Three Regions Health Study

(Mara, Mtwara and Tabora)

Project Report

HMIS Assessment in Mtwara Region and Proposal for Strengthening the MTUHA System

Final draft July 2005

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Acknowledgements:

The compilation of this report would not have been possible without the support received from the following people:

- Dr Martin Mandara for showing us around the Ministry of Health (MoH) and introducing us to the senior managers in that unit;
- Mr Adolf Kapinga in the MoH who welcomed us and facilitated trip and meeting arrangements;
- Mr Gabriel Malisa, EPI Co-ordinator who patiently explained the systems and processes around the information system and took us around to the various facilities. His relationship with his colleagues in the Rural (Mr Clement Bugodole) and Urban District (Mr Ramadhani Chibwana) Municipalities was impressive;
- Ms Gloria Minja, the Clinical officer at the Seventh Day Adventist Clinic, Dr Kivou and Ms Ute Steiner at Ligula Hospital;
- Mr Andrew Kajeguka, and Dr Mboera of the IT and Communications Unit, and Dr Peter Mmbuji at NIMR;
- Mr Rubona in the Plicy and Planning Directorate, and Dr Gabriel Hapana in the Ministry of Health.
- Mr Lumo Junga for his time to show us the work that he had been doing in Bagamoyo, and for sharing a number of articles with us.

This report has been structured in a similar manner to reports prepared by the HISP team. Section 3 detailing the assessment of components of an efficient information system is structured as follows: each sub-section contains:

- a small introductory section that details the theoretical aspects (which could be regarded as the standard that should be set), followed by
- a section detailing the findings during the evaluation period and from a literature review, and
- a brief summary of the key recommendations. These recommendations are discussed in more detail in section 4.

The HISP team have over the last 18 months conducted a number of similar evaluations, and through this process have developed a report outline and structure that appears to make sense to readers and address the many components of information systems. This report thus has drawn on and adapted both the structure, and some of the introductory/theoretical sections and diagrams from similar reports compiled by the author and HISP team members. Where external sources have been used, these have been referenced.

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Executive Summary:

1. Introduction:

The assessment of the current status of the Health Information System (MTUHA) is a requirement of the Three Regions Health Study in Tanzania. However, because numerous similar assessments and reports have been compiled, this report focuses its attention on the development of a comprehensive plan for strengthening the MTUHA information system. The evaluation component was thus scaled back to provide a quick assessment of the status of the information system in one of the regions (Mtwara).

The report briefly describes the methodology (Section 2) utilised in the preparation of the report, and then assesses the key components of an efficient information system (Section 3). Five main areas are assessed, namely the data flow policy, essential data set, human resources for information systems, and access to hardware and software, and then describes the information processing cycle and the steps involved in this cycle. The Recommendations Section (Section 4), while mirroring the structure of the previous section, introduces two new aspects – that of creating a culture of information use, and some detail on the requirements to develop an integrated, long term approach to the development of information systems. This we believe is the main contribution that this report makes to the Tanzanian health sector,

2. Main findings and recommendations:

The main findings and recommendations are highlighted for the five areas of the assessment. In each section, the findings are briefly described, followed by the recommendations, and comments on the implementation steps.

2.1 Data flow policy:

The MoH has invested a lot of effort in the MTUHA System. It has a fairly complete dataset, and well developed registers, but there is a need to clarify reporting timeframes and to fine tune the dataset in order to integrate reporting on vertical programmes into the mainstream MTUHA system. In addition, some data elements that are required to be reported upon annually, should be changed to monthly reporting formats because they should be monitored by managers at a local level on a monthly basis. and therefore need to be collected on a monthly basis. Quarterly reporting is too slow to allow managers to have access to timely data.

Recommendations

1. Change quarterly reporting to monthly
2. Clarify/Define data flow policy for Tanzania
3. Ensure that all facilities provide monthly reports

Clarifying the data flow policy requires the following activities::

- Initiate a consultative process with management (HMIS unit, and programme managers) at MoH;
- The development of draft data flow policy for presentation to senior management
- Improved monitoring of reporting from facilities at a district level.

2.2 Essential dataset:

While the EDS has been defined, and is fairly complete, it needs to be streamlined. Some of the annual reporting is too onerous to be useful (results in huge gaps in the dataset), and the use of indicators is limited.

The MoH and all program managers, and donor organizations need to be involved in the development of a coherent strategy for an integrated information system. This includes buying in to the concept of an essential dataset (with annual revisions) comprised of:

- Routine data (monthly reporting, quarterly and annual reporting) from all facilities
- Annual surveys from selected facilities;
- Use of sentinel sites for selected intense data collection systems;
- Use of demographic and other surveys from time to time.

Developing an essential dataset requires the following steps:

- Evaluate existing departmental objectives and operational plans;
- Review reporting requirements for vertical programmes and NGO's;
- Assess managerial needs at each level of the health service (facilities, region, and ministry);
- Use the above information to compile a draft essential dataset for the country;
- Define the extent to which surveys and sentinel surveillance sites will be used to complement the EDS;
- Identify mechanisms to include population (census) data in the system to provide certain denominator data;
- Convene a stakeholder workshop to ratify the proposed essential dataset.

2.3 Human Resources for Information Systems:

The roles and responsibilities of staff involved in the processing of information appear to be ad hoc additions to people who have other responsibilities. This is not a sustainable strategy, and given the HR constraints experienced in

Tanzania, will require considerable thought and experimentation before the correct mix of skills and staffing levels are identified.

Recommendations:

1. Clearly define the roles and responsibilities for information at each level within the health services. This includes assessing staffing needs at the central level, as well as planning for the IT support functions.
2. Describe the accountability patterns and communication channels between these staff.
3. Develop a broad based, long term training strategy covering both IT and HIS components of the information system.
4. Identify efficient processes for providing support to information systems staff.

The report provides some detail on the steps required to implement these recommendations. Specifically, it builds on the guidelines provided by the Human Resources Development Department (CE/CPD Unit) recommendations for Continuing Professional Development for Health workers in Tanzania. Key strategies involve the assessment of training needs, the development of capacity in zonal training centres and strengthening linkages with academic institutions, and the development of a comprehensive plan for providing training of various types to health workers.

2.4 Hardware and Software:

While there has been an effort to provide regions and districts with computers, the MTUHA software is limited in that it does readily not allow new reporting requirements (e.g. as for the HIV/AIDS epidemic) to be incorporated, nor odes it accommodate the insertion of data elements for local interpretation or use. Its use of indicators is limited.

Recommendations:

1. Develop a policy on the use and access to computers in districts and hospitals.
2. Agree to the use of the DHIS in at least the 3 Regions (Mtwara, Tabora, and Mara). The existing MTUHA data can be imported into the DHIS so as to build on the existing data.
3. Develop an implementation strategy for the development and support for the DHIS in these regions.

2.5 The information cycle:

The information cycle is the process of collecting information in a manner which ensures that quality data is available for processing and analysis. It must be collected in a manner which ensures that data can be compared across facilities

and districts, and that useful indicators are produced from the raw data. There are four steps to the cycle;

2.5.1 Data collection and collation:

While registers are well developed, there are problems in the submission of data from facilities resulting in gaps in the data and probably under-reporting on service delivery. Data is also not quality checked. Vertical, and parallel systems, have been developed for specific programmes (HIV/AIDS and Epi), and these result in duplicate data collection processes.

Recommendations:

1. Clarify definitions of data elements and indicators
2. Streamline data collection tools (registers) with a view to reducing duplication.

2.5.2 Data processing and analysis:

It was impressive to see that some facilities were processing data into indicators at their own initiative. This was happening for some programmes at the regional level as well. There is a need to strengthen these initiatives and to institutionalize them at each level.

Recommendations:

1. Improve data quality through initiation of data quality checks at facility and district levels.
2. Strengthen existing processing and analysis

2.5.3 Data presentation and feedback

There was little evidence of any systematic presentation of information, nor was there evidence of feedback from higher levels.

Recommendations

1. Initiate training to improve presentation of information in facilities
2. Establish formalised feedback processes and procedures in the district

2.5.4 Data use

While data is being used in the planning process, and for submission of budgeting formats, it is not complete or timely enough to be useful for the management and improvement of the quality of health services.

Recommendations

1. Create a culture of information use within the Ministry of Health.
2. Implement the TALI Tool as a means to measure movement towards a culture of information use.

2.6 Strengthening the culture of information use:

The report suggests a number of steps to create a "culture" of information use. These include:

- Ensure that HIS support staff report directly to the head of department, reflecting the increased emphasis on use of information to inform decision making.
- Ensure that standard reports are provided to the Head of Department on a monthly basis;
- Conduct information reviews on a quarterly basis.

2.7 An approach for a sustainable HMIS strategy for Tanzania

Lastly the report provides an overview of an implementation strategy to achieve sustainable development of the HMIS. It emphasizes that a developmental approach should be adopted, with small scale piloting and development of local capacity, prior to larger scale roll-out. This should be achieved within a vision for a 3-5 year implementation schedule.

Three main thrusts to the implementation process are outlined. These are:

1. Strengthening the development of the IS tools (the EDS, the data collection tools, and the software for data collation and its analysis and presentation.
2. Training of staff, as detailed above, building institutional capacity locally, and strengthening local tertiary and zonal training centres;
3. Establishment of a Tanzanian grown NGO for providing ongoing support for the development of the HMIS.

The concluding section emphasizes the need to strengthen existing attempts to create a culture of information use. It further suggests that the process of strengthening the HMIS should be rooted in the creation of sustainable systems and processes in Tanzania.

List of abbreviations:

BEANISH	Bilateral European – African Network for Information Systems in Health
CE	Continuing Education
CPD	Continuing Professional Development
DANAID	Danish Aid
DHIP	District Health Improvement Project
DHIS	District Health Information System
EDS	Essential Data Set
EU	European Union
GoT	Government of Tanzania
HMIS	Health Management Information System
HIS	Health Information System
HISP-SA	Health Information Systems Programme – South Africa
HIV	Human Immunideficeincy Virus
IS	Information System
IDSR	Infectious Disease Surveillance Reporting
IT	Information Technology
MTUHA	Mfumo wa Taarfifa Uendeshaji was Huduma za Afya
MoH	Ministry of Health
NGO	Non governmental Organisation
NIMR	National Institute for Medical Research
PHC	Primary Health Care
TALI	Tool for Assessing Level of Information Use

Section 1. Introduction

The consultant was requested to conduct an assessment of the current status of the Health Information System (MTUHA) as a requirement of the Three Regions Health Study in Tanzania.

Background research revealed that many evaluations of information systems in Tanzania had been conducted over the last 7 years, all with similar findings (Measure Evaluation 2003; HERA Technical Review 2003; Rubona 2004). While many reports do suggest steps to improve systems, few provide a comprehensive long term framework for the development of information systems.

This consultancy, in discussion with project team leaders and ministry officials, decided to focus its attention on the development of a comprehensive plan for strengthening the MTUHA information system. The evaluation component was thus scaled back to provide a quick assessment of the status of the information system in one of the regions (Mtwara), and to use this to confirm the findings of previous evaluations, as a step towards developing the comprehensive plan.

The report briefly describes the methodology (Section 2) utilised in the preparation of the report, and then assesses the key components of an efficient information system (Section 3). Five main areas are assessed, namely the data flow policy, essential data set, human resources for information systems, and access to hardware and software, and then describes the information processing cycle and the steps involved in this cycle. A model is provided against which the ideal, of using information for action, can be measured – it is crudely applied to the Tanzanian sector as an example of its use. The standards set in this model are utilised again in the Recommendations Section (Section 4), to help define the kinds of outputs that can be expected.

The recommendations section, while mirroring the structure of the previous section, introduces two new aspects – that of creating a culture of information use, and some detail on the requirements to develop an integrated, long term approach to the development of information systems. This we believe is the main contribution that this report makes to the Tanzanian health sector, in that many reports and evaluations have reiterated what has been described here, but none appear to recommend a model for the development of an integrated long term strategy. Without this kind of approach, we believe that the Tanzanian HMIS will continue to provide out dated and mediocre information that is of questionable value in informing decisions on resource allocation.

Section 2. Methodology

In broad terms, the consultant undertook the following:

- Assess the organisational structure for the routine HMIS
- Assess data flow from facilities (completeness, timeliness)
- Assess extent of DHIS software utilisation in the district and provincial sites
- Assess hardware capacity and appropriateness
- Dialogue with programme managers regarding their expectations of information, strengths of the existing system and perceived problems
- Develop report on the findings, including recommendations

This report concentrates on the PHC dataset, briefly discusses aspects related to the hospital dataset and does not evaluate datasets related to financial, transport, personnel and inventory data.

The programme of activities are outlined in the table below:

Day 1	Visits to NIMR and Ministry of Health, and University
Days 2-4	Travel to Mtwara Region and meetings and visits to facilities
Days 5,6	Follow-up meetings at NIMR and Ministry
Follow-up	Preparation of report

During the visit, numerous discussions were held with various role players. Key documents were sourced and scrutinised, and findings of previous reviews confirmed through the visit to Mtwara region. In Mtwara, through the good offices of the Regional Information Officer (also the EPI Co-ordinator) Mr Gabriel Malisa, we were able to visit a number of facilities in the Mtwara Urban and Rural Districts. We also met with the information officers in these district offices.

Appendix 1 provides a more detailed list of people and facilities visited.

Section 3. Assessing the components of an effective information system

An information system strives to provide managers (at all levels – facility, district, regional, and central levels) with relevant, timely information that can be used in the decision making process. In order to be able to achieve this aim, all the components of an information system need to be working effectively. If one or more of the components do not work properly, managers will have difficulty in accessing information to inform their decision making.

In this section we will look at the key components of an information system, and explore these in relation to the systems in place Tanzania.

There are five main components to explore. The first four components lay the foundations on which the information system is built. The fifth component is in fact the information process to generate meaningful information out of raw data. The efficient functioning of this process is premised on the other four components being functional.

1. The data flow policy, including the
   - Identification of the reporting units;
   - Clarification of the channels of communication, and the frequency of reporting;
2. Use of an essential dataset (EDS) to Identify the indicators or data elements on which to report;
3. Human resource aspects of the information system;
4. Access to hardware and software;
5. The information cycle.

Each of these components will be briefly discussed in terms of the ideal, and what has been achieved to date. The next section will address recommendations on these components.

3.1 Data flow policy

A data flow policy stipulates clearly the requirements for data submission, including the timeframes (specific dates) for data submission at each level within the hierarchy (from peripheral health facilities through to the central MoH). This applies to both the submission of quarterly data and annual data. Adherence to these timeframes is important to ensure that managers have relevant data on which to base their decisions. Hospitals need to have a data flow policy which

establishes the requirements for data submission from reporting units through to the central management structure of the hospital.

