health Care Policy and Strategy for the Sudan is known, clear and

well-documented. In contrast, the Strategy for the relevant eHealth support to the Health Policy is almost non-existent. In reality, there are a few simple applications in actual use, only parts of the FMoH main offices are locally networked, and Internet is accessible by a small proportion of the health sector staff. The need for the eHealth Strategy proposed in this report has been strongly expressed, and enthusiastically contributed to, by all staff interviewed at all levels.

The approach followed so far is essentially a ***top-down*** approach whereby we started with an analysis of current problems and alternative solutions, and followed some key strategic steps that eventually led Strategy, proposed in this report, of giving top priority to the development of specific systems and a network.

In contrast, the approach for the actual implementation is the reverse. That is, a ***bottom-up*** approach is followed whereby the methodological and technological support are developed and put in place first, before the new or "reformed" systems and services are introduced and gradually extended throughout the health sector nation-wide. Specifically, the approach delivers on these actions:

- develop and initiate the proposed Aafya-Net network;
- decide on critical choices, e.g. a Patient Numbering scheme.
- ascertain the pilot hospitals and health centres connect to Aafya-Net;
- extend the TeleMedicine links, geographically and functionally;
- develop the necessary Digital Security measures;
- develop and implement the core modules of NHC/MIS on Aafya-Net;
- adapt the methods of work of the various levels of the health care services, and related reporting requirements, to the new eHealth support;
- evaluate above and extend these geographically and functionally.

Thus, this chapter brings together all the main recommendations made throughout this report, and organises them in the manner these could be more effectively executed. In the table below,

a) the "work" involved is expressed in main steps numbered I, II, III, etc... and sub-steps numbered 1, 2, 3, etc....

b) a distinction is made between "Management" and "Senior Management". "Senior Management" is meant to refer to the Federal and State Ministers of Health, Under Secretaries and the Deputy Under Secretaries. And "Management" are the Directors and Heads of Departments, Medical Care or support services, including those managing hospitals and health centres.

c) cross-reference to other parts of this report is given within **<...>** brackets.

	Action by	I – Preparatory Decisions and Actions
1.	Management	Send copies of this report to all State Health Ministers and Under Secretaries for information and review, and all who contributed to this study **<**Annex I**>**.
2.	Senior Management	Announce which recommendations in this Report are to be fully implemented as priority and within the next 2-5 years.
3.	Senior Management	Designate the "pilot" hospitals and health centres for the initial networking and introduction of the new systems and services.
4.	Senior Management of MoH & MoF	Ascertain the necessary Budgetary provision **<**para 9.2**>**.
5.	Senior Management	Start the recruitment of four additional IT professionals **<**para 8.2**>**, and eventually designate responsibilities of each member of IT Team **<**para 9.2**>** to also include each of these areas, Federal and State: - Aafya-Net and LANs in hospitals & centres; - Pilot Hospital & Centres MIS's including the NHDD; - Extending the National TeleMedicine Network; - Digital Security.
6.	Senior Management	Request the National Information Centre, Khartoum, for the proposed standards for **<**chapter 6**>**: - Locations, e.g. Hospitals, health centres, Laboratories, … - Professional Groups (physicians, nurses, technicians, …) - The Arabic and Latin spelling of popular names and titles
7.	Senior Management	Designate relevant tasks and ascertain the following is done: - National consensus for a Patient Numbering Scheme - Agree on and prepare secure physical site for the Digital Security "Registration Authority" server - List of all current and approved Data Standards in Sudan - List of current or new Legislation needed to cover eHealth
8.	Senior Management	Issue the Request for Proposals **<**Annex III**>.**
9.	Technical Task Forces and Senior Management	Evaluate offers, choose successful bidder for each of these work areas, noting a bidder may win more than one area: - Aafya-Net and LANs in hospitals & centres; - Pilot Hospital & Centres MIS's including the NHDD; - Extending the National TeleMedicine Network - Digital Security.
10.	Senior Management	Negotiate Contracts with successful bidder(s), including the eventual post-Guarantee Maintenance contracts. Sign an installation contract that clearly cites the key Milestones and schedules and relevant penalty clauses (e.g. for delays).
11.	Contractor and Management	After elapse of Guarantee period(s), sign the Maintenance contract.
12.	Management	Announce a future date for, and start the Organisation of, the 1st National Conference on eHealth **<**para 8.3**>**

	Action by	II – Aafya-Net, or *"Shabakat Al-Aafya"* <chapter 5>
1.	Management	Establish a "Aafya-Net Task Force" to coordinate the implementation and designate a specific member of the FMoH IT Team as the Responsible Officer.
2.	Contractor and Task Force	Ascertain that all the users PCs are installed and tested in the pilot 12 hospitals and 12 health centres.
3.	Contractor	Install a Local Area Network (LAN) in each of the designated pilot hospitals and health centres.
4.	Contractor	Ascertain that Aafya-Net links reach the actual users sites of the designated pilot hospitals and health centres.
5.	Contractor	Connect the Look-Up information services, e.g. Epidemiology and Health Statistics; policy documents; reports; etc.
6.	Contractor, Task Force and Management	Acceptance Testing, together with system documentation.
7.	Contractor	Users Training, "Users Manuals" and the recommended set-up and operation of "Users Help & Support" desk.
8.	Contractor and Senior Management	Launch the operation of Aafya-Net.
	Action by	**III – National Health Care MIS and a National Health Data Dictionary**
1.	Management	Establish a "NHC/MIS Task Force" to coordinate the implementation and designate a specific member of the FMoH IT Team as the Responsible Officer.
2.	Contractor and Task Force	Ascertain that all sites are ready for the start of installation of Hospital Management Information System (HMIS) software, and related Health Centre MIS (HCMIS) software, in the 12 pilot hospitals and 12 pilot health centres **<**chapter 4**>**
3.	Contractor	Install and test the six core functions of the chosen HMIS, and the related Health Centre functions, in each of the 12 pilot hospitals and 12 pilot health centres **<**para 4.2**>**.
4.	Contractor	Gradually build up the National Health Data Dictionary, as used by the NHC/MIS and augmented by other collections of data, codes and coding schemes **<**para 3.10.2**>**.
5.	Contractor	Document, in user-friendly content and format, the necessary changes in the procedures related to all the newly installed tools, e.g. Patient Registration; daily and monthly reporting; accounting; etc...
6.	Contractor and Management	Acceptance Testing for both, the NHC/MIS and NHDD.
7.	Contractor	Users Training, "Users Manuals" and the recommended set-up and operation of "Users Help & Support" desk.

8.	Contractor and Senior Management	Launch the operation of the NHC/MIS.
	Action by	**IV – Digital Security**
1.	Management	Establish a "Digital Security Task Force" to coordinate the implementation and designate a specific member of the FMoH IT Team as the Responsible Officer.
2.	Contractor	Install the Registration Authority, in the physically secure site agreed for this purpose, for the issuance of Digital Certificates
3.	Contractor and Management	Acceptance Testing
4.	Task Force and Management	Prepare a full list of the authorised users, and their access levels, of Aafya-Net and all its systems and services
5.	Task Force and Contractor	Authenticate each user; then issue relevant Digital Certificate on the physical medium offered by the successful bidder
6.	Contractor	Users Training, "Users Manuals" and the recommended set-up and operation of "Users Help & Support" desk.
7.	Contractor and Management	Launch and declare start of the operation of Digital Security.
8.	Task Force and Contractor	Monitor, and ascertain that "logs" are automatically and properly kept by the system
	Action by	**V – Extend TeleMedicine Links**
1.	Senior Management	Establish a "TeleMedicine Task Force" to coordinate the implementation, and designate a specific member of the FMoH IT Team as the Responsible Officer.
2.	Task Force	Ascertain that the users PCs and their links to Aafya-Net, in all the selected 22 additional hospitals, are installed, tested and in perfect working order.
3.	Contractor	Install the TeleMedicine workstations
4.	Contractor, Task Force and Management	Acceptance Testing
5.	Contractor	Users Training, "Users Manuals" and the recommended set-up and operation of "Users Help & Support" desk.
6.	Contractor and Senior Management	Launch the operation of the expanded TeleMedicine Network

11. EPILOGUE

The Author wishes to thank all the colleagues in the health sector in the Sudan who contributed to this study (**Annex II)**. Their viewpoints, and enthusiasm for eHealth support, greatly enhanced the scope and quality of this study.