The data flow policy also defines the channels of communication – supervisors of health facilities need to receive the monthly information, check its accuracy, and submit it thereafter to the HMIS unit. In this way they become involved in the process of data collection and can take some responsibility for its accuracy.

Summary of main findings:

a) The MTUHA Manuals (MTUHA Version 2.0) clearly identify what has to be collected, but there do not appear to be any clear time-frames for data submission, other than to state that some data is to be submitted annually and others quarterly.
b) Quarterly submission of routine data does not provide managers with timely data: by the time the quarterly data has been submitted and compiled, it is too late to address problems that are raised by the data (e.g. a facility that reports an inability to treat STI infections because of a problem with accessing drugs needs to be addressed immediately, not allowed to continue for three months before it is drawn to someone's attention).
c) Certain programmes have initiated monthly reporting: It is interesting to note that some programmes (e.g. EPI programme) do require monthly reporting (presumably because they have identified the need for timely data in order to be able to manage the programme) – however, this not only duplicates the MTUHA system, but also undermines it as parallel information systems develop as a result (See report on visit to Mtwara Regional Office). In a resource constrained environment (staff shortages, shortages of paper and access to computers), this kind of duplication depletes resources unnecessarily, and detracts from the ability to focus resources on the main purpose of the health system – patient care.
d) Not all facilities submit their data to the Information Units: when reviewing data at the district level, we found that in many instances the "private" facilities did not submit data at all. It is not possible to manage health services comprehensively if data submission is incomplete, even if these facilities are only partly funded from state resources.

Recommendations Data Flow Policy:

1) Change quarterly reporting to monthly
2) Clarify/Define data flow policy for Tanzania
3) Ensure that all facilities provide monthly reports

3.2 Essential dataset

An “Essential Dataset” (for PHC) can be defined as **a set of the most important data elements, selected from all PHC vertical programmes, that should be reported on by health service providers on a routine basis, with the aim of being able to generate indicators that monitor the provision of health services in an integrated manner** (Shaw 2005)**.**

There are two key messages in this definition. They are contained in the words “integrated” and “essential”, and the two concepts are linked. Programme managers (e.g. co-ordinators of EPI, Women’s health, HIV/AIDS and STI, and TB programms), driven by efforts to ensure that all angles of service delivery are addressed, often require a huge amount of information for their specific programme. Their primary concerns are their programme needs, and little attention is given to the means of collecting the information, or the needs of other programmes. The result is that the health worker at the health clinic level is bombarded with a long list of data elements on which they are required to report. The requirements of various programmes may duplicate each other, and the vertical reporting of this information often requires separate data collection tools. As a result, the health worker is faced with a myriad of books and forms, all used to collect data for specific managers, but with little integration and no vision of the use of the information at the local level. Experience has shown that the larger the number of data elements to be reported upon, the poorer the quality of the data (Stoops 2003; Williamson 2001).

The creation of an essential data set is based upon to two key principles:

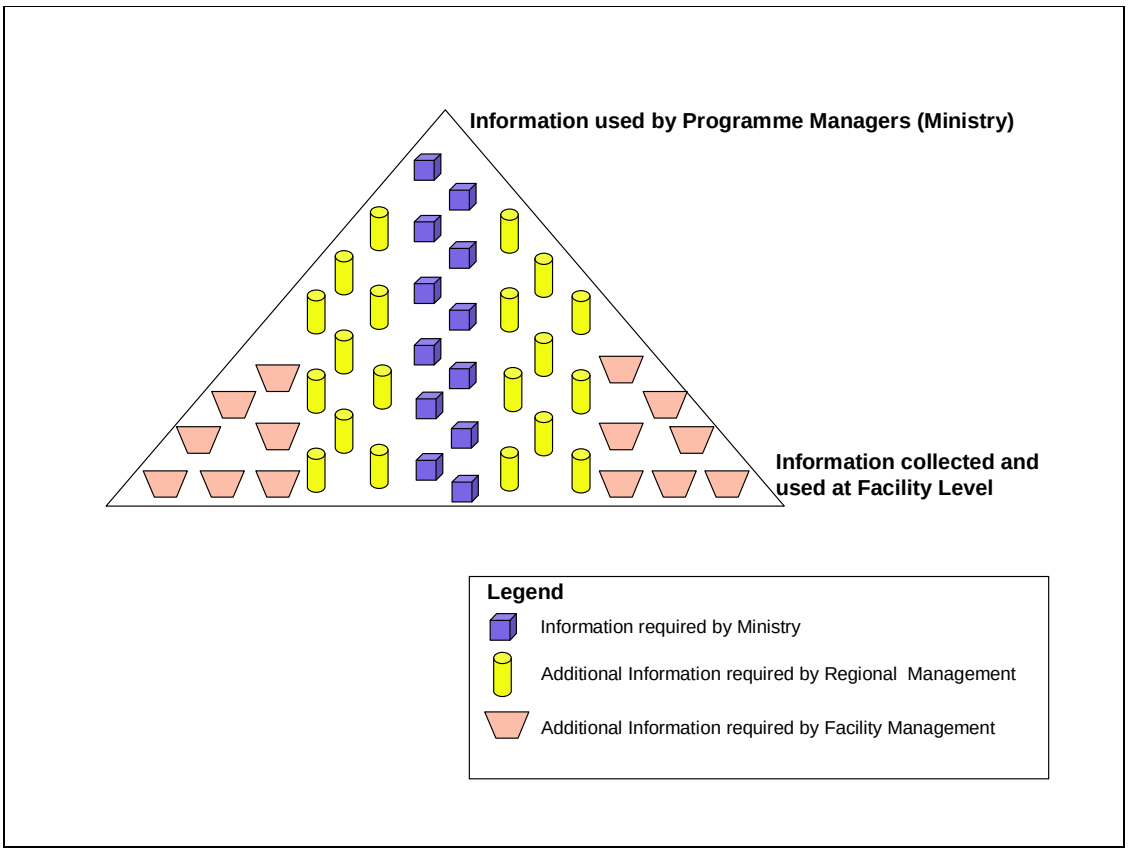
a) Limit the routine reporting requirements for PHC and Hospital services to a set of 100 to 150 data elements, enabling the calculation of 80 to120 indicators,
b) Integrate the reporting requirements of various programme managers, so that their needs are contained within the set of essential data elements and indicators.

All decision-making levels do not require all indicators. Facility managers need a broader base of information in order to manage their services effectively (for example – a facility level manager might need to know which geographic areas are accessing their services. This is locally relevant information, but is of no relevance at the National level). The amount of information needed at successive levels of the health system decreases from peripheral to central levels. An information pyramid is thus created (Figure 1), with the EDS being the minimum data necessary to flow through all levels to the central level.

Each level can add to the EDS the indicators they believe to be important at that level. The regional level can expand the national EDS and develop a regional data set (RDS) specific to regional needs. Facilities can in turn add further data elements to develop a facility data set (FDS) to suit their particular management

needs. These additional elements may not be relevant at a higher level and are therefore not submitted to higher levels.

Figure 1: Information pyramid



Vertical programmes such as EPI, TB and HIV/AIDS can include relevant data elements within the EDS, and/or submit additional data that could be collected using surveys.

Surveys should be used to collect information that will complement the routine reporting. As some indicators do not change much over time, they do not need to be reported on monthly – they can be collected annually or quarterly through the use of surveys. Typical contents of a survey questionnaire would be questions about quality of care, availability of equipment, staffing and budget allocations. Surveys can be used creatively to strengthen health services – for example, it may be that in order to reduce the cost of surveys, a three year rolling plan is developed, ensuring that annually a third of all facilities are surveyed. Over the three year period all facilties are surveyed. A survey dataset would contain core information that is common to all the years, and additional information that could be changed from year to year, depending on the need.

Summary of main findings:

a) In discussions with Mr. Rubona (Head, Health Information and Research Section of the Policy and Planning Directorate), he indicated that the country had identified 33 indicators with which to evaluate the health sector, included in which were 19 indicators for health districts. Some of these were in the quarterly or annual reporting requirements. He indicated that "this is the essential dataset, but additional data is also required to assist other programmes".
b) An analysis of health sector performance measuring 19 indicators was conducted during 2004, and published in Jan 2005 (NIMR 2005). The indicators used in this study have been identified through the Annual Health Sector Reviews process. These indicators are listed in Appendix 2.
c) The MTUHA Version 2.0 Data Documentation manual provides a list of data elements entitled the "MTUHA National Database". This section lists the reporting requirements by data elements, grouped in a number of categories.

Some suggestions for improvement of some of these reporting requirements are:

- The annual reporting requirements introduce new data elements (e.g. out-patient diagnoses, family planning acceptors by method) that are not included in the quarterly reporting requirements. Because these data elements need to be collected on a monthly (daily) basis in order to address the annual reporting requirements, they should form part of the monthly (or quarterly) reporting system. The annual reporting should be reserved for data that only needs to be collected at a single point (slice in time data) during the course of the year.

- The annual reporting requirements are too onerous, and should be reduced to essentials. Sentinel surveillance sites should be used to collect disease/diagnostic specific data.

- The list hints at the creation of indicators, but is in fact a list of data elements. These should be converted into indicators, and each indicator should have a defined numerator and denominator. Thus:

		Comment
Current data element	Number of facilities reporting late arrival of drug kit.	Presumably the aim of this data element is to be able to assess the improvement in delivery of drug kits. But, does this mean one late delivery or twelve or five. In addition, all facilities get afforded equal status, irrespective of the number of late drug kits received. It will not provide useful information for managers as it currently stands.
Proposed indicator	Percentage of drug kits received late.	Numerator: # drug kits received late Denominator: # drug kits received This indicator enables the manager to assess the number of deliveries that took place, and the number that were late. It will

- There is no reporting in this list on
  - tuberculosis (and leprosy),
  - HIV/AIDS.

  These are being addressed through vertical reporting systems.

- The reporting requirements of the "Essential Dataset" are not consistent with the reporting formats in that:
  - Some data required in the Essential dataset are not reported on in the Health Facility Annual Report (F005) (e.g. dental clinic data, maternity data);
  - Some data required in the Essential dataset are not reported on in the Health Facility Quarterly Report (F004) (e.g. family planning data)
  - Facility quarterly reports do not always feed logically into District quarterly reports (e.g. District Quarterly Reports requires data on "Days drug kits late" which is not included in the facility Quarterly Report).

d) Duplicate reporting is taking place because of the parallel systems that have been developed to complement the inefficiencies in the MTUHA software, and data processing.

Recommendations Essential Dataset:

Involvement of the MoH and all program managers, and donor organizations (including CDC) to develop a coherent strategy for the development of an integrated information system with buy in to the concept of an essential dataset (with annual revisions) comprised of:

- Routine data (monthly reporting, quarterly and annual reporting) from all facilities
- Annual surveys from selected facilities;
- Use of sentinel sites for selected intense data collection systems;
- Use of demographic and other surveys from time to time.

3.3 Human Resources for Information Systems

In this section the skills requirements and training of staff and the roles and functions of staff are discussed. In many countries, the function of data entry and processing is assigned at district and regional level to staff specifically appointed for this function – generally called “information officers” or “statisticians”. At health facility level, various models are used – in smaller centres, the function of collating data is an added responsibility assigned to the person in-charge or a deputy. In larger facilities or busy hospital wards, clerks are utilised for this purpose.

The interpretation and use of information becomes the responsibility of the facility manager (for example person in charge of the hospital ward, hospital manager, or person in charge of dispensary, health centre) or programme manager (at the district, regional and central levels). These functions and responsibilities are summarised in the table below.

Position	Functions	Skills Requirements
Health workers and clerks in facilities	• Enter data into register books • Complete tally sheets / summary forms	• Knowledge of basic principles of information systems (definitions of data elements; collection systems; data quality; basic use of information)
Facility managers, supervisors and programme managers at district, regional and central level	• Receive and check information • Pass information on to the next level • Analyse relevant local information • Act upon local information	• Knowledge of the above, plus analysis skills and an understanding of their role in reviewing, interpreting and acting upon locally relevant information
Data capturers (at hospital, district, regional or central levels)	• Enter data into computer • Ensure data quality • Produce local reports.	• Computer literacy • Knowledge of basics of health information

Summary of main findings:

At health facility level, it appears as if the responsibility for data processing is an added responsibility to staff who have other responsibilities as well. In Mtwara it is the EPI co-ordinators who capture data in the MTUHA database and collate the MTUHA reports. In the facilities (hospital wards, dispensaries, and health centres) the compilation of monthly reports is performed by the clinical officer. When asked, this was clearly seen as an “add on” responsibility to other responsibilities.

The Epi co-ordinator in Mtwara had conducted training on the MTUHA software for his counterparts in the Mtwara urban and district municipalities. This was impressive as it had been done on his own initiative. While the two municipality information officers were not entirely computer literate, they were able to negotiate around the MTUHA data base as a result of this intervention.

Recently regions and districts had been asked to identify a focal person for information (both information and research) – this will hopefully improve the accountability of staff towards ensuring that data is collected, collated and submitted in time.

The Health Information and Research Unit had been assigned the responsibility of collating and integrating the various information systems – this was not an easy task and tended to get shelved because of other competing priorities.

It is not clear who is responsible for the IT components of the information system, NIMRI is currently involved in establishing an network for sections of the Ministry in Dar es Salaam, and the intention is to link with regions as well. But as computers become more common, a dedicated IT unit will be needed.

A training course for 30 students is offered at the University of Dar es Salaam (and funded through DANAID and NORAD). This course is conducted over two semesters (in February and September). Each semester is a four week period. Three modules are presented in this course:

- Health information systems (6 credits)
- Design and development of health information systems: methods and approaches (10 credits)
- Implementation of health information systems in developing countries: international experiences (5 credits)

The courses are presented jointly by HISP team members in Tanzania, Oslo, Mozambique and South Africa.

However, they are not frequent enough to address the huge needs of the country, and being centrally located make the training costs to high for more peripheral areas. There appeared to be general support for the idea that the zonal training centres (e.g. Muhimbili Institute in Dar es Salaam, PHC Institute in Iringa, and the various Nurse Training Units) should be utilised for conducting training in the regions – however, there would be a need to build capacity in these centres before they would be able to conduct their own training.

The focus of training should be on the practical application of information systems, and interpretation and use of data using the participants own data. Supervision, and what it entails was an area that also required considerable support and development.

Recommendations Human Resources for Information Systems:

1) Clearly define the roles and responsibilities for information at each level within the health services. This includes:
   a) assessing staff functions at the central, regional and district level;
   b) determining staffing needs at the central, regional and district level;
   c) planning for the IT support functions;
2) Describe the accountability patterns and communication channels between these staff.
3) Develop a broad based, long term training strategy covering both IT and HIS components of the information system;
4) Identify efficient processes for providing support to information systems staff.