Annex I - Terms of Reference of the Expert Consultant

1) Assess current ICT status at health care institutions in the Sudan;

2) Recommend relevant ICT options for health care institutions in the Sudan;

3) Develop a detailed mid/term five year ICT plan for health care institutions in the Sudan;

4) Suggest a framework or a 25-year ICT strategic plan for ICT in health in the Sudan;

5) Submit a mission report with all above within three weeks of end of mission.

Annex II - People Met & Institutions Visited on this Assignment

Federal Ministry of Health	
Dr Ahmed Bilal Osman	Federal Minister of Health
Dr Abdalla Sid-Ahmed Osman	Federal Under Secretary
Dr Issam El-Din Mohamed Abdalla	Director, International Health Relations
Dr Mustafa Salih Mustafa	Director, Planning
Dr Ashraf Obeid	Manager, eHealth and IT Team
Mr Hussein Awad Mohammed El-Amin	Head, IT Team
Mr Hassan Khidir	Senior Programmer, IT Team
Ministry of Health, Khartoum State	
Dr Talal El-Fadil Mahdi	General Director
Dr Mohamed Omer Atia	Director, Statistics and Information
Dr Mahmood El-Qaim	Director, Planning
Dr Abdeen Mohammed Ahmed Mohammed	Deputy Director, Epidemiology
Mr Mohamed Abdallah	Maintenance
Mr Yaseen Abdel-Aziz	Director, Computer Centre
Mr Ashraf Ahmad	Programmer
Dr Osama Moosa Bala	Supervisor, Hospital Pharmacies
Dr Hind Moosa Ibraheem	Deputize Chief, Drug Info. Centre
Ms Rehab Basheer	Programmer
Mr Emad El-Din Abdel-Karim Ismail	Programmer
Dr Ahmad Abdel-Aziz	Medical Director, Khartoum North Accidents Hospital
Mr Abu-Obeida Hamid Soliman	Supervisor, Computer and Network, Khartoum North Accidents Hospital
Ministry of Health, El-Gazeera State	
Dr El-Sadig Gasm-Allah	Minister of Health
Mr El-Shaib Busha Mahmoud	Director, Statistics & Information
El-Hasaheisa Hospital, El-Gazeera State	
Dr Omer Ibrahim	Chairman of the board (physician)
Dr Abdel-Latif El-Zein	Director General
Dr Shom Jok	Medical Director, Pediatric Dept.
Dr Elnaeem Abdel-Rahman	Director General, Ophthalmology Dept.
Dr Mahdi Wisa	Director General, Maternity Dept.
Dr Abu-El-Gasim El-Rasheed	Medical Director, Emergency Dept.
Dr Ali Abdel-Wahab	Director General, Dental Dept.
Dr Huda Hassan	Medical Director, Maternity Dept.
Dr Slam Gulait	Medical Director, Dental Dept.
Mr Thabit Bowsher	Director, Medical Statistics
Mr Abdallah Ali Ibrahim	Inspector, Statistics
Mr Awad Shambol	Director, Administration

Dr Othman Fadel El-Sid	Medical Officer, Emergencies Dept.
Dr El-Haj Othman	Director, Emergencies Dept.
Mr Jamal Ahmed El-Sheikh	Financial Comptroller
Ms Entisar Mohamed Ahmed	Accountant/programmer
Mr Najm El-Din Ali Mustafa	Accountant
Abo El-Ela Health Centre, Wad Madni, El-Gazeera State	
Dr Tarig Dafallah	Director, Curative Services
Dr Assad	Medical Director
SudaTel	
Dr Emad	Managing Director
Dr Abdel Aziz Osman Abdel Aziz	Outgoing Managing Director
Mr Ihab Ibrahim Osman	Manager, Marketing Relations

Annex III – Requirements & Specifications of eHealth solutions

(reference chapter 4 of this report)

Health care services in the Sudan is provided by 951 Primary Health Care centres supported by 334 hospitals: 53 specialised hospitals, and 281 general hospitals of which only 66 has any specialists at all. Annex IV gives the other statistics on the numbers of support institutions such as medical laboratories, blood banks, X-Ray units, Ultra-Sound units, etc... There are relatively fewer private hospitals and other institutions, but these are fast increasing and growing in variety and depth of health care services.

Following a major study, carried by an ITU-WHO Senior Expert Consultant, on the main eHealth requirements of the health sector in the Sudan and on a Strategy for providing these, the health authorities of the Sudan accepted the recommendations of the study and is seeking to implement these. These included the development of:

A) A national health information network, or Intranet, to link and support all the health institutions in the Sudan – referred to as Aafya-Net ("Shabakat Al-Aafya);
B) A National Health Care Management Information System (NHC/MIS) to support the day-to-day administrative & clinical work in hospitals and health centres;
C) A National Health Data Dictionary, as a support to the above and as a Look-Up information services supporting nation-wide compatibility and operations,
D) An expansion of the current pilot National TeleMedicine Network (5 sites in states) by another 22 sites in the remaining states; and
E) A Digital Security solution that ascertains Authentication of users, the Integrity and confidentiality of all content, and the Non-Repudiation of all transactions.

Two overriding aspects of the Sudan eHealth Strategy are:

- the adherence to international norms and standards, and where these do not yet exist to the best de facto standards; and
- the maintenance of Nation-wide Compatibility that ascertains the best cultivation of health data and the efficiency and cost-effectiveness of technological solutions and the uses of human resources.

The rest of this document is divided into five sections (A) to (E), one on each of the above items and describing the related "Requirements and related Technical Specifications" for the pilot design, supply, installation, user training and start of operations.

SECTION A: Aafya-Net, or Shabakat Al-Aafya

The existing MoH LAN is largely used for eMail and access to the Internet. The effective links between the various health institutions in the Sudan are technically poor, manual, slow and prone to losses and errors.

What is required is a Nation-wide platform for health information flow, exchange and uses by all levels of the health care services. That is, a Health Intranet of the Sudan that is recognised as such, and trusted as the secure national platform for all Health Information activities, either systems or services or both. It is to be referred to as ***Aafya-Net***, and in Arabic as "Shabakat Al-Aafya".

Thus, bidders are invited to design, develop, install and initiate operations of:

- an Aafya-Net that links the varied and geographically spread organisational units and their peripheral and common equipment, into a cohesive whole;
- a central Aafya-Net Operations Centre; and
- all the necessary procedures, protocols and standards, that enable the secure flow of information and transactions and the sharing of common resources and services between all those linked and authorised to use it.

A1) APPLICATION/DATABASE SERVERS

The Bidder must fully specify the recommended central processing units for each of the listed pilot sites: hospitals, health centres, and for the Aafya-Net Operations Centre. It is the responsibility of the supplier to ensure that the equipment has sufficient capacity and processing power to support the workload at the pilot hospitals and health centres as evidenced by the utilisation statistics. The supplier must provide the parameters on which the responses were based.

A1.1 The MoH reserves the right to acquire the equipment so specified from an alternative supplier. In this event the successful Bidder will still be responsible for the installation of these.

A1.2 The Bidder must fully specify the recommended associated support equipment for each of the listed pilot sites: hospitals, health centres, and for the Aafya-Net Operations Centre. It is the responsibility of the supplier to ensure that the equipment has sufficient capacity and processing power to support the workload at the listed hospitals and health centres as evidenced by the utilisation statistics. The supplier must provide the parameters on which the responses were based.

A1.3 The MoH reserves the right to acquire the equipment so specified from an alternative supplier. In this event the supplier of the application software will still be responsible for configuration and installation of the supplied hardware and for its integration into the Bidder's own solution(s).

A1.4 Bidders must agree to their equipment being connected to other manufacturers' equipment and to provide the technical specification for such interfaces and any other information which may be required to allow such connection and ensure its efficiency.

A1.5 The hardware must be designed and configured as a fault tolerant system with no single point of failure.