3.4

3.4 Access to hardware and software:

The technical resources supporting an information system must be appropriate to the context. In most developing countries, paper-based and computerised systems are combined to varying degrees, depending on the infrastructure and resources available.

3.4.1 Computer hardware

Appendix 3 provides guidance on the appropriate hardware required to support a HMIS in resource-constrained settings.

Summary of main findings:
According to the MoH, most regions and districts have been provided with computers. These are relatively new and would meet the basic specifications suggested in Appendix 3. However, it is not clear whether a policy exists regarding the placement of computers, and the frequency with which they will be replaced. Computers have a limited lifespan, and if measures are not put in place to ensure that they can be replaced at least every four years, then they will soon become redundant and will negatively affect the information system.

3.4.2 Computer software

Many different software systems are available for use in the health sector. These vary hugely, and can generally be placed somewhere along a continuum based on the following characteristics:

- Patient based information systems versus systems for aggregating anonomised data;
- Proprietary versus open source systems;
- Networked systems vs stand alone systems;
- Using sophisticated databases vs simple readily available databases.

Suggested criteria for basic health information software:

Data capture:

- Prevents the capture of duplicate datasets.
- Has validation checks that allocation of dates to data is consistent
- Has mechanisms for data validation.
- Can be adapted by users to reflect the changing reality in the health sector. This includes changing facilities, adding new data elements and defining new indicators.
- Is able to calculate indicators that use population as a denominator.

Reporting functions:

- Reporting must be readily available to provide managers with real time data.
- Can provide automatic reports to various organisational levels.

Export/Import function:

- Can automatically export data from lower levels for import at higher levels.
- Can specify data export of different groups of data (for onward transmission to various stakeholders – e.g. donors, programme managers, etc.

Maintenance:

- Can be locally (in country) supported, developed and adapted.

Summary of main findings:

The MTUHA system uses Microsoft Access to collect aggregated information from facilities. The software is very basic, and generally hardcoded, meaning that only the programmer, who holds the source code, can effect changes in the system. It operates as a stand alone system on individual computers, and has a basic import and export function. The main problem with the MTUHA software is linked to the fact that it is hardcoded. This means that:

- As reporting requirements change (e.g. with the HIV epidemic, reporting requirements have changed remarkably over the last two years), the system cannot accommodate the changes – this means that new systems are developed to complement the hardcoded system, resulting in fragmented information systems;
- Reports are also hardcoded – if a manager wants a slightly different report, the system cannot deliver it;

- The system does not allow reporting of indicators – at present it only reports on aggregated numbers.
- In discussions at the district level, the MTUHA system appeared to require quarterly district data to be entered, rather than it being calculated from the sum of the quarterly reports from the facilities. The software programme should be able to do these calculations for both the district and annual reports.

Data is entered into the computers at district level, from where it is transferred on a floppy disk to the regional level. At the regional level the data is collated from the districts, and then exported on a floppy disk to the MoH. During the period of the review, we were not able to access the MTUHA database in the Ministry, so the timeliness of data at this level was not able to be assessed.

The District Health Information System (DHIS) software was initially introduced in Bagamoyo in Tanzania (Lungo, 2003), and has subsequently been rolled out in Kibaha, and 3 municipalities in Dar es Salaam. The DHIS software is an access based system, collecting aggregated data from health facilities. It is however much more sophisticated than the MTUHA system, allows for the kinds of flexibility that is listed in the box detailing software specifications, and is an open source system. Development of the DHIS software is being co-ordinated through a growing international network (the Health Information Systems Project - HISP) of developers in various countries (South Africa, India, Ethiopia, Tanzania, and Oslo). Being open source it is free, and users are entitled to develop it and customise it in accordance with their needs. In Tanzania a team based at the University of Dar es Salaam Department of Computer Sciences, has been working along with the Ministry, and colleagues in South Africa and Oslo (the HISP Network) to adapt the system for use in Tanzania.

Recommendations Hardware and Software:

Develop a policy on the use and access to computers in districts and hospitals.
Agree to the use of the DHIS in at least the 3 Regions (Mtwara, Tabora, and Mara). The existing MTUHA data can be imported into the DHIS so as to build on the existing data.
Develop an implementation strategy for the development and support for the DHIS in these regions.

3.5 Steps in the information cycle:

The figure below describes the steps in the information cycle. Each step will be discussed separately. It is important to understand that the information cycle should be intricately linked to the planning cycle in that the data that is collected should be used to inform the goals, targets and indicators developed in the planning process.

Example of linkage between data collection, and district goals and targets

A district (or facility) plans to provide anti-retroviral therapy in the first year of its programme to 200 of the expected 1000 patients who have AIDS. In order to monitor progress towards their goal, the data set for that facility should include the data element "New patient for ART".
An indicator is developed "Percentage of expected ART candidates placed on ART". The numerator is the number of patients "New patient for ART", and the denominator is 1000.

In this case, for the first year, the target is 20%.

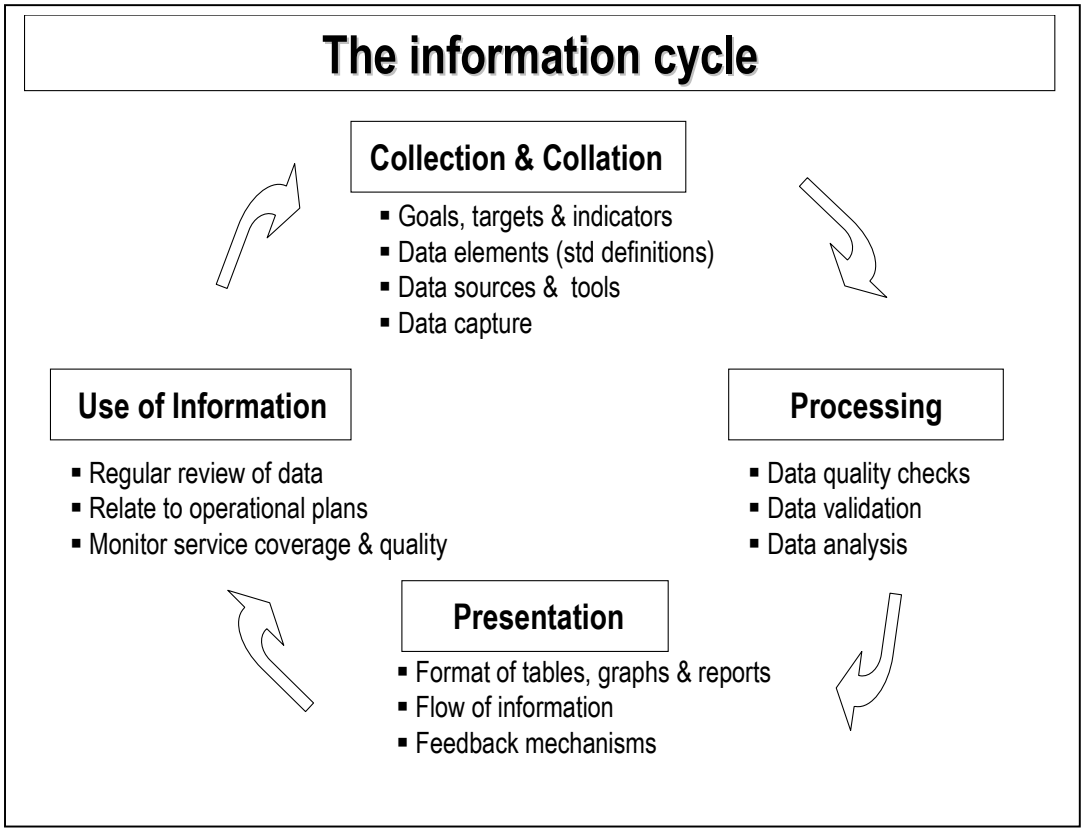


Figure 1: The Information Cycle

Many of the Comprehensive District Plans of the three regions record the observation of the Council Health Management Team (CHMT) which reads thus "The MTUHA System is in place but not all health facilities report in a timely manner, and some newly employed health workers need training in the MTUHA system and the ones who were already in the system and who received training in the MTUHA system before need refresher courses in the system to improve their performance in handling data".

This is supported by the observations of Mboera et al (2001) who conducted a study of the use of the HMIS data for disease surveullance in 45 randomly selected districts of mainland Tanzania. Seven of the 45 districts are from the Three Regions Health Study of Mara (Bunda and Serengeti) ,Tabora (Igunga and Tabora Rural) and Mtwara (Mtwara Rural,Tandahimba and Newala). Their findings were:

- between 17.85 and 44.4% of Districts could not provide demographic data on Infant Mortality Rate, Under- five Mortality Rate and Maternal Mortality rate;
- data analysis and utilization was poor in 51.1% of Districts.

3.5.1 Data Collection and Collation:

All data elements used as numerator or denominator for indicators must have standardised definitions. Data collection sources must be identified and tools must be aligned to the essential dataset. Uniform data capturing tools help to ensure that the data captured at different sites has similar meanings. Both manual and computerised data capturing processes require mechanisms (checks) that support good data quality. For example, manual systems can have simple double check procedures to ensure that arithmetic is correct and comparisons with previous data help to highlight unlikely entries. In computerised systems, a validation rule included in the software can be programmed to flash a warning when an unlikely figure is entered.

Summary of main findings:
The MTUHA data collection system is well developed. Registers have been developed, and assist in the process of data collection. While some reports of difficulty in accessing registers was reported, this was not evident in the facilities visited.

Problems exist in the collection and collation of data – not all facilities report as required, and this results in gaps in the data.

Not enough attention is paid to the data collection and verification process.

Duplicate reporting systems exist. These result in unnecessary demands being placed on the time of already overworked health workers. The maternity ward at Ligula Hospital had three registers that collected similar information. One register was initiated by Dar es Salaam University, and data from this was supposed to be entered into a computer (EPI database – see figure 2) by the doctor (the visit took place in April 2005 and she was still busy entering data from previous deliveries – she had progressed to August 2004)

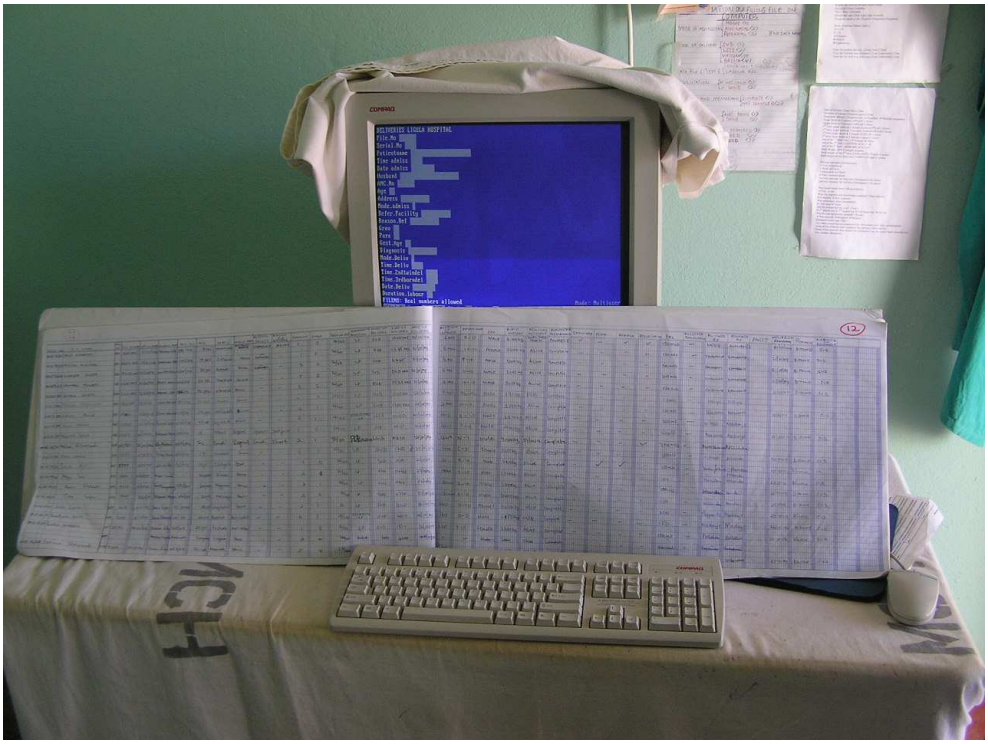


Figure 2: Delivery register #1: Ligula Hospital Maternity Ward

The second was the MTUHA register (see Figure 3).

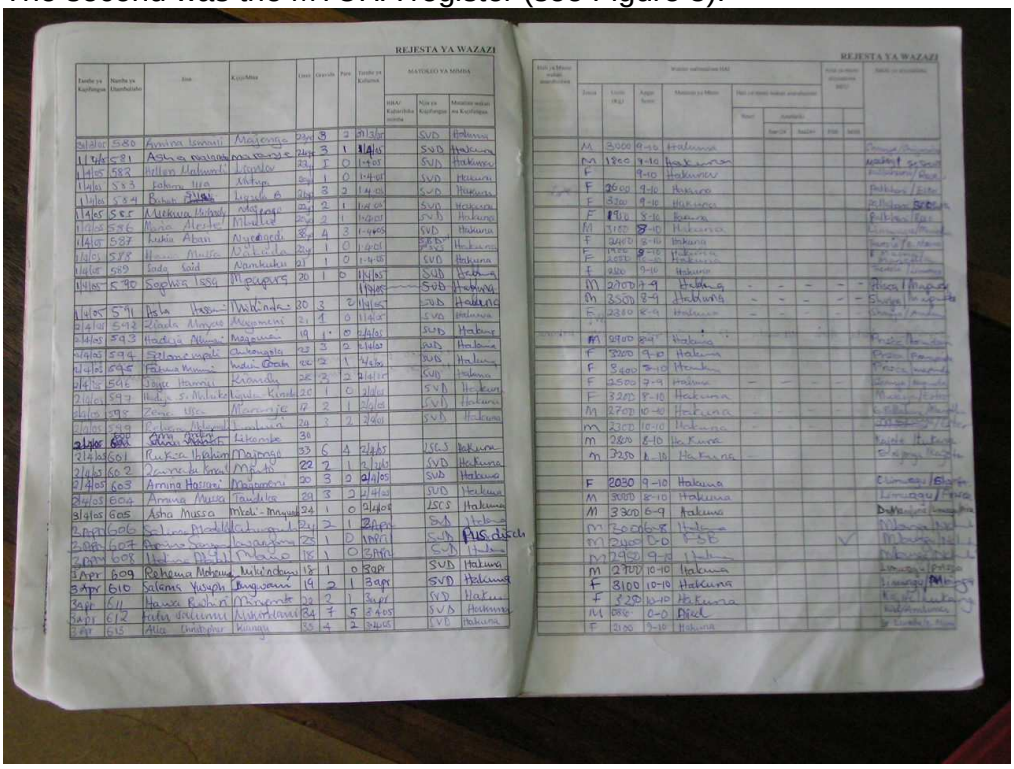


Figure 3: Delivery register #2: MTUHA register at Ligula Hospital

And the third register was a book depicted in the photograph in figure 4.