A1.6 All hard disk units must be hot swappable and use RAID technology.

A1.7 Bidders must provide a detailed description of the proposed system's operating system, including user facilities to control the system.

A1.8 Bidders must indicate whether they have the distribution rights of the operating system software in Sudan; confirm that the operating system is fully supported in Sudan and detail how and from where the operating system is supported.

A1.9 Bidders must indicate what form of data security is provided in the operating system. If alternate facilities are available these must be fully specified and cost comparison must be given. Bidders must give reasons as to which of these methods they consider preferable to use.

A1.10 Describe the central processor or processors offered, including:

- The internal technology of the CPU and proposed maximum memory size;
- The performance ratings processor in terms of MIPS, TPS or another standard measurement;
- Input/output bandwidth;
- Available memory size;
- Details of the proposed and maximum terminal connectivity;
- The minimum number of concurrent users undertaking different types of system functions which the Bid solution is sized to support, and the capability for future expansion;
- The limits to the disk capacity and/or number of disk drives that can be attached.

A1.11 Describe how the system in general would be upgraded, and provide cost schedules, to accommodate more peripherals. What is the maximum number of peripherals the CPU could accommodate before requiring an upgrade?

A1.12 Can the solution support a mix of equipment of differing makes? If so, what are the effects of mixing equipment on the system and any specific limitations thereon.

A1.13 The solution must provide an automated backup facility without any downtime impact on the availability of the applications or the database.

A2) DATA REPOSITORY SYSTEMS

A2.1 It is required to facilitate, host and support national health data repository systems. An example a such a repository is that which holds individual Electronic Health Records. A description of how such repositories are supported over Aafya-Net must be provided.

A2.2 These repositories are to be partly fed from (the MIS's in) the selected pilot sites. However, Bidders are is required to confirm that these are scalable upwards to gradually cover all Sudan health care institutions. Bidders must cite the tools, and related protocols, for downloading and uploading data onto repositories.

A2.3 The rules that may be selectively applied to validate the data before it is definitively added to the repository(ies), including the security measures.

A3) COMPUTER NETWORKS INFRA-STRUCTURE

A3.1 The Aafya-Net infra-structure covered by this RFB is that initially required to connect the selected pilot sites. However, Bidders must provide a full description of the architecture proposed for a nation-wide Aafya-Net that is scalable, secure and manageable.

A3.2 Bidders must provide a listing of the proposed technological components of Aafya-Net, such as end-users equipments, perimeter routers, load balancers, cloned front-end Web servers, multilayer switches, firewalls, infrastructure servers, communication technologies and back-end database and management systems and their hosts.

A3.3 Aafya-Net infra-structure must be readily expandable to meet all the connection requirements (including line speeds) of the health care institutions in the Sudan.

A3.4 Aafya-Net must be able to cope with all service requests coming from any end-user.

A3.5 A remote user could rapidly restore a connection with a recovery aid.

A4) BUSINESS CONTINUITY AND DISASTER RECOVERY SYSTEM

A Disaster Recovery System is essential to ensure the continuity of the service in the event of a major disaster. Disaster Avoidance is the means to anticipate events that can adversely effect system operation and to act if these occur. Events that can disrupt services range from an Internet connection problem to minor failures in components that cannot readily be replaced, or more complex software problems. A Disaster Recovery Plan are the pre-set steps, and related preparedness, to recover from disasters and outages that could not have been avoided.

A4.1 Bidders must propose a Disaster Recovery System(s), and provide a full description of such a system.

A4.2 The Disaster Avoidance Plan should include geographical redundancy and remote storage of backup facilities.

A4.3 The Operations Centre architecture should provide resilience with no single point of failure. It is still essential, however, to plan for adequate backups so that data and systems configuration can be restored in the event of a catastrophic failure.

A4.4 Disaster Recovery should cover all systems including:

- Hard disk subsystem failure
- Power failure (resulting in corrupted data)
- Systems software failure
- Accidental or malicious deletion or modification
- A destructive virus
- Natural disasters (e.g. fire, flood, earthquake, and so on)
- Theft or sabotage
- Operating Systems
- Data Warehouse & Database
- Application software
- Servers
- Network devices
- Cabling infra-structure
- Security Devices
- Transmission lines

A4.5 A disaster avoidance plan must be proposed and based on the performance and availability requirements for the NHC/MIS and applications such the National Patient Data Base and Electronic Health Records.

A5) CABLING OF HOSPITALS AND HEALTH CENTRES

A5.1 Bidders should investigate the current infra-structure of the proposed pilot

hospitals and health centres, and include in their bids the necessary basic infra-structure developments, including:

- Structured Cabling,
- Electric Power Supply.

A5.2 The Bidder's attention is drawn to the fact that this RFB also seeks the necessary cabling and installation of the necessary LAN, where it does not exist, in each of the selected pilot sites.

A6) AAFYA-NET MANAGEMENT

A scalable, reliable, secure, and manageable Aafya-Net Operations Centre is required to be equipped and charged with the duties of the day-to-day management of Aafya-Net and its related services. Bidders are required to propose the management system, procedures and other tools they would provide for such an Operations Centre.

A6.1 The Management System facilities should include the means to carry out the necessary performance measurements, monitoring and alerts, scale of operations, availability and security. Bidders should provide a full description of their proposed systems.

A6.2 The services over Aafya-Net need to be provided without interruption, in a secure and controlled manner. These services must be consistently available and have the capacity inter alia to grow as the requirements increase. These services would also allow Aafya-Net to quickly, efficiently monitor applications and extract necessary information for long-term business needs. Bidders should describe their solutions.

SECTION B: The NHC/MIS

Bidders are invited to bid for a Hospital Management Information System (HMIS) software: its supply, installation, testing, users training and launch of operation. The system sought is such that it can scaled down to run in small general hospitals and in health centres and clinics.

This Request for Bids (RFB) is for a **Pilot** of 10 hospitals and 10 health centres, to be designated by the FMoH and State MoH from amongst those that are covered by and within the reach of the services of the SudaTel Network backbone.

Moreover, this RFB is for **six core functions** of the successful HMIS. The rest of the functions/modules will be covered in a near future phase of implementation.

Section (B1) covers the HMIS software and sets out some general

requirements thereon. Section (B2) invites Bids for hardware, that is the Servers and users PCs and Printers. Sections (B3) and (B4) sets the main considerations and technical features that a proposed HMIS must minimally satisfy. Section (B5) summarises the principle functionalities that the required HMIS must provide even as not all these functionalities are actually required with this Bid. Section (B6) outlines the mains steps, as viewed by the FMoH, for the implementation of the proposed HMIS.

B1) Bidding for the HMIS Software

Bidders for the software to satisfy the hospital and PHC care Management Information System requirements must:

(a) present the overall design of the Bidder's proposed solution mapped over the planned nation-wide health information Intranet (or Aafya-Net), and showing the placement of Servers and examples of users' peripherals;

(b) give the full technical specifications of the proposed software including the computing and networking hardware and system software required to support the HMIS software at both the users and the servers levels;

(c) show how their product(s) meets the requirements outlined in sections (B3), (B4) and (B5) of this document;

(d) highlight any features that are more than or short of the requirements outlined in this document;

(e) give a clear cost quotation for every item required for the one-time installation and initiation of operations, and for the ongoing costs thereafter;

(f) spell out clearly the users training included in their offer and confirming that it is what is required for the HMIS operation;

(g) give a workplan, with minimum and maximum duration, for the major steps in the supply, installation, testing, training and initiation of operations; and

(h) list out any other conditions upon which their bid(s) stand; and

(i) offers are required to include quotation(s) for differing possibilities for an optional 'national licence for an 'unrestricted number of workstations and users' within the Sudan health sector.

B2) Bidding for the related Hardware & System Software

Bids may also be made for the hardware and system software (e.g. operating

system) required to run and support the proposed HMIS. The initial phase of the implementation of the HMIS is estimated to require, apart from the needs at the central/servers level, the following:

120 PC units;
295 Printer; and
X Servers.

Bidders are required to argue and stipulate the necessary minimum configuration for each of the above three categories, and make their offers accordingly.

The FMoH reserves the right to acquire the equipment so specified from an alternative supplier. In this event the HMIS software supplier will still be responsible for configuration and installation of the supplied hardware and for its integration into the Bidder's own solution(s)

B3) MAJOR CONSIDERATIONS

A key requirement is that the HMIS should be modular, scalable and completely developed. The introduction of the HMIS will not be the conventional installation and testing in one hospital, followed by an evaluation and then a gradual implementation in other hospitals.

The strategy adopted calls for six core HMIS functions to be installed in ALL the pilot sites: about 10 hospitals and 10 Health Centres, within a period of about 3-months of the start of implementation, with the appropriate users training to the staff concerned. These six core functions are:

- Admissions, Discharges and Transfers; that is patient registration with the related Master Patient Index;
- Electronic Patient Records (Minimum Data Set for ...)
- Order Entry;
- Laboratory;
- Pharmacy; and
- Patient Billing.

Simultaneously, a pilot National Patient Data Base is to be created and linked, via Aafya-Net, to all the pilot hospitals and Health Centres to both contribute to and use the data base.

Thus, the HMIS must have the main characteristics discussed in the following paragraphs (B3.1) to (B3.6).

B3.1 Modularity and Scalability

The features and functionalities required in the HMIS system vary from hospital to hospital (e.g. general and specialist hospitals), and certainly vary from one Health Centre to another, depending on its size and scope of service. Hence, the HMIS should be modular, scalable and flexible so that only relevant modules are implemented in each hospital and Health Centre.

B3.2 Hardware Independence

The HMIS Software must totally independent of the hardware it is run on.

B3.3 Centralised Data Bases

The HMIS must efficiently support centralised data bases of a wide variety of data including multi-media. This should enable data to be stored where necessary but made accessible to any other authorised user regardless of location.

B3.4 Security and Confidentiality

The data, transactions of HMIS, and the HMIS itself, must be thoroughly digitally secure. This requirement is so important and vital that it is covered separately in section (E) of on this document.

B3.5 End User Interface

The HMIS should provide a high level of user-friendliness. In particular, it should have automated & flexible data entry interfaces, a facility for ad-hoc queries and an easy to use pre-set reports and the ability to create new reports without having to refer back to the system vendor.

B3.6 Bilingual, or Arabization

The HMIS should have Arabic and English capabilities, in particular to store patient registration, demographic and other data. The bidder must clearly state what Arabization standard(s) is adopted in the proposed system and whether it includes the means and tools for transformation to and from other standards.

B4) GENERAL SOFTWARE REQUIREMENTS

The HMIS should be characterised by the features cited below.

B4.1 Comprehensive

The HMIS should be proven to be comprehensive, offering the full range of Clinical, Financial and Administrative facilities and applications.

B4.2 Modular Design

The HMIS should be modular with the modules corresponding to specific functional requirements.

B4.3 Ad-hoc Queries

The HMIS should have extensive facilities to manipulate data in an easy and efficient manner. In particular, the HMIS should enable user definable queries.

B4.4 Bi-lingual Support

Whereas the medical information could be predominantly in English, the demographic and administrative information should be in both Arabic and English. Ideally, the HMIS should be totally bi-lingual, but some operational limitations could be inevitable. The offers submitted must clearly spell out which features are supported bi-lingually.

B4.5 Phased Implementation

The HMIS must permit phased implementation, both in one health care institution or across several institutions.

B4.6 Centralised Databases

The HMIS should enable any of its features to be organized around central databases, e.g. a proposed National Patient Care Data Base. The HMIS must support different levels of access enabling restricted views of the centralised databases(s).

B4.7 Help Features

The HMIS should have a "contextual on-line help" facility. By clicking an icon or a special function, the system should provide brief descriptions of the function or entry being performed and tips on how to proceed. The system must also have an escape-like function.

B4.8 Digital Security

This is such an important crucial requirement that it is covered separately in section (E) of this document.

B4.9 Look-up Facility

The HMIS must have the means to facilitate data entry by the optional display of the list of codes and descriptions and selection from the list.

B4.10 Training Package

The HMIS must include a package which exactly mimics the operational system. Such a training package should include a training database which can be (optionally) used in training users without any effect on the operational system. Both the training and operational databases could be in operation at the same time.

B4.11 Test Database

The HMIS should include a test database to test new applications or changes to the system. Both the test and live databases could be in operation at the same time.

B4.12 Multi-User Support

The HMIS should provide simultaneous record retrieval access to any number of users over the health sector Intranet, that is Aafya-Net.

B4.13 Data Recovery

The HMIS must be able to set up a duplicate data base and update it throughout the normal operations of the system. In case of a failure of any of the two databases, the system must be able to continue to operate uninterrupted. Data apart, the HMIS should also recognise duplicates of any of its applications specified by the user as critical.

The HMIS should enable recovery of the failed data files to their current status.

B4.14 Transaction Logging and Recovery

The HMIS should have the facility to tag all or selected transactions with (as a minimum) user flags, workstation number and date and time, and to maintain transaction logs. In case of a disaster rendering the operational and duplicate databases unusable, the HMIS should be able to restore a database to its original status by using the last backup and applying the contents of the transaction log files.

B4.15 Standards

The HMIS should be fully compliant with the "open systems" standards, and should

- fully operate on an IP network;
- have been developed using modern-day applications software development tools, a relational database management system and a Data Dictionary;
- have interfaces to popular programming languages; and
- supports multi-media interface.

B4.16 Log of HMIS Use

The HMIS usage log should contain the time, date, workstation number, user identification with the application(s) accessed and operations performed.

B4.17 Data Capture

The HMIS should support automated data capture, wherever feasible, including interfaces to bar-code readers, on-line analyzers, optical character readers and image digitizers/scanners, audio-video and biometric devices.

B4.18 Interfaces to Other Software Products

The HMIS should interface with commonplace office software packages such as eMail, Word Processing, Spreadsheet and Statistical analysis. This feature should include easy-to-use interfaces to files maintained by the HMIS applications, as well as the ease to down-load the required data from the central database to the relevant packages for further analysis.

B4.19 Menu Driven

The HMIS should be menu driven and has flexible, easy to use menu and icon generator.

B4.20 Error and Warning Messages

The HMIS should provide the System Administrator with the tools to customize error and warning messages. Error and warning messages, where feasible, must be reported interactively to enable the user to complete the services effectively and efficiently.

B4.21 Documentation

The HMIS should include an eVersion and a hard copy of the system and user documentation for each functionality and for the HMIS as a whole.

B5) FUNCTIONAL REQUIREMENTS

Whereas the Ministry of Health will initially (as pointed out in the introductory paras of this document) contract out the installation of only six functions of the successful HMIS, the latter must be proven to be complete and proven to exist as such.

"Complete" means that the HMIS supports all the functions listed in the following paragraphs. "Proven" means that the system, in its entirety, is demonstrably operational in a real health care institution somewhere in an Arabic speaking part of the world, and the bid, in total or part, must not include any 'applications development' or 'modifications' costs - other than the understandable “customisation”.

B5.1 Patient Registration & Master Patient Index

B5.1.1 Patient Identification:

"Patient registration" and a related "Master Patient Index" are the main repositories of the core information on patients. All patient related systems draw on the master patient index information.

The HMIS should be able to identify a new patient based on the Sudan Civil Identification Number, and one or more other identities. The HMIS should issue a unique patient identification number to each patient and permit the use of the same number in all hospitals and Health Centres in the Sudan. The HMIS must permit registration of new born babies by defaulting the information from the mother's record.

The HMIS should issue an identification card with alternative automatic identification facilities (e.g. magnetic strip, bar-code cards, etc...). It should also be capable of printing patient labels with bar code identification, for use in the wards and other clinical support areas.

The system should enable the distinction between Sudanese and non-Sudanese patients and cater for differing requisites such as “patient billing”.

B5.1.2 Patient Search:

The HMIS should provide, in addition to the normal search facilities, a phonetic search on names. The phonetic algorithm should cater for the typical problems due to non-standard, alternative spellings of Arabic names in English. The phonetic search could be carried out on a combination of names including family names.