Recommendations on Data Collection and Collation:

Given the detail of the MTUHA data collection system, little needs to be done here except to adapt the existing registers to a few new indicators.
Emphasis is needed to provide an integrated information system.

Step 1: Clarify definitions of data elements and indicators
This should be done in consultation with the Ministry of Health and programme managers.

Step 2: Identify a pilot district in each region. In this district:
Assess data collection instruments used in the facilities (begin with PHC facilities, then move onto hospitals – in PHC facilities these will be largely the MTUHA registers, and vertical programme reporting formats);
Determine areas of unnecessary duplication and streamline these;
Clarify reporting requirements (data to be reported upon, timeframes, and whether it includes private facilities or not) in terms of the data flow policy;

Step 3: Roll out lessons from pilot district to other districts

3.5.2 Data processing and analysis:

The data processing stage should also include various data quality checks and data validation processes. This ensures that when raw data are converted into information during the analysis phase, the resulting indicators are accurate and provide a true reflection of they situation they are intended to measure. If data quality is not assured, the other stages of the information process have little value.

Good quality data are defined as being:

- correct: the data are accurate, i.e. the numbers provided are what actually occurred.
- complete: all, or almost all, of the data have been collected from the available sources and reporting units have reported for each month they functioned.
- consistent: the data are stable and show no unexplained large variances.

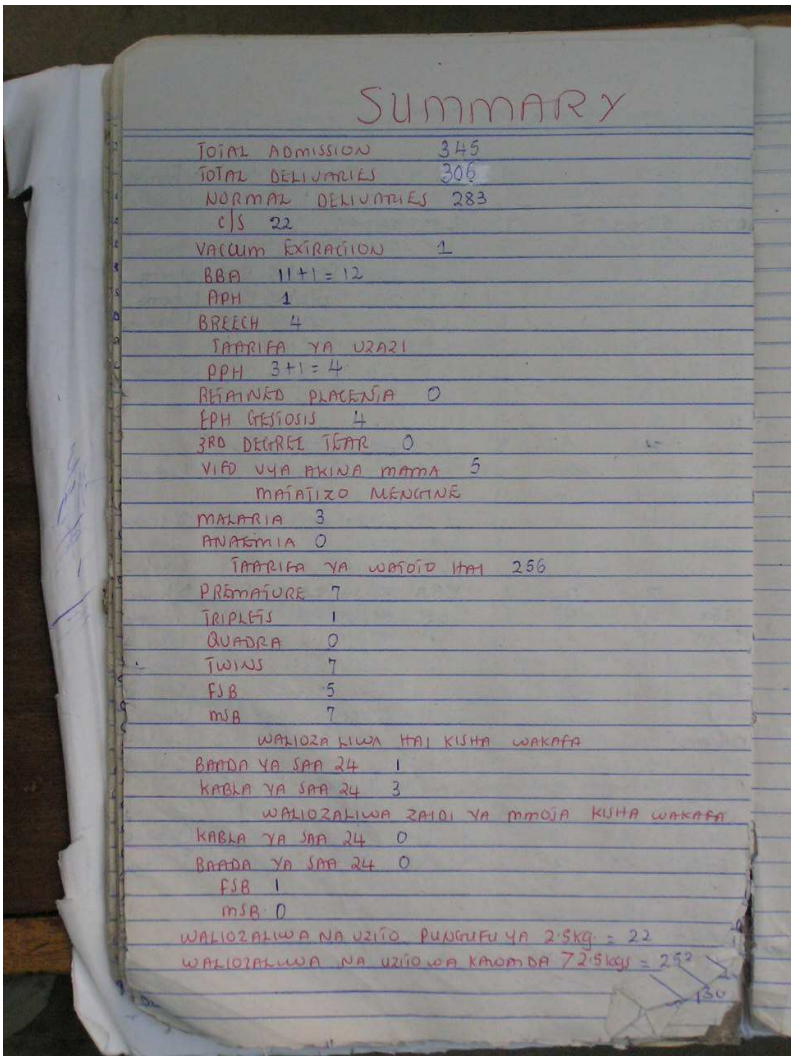


Figure 4: Ligula Hospital Maternity Ward - summary data

Summary of main findings:

Facilities have the data available at their fingertips. This was evident in most facilities visited. In most instances they have summarised the data for the last month, and in some instances have calculated some indicators, as was evidenced during visits to Likombe Dispensary, and the maternity ward at Ligula hospital (ironically the

computer system could not provide analyses, but the staff had done so at their own initiative!).

The EPI Co-ordinator for the Mtwara region had developed a simple excel spreadsheet in which he entered raw data on a monthly basis from facilities. Beside the table in which raw data was entered, he had developed a duplicate table containing formula's which automatically calculated certain coverage rates for him. Here again was a duplicate system that was simpler in its application than the MTUHA database, yet produced more meaningful information for the manager.

Recommendations on Processing and Analysis:

Acceptance of the recommendation to utilise the DHIS to process the information is critical to the successful implementation of the recommendations on processing and analysis.

Step 1: Initiate data quality checks at facility and district levels:
Data quality checks need to be instituted at facility level by supervisors, and at district level at the time of data entry.
Define validation checks in the DHIS software.

Step 2: Strengthen existing processing and analysis in facilities
Facilitate district workshops to assess data and indicators between facilities.
Support facilities in their processing and analysis of their own data.

Step 3: Strengthen processing and analysis of data and information in districts
Use the DHIS software to provide reports for

- programme managers;
- for comparing facilities across the district.

3.5.3 Data Presentation and Feedback:

Presentation involves compiling information into a format that is quickly and easily understood. After analysis, the information is presented as reports which emphasize indicators and include tables and graphs. Reports are essential in supporting the feedback process.

The establishment of a data flow policy is necessary to ensure appropriate flow of information and feedback. Data/information flow should occur vertically in both directions, i.e. upwards from facility through intermediate levels to national level and downwards from higher levels to facilities. A horizontal flow of information between role-players at each level is also important. Thus, feedback to facilities should include analysis of indicators for each facility or region as well as across facilities and regions. This allows for comparisons as well as providing an overall view of a situation. Reports must be regular and timely if the information is to be used to inform decision-making. Review of historical data is rarely of value, as the current trends may be quite different.

Summary of main findings:
There was little evidence of any systematic presentation of information, nor was there evidence of feedback from higher levels.

It is not entirely clear whether programme managers at district or regional level have access to data from the MTUHA system. Even if they did, it is questionable how useful the information is given its incompleteness. It is assumed that most programme managers access their data through systems (parallel) that have been developed to complement the MTUHA system.

Recommendations on Data Presentation and Feedback:

Step 1: Initiate training to improve presentation of information in facilities
Step 2: Establish formalised feedback processes and procedures in the district

3.5.4 Data use

Information is used to support the management processes of planning, budgeting, implementation of operational plans, and monitoring and evaluation of implementation strategies. Indicators reveal progress towards stated management targets and objectives. A culture of regular use of information must be developed through the production of regular reports, and the process of analysing these reports and acting upon them must be institutionalised as a monthly activity.

A simple evaluation tool (the TALI Tool –Tool for Assessing Level of Information Use) has been developed for evaluating the use of information for management. This tool has been adapted for the Tanzanian context, and is described in Appendix 5. The initiation of an evaluation exercise using this tool is helpful is raising awareness of the information process.

Summary of main findings:
At a local level in we found evidence of the use of information at a very basic level (list of top ten diagnoses, and catchment populations charted on the wall of the Likombe Dispensary)

At Ligula Hospital, through the intervention of the District Health Improvement Project in Mtwara (TGPSH) Hospital Management Advisor, the hospital had prepared an annual report for 2003 from MTUHA data and other sources (mainly to complement the incomplete MTUHA data, and to provide a more detailed analysis of hospital diagnoses required for a hospital of this nature).

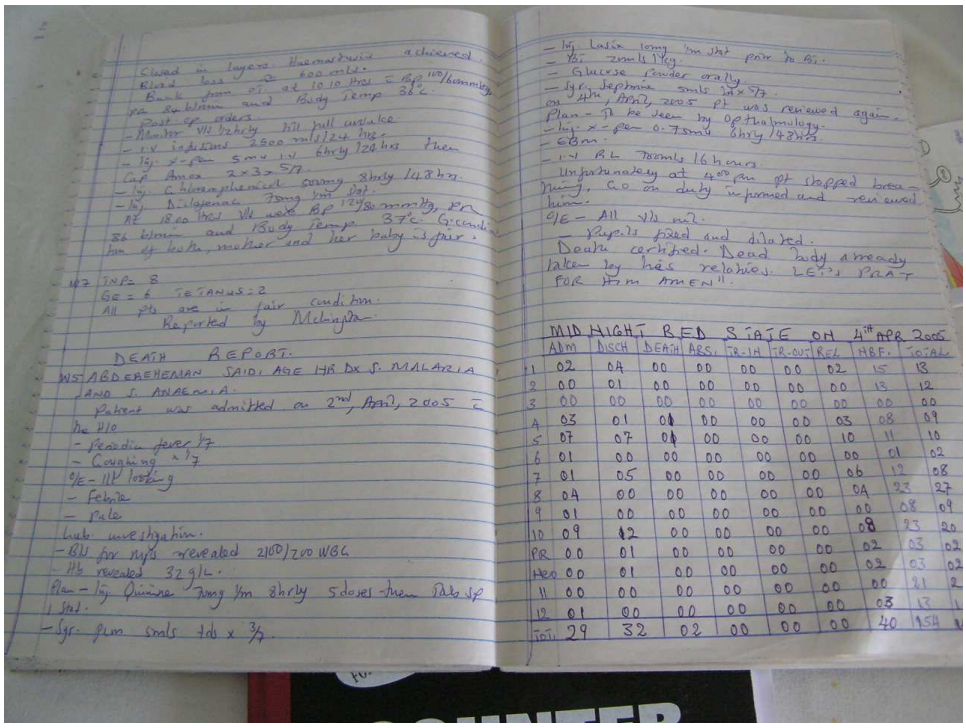


Figure 5: Ligula Hospital daily Bed Status Report

It would appear that because the MTUHA data is slow in being communicated to the various levels, the data is largely irrelevant for use in immediate assessment of service delivery. Vertical programs probably serve to address some of the needs of programme managers.

Applying the TALI tool are able to assess the level of information use at district, region and national levels as still trying to address the requirements of Level 1. Some facilities could possibly be placed at Level 2 (Ligula Hospital) and possibly at level 3 in some of the reporting units in the hospital.

Recommendations Data Use:

Create a culture of information use within the Ministry of Health.
Implement the TALI Tool as a means to measure movement towards a culture of information use.

Section 4. Discussion and recommendations:

4.1 Introduction:

This section mirrors the preceding section (Section 3 Assessing the Components of an Information System). The start of each subsection begins with a summary of the key recommendations drawn from Section 3, and elaborates on this. Thus recommendations address the EDS, data flow policy, human resources and training, and access to hardware and software. No specific recommendations are tabled regarding the information cycle, as it is believed that addressing these key components will go a long way to improving information flow. Rather two new sections have been added, one detailing the requirements to "create a culture of information use" in the health sector, and the other the presentation of some thoughts on a structured framework for the long term development of the HMIS in Tanzania.

The Research Section of the Department of policy and planning of the MOH (as part of their HMIS improvement plan) made the following recommendations:

1) Development of a Human Resources Plan for HMIS for the whole Country.
2) Introduction of a minimum package of information for Dispensaries , Health Centres and District Hospitals
3) Improvement of quality control within HMIS
4) Improvement of Information sharing

Our recommendations are in essence similar, but we have approached the evaluation of the Tanzania MTUHA system from the point of view of it needing to address the following goals of an information system (Heywood):

> *" To support the district-based primary health care (PHC) approach.*
> *To collect essential data used to calculate indicators.*
> *To encourage decentralised use of information by health workers.*
> *To include all service providers at all levels, and*
> *Integrated with and supports other information systems…"*

4.2 Recommendation on Data Flow Policy:

Recommendations Data Flow Policy:

1) Change quarterly reporting to monthly
2) Clarify/Define data flow policy for Tanzania
3) Ensure that all facilities provide monthly reports

The steps required in terms of the data flow policy are not complicated. Clarifying the timeframes for reporting would be the first step once agreement has been reached on a monthly reporting process. This is an absolute prerequisite in terms of improving the information system.

The data flow policy will require some definition of roles and responsibilities amongst the various staff involved in the information cycle. Job descriptions need to be developed, and formally adopted as part of this process.

Clarifying the data flow policy requires the following activities:

- Initiating a consultative process with management at MoH (HMIS Unit and Porgramme Managers);
- The development of draft data flow policy for presentation to senior management. If agreement is obtained, this is then discussed in regions. A key aspect is the requirement for all facilities to report on their services, whether private, voluntary, or state funded. Final draft produced which incorporates the recommendations from regions.
- Improved monitoring of reporting from facilities at a district level. Districts provide feedback on monthly reports received and identify those facilities not meeting the data flow policy requirements.

4.3 Recommendation on Essential Data Set:

Recommendations Essential Dataset:

Involvement of the MoH and all program managers, and donor organizations (including CDC) to develop a coherent strategy for the development of an integrated information system with buy in to the concept of an essential dataset (with annual revisions) comprised of:

- Routine data (monthly reporting, quarterly and annual reporting) from all facilities
- Annual surveys from selected facilities;
- Use of sentinel sites for selected intense data collection systems;
- Use of demographic and other surveys from time to time;

The process of confirming an essential dataset is one which will require time, and should probably be phased in over a one year process – this in order to allow adequate consultation between stakeholders to take place – if this process is rushed, the risk is that key stakeholders will dig in their heels and the process will be derailed.

The aim of this process is as follows:

- All programmes and programme managers, including NGO's, buy into the creation of an essential dataset. The aim is to develop an integrated EDS that addresses the needs of all managers and programmes;
- The data set identifies indicators used by programme managers to measure the implementation of their objectives and action plans. This will ensure that information collected is relevant to the needs of programme managers;
- The dataset is limited to about 100 -120 indicators;
- The dataset is reviewed from time to time, enabling the dataset to develop over time in response to the changing needs of managers;
- The indicators to be reported on are applicable to all facilities within the health service;
- Managers at each level in the hierarchy can add indicators that are considered important for their particular management purposes.