B5.1.3 Multiple Patient Identification Numbers:

The HMIS must facilitate detection of multiple identification numbers for any patient by providing query facilities to the master patient index on various user definable criteria. The HMIS must enable - for any cases when a patient is found to have more than one Identification Number - the merging of the visit histories of such identification numbers to the one chosen as well as the following options for the other identification number:

- Delete the number;
- Release the number for a new patient; or
- Maintain cross reference to the correct number to facilitate directing the patient to the correct number, if he/she again presents an erroneous card.

B5.2 Inpatient (includes: Admissions, Discharges and Transfers)

The HMIS must fully support the processing of Admissions, Discharges and Transfers of inpatients. The HMIS should report on the current and expected open beds, and facilitate the management of waiting lists for elective and urgent patients.

The HMIS should permit admissions from several locations including the admission of emergency patients. Emergency admissions, with incomplete data, should be permitted. However, all such admissions should be highlighted to facilitate the eventual updating of incomplete records.

The HMIS should generate, as required, patients' admission documents including labels and wrist bands, and should provide the tools to specify the relevant preferred format and contents.

The HMIS should record newborns and assist in maintaining the Birth Register.

The HMIS should record inter or intra ward patient transfer requests. The actual transfers should also be appropriately recorded.

The HMIS should enable Patient Discharges to be entered either at the nursing stations or at the Medical Records office. Deaths is to be processed as discharges

but should be recorded separately to facilitate maintenance of Death Register. The Death Register should also include cases in outpatient clinics and those brought in dead to the hospital or health centre.

The HMIS system should produce daily bed census statements along with other statistical reports like occupancy rates, average length of stay analysis, etc. The format and content of these reports should be user-defined.

For all paying patients, the HMIS should permit maintenance of the payment and deposit status at the time of admission. The HMIS administrative and clinical modules should interface with Patient Billing module to transfer 'Inpatient Stay' details to enable accurate billing.

B5.3 Outpatients

The HMIS should record the outpatient visits to various specialist and general clinics with recognition of first visits and re-visits, and the production of visit sheets. The HMIS should permit recording of actual/scheduled information along with no-shows to ensure production of accurate monthly utilization reports.

B5.4 Appointment Scheduling

The HMIS must permit booking of appointments to specified consultant clinics and other services (e.g. vaccination, periodic maternal check-ups, ...). Different services within the hospital have different master schedules and the HMIS should be able to keep track of the different scheduling characteristics of each service. The appointments may be given either for a specified time or for a time-bracket and should enable a conscious overbooking and the handling of emergencies. The HMIS should detect conflicting appointments and to track no shows, and to enable appointments rescheduling and cancellation of appointments, to the various hospital .

The HMIS should allow requests for appointments to be initiated at remote sites, particularly at the Health Centre level, and should issue the corresponding confirmation notification or otherwise.

B5.5 Medical Records

B5.5.1 The record:

The HMIS should provide the full facilities to maintain Patients Records, for all inpatients and outpatients, and to enable the following main data categories to be maintained in the appropriate format, including Multi-Media:

- Demographic data
- General Medical Information

- Treatment History (by episode and/or visit reference)
- Diagnosis
- Discharge Summary.

When the patient is admitted or when he/she is being treated in outpatient specialist clinics, a detailed current record should be maintained. Upon completion of treatment or discharge a summary record should be generated automatically by the HMIS, for verification by authorized medical record staff and for adding any missing information, to be recorded in consultation with the treating doctor. At the same time, the result of investigation of the various services should be consolidated.

The HMIS should, on completion of the summary or abstract of treatment details, have the tools to render the record non-modifiable. From then on, the HMIS should maintain that as part of the individual's medical history, that can be accessed only by authorized users.

The HMIS must enable the initial definition of a core medical record, according to the following Minimum Data Set:

- unique identifier;
- date and time of contact;
- where e.g. Health Centre, Hospital, inpatient care, emergency, home visit;...
- health problem (maximum of three per contact);
- type of care provided (medical intervention);
- medication provided (by class or specific type); and
- disposition.

B5.5.2 Diagnostics & Procedure Codes:

The HMIS must provide easy to use data entry routines using standard codes for diagnosis and procedures. The HMIS should provide the flexibility to use more than one coding scheme if necessary.

B5.5.3 Reporting

The HMIS must enable the generation of various disease-related and services-related statistical reports to support planning, budgeting and other managerial decision making.

B5.5.4 Archiving:

The HMIS should enable the patients history to be archived according to set guidelines. And, the system should enable the easy restoration of such data, by those authorised to do so, and to process queries thereon.

B5.6 Special Disease Registers

The HMIS should enable the creation and maintenance of special disease registers (e.g. Cancer, Diabetes, Tuberculosis, HIV, ...), with differing levels of access authorization.

B5.7 Patient Notes Tracking

The HMIS should provide alternative means of maintaining "patient notes" and should distinguish between the traditional hard-copy notes and eNotes. For example, these may be stored centrally in one location, or may be decentralized to a Health Centre or clinic within a hospital, holding relevant notes. In either case, the HMIS should track the availability and movement of patient notes. The HMIS should permit signing out of the notes when they are physically moved from the storage area and it should be easy for the medical records personnel to indicate when the notes have been returned.

The HMIS should also indicate the storage location of the notes. It should also generate a variety of exception reports to monitor location of notes. e.g. notes not returned to medical records department over a certain duration after the borrowing date. Recent patient notes movement details should be on-line.

B5.8 Order Entry

The HMIS should enable the entry of all patient and non-patient related orders from any workstation in any location. The HMIS must cater for different types of orders such as appointment requests for out-patient clinics, laboratory test requests, radiology orders, medication orders, request for patient notes, etc.

The system must have the means to validate each order for completeness and consistency, and to ensure its integrity and, as necessary, to generate a periodic audit trail of all orders generated including the source and destination department. The HMIS should include the means, for those authorized, to review the contents of an order and to authorize these. On authorization the HMIS should have an option to electronically pass the order to its intended recipient, or to print the order at the source area and/or at the destination service area.

B5.9 Results Reporting

A wide variety of tests are performed in hospitals and the HMIS should process the results of all different types of tests and examinations. The processed and verified results should be printed at the service area or at the destination department. If a patient has been transferred to a different unit since the test was ordered, the test results must be automatically printed at the current location of the patient. Test results of outpatients should be printed at a location decided by the hospital.

The HMIS must allow printing of results in, or eSending these to more than one location. The HMIS must be able to flag results upon which immediate action must be taken. Cumulative reports containing test results over a given period of time should also be provided for. Authorized users should be able to check the status of all orders and results for a given patient.

B5.10 Laboratory

The HMIS should provide automation support for laboratory functions such as:

- Pathology
- Cytology
- Clinical Chemistry
- Haematology
- Microbiology, including bacteriology, parasitology, virology and serology.

Bidders are required to indicate the data/information measured and maintained for each of the above functions.

B5.10.1 Entry of Test Requests

The HMIS should provide for entry of test requests either at ward, outpatients, casualties or in the laboratory and should integrate with the Master Patient Index to retrieve other relevant data. Labels should be produced to assist with specimen procurement and identification and the system should flag hazardous specimens as "High Risk". The system should enable tests to be entered as codes for both individual tests or panels, and enable requests for multiple item tests or test groups for a patient.

B5.10.2 Parameters:

The HMIS should provide for extensive parameterisation of laboratory tests, including as a minimum the following:

- Source Codes
- Consultant Codes
- Specimen Type Codes
- Request comments
- Result comments
- Individual/Group test codes
- Profile test patterns
- Quality control and standards
- Referred laboratory codes
- Work list formats
- Antibiotic/organism codes.

B5.10.3 Work lists

The HMIS should provide for flexible work list formats for a single test or related tests. The HMIS should enable user-definable work lists (size, format and sequence), and must detect and enter all incomplete tests into the work list. Urgent requests must be highlighted. It should be possible to electronically transmit the work list data directly into the on-line analyzers.

B5.10.4 Result Entry and Validation

The HMIS should enable the entry of results either directly from automated analyzers or manually by patient identifier, test code or work list. In the manual mode it should be possible to input results as numbers, coded comments or free text. At the time of result entry, access should be provided to view previous results.

The system should validate results against reference and abnormal ranges and previous tests. The validation criteria for test results should be flexible and user definable.

B5.10.5 Reporting

The HMIS should optionally generate reports as and when the tests are completed or in a batch mode. The HMIS should allow printing on pre-printed as well as blank sheets. Cumulative reporting facility on completion of treatment or at user defined intervals should be provided for. It should be organized by date/time in reverse chronological order. The availability of urgent results should be brought to the notice of requesting location.

B5.10.6 Quality Control

The HMIS must provide for quality control which should include calculation of means, standard deviation and coefficient of variation for each quality control sample. The quality control analysis data must be stored for user definable periods for display and analyzers. The system must support quality control by user-definable techniques.

B5.10.7 Archiving

The HMIS should archive completed requests. The length of time for which the finished reports are allowed to remain on the system will be decided by the hospital and could be based on multiple criteria. It should be easy to access the archived results.

B5.10.8 Workload

The HMIS should enable the entry and accumulation of unit work

values for all the tests carried out in all types of laboratory tests.

B5.11 Blood Transfusion Services

The HMIS should allow the various codes to be user definable, covering at least the blood group, genotypes, antibodies, anticoagulants, additives, blood products, fat codes and transfusion reaction codes. The HMIS should maintain donor information and history with facility for screening for quality and quantity.

Blood stock operations should cover maintaining information at product/unit level and monitoring the status including expiry date. Other functions to be provided by the HMIS should include request for blood group, cross matching and allocation and recording of blood transfusion or return to stock.

The HMIS should have the means to interface with other related services, notably the Blood Bank.

B5.12 Radiology (and Nuclear Medicine)

This HMIS should support automation of the radiological and nuclear-medical services. The functions available should cater to scheduling of examinations for inpatients, casualties and outpatients, recording of requests, printing of labels for identification of X-ray films and result recording.

The HMIS should enable result entry to be either in the form of free text or modification to standard text blocks maintained by radiologists. Authorized and signed off results could, optionally, be displayed and printed in single or multiple copies either in the Radiology, or Medical Imaging, department or in the designated printer of the requesting departments or in the Central Medical records section. Reprinting of results should be possible.

The system must keep track of all films produced at requisition/examination level and monitor borrowed films.

B5.13 Operating Theatre

The HMIS should maintain a waiting list of operations for both inpatients and outpatients. The confirmed list of operations should be used for scheduling of operations taking into account the scheduled availability of surgeons, special equipment, anaesthetists and other staff.

The HMIS should provide user-modifiable pre-operation(s) checklist(s) which could also be used to enter orders for various services and automatically check the completion of patient preparation procedure taking into account results of all related

investigations. The operation list produced for each operation should identify all facilities required including surgeon's preferences. Surgical reports should be entered in free text format.

The HMIS should have the facilities to enter operating theatre records (anaesthesia, procedure and recovery timings, attending surgeons, actual procedure done, diagnosis etc..) to generate a variety of statistical reports on utilization of operating theatres.

B5.14 Pharmacy

The HMIS must support the pharmacy functions in these ways: formulary, drug dispensing for inpatients and outpatients and interface to medical stock within the hospital and the Central Medical Stores, mainly managed by FMoH. The HMIS should maintain a formulary (non-proprietary names) of drugs with supplier information. Selected formulary details should be available to authorised personnel, if necessary complimented by commercially available drug information.

The HMIS should provide for entry of prescriptions and medication orders at outpatient clinics or wards. Alternatively, the prescription can be entered by pharmacists in the pharmacy. On entry of prescription for a particular patient the system should display other drugs currently taken by the patient if any. It should also check for allergies/sensitivities, possible drug interaction, contra-indications, over dosages, special instructions etc.

Taking into account the route, dosage, forms and times of administration, drug labels should be printed for each patient's prescription. The system should have a controlled procedure for the authorization of all issued drugs and should maintain a separate register for controlled drugs and narcotics.

For inpatients, the HMIS should maintain patient medication profiles and prepare medication administration schedules with days, times and dosages. The system should support both the imprest and unit dose system of drug dispensation.

B5.15 Accident & Emergency

The HMIS should allow the registration of accident and emergency patients even minimum demographic data. Other information gathered should include accident type and location. Other features required are facilities to record the nature, duration and type of complaint, interventions made, outcome of the visit and statistical reports.

B5.16 Clinical Services

The HMIS should also facilitate the maintenance of clinical sub-systems

which should also integrate with the Master Patient Index to access patient demographic data. A complete patient record in a clinical sub-system should include the following:

- Basic demographic data
- Department treating the patient
- Referral Information
- Important dates [referral, assessments, treatments and follow up]
- Therapist and other staff assigned
- Type of treatment received
- Outcome.

The system should enable the review of case histories either by patient or for a given type of service.

B5.17 Nursing Care Planning

The HMIS should include procedures to guide a responsible nurse through the steps of patient assessment, to assign the patient classification from the adopted classification system. The system should convert the patient classification index into required nursery houses (by nurse type) and indicate the cumulative nursing care required. The system should compare the required and actual levels to generate differential reports.

The HMIS should provide for maintenance of standard care plans based on age and diagnostic grouping of a patient. These standard care plans should be modifiable on review by the treating doctor and assigned nurse. As part of the modified nursing care plan, the system should allow recording of nursing notes. The data should be organized in sections and should include expected discharge date, changes in patient classification, personal care, psychological and spiritual needs, nutrition care and notes, diet restriction, required tests and examinations, medication and allergies. The nursing notes should be displayed in the chronological order with each type of note. This system should interface with the Master Patient Index, inpatients and order entry & result reporting.

B5.18 Patient Billing

The HMIS should have an integrated billing module. It should provide flexibility in billing by relating charge items to billing actions.

Billing actions, rates for billing and billing groups must be user definable, and could be at service, visit or episode level. There should be a provision to bill at fixed intervals also.

The system should integrate with the inpatient module to transfer the room

charges to the patient folio. It should integrate with all other modules so that service information can be passed on for billing purposes. Manual entry of charge items should also be enabled. The system should enable authorised individuals to modify a system generated invoice. The system should also permit billing of other institutions, e.g. a Health Insurance Scheme or other companies.

B5.19 Medical Stores

This HMIS should provide comprehensive facilities for managing each hospital's and Health Centre's inventory of drugs, medical, surgical and laboratory items, and for the appropriate interface (including transactional interface when needed) to a Management Information System of the Central Medical Stores of the FMoH.

The system must support user defined classification of items with provision for storing an item in multiple locations. There should be provision to record receipts, requisitions, issues, returns, transfers and adjustments. Multiple items in a voucher should be permitted. The system must be on-line to update the stock balance on confirmation of transaction. Such transactions must be costed on average cost basis.

The HMIS should control and monitor expiry dates and to automatically select the earliest expiring batches and warning on soon-to-expire items and, on confirmation, to automatically adjust stock quantity for expired items. The system must generate physical stock verification lists with facility for generation of variance reports and automatic adjustments. The system should generate various consumption, movement costing and analysis reports.

B5.20 General Stores

The HMIS should provide all the facilities mentioned in para “B5.19 Medical Stores" above, except for expiry date monitoring. The system must maintain stock movement history and purchase history for a user-specified duration. Using a predetermined re-order level, the system must generate requisitions with prioritized options.

B5.21 Sterile Stores

The HMIS should maintain a master file containing all sterile items including, where appropriate, instruments, metalware, consumables and linen. Items are grouped into sets. The HMIS must maintain set information as well as monitor the issue/return, at the set and instrument levels, and record lost instruments.

B5.22 Purchase Order Control

The HMIS should maintain contract information containing supplier, items, quantity, unit price, delivery period etc. Purchase requisitions are raised from the stores. All authorized purchase requisitions should be automatically converted into bids and/or local purchase orders. Alternatively, the local purchase orders can be manually prepared and then entered into the system. The HMIS should enable Purchase Orders to be monitored against delivery schedules.