The development of an EDS does not preclude having other information systems with specialised functions. Epidemiological surveillance systems may still be required – these generally require data with which the patient can be identified (name, address, age, contacts, etc.) and an anonymised routine reporting system

cannot support this need. In addition, other systems are needed which provide detailed, or specialist information, to specific groups (for example, a human resource payment or accounting system). In these cases, it is often advisable to support the development of such systems, but to develop interfaces so that subsets of data can be transferred from the specialist system to the routine reporting system, e.g. the number of cases of Acute Flaccid Paralysis (AFP) reported on a monthly basis from regions.

The functioning of the various components of the integrated HIS should be coordinated by the HMIS Unit, whose role it is to ensure that duplicate systems are not developed and that all systems meet the criteria set by the MoH.

Another important point is to utilise survey methods and introduce sentinel surveillance sites as mechanisms to complement routine data. These tools allow the EDS to be kept small, yet allow programme managers to obtain detailed information to address their programmatic needs.

Once the EDS has been developed, the MTUHA data collection tools will need to be evaluated and adjusted somewhat – this is not envisaged to be a difficult process.

Developing an essential dataset requires the following steps:

- Evaluate existing departmental objectives and operational plans;
- Review reporting requirements for vertical programmes and NGO's;
- Assess managerial needs at each level of the health service (facilities, region, and ministry);
- Use the above information to compile a draft essential dataset for the country;
- Define the extent to which surveys and sentinel surveillance sites will be used to complement the EDS;
- Identify mechanisms to include population (census) data in the system to provide certain denominator data;
- Convene a stakeholder workshop to ratify the proposed essential dataset.

4.4 Recommendation on Human Resources for Information Systems:

This section discusses the process of ensuring that staff are available at each level of the health system to support the information system functions. It looks at the process of determining staffing needs based on roles and responsibilities at the Central Ministry level, and at the regional and district levels, as well as at the facility level. This section also explores the process of determining training needs, and suggests an implementation plan for building capacity in the country to conduct training in a sustainable manner. Lastly it briefly discusses the importance of providing on-going training to information systems staff.

Recommendations Human Resources for Information Systems:

1) Clearly define the roles and responsibilities for information at each level within the health services. This includes:
   a) assessing staff functions at the central, regional and district level;
   b) determining staffing needs at the central, regional and district level;
   c) planning for the IT support functions;
2) Describe the accountability patterns and communication channels between these staff.
3) Develop a broad based, long term training strategy covering both IT and HIS components of the information system;
4) Identify efficient processes for providing support to information systems staff.

4.4.1 Determining Human Resource needs for the Information System

a) Staffing the MoH HMIS Unit

Staffing norms for each level of the information system need to be determined – at the central MoH level as well as in the regions, district and facilities. This requires clear identification of tasks performed at each level, and an assessment of the skills required. Once this has been done, the skills mix of staff can be identified. Medical informatics is a new field, and up to now has not received the required attention, especially in resource constrained settings. This does not mean that the staffing requirements are insurmountable or unsustainable – rather

a strategic approach is needed to determine needs and establish a process that allows the needs to be addressed.

One way of evaluating the staffing norms at the central level is to unpack some of the main areas of responsibility of the HMIS Unit. An illustrative example is provided in the table below:

Technical Area	Role of Ministry	Role of Other Stakeholders	Comments
Setting policy, standards and defining practice	Co-ordinate, determine priority areas	Support Ministry	Gradual process, beginning with most pressing areas, and gradually moving through a list
Development and maintenance of routine information systems	Set standards and reporting requirements. Co-ordinate and integrate different systems. Make information available to programme managers	Support Ministry	Reporting on the routine information system will differ depending on the programme and the type of facility (hospitals reporting will differ from PHC facilities)
Surveys and audits	Ministry must co-ordinate	NGO's and other stakeholders can effect	Surveys must be available to complement routine IS
Research	Ministry must co-ordinate	NGO's and other stakeholders can effect	
Information technology, including telemedicine, networking, and interfacing of information systems software.	Ministry must co-ordinate	NGO's and other stakeholders can effect	A key area here is the co-ordination and development of a sustainable information system in the country

A key area of responsibility of the HMIS Unit is to make the national dataset available to managers, so that they can extract the information that is relevant to them.

Having determined the key performance areas, and the vision and mission of the HMIS unit, the skills mix of units can be determined. “Out sourcing” some services can complement weaknesses within the public sector in terms of retaining and developing staff – a classic example is the “out-sourcing” of software development (governments are notoriously poor in retaining this cadre of staff because of the attractive counter offers industry can provide) – this can be done through a parastatal or academic unit, while still maintaining control over the development process so that government ensures that their needs are addressed.

b) Staffing the Regional and District level with staff to manage information systems :

Regions and districts have a vital role to play in the analysis and presentation of data. A cadre of health workers skilled in this area will need to be developed over time. This is not going to happen overnight, and will be brought about through:

- Training of existing staff – health workers trained in information systems have been shown to be able to be retained in the health sector for longer periods of time than IT workers trained in the health aspects of their field;
- Movement of staff from facilities where they have gained experience working with information systems;
- Training at undergraduate level if this can be accomplished within the academic institution in the country.

The critical steps in this process are as follows:

- Identify functions at the district and regional level
- Determine staffing norms
- Provide appropriate training (see below)
- Provide continued support and supervision (see below)

c) Staffing at the facility level for information systems:

- The importance of HIS work should be recognised and staff time should be 'ring fenced' to this function. HIS staff members must not be hijacked to perform other administrative tasks.

- Ensure that the responsibility for information functions at the facility level is included in job descriptions. In these facilities the role of ensuring that data is collected accurately and communicated to the next level in a timely way, can be integrated into the job description of a senior staff member in the unit. For example, the professional nurse in charge of a clinic could have this responsibility included in their job description.
- Identify staff to be dedicated "Information Officers" at larger hospitals and regional offices. At hospital level, the task of coordinating information flows and ensuring quality is a more full-time responsibility than in clinics. While technical support should be provided by the HMIS Unit, hospital information officers should be accountable to hospital management.

4.4.2 Training on information systems

The next two sections build on the guidelines provided by the Human Resources Development Department (CE/CPD Unit) as outlined in their booklet entitled Strengthening Continuing Education/Continuing Professional Development for Health workers in Tanzania. Key strategies involve the assessment of training needs, the development of capacity in zonal training centres and strengthening linkages with academic institutions, and the development of a comprehensive plan for providing training of various types to health workers.

In order to develop the information system and ensure its sustainability the establishment of a core group of staff with HIS skills who will ultimately train and support others is essential. The Ministry of Health should develop linkages with a formal tertiary level teaching institution, e.g. a technicon or university, to ensure ongoing support and build sustainability in the country for the training component. Capacity needs to be developed centrally (e.g. in Dar es Salaam) but also in the zonal training centres so that these centres can provide support to regional staff.

Training may include a series of one week courses or workshops at various levels (refer to table below).

Possible topics for short courses

Level	Types of courses that might be provided
Ministry	Using Information for management of health services
	Refinement of operational plans to include the use of routine indicators
	Interpretation and use of Information
HMIS UNIT	Using Information for management of health services
	Use of software (basic, intermediate, advanced)
Regional Offices	Using information for management of health services
	Use of software (basic, intermediate, advanced)
Hospitals/health centers	Using information for management of hospital services
	Use of software (basic, intermediate, advanced)
Clinics/PHUs	Using information for local management of health services

Implementation of the training programs will require the following steps:

1) Confirmation of training needs. This is determined by an assessment of training needs at each level in the hierarchy, and for the different cadres of health workers;
2) Development of quality training materials (through pilots in regions 1, 2, 3. The training materials would initially focus on DHIS training, and the principles of information use, with a later focus on the materials for the use and analysis of information)
3) Development of cadre of staff able to conduct training in country

4) Development of a training plan for informal training;
5) Establishment of:
    a. a training plan for formal training through “Summer/Winter School courses” (with academic flavour for more advanced managers) and provision of courses in districts and regions (focus on service delivery and practical hands-on training).
    b. courses with built-in costing to other NGO’s and interested parties (fund raising activities to make the NGO sustainable).

Steps required to implement a training plan:

1. Identification of a partner in a tertiary institution or NGO to assist and support the MoH in developing and implementing a sustainable training plan;
2. Quantification of the training needs at each level (numbers of staff, likely duration of training, implications of this in terms of absence from workplace, cost of training, etc);
3. Clarification of course content for each cadre;
4. Development of a comprehensive training strategy that will address:

4.4.3 Support and on-going training to information systems staff:

Ongoing in-service training and support are crucial to support staff in making optimal use of newly acquired skills. As capacity is developed at regional and district, senior staff must provide support to ensure that standards are met and maintained. This can happen through a process of supportive supervision to staff working in the information systems field. The supervision could be provided through either zonal training centre staff or supervisors.

4.5 Recommendations on Computer Hardware and Software:

Recommendations Hardware and Software:

Develop a policy on the use and access to computers in districts and hospitals.
Consider, and agree to the use of the DHIS in at least the Regions (Mtwara, Tabora, and Mara) .
Develop an implementation strategy for the development and support for the DHIS in these regions.

4.5.1 Computer Hardware

A policy detailing how the MoH will maintain an adequate standard of hardware for its services is required. This should spell out a plan which is practical and affordable, and ensures that computers of an acceptable standard are purchased to replace outdated equipment.

Annex 4 provides recommendations on hardware appropriate for health information systems.

Steps to develop a policy to provide appropriate computer hardware:

1. Embark on a consultation process with stakeholders;
2. Develop draft policy

4.5.2 Computer Software

The current software application contains significant problems. In order to meet the standards suggested in the box “Criteria for HIS software”, there are two options:

1. Invest a significant amount of time and financial resources in the existing system to get the programming adjusted to meet the criteria listed; or
2. Obtain a free and open source system that has been developed and tested in other sites, and which can be adapted at relatively little cost to the Tanzanian context. An example of such a system is the DHIS. This is

an Access-based (programmed in VBA) programme developed for use in the PHC setting and has been recently adapted to accommodate hospital settings. It is a simple system that has been shown to work in resource-constrained settings. The system is affordable, the only requirements being one computer, with MS-Office (with MS-Access), and some training and initial support. The software is adaptable in terms of determining the reporting units, developing data elements and indicators, validation rules, etc. It can thus be customised to suit an individual hospital's needs. The DHIS software programme allows data from the various reporting units to be entered and then uses reporting tools to present the aggregated data in different ways. (There are two reporting tools, Excel pivot tables and a built-in report generator.) For example, the paediatric ward data from multiple paediatric wards could be aggregated to provide an overview for the paediatric department. In the case of less specialised hospitals, all the data from all the wards could be aggregated to provide an overview for the entire hospital.

Furthermore, the DHIS allows the addition of modules to meet the needs of vertical programs, e.g. HIV/AIDS. Appendix 4 provides a more detailed description of the DHIS.

The HISP has adopted the approach of gradually building up a system from the bottom, and building on existing systems. The intention is to encourage the development of small software programmes in individual units, based on need as well as the availability of programmes/software/hardware, while at the same time finding ways of ensuring that data from these smaller systems are integrated into the broader “Health Information System”. It is envisaged that, as the system develops, it will include increasingly complex data related to service delivery, transport, personnel and financial datasets.

Steps in implementation of recommendations for computer software:

1. Agree on the specifications suggested for software to be used by the MoHS (This is important, because the software must support the aims of the information system, namely providing managers at all levels with relevant, timely and quality information with which they can monitor the implementation of health services and programmes, and use to inform their decision making);
2. Make a decision whether to invest in the existing software to enable it to meet the required specifications, or utilise available free and open source software
3. Develop an implementation strategy for the software utilising a piloting approach initially with then a phased roll-out to other districts/regions

4.6 Recommendations on Improving Steps in the Information Cycle:

These recommendations are for implementation in the districts, and form an integral part of the Phase II report (action plans for districts). The success of the implementation of these steps is linked to decisions and successful implementation of action plans related to the EDS, the data flow policy, the human resource recommendations (especially the training components), and the implementation of the DHIS software. Because the main report sections 3.5.1 to 3.5.4 describe the steps in detail, they are briefly summarised here.

Recommendations for data collection and collation:
In this section, emphasis is on the provision of an integrated information system.

- Clarify definitions of data elements and indicators
- Identify a pilot district for the clarification of data collection tools.
- Roll out lessons from pilot district to other districts

Recommendations on data processing and analysis:

- Initiate data quality checks at facility and district levels:
- Strengthen existing processing and analysis in facilities
- Strengthen processing and analysis of data and information in districts

Recommendations on data presentation and feedback:

- Initiate training to improve presentation of information in facilities
- Establish formalised feedback processes and procedures in the district

Recommendations on data use

- Create a culture of information use at the district level (similar in its intent to section 4.6 which describes the steps to be taken at the central ministry level to create a culture of information use).
- Implement the TALI Tool at the district as a means to measure movement towards a culture of information use.

4.7 Creating a culture of information use within the organisation:

Managers are using available information to some extent within the organisation. However, further developing and strengthening the culture of information use requires that managers at senior level are seen to be demanding regular reports on indicators, and to use these to inform their decision making, particularly related to resource allocation.

Key steps in strengthening this are:

- Placement of the HMIS Unit in a central position to report directly to the head of department will demonstrate the importance that senior management places on timely and accurate information;
- Provide Head of Department and Senior Managers with monthly reports
- Initiating a process of information reviews. Information reviews of this nature would require regions to present and discuss the information "in the system" before a panel of reviewers (senior managers, and representatives from academia and NGO's). A process of this nature rapidly demonstrates to health workers the importance that senior management places on information, enables managers to gauge the quality of services in a short period of time, and is a very powerful platform for learning through peer review.

To emphasise the central role that information plays in decision-making, the following steps are suggested:

1. Ensure that HIS support staff report directly to the head of department, reflecting the increased emphasis on use of information to inform decision making.
2. Ensure that standard reports are provided to the Head of Department on a monthly basis;
3. Conduct information reviews on a quarterly basis.

4.8 Some Thoughts on an Approach to Achieve an Efficient and Sustainable HMIS in Tanzania

4.8.1 Introduction:

While the report has discussed various aspects of the information system that require improvement, it has not provided a structured approach within which these changes could be effected. It is our firm belief that a piecemeal approach to improving the HMIS will not succeed. From discussions with various stakeholders, both within and outside of the MoH, there appears to be some understanding for the need to address the problems with the HMIS in a concerted effort. The following paragraphs attempt to expand on these ideas.

We believe the vision for the HMIS is encapsulated in the quote presented in the introductory section to this section. Moving from where the system is at present, to a situation where it is addressing those four ideals, will take some time. Given this, the following framework is suggested.

Improvements to the HMIS system should be initiated as a 3 - 5 year project with the aim of providing MoH officials (health workers and managers), NGO's, local and central government politicians and leaders with reliable and timely information to enable them to effectively mobilize and allocate resources.