The HMIS should allow entry of supplier invoices against purchase orders to monitor the status of the order. The system should also support direct purchases and purchases against quotations, and to monitor vendor performance and to compare price quotations. The system should be fully integrated with its "Stores" functions (paras B5.19 to B5.21 above).

B5.23 Engineering Maintenance

The engineering maintenance comprises the following:

- Breakdown maintenance
- Preventive maintenance
- Inventory Control and Management
- Energy Management
- Vehicle Management.

The HMIS should maintain a list of all equipment in the hospital including electrical, mechanical, air-conditioning etc. The system should support the entry of all breakdown reports, either directly by users from their workstations or centrally at a designated location in the Engineering Department. Such input includes equipment code and/or description, type and details of fault, urgency, requesting department and person. The system should be capable of printing a work order request slip.

For allocation and assignment of work, the HMIS should maintain a table of employees with type of expertise. The system should print work sheets, the contents of which should be user definable. Completed work orders could be entered into the system to monitor the outstanding work.

The HMIS should generate preventive maintenance schedules at fixed intervals with a check list of all work to be carried out and the type of expertise needed. The system should monitor all spares for equipment maintenance with the associated cost details. Other facilities required are to maintain supplier maintenance contracts and internal communication directory.

B5.24 Dietary Services

The HMIS must provide the means to maintain a dietary profile for a patient containing all diet-related information required for the proper treatment of the patient.

The information maintained in the dietary profile should include diet orders, temporary meal requirements, nourishments, food preferences and food allergies. The HMIS must also provide for stock control of kitchen items and also for costing of meals.

B5.25 Financial Accounting

The HMIS must permit flexible accounting including the interactive entry of the General Ledger transactions. It should be possible to define standard journal entries for recurring and allocation entries. It should be possible to define a journal voucher as reversing type so that a reversal entry is automatically passed in the following accounting period.

The system should permit unit accounting in addition to value accounting. The general ledger system should provide for full integration with other HMIS applications. The system should also provide flexible means for access to and extraction of information for financial auditing.

B5.26 Personnel & Payroll

The HMIS should readily interface with the computerised systems of other government departments for both, down-loading personnel information and passing on payroll related data.

The HMIS should have the means to maintain profiles of all (e.g. medical and paramedical, support, administrative, ...) staff including their qualification, expertise and experience details. The payroll calculation process should use a table driven approach, whereby different types of fixed and variable allowances and deductions can be stored against each employee and grade. The system should be fully integrated with the General Ledger system.

The HMIS should also generate staffing rosters (e.g. for nurses) with indication of under staffing and over staffing, taking into account absences or unavailability. It should display and list rosters by department and/or ward.

B5.27 Clinical Costing and Management Information

The HMIS should facilitate the *performance evaluation* of Hospitals and Health Centres, so as to ensure the efficiency of health care services and the optimal use of resources. Such performance evaluation could be based on Ministry of Health “indicators” and a management accounting system to highlight, in tangible terms, the strong and weak points in different aspects of the health care services.

Thus, the HMIS relevant patient care and administrative modules should be integrated with the General Ledger system which should hold the budgetary details

and an analysis of actual expenditure against budgetary figures.

The HMIS should also be capable of building a patient's 'Episode Cost Profile' by accumulating cost transactions for the duration of treatment from various HMIS service modules. These transactions should contain details regarding the patient and the episode, the hospital department or Health Centre and the treating doctor and the nature of service. Using this information the system should arrive at the cumulative cost of a patient's episode and also determine the breakdown of total treatment cost by functional departments, by nature of service and by treating doctors.

The HMIS should support user-definable diagnosis related grouping (such as but necessarily DRG) to permit costing of resource usage. It should provide facilities for assignment of DRGs to episodes and to compare actual costs with established standard costs. The system should generate various management reports to help assess the performance of the hospital, a hospital unit or a Health Centre. Some examples of the reports envisaged are:

- Actual vs. Budget variance reports
- Actual vs. Standard DRG costs
- Cost reports by DRG, Doctor, Functional Department and Service
- Patient exception reports e.g. when the cost/length of stay is in variance with DRG Units.

B5.28 Medical Modules

The medical modules of the HMIS should assist in quality control of the specialized disciplines and in gathering data for case-mix management.

The HMIS should ensure that data is captured only once and at the originating point of care. The data once captured should be shared by all applications anywhere along Aafya-Net. The general features of the medical modules should be:

- Ease of use noting that data is to be entered mostly by health care staff.
- The system should be designed in such a way that data collection is part of normal work.
- The system should facilitate incorporation of any appropriate coding schemes so that different medical modules may use different coding schemes; and all the coding schemes are then linked to the coding scheme used by the HMIS.

B6) PLAN OF IMPLEMENTATION (Key Steps)

As a general guide, the following main steps reflect the FMoH view on the expected Plan of Implementation by the successful bidder. These assume that the main steps for Aafya-Net development, though cited in section (A) above, will be fully synchronised with the main steps cited below.

- Issue invitations-to-bid; Select successful contractor; Negotiate and prepare contract with set schedules and dates; Sign contract.

- Establish an 'implementation team' in, and a Workplan for, each of the pilot Hospitals and Health Centres; terms of reference to include definition of the liaison between the contracted company and the FMoH eHealth team for the site preparation for the system installation, for acceptance testing and for the users training.

- Contractor starts and completes implementation in all the pilot sites.

- Receive system from contractor for pilot testing, evaluation and, if necessary, requesting refinements. Repeat process until implemented system fully meets contractual requirements.

- Formalise the System Acceptance, and conclude the post-guarantee contract for ongoing system support and maintenance.

- Approve the system for operation indicating clearly the date of its formal start and the cut-off date for discontinuing the "old" system(s).

- Conduct the training courses for the end-users and the FMoH eHealth team.

- Commence system operations (including the loading of initial data), and conduct the parallel runs of the old system as necessary.

- Monitor system operations and efficiency, and measure its effectiveness; use resulting report(s) to gradually phase out the old system, and to record and transfer experience to ongoing and future systems development.

SECTION C: A National Health Data Dictionary

It is understood that some of the solutions to be offered in response to this RFB will include a Data Dictionary to hold and maintain the definitions of data items and entities used within those solutions. For example, the data dictionary of the Data Base Management System (DBMS) of a proposed Hospital MIS specified in section (B) of this RFP.

The MoH requires, as a part of this RFB, to have one National Health Data Dictionary (NHDD) for all the data items, entities, coding schemes and codes, etc... used in the health sector – both those used in computerised and non-computerised applications . In other words, a National Health Data Dictionary 'system' is a requirement in this RFB, which would be both, serve the conventional data dictionary purposes and posted as a National look-up Information Service.

C.1 A Bidders is required to provide a clear description as to how it conceives such a National Health Data Dictionary system, and how it proposes to have it developed, maintained and run.

C.2 General: The NHDD shall be kept on a server at the Operations Centre, and access to it is provided via Aafya-Net. A brief description of this procedure is required.

C.3 Authorisations: Applications and users need to be authenticated for authorisation to access the NHDD: read only; read and edit.

C.4 Version Control: All coding schemes contained in the NHDD shall be version controlled. The NHDD should be easily updated in case of a new version of coding schemes released such as ICD-10. A description of a relevant "update wizard" is required.

C.5 "Terminology" Contents of the NHDD: This is the traditional content of a Data Dictionary and contains the 'definitions' of all data items and entities used in all the computer-based applications, as well as entries that could be of future importance but are currently manually used. Such definitions would include the literal name of an item/entity, its explanation, its abbreviation, the applications or modules using it, its value range, its validation rules, who is authorised to view it, who is authorised to update it, etc….

C.6 "Codes" Contents of the NHDD: The NHDD is also required to maintain a proper and usable description of all the Coding Schemes and corresponding Codes used throughout the health sector in Sudan – whether in computerised applications or not.

C.7 Other Contents of the NHDD: The MoH intends to adopt the HL-7 Standard for expressing its message schema as a part of its Health Information Reference Model. Thus, the NHDD could usefully also contain such standard and shareable information and/or "metadata". It is readily recognised that the description of this standard may not fit into the proposed NHDD. Bidders are requested to propose how could such an eventually adopted HL-7 Reference Information Model may be stored and accessed over Aafya-Net.