It needs to be understood that the development of sustainable system, and the creation of a culture of information use should be seen within a longer term framework (10 – 15 years). The approach suggested is to adopt a developmental approach, with each step building on and informed by experience and in response to changing needs of the country.

4.8.2 Creating the Foundations for the HMIS Development:

Any long term strategy needs to be appropriate for the context in which it is to operate. A number of steps are outlined below to provide a firm foundation, and to establish the principles on which the HMIS will be developed:

1. Establishment of a technical oversight team (or utilize an existing team) consisting of representatives from the
   - MoH Information unit – to manage the process, and provide support and guidance, and access to program and project directors
   - NIMRI – to build on existing projects and facilitate access to the DHHIS data for research and reporting purposes
   - University staff - to develop a cadre of trainers in the regions (through the zonal training centres) and to provide software development support.

   This team should guide and monitor the project and its implementation.

2. Establishing a sustainable unit, comprising expertise from universities and partner organizations, that can provide training and software development support to the MoH. This unit should be sustainable in the long term through donor support for the contracting of services. This unit would drive the customization and development of the HIS to enable it to address the needs of the Tanzanian Health Services. This unit would have as its main aim to:
    - Develop and retain skills in information systems and in information technolgy in Tanzania. They would draw on the existing expertise developed in Tanzania and to build these people into a coherent team.

3. Utilise open source software to collate information from the facilities and districts. The DHIS Software would be made available for this purpose, as well as exiting training and operator materials.

4. Agree to utilize existing networks to provide high level support. Examples of such networks include the Health Metrics Network (HMN), the HISP (Health Information Systems Programme), MEASURE programme, BEANISH project, and networks and linkages between existing role players in the country (CDC, JSI, HISP, etc). Support should initially be intense and co-ordinated, to ensure that systems are put in place, and then gradually decreasing the level of support as capacity is developed in Tanzania;

4.8.3 The Implementation Process:

A number of approaches are suggested. However, the approach that we would feel most comfortable with is a gradual, phased approach, starting small in a number of sites, and building capacity and alliances over time, with the eventual aim of rolling out in a sustainable manner across the country. This is the underlying philosophy that should be adopted.

Where the HISP has applied this approach, the result has generally been the development of sustainable, locally appropriate solutions to information systems needs. The cost of these initiatives are generally far less than those of large, complex information systems. Lowered costs are achieved through the synergies brought about by the open source network which provides development of the information systems software at a very low cost, the sharing of skills and resources openly in an environment that is centered around the “not-for-profit” philosophy, and utilizing mainly local facilitators and consultants. The outcome has generally been a vibrant and sustainable information system. This is the approach that is advocated in this report, and the implementation process builds

on this model, drawing in the HISP expertise to assist in developing the systems in Tanzania.

Option 1: The developmental approach: (the preferred option):

1) Pilot the recommendations suggested in this report in one of the regions. Develop a phased approach, working closely with the MoH and regional and district management teams.
2) As experience develops, and as capacity is built, expand to another two regions over a fixed period of time, and therafter roll out the lessons learnt to the remainder of the country.

Option 2: The centralized rollout approach:

Another option is to begin at central ministry and effect change there and roll it out across all regions equally and at the same time. This approach requires large scale development of capacity first, and then subsequent roll out to the regions.

Option 3: The combination approach:

This is a combination of both processes, where a developmental approach is adopted, but not necessarily confined to a single region.

4.8.4 The project should have three main thrusts:

1) Development of IS tools (an EDS, the adaptation of the data collection forms, and reporting forms; including the development and customisation of the DHIS software);

2) Training of staff – initially DHIS and its use, principles of information systems development, and later use of information;

3) Establishment of a Tanzanian grown NGO to continue the development of information systems in close co-operation with the MoH.

Each of these areas will be explored briefly.

Development of Information Systems Tools:

The aim is to achieve level 1 of information utilization for PHC at facility, district and regional levels within one year in at least one region.

The tools we refer to in this section are:

- The essential dataset;
- The data collection tools (registers and reporting formats);
- The software for collation of data, its analysis and presentation.

For this focus area, intense support would be provided in years 1, 2 by for example HISP-SA, with gradual phasing out in years 3, 4. Years 3 and 4 would

be driven mainly by a Tanzanian NGO, with back-stopping support from HISP-SA, with year 5 onwards provided by a Tanzanian NGO.

Implementation process:
1) Use HISP-SA staff with Tanzanian staff to initiate work as follows:
- Ministry level: Clarify the EDS, including reporting requirements for vertical programmes, especially the HIV/AIDS programme
- Region 1: Develop proposed EDS, and adapt the data collection tools for use on the EDS; Roll this out to the other two regions;
- Regions 1, 2, 3: Customise the DHIS dataset, and implement it in all three regions.

In this process focus initially
- on PHC data set (year 1, months 1-12)
- Later add in financial and HR data (year 2)
- Then add in hospital datasets and systems (Year 2)

2) Provide support for the existing work in Bagamoyo and Tebora and 2 districts in Dar es Salaam.

3) At the end of year one, conduct an assessment of the implementation process in the three regions, and, based on this make suggestions for work plans in each region for the subsequent years.

4) Plan the roll out to other regions for years 3, 4, 5 (Year 2, months 1-6)

Training of staff:
Sections 3.3 and 4.4 detail aspects of developing a training strategy for staff involved in the information system/processes. This section builds on these recommendations.

We would envisage two phases to the training programme:

- Phase 1 includes training in two areas - training on the use of the software (DHIS), and training on the principles of information systems. These aspects support the achievement of levels 1 and 2 of information utilization at facility, district and region levels within 2 years. The target groups for the two types of training are different – the former (software training) targets the information officers, and the data capturers, while the latter targets the health workers at facility level, and their managers at district and regional levels.
- Phase 2 which focuses on the use and analysis of information, and which supports the achievement of levels 2 and 3 of information utilization at facility, district, regional and ministry of health levels by end of year 3: This step of the project will require:
  - Identification of senior staff skilled in use of information;

- Provision of both formal and informal training by the senior staff.
- Initiation of information reviews at the district, regional and national levels on a quarterly basis.

Section 4.4 details the steps required to develop a training plan. It is envisaged that this would be completed by the end of year 1, and be ready for implementation 2nd quarter of year two.

For this aspect, HISP- SA would co-ordinate the materials development in association with the University team, building on expertise in both groups. HISP support would gradually phase out in years 2 and 3. Years 3, 4 and 5 would be driven mainly by Tanzanian NGO, building on University staff.

Establishment of a Tanzanian Non-Governmental Organisation:
This aspect is aimed at providing a sustainable mechanism for providing ongoing support to the Tanzanian health system. During year one, there would be an exploration, (along with the MoH, NIMRI management, and the University), of options for development of a sustainable organization to continue information systems development in Tanzania. By end of year one, a proposal for implementation would be developed based on the model that is suggested by the partners.

Section 5. Concluding remarks:

Managers need to be able to access accurate and complete information on service delivery in a timely manner if the information is to be used for planning new services, or for assessing the quality of existing services. At present managers do not have an integrated information system that addresses these needs.

This report attempts to provide an overall framework for building on existing systems, to improve the HMIS in Tanzania. It emphasises the need for an integrated approach to information systems development. In this respect the report suggests mechanisms to clarify policies and processes at the Central (Ministry) level (like the confirmation of a data flow policy, an EDS, and support for the piloting of appropriate software), as well as the need to provide support for the development and provision of inputs into an information system (like human resources, HR capacity, computer hardware and software). It emphasises the need to strengthen existing attempts to create a culture of information use through providing a high profile to the HMIS unit and by initiating “Information Review” processes at the regional and central levels.

The process of strengthening the HMIS should be rooted in the creation of sustainable systems and processes in Tanzania, and to this end the creation of a “Tanzanian grown” NGO, to partner the ministry, universities and service providers is suggested.

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Appendix 1: Brief list of activities in Mtwara Region:

Date: 5 – 7 April 2005

Dr Vincent Shaw
Dr Luc Janssens

Sites/People visited 6,7 April 2005

Person visited	Position	Contact details	Email/Cell
Mr Mbava	Regional Health Officer		
Mr Malisa	Regional EPI Co-ordinator and Information person (additional responsibility)	Regional Offices at Ligula Hospital	Cell: lost Email: nil
Mrs Pili A Mkiwa	Regional Nursing Officer	PO Box 520 Mtwara Region	
Dr Phillip Kaisi	Mtwara Urban District Council Medical Officer	PO Box 92 Mtwara	Cell: 0784 308.88.4
Mr Bright Msalya	Acting Town Health Council Director		
Mr Ramadhani Chibwana	EPI Co-ordinator for Mtwara Urban District and Information officer (additional responsibilities)		
Mrs Gloria Minja	Clinical Officer Likombe Dispensary		
Mr Clement Bugodole	EPI Co-ordinator for Mtwara Rural District and Information officer (additional responsibilities)		
Clinical officer	7th Days Adventist Health Centre		
Dr Kivo	Medical Officer in charge Ligula Hospital		
Ute Steiner	DHIP Mtwara (TGPSH) Hospital Management Advisor	+255 (0) 748 468 951 +255 (0) 23 233 3961	dhip@makondenet.com
Carine Werder	DHIP Mtwara (TGPSH) Project Co-ordinator	+255 (0) 748 591 079 +255 (0) 23 233 3710	dhip@makondenet.com

Sites visited:

Site visited	Purpose
Mr Malisa, Regional office person responsible for MTUHA	Gain an understanding of the use of the MTUHA system, in particularly its completeness and ability to provide accurate timely information to managers Identify sites to visit Obtain copy of MTUHA database
Maternity wards. Ligula Hospital	View the data collection and reporting systems in use
Mr Ramadhani Chibwana Mtwara Urban District office person responsible for MTUHA	Gain an understanding of the use of the MTUHA system at district level, in particularly its completeness and ability to provide accurate timely information to managers Identify sites to visit Obtain copy of MTUHA database Review the use of the District Information Processing File Review summary forms being submitted from facilities
Likombe Dispensary	View the data collection and reporting systems in use (reviewed books used by CO, and by maternity unit)
7th Day Adventist Clinic	View the data collection and reporting systems in use (reviewed clinic headcount register, and NHIF registers)
Mr Clement Bugodole Mtwara Rural District office person responsible for MTUHA	Gain an understanding of the use of the MTUHA system at district level, in particularly its completeness and ability to provide accurate timely information to managers Identify sites to visit Obtain copy of MTUHA database Review the use of the District Information Processing File Review summary forms being submitted from facilities
Nursing officers office, Ligula Hospital	View the daily report format used
Male Ward Ligula Hospital	View the data collection and reporting systems in use (in particular the admission and discharge book)
Advisor Ligula Hospital Management and Administration, Ms Ute Steiner and Ms Carine Werder, Project Co-ordinator DHIP Mtwara	Explore the input from the German Cooperation program in Mtwara region. Especially aspects of collaboration between Public and Private Health Care Providers and Human Resources Development and Management.

Appendix 2: Indicators in use in Tanzania

Table of Annual Indicators used to Measure Health Sector Performance

(Adapted from NIMRI 2005)

Indicator category	Indicator	Data source	Comment
Input	Total GoT allocation per capita	Annual Public Expenditure Reviews, national Population Census	Actually three indicators measuring amount budgeted, amount received, amount spent
Input	Total GoT and donor allocation per capita	Annual Public Expenditure Reviews, national Population Census	Actually three indicators measuring amount budgeted, amount received, amount spent
Input	Recurrent expenditure broken down by level	Annual Public Expenditure Reviews, national Population Census	Actually three indicators measuring amount budgeted, amount received, amount spent
Input	Available medical officers as proportion of staffing norms	Integrated HR system, staffing levels in facilities	
Input	Available assistant medical officers as proportion of staffing norms	Integrated HR system, staffing levels in facilities	
Input	Available public health nurses as proportion of staffing norms	Integrated HR system, staffing levels in facilities	
Input	Percentage of GoT funds as measured against overall district budget	Public expenditure supply vote	
Process	# of districts showing use of HMIS and NSS performance indicators in the preparation of health plans	Quarterly technical and financial reports	
Process	Proportion of health facilities in a good state of repair	MTUHA	
Process	Average stock out days per facility for 4 tracer drugs and one vaccine	MTUHA	Should be a monthly indicator
Output	Cost sharing fees collected by public facilities as a percentage of target	MoH Appraisal accounts	
Output	# outpatients per capita	MTUHA	
Output	Proportion of TB/Leprosy cases completing treatment	MTUHA	
Output	Proportion of women in child bearing age groups using family planning methods	MTUHA	
Outcome	Immunisation coverage (measles, polio3, BCG, DPTHB)	MTUHA	Should also measure children under one completing immunisation
Outcome	Percentage of children born to HIV+ mothers that are positive	PMTCT program	

Outcome	HIV prevalence 15-24 year age group	Sentinel HIV surveillance	
Outcome	Proportion of births taking place in government health facilities	MTUHA	
Outcome	Top 6 causes of morbidity among OPD attendees	MTUHA	Actually three indicators: <5, >5, and overall Because of the large burden of work that this type of data collection requires, it should be collected at sentinel surveillance sites rather than at all facilities
Outcome	Top 6 causes of mortality	MTUHA	Actually three indicators: <5, >5, and overall Because of the large burden of work that this type of data collection requires, it should be collected at sentinel surveillance sites rather than at all facilities
Impact	Percentage of mortality attributable to malaria amongst <5 year old children	NSSS	
Impact	Proportion of deaths occurring among women of child bearing age due to maternal causes	NSSS	

Table of reporting requirements as listed in MTUHA Version 2.0 Data Documentation manual

Data frequency	Data category	Comment
Quarterly data	Community data	
	Lateness of drug kits	
	Cold chain failure	
	Commodity stock outs	
	Total days stock out (drugs)	
	Commodity total stock balance (selected drugs)	
	Curative services attendance	
	Preventive services attendances	
Annual data	Administration	
	Services provided	
	Staff by service	This requires a denominator value (that is the number assigned to that facility as well if it is to be meaningfully utilised)
	Catchment population estimates	Should be determined at a district level or higher.
	Number of drug kits received	
	OPD Diagnoses from all health facilities: <5 years and >5 years	Not included in quarterly data. This list should be reduced to essentials. Sentinel surveillance sites could continue collecting the full list.
	OPD Diagnoses from hospitals: <5 years and >5 years	Not included in quarterly data. This list should be reduced to essentials. Sentinel surveillance sites could continue collecting the full list.
	In-patient Diagnoses from hospitals and health centres: • <5 years and • >5 years, and also by • Admissions and • deaths	Not included in quarterly data. This list should be reduced to essentials. Sentinel surveillance sites could continue collecting the full list.
	In-patient Diagnoses from hospitals only: • <5 years and • >5 years, and also by • Admissions and • deaths	Not included in quarterly data. This list should be reduced to essentials. Sentinel surveillance sites could continue collecting the full list.
	Curative services attendance	This list is different from the quarterly list, and includes some new data, and excludes some data.
	Preventive service attendance	

Annual data aggregated to district	Outreach activities in the service area	
	Information on survey of households in service area	
	Equipment and structures	
	Curative services attendance	Introduces new data elements (dental clinic data) that should rather be included in quarterly (monthly) data reporting requirements.
	Blood donor testing for HIV	New data elements, presumably obtained from laboratory
	Laboratory test	
	Preventive services attendances	
	Maternity Services	Introduces new data elements that should rather be included in quarterly (monthly) data reporting requirements.