C.8 Bidders are also required to provide the applications needed to manage the NHDD. Please indicate these and list their respective features.

SECTION D: Expanding the existing Pilot TeleMedicine Network

The Sudan has just completed the installation of five pilot sites of a Sudan National TeleMedicine Network. The Network is to bridge the severe shortages of Experts and Specialists, and the lack of specialised diagnostic facilities in the States, with support from Khartoum. This Federal MoH-led network links the main hospitals in Kassala (Kassala State), Kosti (White Nile State), El-Damazien (Blue Nile State) and Niyala (South Darfur State) with the University of Khartoum Teaching hospital in Khartoum, for support with Diagnosis and proposed Treatment using these services:

- **TeleRadiology**, whereby radiological images prepared in any of the above cited four sites, are sent for expert readings by Specialist Radiologists;

- **TelePathology**, whereby microscopic images of pathological samples, prepared in any of the above cited four sites, are sent for expert readings by Specialist Pathologists; and

- **TeleUltrasound**, whereby ultrasound images or even films, prepared in any of the above cited four sites, are sent for expert readings by Specialists, starting first with maternal and foetus images examined by expert Obstetricians and Gynaecologists.

This installation had just been completed, and its pilot operation started in mid-May 2005. The same network will also serve to support:

- **TeleEducation**, whereby lectures and training courses will be provided over the same communication links by Experts from either Khartoum or abroad, and eventually for Continuous Professional Development for all health care professions, including Continuous Medical Education (CME) for physicians.

A team of IT professionals in the Federal MoH, and their counter-parts in each of the four sites mentioned states, are trained to trouble-shoot and conduct preventive maintenance and training services. They are backed by a 2-year Guarantee and Maintenance services by the original TeleMedicine equipment vendor.

The pilot run of these TeleMedicine links between Khartoum and the four pilot sites indicate a positive evaluation and echo a strong call for similar TeleMedicine links to other truly under-served areas, starting with a link to the main general hospital of each of the other 22 states.

D.1 the supply of 22 TeleMedicine facilities, their installation and users training and start of operations, in the following general hospitals:

D.2 Each facility will include the necessary TeleMedicine peripheral equipment for the following applications:

a) **TeleRadiology** (scanning & transmitting medical Images);

b) **TelePathology** (scanning & transmitting medical Images); and
c) **TeleUltrasound** (for Maternal and Foetus care).

D.3 The indicative technical specifications for the above are shown in an appendix.

D.4 Bidders are required to separate, where possible, the (PC) computer and its system software from the rest of the hardware and software that comprise the relevant TeleMedicine workstation. Where the PC is separable, the Bidder must simply give its minimum hardware and software specifications and quote for these separately.

D.5 Bidders must separately indicate the cost of installation and testing.

D.6 Bidders must indicate the cost of staff training on the uses of the installed facilities and the initial trouble-shooting.

D.7 The MoH also wishes to explore the practical implications and benefits of providing **TeleEducation and TeleTraining** over the installed facilities, by expanding the one-to-one links onto one-to-many by the uses of Video Conferencing monitors. Bidders are therefore also requested to include in their Bids the necessary additional facilities, their technical specifications and cost – assuming classes of between 10-20 participants.

SECTION E: Digital Security

The term 'Digital Security' is used to refer to all the methodological and technological measures and procedures employed to ensure the security, confidentiality and integrity of all data and transactions flowing or being processed in computer applications and networks. This includes authenticating the identity of the users at all levels, ascertaining the integrity of all transactions, and maintaining logs of and all operations at the individual, workstation and servers levels.

An effort is ongoing to establish a national Digital Certification Authority (CA), based on PKI (public key infrastructure) technology. This authority would then authorise other institutions to provide Registration Authority (RA) Services. For example, the MoH or another designated health institutions will be merely required to authenticate and send lists of their authorised users, and the CA will issue each with their unique Digital Certificate. The Digital Certificates may be issued on media such as Smartcards and USB tokens.

Bidders are therefore required to ascertain that the 'security' aspects of their offers

take into full consideration, and as necessary be based on, the above anticipated services.

E1. GENERAL REQUIREMENTS

E1.1 All the security needs should be implemented in all the selected pilot sites.

E1.2 The Security measures should be readily expandable to all health care institutions.

E1.3 All the transmission should be based on Virtual Private Network (VPN) and Public Key Infrastructure (PKI) technologies.

E1.4 The software included in any Bidder's offer must be fully operable with the 'Digital Security' technologies as cited above.

E2. SECURITY WITHIN AAFYA-NET

Any and all Data and Transactions over Aafya-Net must be protected on several levels.

E2.1Security at the End-User level

- All individuals referred to within Aafya-Net, including applications such as NHC/MIS, will bear a unique reference number based on the national Numbering Scheme.
- Since the medical record belongs to the patient concerned, the latter's consent is required before availing access to any health care professionals, including the patient's doctor.
- Patients are entitled to access their medical records over the from internet, subject to the appropriate Digital Security measures.
- Should a patient decide that a health care professional should not access his/her medical record, then such a professional could communicate the results of, for example, an examination into the Patient Record using a blank form.

E2.2Security of Data Centres

- Servers will be based in a secure environment and continuously guarded.
- Access to these servers must only be allowed to authorised personnel, who are normally the accredited Aafya-Net Operations Centre staff.
- Data on the servers must be encrypted.
- Only the Data Base Administrators are authorized access to the data bases and, even then, the level of authority is pre-determined. Bidders are requested to indicate how this is to be catered for.

- Operations Centre management tools should enable the authorised staff to, for example, check server operations**,** monitor status, analyze access, designate authorisation levels, etc… Bidders are required to list out all the relevant management tools built into their offers.

E3. OTHER SECURITY MEASURES FOR SITES WITH LANS

E3.1 Unauthorised access must be prevented to or from Aafya-Net by firewalls. It should provide load balancing, redundancy features and adherence to the Digital Security measures cited above. They also must monitor attempts to breach the system. It can be noted that a document entitled 'Information Security Policy of the MoH' is under preparation.

E3.2 Applications should be protected from hackers and other malicious attacks.

E3.3 Network security should be provided by applying network based intrusion detection and prevention systems. It should continuously monitor and take necessary responsive activities to prevent attacks on the segment it applied

E3.4 Servers security should be provided by applying host based intrusion detection and prevention systems. It should continuously monitor and take necessary responsive activities to prevent attacks on the segment it applied

E3.5 Servers should be protected against Viruses. All traffics (SMTP, POP3, SNMP, FTP, SSL) must be scanned against viruses.

E3.6 Anti-virus, firewall and intrusion detection and preventing systems should be centrally managed with Security Management System. It should monitor and report the systems, and get information from the data so that weak points and attack sources should be located so some preventive actions will be taken against them. It will also consolidate with Security Policy Control System. Therefore, Security Management System should manage and control security policies centrally.

E3.7 Servers should be protected continuously against security gaps (i.e. code, paths etc.) and it will be integrated with Security Management System.

E3.8 Security vulnerabilities for systems and applications at risk should be continuously discovered. It should allow administrators to take proactive measures to effectively repair vulnerabilities most at risk.

E3.9 Identity Management system should be used to automatically manage who has access to which resources and services; logging and reporting what they have done; and enforce organizational, privacy and security policies.

Annex IV

Health Care Institutions in the Sudan (Government Sector)

Health Facilities:

Total Number of Health Centres	**951**
Hospitals:	
Hospitals with specialists	66
Specialized Hospital	53
Rural Hospital	215
Total Number of Hospitals	**334**
Total No. of beds	23'976
Blood Banks	58
X-Ray Units	105
Laboratory Units	783
Endoscopy Units	19
Ultra-sound Units	41
ECG Units	25
Rural Unit Dialysis	10

Medical Staff:

Medical Staff	No.	per 100'000
Total Number of Doctors (including GPs, Specialists, Pharmacists & Dentists)	6'193	18.4
Specialists	1'030	3.1
Dentists	244	0.7
Paramedical Staff		
Technicians	3'194	9.5
Medical Assistants	6'730	20
Nurses	17'174	51.5