Appendix 3: Hardware and Software Specifications

Taken from DHIS Installation CD

Hardware/software for Health Management Information Systems

To: Whomever it May Concern

From: Calle Hedberg, Health Information Systems Programme (HISP)

Date: Aug 02, 2005

Re: Hardware/software for District Routine Health Information Systems

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Background

Some computer equipment available at district or local levels are either hand-me-downs or purchased some time back using the rock-bottom options in various "Government tender" specifications. Many provincial/national administrations have traditionally also been constrained to the latter when purchasing personal computers. Such equipment, while adequate for word processing, normal spreadsheets and smaller databases, is often inadequate for processing the rapidly growing National Indicator/Data Sets (NIDS) at local, provincial, and national levels. The most serious problems are:

1. Small hard disks (10-40 GB) and a small amount of RAM (64-256 MB), combined with a relatively slow CPU (1,200-2,000 MHz), result in unacceptable response times. People used to "older" specifications might think that for instance 256 MB of RAM is a lot – but I have recently inspected several PCs running Windows XP and a host of networking & communication software that end up using up to 200MB of RAM – before a single application like MS Office has started up.

2. Small monitors (14"-15") are ergonomically sub-standard for people spending a large part of their time working on the computers (eyestrain, neck and shoulder pains). Research has indicated 20-30% productivity gains by using larger monitors due to less strain and the ability to display a larger part of your data simultaneously. Flat-panel LCD monitors, in particular, have a larger active display area and are much better ergonomically (clear, crisp text, no glare, i.e. no eyestrain).

3. Most PCs bought prior to 2004 have no CD-writer, which inherently means that many PC users have no proper system for backing up data. Maintenance of PCs is often poor because technical support personnel in the public sector usually are very young and inexperienced IT people, or it has been outsourced to companies on a cut-throat price basis. Again, I regularly come across cases where a company is contracted to provide 24- or 48-hour turnaround time for repairs, but end up taking weeks or even months.

4. Few printers able to produce colour wall graphs in colour A3 size, or to rapidly print reports and slides in colour.

5. Outdated Operative Systems (Windows 95/98) and basic applications (Office 97) that are no longer supported by Microsoft.

6. Software with little or no protection against new worms and viruses. This problem is often aggravated by the fact that many IT departments (a) struggle to keep all their PCs up-to-date with Service Packs and patches, while (b) do not want to enable/train users to install such updates themselves. *Several departments are addressing these updating problems by installing remote control software like "NetWizard" etc, enabling trouble-shooting, software installation, and monitoring from one central point.*

The net result of using such equipment is that time is wasted waiting for data processes to finish, PCs are full of viruses and worms, and the focus of users shifts from data analysis and output towards solving equipment constraints. In other words, buying sub-standard equipment is penny-wise and pound-foolish. *Another key point to keep in mind when confronted by the bean counters is that district information systems probably receive only 1-10% of total investment in health care information systems in most developing countries, despite attempts at information-driven Health Sector Reform and a shift in focus towards a district-based health system.*

This memo aims to give some guidelines to users on what kind of computer equipment to buy for purposes of running a District Health Care Information System (e.g. the District Health Information Software from HISP). The first sections deal with the main types of such equipment. The last section deals with upgrades and minor modifications to existing equipment that would improve its performance etc as a stopgap solution.

Tentative prices based on recent quotes are included, but note that the computer market is volatile. It takes only 12-24 months for e.g. a new microprocessor to move from the top-end to the bottom-end of the market. We are currently (Aug-2005) seeing very low prices for many core computer hardware components (in particular in South Africa, due to the strong Rand). Software (unless you use Free and Open Source software) today might cost *more* than low-end hardware.

Finally, note that a number of web sites can provide you with both good information and performance/quality tests as well as links to web-based vendors. Some examples:

- Tom's hardware Guide: http://www.tomshardware.com

- Computer shopper: http://shopper.cnet.com

- ComputerWorld: http://www.computerworld.com

- PC World: http://www.pcworld.com

I can also provide SA users with the contact details of my own computer supplier in Cape Town – it's a small company with competitive prices and very good, personalised technical service (but most of you would prefer a local supplier, I presume). Otherwise, most of you will probably have to buy based on the Government tender or at least get three quotes for smaller orders. Large orders should obviously go out on tender, or you might have to use the standard government tender specs. These have become better recently, with clauses that keep prices constant but upgrades components as the market moves – they are also more flexible than before with regard to options (e.g. using more RAM or larger (LCD) monitors).

Technical Options

The current desktop PC market can be broken down into four groups (these examples use Intel processors, but note that AMD and other manufacturers have similar processors on the market):

1. Entry-level PCs ('home computers'), using 2.5-2.8 GHz Celeron or AMD CPUs with 256 KB cache or similar, 256 MB DDR2 RAM (400 MHz), 40-120GB hard disks, and 15-17" monitors – base price from to USD 700-1,100 (R 4-7,000). *Note that 14" monitors have disappeared from the market and 15" standard monitors are going the same way (LCD monitors now have nearly 50% of market), and that "old" SDRAM chips are being phased out and replaced by the faster DDR RAM (400/800 MHz).*

2. Medium-level PCs ('small business computers'), using 3.0-3.4 GHz Pentium 4 Hyper-Threading or AMD CPUs with 1 MB cache, 800 MHz Front Side Bus (FSB), 512MB-1GB DDR2 RAM, 80-160 GB Serial-ATA hard disk, and 17-19" (preferably LCD) monitors – base price USD 1,200 – 1,800 (R 8,000 – 12,000).

3. Technical Workstations, using (multiple) 3.2-3.6 GHz Pentium 4 (Xeon) with 800 MHz Front Side Bus (FSB) and 1-2MB cache, 2GB – 16GB DDR2 RAM (400 MHz), 160-400GB GB Serial-ATA RAID hard disks, and 19-24" (LCD) monitors – base price USD 1,800 – 5,000 (R 12,000 – 35,000).

4. Organisation-wide Servers, using (multiple) 3.2-3.6 GHz Pentium 4 (Xeon) with 800 MHz Front Side Bus (FSB) and 1-2MB cache, 4-64GB DDR RAM, multiple RAID hard disks, and small monitors – base price USD 5,000 – 10,000 (R 35,000 – 70,000).

Intel Celeron and many AMD CPUs are cheap (R 600-1,000), but they have only 256KB on-board cache (a cache is very fast memory integrated with the CPU) and they are generally only used in PCs with cheap components and motherboards. Medium performance Intel Pentium 4 (3.0-3.4 GHz) or similar AMD Athlone CPUs are therefore recommended. *The price of computer memory is low compared to a year or two ago – you get 512MB DDR2 RAM chips for R 500 and 1GB DDR2 RAM chips for about R 1,000. It no longer makes sense to buy less than 1GB for PCs that are supposed to do serious database or data analysis work.* Note that faster RAM chips like the 400 MHz DDR2 (Double Data Rate) RAM have very good price/performance ratios. High quality motherboards that support faster RAM and include RAID controllers are relatively cheap, and the older SDRAM (twice as expensive as DDR RAM) is now difficult to find and expensive.

Considering most aspects of current and future needs as well as the funds normally available, I would recommend a group 2 model ('small business computer') for data capturers etc at district level and a group 3 model ('technical workstation') for Health Informatics Teams at Provincial/National levels.

For information officers that normally needs to travel around and interact with both facilities and higher-level managers through workshops etc, I would strongly recommend buying a high-end notebook instead of a desktop PC. Widespread use of notebooks are also a major advantage with regard to training, since trainees can bring their own notebooks with their own data.

National and sub-national levels might also need a larger server in order to share the software and data among 10-500 managers. In addition, all Health Informatics Teams need a digital projector (USD 1,400-2,000), in order to facilitate training, group discussions with management and public presentations to others. Digital projectors are now *much* cheaper than a few years ago – they have become a mass market commodity.

A few additional components (e.g. an A3 inkjet printer) are also described below with some tentative prices. The reasoning behind the selection of various components is as follows:

- **Computer case:** Most users would be OK with a standard Midi case at USD 60-100 (R 500-800). If possible, try to get a case with a 300 W power supply and with 2 or 3 USB ports in *front*. Front-side USB ports saves you from a lot of crawling when you want to plug in thumb/flash drives, printers, etc. For larger workstations or servers with several hard disks and several DVD-reader/CD-writers or DVD-writers/CD-writers, a full-tower case with 400 W power supply might be better. If possible, test the case on beforehand with regard to noise – good quality cases have negligible noise from fans and no vibration.

- **CPU:** The Intel Pentium 4 3.0-3.4 GHz has a good price/performance ratio, the same goes for the equivalent AMD processors (recent market trends indicate that AMD's popularity is increasing). The technical workstations should ideally support dual processors, which would allow an easy and cheap 'upgrade' in a year or two, but dual-processor motherboards are still relatively expensive. *Note that tests by the DHIS development team indicate that DHIS performance is more dependent on CPU speed, CPU cache, and RAM type/amount than on hard disk speed. In other words, it is more computation intensive than read/write intensive.*

- **Motherboard:** The standard office desktop PC would use a motherboard supporting one CPU only and slots for 1.5-4.0 GB RAM and 800 MHz Front-Side Bus. A workstation PC might have a motherboard with two CPUs (don't have to buy both at once) and slots for at least 4 GB of RAM. Servers might have 4 or more CPUs. Both types should preferably have AGP slots for the graphics adapter. The technical workstations should also be using motherboards and CPUs running at 800 MHz bus (FSB), which might make a significant performance boost (older Pentium III/Celeron CPUs run at 100/133 MHz). They should also have built-in modem and 1,000/100/10 MHz network card, and support for Serial-ATA and RAID (a RAID controller enables fast access to several linked hard-disks).

- **Monitor:** Ergonomics and productivity are decisive factors for suggesting 19" and 21" monitors (preferably LCD). Standard 17" CRT monitors now cost around USD 120-180 (R 800-1,200), the price of a 15" monitor 3 years ago. The price of flat-panel LCD monitors have also dropped radically – 17" LCD monitors with 1280x1024 resolution are now around USD 300 (R 2,000), and 19" LCD monitors with 1280x1024 resolution can be found down to USD 400 (R 2,500) if you are lucky. You can also get 23-24" LCD displays with 1920x1200 resolution for high-end workstations – nice if you are going to use it for GIS or Image Processing work, but still relatively expensive (around USD 2,000 / R 10-12,000). *I have completely switched to using LCD monitors – they are fantastic compared to traditional CRT monitors: The viewing area is 20% larger (i.e. a 17" LCD is equivalent to a 19" CRT), the text is razor-sharp and there's no glare and reflections so much less eye-strain, refresh rates are now high so there's no flickering, and they weigh less and take up much less space on the desktop. Most LCD monitors can also be rotated 90%, if you are editing documents.*

- **Graphics cards:** A 32MB graphics cards will support 1600x1200 resolution and true colour for 19" monitors – a 64 MB card will do the same for a 21" monitor. The price difference is relatively small, and 128-256 MB cards are now standard for both small business PCs and workstations. More graphics RAM normally means that you can run the monitor at a higher refresh frequency, resulting in less "flickering".

- **Hard disk:** Database applications and GIS applications is often both CPU and hard disk I/O intensive, so 7,200 rpm or 10,000 rpm hard disk drives are clearly preferable to 5,400 rpm hard drives. The price difference is negligible as long as you stick to IDE drives, and some manufacturers like Western Digital are providing longer warranty for 7,200 rpm drives (probably because the 5,400 rpm drives are on their way out). ATA-133 (actual transfer speed up to 80MB/second) and Serial-ATA (theoretical transfer speed of

150MB/second) are now increasingly the standard. *High-end motherboards also have RAID controllers that enable mirroring of dual hard disks for maximum safety – if one hard disk crashes; it can be replaced and set up again using the second mirror drive.* All PCs today also have one or more so-called USB ports that allow daisy-chaining devices like printers and scanners + allow easy transfer of data using USB thumb drives. USB 1.1 is still dominant among existing PCs purchased before 2004 (transfer speed up to 12Mbits/second), while High-Speed USB 2.0 (transfer speed up to 480Mbits/second) are now standard in all new PCs and most peripherals too.

Warning: *Many new ATA-100/133 IDE hard disks are no longer compatible with the older ATA-33 and ATA-66 controllers.*

- **Removable media:** All new facility and district PCs and notebooks should have at least a combined DVD reader and CD writer/rewriter – the cost has now dropped to around USD 50 (R 300) and blank CDs cost R 1 each. This in order to facilitate local replication of e.g. DHIS and other freeware, exchange of large data sets, *and regular backups*. New desktop PCs and notebooks at the national and sub-national level should have a combined DVD double-layer writer/re-writer (double-layer media can store up to 8.5 GB of data), costing around USD 100 (R 700). Writing/reading speeds vary, but for CDs 40X re-writing, 52X once-writing, and 52X reading are common – for DVDs 8x re-writing, 16X once-writing, and 2-4x double-layer re-writing are common. An important factor is the CD and DVD media itself – our experience is that Sony or Verbatim CDs and DVDs are very good choices. Prices range from around R 1 per recordable CDs via R 5 for recordable DVDs to R 25 for double-layer, re-writable DVDs (crystal cases excluded – prices with cases are a bit higher). *The DVD/CD-writer software we have found to be best is called Nero.*

- **CD-ROM/READER:** All PCs should have a standard (52X) DVD/CD-ROM drive in addition to the DVD/CD writer/rewriter, to facilitate CD replication. *Note that it might be smart to put the CD writer/rewriter on one IDE channel and the CD reader on the other – this will speed up transfers during CD replication.* These readers now cost only around USD 25 (R 150).

- **Network adapter:** Any standard 10/100/1,000 Mbits Ethernet adapter will do, just make sure that the connector fits your network. They cost around USD 15 (R 100) each. A standard 10/100Mbits Ethernet hub with 8-12 ports cost around R 600. 1,000 Mbits (1 gigabits) Ethernet adapters cost around R 150 and are increasingly standard (i.e. part of motherboard) in new PCs and notebooks, but an 8-port Gigabit hub still cost around R 1,000 (prices are dropping fast, though). The most common networks are using Twisted Pair cabling (the contacts looks like large size telephone plugs), but Thin Ethernet is still in use in a few places (the contacts are BNC, a kind of plugs to screw in with a half-twist). If your network is the latter, the smart thing is usually to buy a combo card with both options. *Note that if you have two computers with twisted pair cards, you can connect them using a modified network cable: Pins 1 and 3 and pins 2 and 6 must be swapped on one of the contacts.* USB 2.0 hubs are also increasingly popular for small networks – you can get 4-port USB 2.0 hubs for a little as USD 15 (R 100).

- **Mouse:** An *optical* mouse (USD 30 or R 200) is much better than a mouse with one of those roller-balls (USD 7-10 or R 50-80) – the latter always picks up dirt and becomes nearly useless after a while. So called wire-less mice is using a separate "base station" connected to the PC, and is not recommended unless you have special needs to move around while working.

- **USB thumb drive:** USB thumb drives (also called Flash Drives or USB Memory Key) – about the size of a cigarette lighter – are increasingly popular for easy transfer of up to 2 GB of data between PCs not on the same network. Note that old-fashioned "Laplink"

cables connecting serial or parallel ports work poorly with newer PCs and Operating Systems, whereas USB thumb drives work very well. Expect around USD 15 (R 120) for a 128 MB drive, USD 25 (R 200) for 256 MB, USD 45 (R 350) for 512 MB, USD 70 (R 500) for 1 GB, and USD 150 (R 1,000) for 2 GB drives. Note that all computers purchased from 2004 onwards have USB 2.0 ports, which is much faster than the old USB 1.1.

Our general experience with USB to USB cables has been mixed, but they are generally more difficult to set up and use than USB thumb drives. One big advantage of thumb drives is that you do not need to install extra drivers under Windows 2000 and XP – just plug in the drive. *BUT you need drivers for Win98 and Win95B!*

- **External hard disk:** If you regularly need to transfer more then 1-2 GB of data, then an external USB 2.0 hard disk is a *good* option. For notebooks and easy travel, an external mobile disk box with USB cables (about R 150-200) plus a 9 or 12.5mm notebook hard disk (80 GB costs around USD 180 or R 1,300) is recommended. The same external hard disk can obviously easily be moved between different notebooks or desktop PCs. If you need even more space and do not care so much about weight, then there are a range of external mobile hard disks on the market in sizes up to 300-400GB. *NOTE: Some USB ports in notebooks do not provide enough power to run a mobile disk, so make sure that you have an extra USB "power" cable or other device that can be used to boost the power supply to the mobile disk.*

- **Modems:** A modem is needed for Internet and email connections, unless this is done via your network. On the South African market, there are currently three main options available: (1) Dial-up through a normal phone/fax line is done using standard 56-90Kbits analogue modems – a Telkom line is about R 80 per month plus call units. (2) ISDN lines/modems give you two channels of 64Kbits each – an ISDN line is around R 300 per month + call units (plus the cost of the ISDN modem). (3) Telkom introduced ADSL in South Africa in 2004, which provide up to 256 KB upload and 512 KB download speeds (128 KB and 256 KB combinations are available for "home" users) as well as a continuous connection – an ideal solution for intensive Internet users as long as they transfer less than 3GB of data per month. The cost is R 480 for domestic users and R 600 for business users + R 200 or more for email accounts, but the ADSL modem and (if you need it) initial installation is around R 1,000 extra. The ADSL modem sold by Telkom is not recommended – better self-dialling modems are available, in particular if you want to share one ADSL account over a network. ADSL is currently mainly available in metropolitan areas, but it will be rolled out to other areas in the years to come. *Note that if you need to transfer MORE than 3GB of data, then attractively prices packages of up to 30 GB per month are available from Axxess – see www.axxess.co.za for details.*

  Telkom-ADSL (monopolistic) pricing is more than twice the price of comparable countries, and far, far above the price in e.g. Europe. As an example, the UK is about to introduce a 24 Mbits ADSL+ service for around R 300 per month (Sweden has had it for a year) – in other words, the Britons and Swedes get 50 times better performance for half the price….

  There are a range of other Internet connection options available, mainly from Telkom: Fixed Diginet lines, VSAT satellite channel links, and so forth. Another company, Sentech, also recently introduced a sort of "wireless ADSL", but customer satisfaction with that solution so far has been seemingly low. The cell-phone providers have also recently introduced 3G connectivity, with bandwidth up to 384 Kbits/second and max usage of 1 GB per month. It is expensive, though, connections are often poor, and only a few metropolitan areas are covered. *3G is not yet recommended, unless all your travels etc are within the three large metropolitan areas.*

- **Notebooks:** The desktop configurations and other items above must be modified if you are purchasing a notebook. The main recent innovation here is the Intel Pentium M (also called "Centrino") processors – they have lower clock-speed but a 1 or 2 MB internal cache. The net result is that they have low power consumption, yielding notebook battery life of up to 5-7 hours. Performance is good – a Pentium M 1.6 GHz CPU runs the DHIS as fast as a Pentium 4 2.8 GHz CPU, and a Pentium M 2.0 GHz (currently the fastest) is roughly equivalent to a Pentium 4 3.2 GHz. Notebook prices have dropped radically the last 2 years, with the cheapest Pentium M notebooks costing R 7,000 and the most expensive base model around R 20,000. The models I would recommend have a Centrino processor (because of it's extended battery life) and cost from USD 1,200 (R 8,000 – Centrino 1.6 GHz, 15.1" display, 512 MB RAM, 60 GB disk) to around USD 2,500 (R 16,000 – Centrino 2.0 GHz, 17" display, 1GB Ram, 100 GB disk).

- **Operating system:** Windows 2000 is supposedly no longer supported by Microsoft, so new PCs (or upgrades) should go for Windows XP Professional (with Service Pack 2!!). *Note that the DHIS version 2 is in the pipeline – this version will run under Windows and Linux as well as mainly using Open Source components – but version 2 modules cannot realistically be expected before the end of 2005 and into 2006.* Windows XP Home is *not* recommended. Windows 95 and NT are no longer supported by Microsoft, and while Windows 98 and Windows ME will receive some support from Microsoft longer than anticipated (until 2006) they are falling behind in many respects. Make sure all service packs are installed. The main reason for using 2000/XP is the possible use of e.g. ArcView (see below), as well as the fact that Windows 9x is being phased out (Win9x versions are still running on top of MS-DOS). Windows XP Professional cost around USD 240 (R 1,900). *You are today increasingly paying almost as much for Windows + Office + other standard application software than you pay for the PC itself – a good argument for increasing the use of Open Source software like Linux and OpenOffice.*

- **Application software:** All PCs should have Microsoft Office 2000/2002/2003 Professional (with Access). Office 2003 Professional costs around R 5,500 (upgrade around R 4,000), but it is usually possible to get it cheaper through organisational licenses or through PC bundles (Dell charges R 2,450 for Office 2003 Pro when bundled with a new PC). Anti-virus software (usually around R 250 per year) is also a must. *I check for antivirus updates every day – recent worms and viruses spread world-wide within 48 hours, so you must be on top of this.*

- **GIS software:** The District Teams could be using ArcExplorer 2.0 or later (freeware) to generate maps. The provincial/national PCs should have ArcView 3.3 (R 12,000) or ArcView 8/9 (R 15-20,000) or later, a desktop GIS package that enables more advanced spatial analysis and development of spatial data sets tailored to health sector needs. MapInfo is another package that's popular, but my impression is that the Arc/Info family of software (including ArcView) is dominating in SA. There might be some variation from province to province, though. Note here that some provinces are in the process of establishing spatial databases, often using Spatial Database Engine (SDE) and Arc/Info software. The spatial layers in this database will be available to everybody over the provincial network. *(Note: The distribution rights to ESRI products in Southern Africa are vested in Geographical Information Management Systems – GIMS – in Midrand, so the ArcView software must be purchased there or through a local reseller.)*

- **Inkjet printer:** Most district offices already have either a black & white laser printer or an A4 inkjet printer, but experience shows that A3 colour graphs are far more suitable for wall displays etc. A3 colour graphs / pictures can also be included in A4 reports as foldouts, with good effect. A4 Inkjet printers are very cheap (from R 350), but note that ink cartridges are expensive. If the office has no A4 printer, I would recommend *both* an A4 laser printer (faster with standard pages) *and* an A3 colour inkjet. The price of an A4 black & white laser printer is in the R 1,500-4,000 range, and an A3 (for instance HP

Deskjet 9300) will normally be around R 4,000. Note that the prices of colour A4 laser printers have come down – for instance, the HP Colour Laserjet 1500L costs around R 4-5,000 – so they are increasingly a very good alternative instead of a black & white laser also for standard Office printing.

- **Scanner:** All informatics teams need a standard A4 flatbed scanner. A medium quality 30-36 bits colour scanner with at least 1200x1200 *real* optical resolution will be sufficient to scan printed text, drawings, clippings, photos and similar. It is assumed that graphical and OCR (Optical Character Recognition) software of reasonably quality is bundled with the scanner.

- **Digital camera:** All Health Informatics Teams should have a small digital camera, or they can utilise the cameras now increasingly being standard with many cell phones. As elsewhere in the world, politicians, decision-makers and mass media tend to focus most of their attention on larger hospitals. Community Health Centres, clinics and mobile services are widely distributed and often difficult to access. A digital camera would make it possible to visually document the state of Primary Health Care facilities – many of them dilapidated and with broken equipment. Relevant cameras are today 3.5-5 megapixels costing R 1,000-5,000, but the field is developing extremely fast. Semi-professional cameras, costing R 4-10,000, have 5-8 megapixels (e.g. 1600x1200 or better) and are sufficient for pictures to be printed in e.g. newspapers. The cameras should have a CompactFlashRAM card of reasonable size (128MB+).

  Cell phone cameras are a different breed – much simpler – but their specs are continuously improving. *It is just a question of time before high-end cell phones are a combined phone, data transfer unit, pocket PC, GPS, and digital camera.*

- **Digital Projector:** All Health Information teams need a digital projector for training, sensitisation, and workshop discussion purposes. It must be portable (max 2-2.5 kg for the basic unit – really light-weight units are only about 1 kg), with at least XGA (1024 x 768) resolution and provide even light of 2,000-3,000 lumen under variable lighting conditions (lumen is a measure for light intensity or brightness – so the more lumen you have the better). One replacement bulb should be included with each projector (they usually blow in the middle of an important presentation!). Prices have dropped radically and are now in the R 8-15,000 range (you can even get projectors for around R 6,000, but those are usually only SVGA or 800 x 600 resolution – those are *not* recommended). Asus, NEC, 3M, Dell, HP and InFocus are known brands with good quality projectors.

- **Memory and hard disk upgrades:** If you have an older PC and cannot afford a new one, the best performance gains are normally achieved by increasing the amount of memory (RAM). The really old type of RAM chips with 72 pins is now *very* expensive – if you can get it at all – and standard SDRAM chips are nearly twice as expensive as DDR(2) RAM. So it might be more cost-effective to purchase a new motherboard, a 3.0-3.4 GHz CPU, and 512 MB DDR2 RAM (approximately R 2,000). Consider carefully if others could utilise older PCs for word processing, email, etc, though – if yes, it is more cost-effective to buy another new computer.

Equipment for District Informatics Teams

Based on the technical considerations outlined in the previous section, the equipment for each District Team should be as follows:

One or two Office PCs with
- CPU: Pentium 4 or AMD processor 3.2 GHz w/ 1MB Cache and 800MHz FSB
- Memory: 1 GB 400 MHz DDR2 RAM, expandable to at least 2 GB
- Monitor: 17" LCD monitor
- Graphics Accelerator: 128MB AGP Graphics Accelerator
- Hard Drive: 120GB 7200RPM Serial-ATA hard drive
- Floppy Drive: 3.5inch 1.44MB diskette drive
- CD-ROM: 52X CD-ROM drive
- DVD reader & CD writer/rewriter: Recordable/Re-Writeable drive, at least 24X 52X 52X
- Network Adapter: PCI 10/100/1000 twisted pair Ethernet (integrated on motherboard)
- Keyboard: Standard Keyboard
- Mouse: Microsoft (IntelliMouse) *Optical* Mouse or similar
- Operating System: Microsoft Windows XP Pro with SP2 (usually bundled)
- Application Software: MS Office 2003 Professional (bundled or extra)
- Additional Software: File compression utility (e.g. 7-zip, which is free) and anti-virus software.
The approximate price per system would be around R 7-10,000.

Peripherals
- Printer: A3 colour inkjet, at least 600dpi, with 3m cable. Approximate price R 4,000. In addition a black & white laser printer is recommended (approximate price R 2,000), or even better a colour laser printer (price from R 3,500 to R 8,000, depending on printing volume)
- Scanner: 30-36 bits colour A4 flatbed scanner, min. 1200x1200 real optical resolution, with necessary interface card and bundled graphics/OCR software. Approximate price R 1,500.
- Network hub: A standard 8-12 port Ethernet hub, or a USB hub if the PCs are in the same room. Approximate price R 600. A hub that also support Gigabit Ethernet is around R 1,000
- Digital projector: Portable, at least 1024x768 resolution, 2,00-3,000 lumen, not more than 3 kg. Approximate price, including 1 spare lamp: R 9,000-14,000

Equipment for Provincial/National Informatics Teams

Based on the technical considerations outlined in the previous section, the equipment for each Provincial/National Team should be as follows:

One or more Technical Workstation PCs with
- CPU: Pentium 4 3.4 GHz w/ 2MB Cache & 800 MHz FSB
- Motherboard: Must support CPU and Memory options, preferably with RAID controller
- Memory: 1,024 MB (2x512MB) 400 MHz DDR RAM, expandable to at least 2.0 GB
- Monitor: 19" or 20" LCD monitor
- Graphics Accelerator: 128-256MB AGP Graphics Accelerator
- Hard Drive: 2 ex 120GB 7200RPM RAID Serial-ATA hard drive (mirroring for safety!!)
- Floppy Drive: 3.5inch 1.44MB diskette drive
- CD-ROM: 52X CD-ROM drive
- DVD/CD combo writer/rewriter: Recordable/Re-Writeable DVD/CD drive (write/read speed at least 24X 52X 52X for CD writing and at least 4X 16X 40X for DVD writing).
- Network Adapter: PCI 10/100/1000 twisted pair Ethernet (might be integrated on the motherboard)
- Keyboard: Standard Keyboard
- Mouse: Microsoft (IntelliMouse) *Optical* Mouse
- Data Transfer: USB 2.0 Thumb drive (at least 1GB), or a USB 2.0 Mobile disk (at least 60GB)
- Operating System: Microsoft Windows XP Pro with SP2 (usually bundled)
- Application Software: MS Office 2003 Professional (bundled or extra)
- Additional Software: File compression utility (e.g. 7-zip, which is free) and anti-virus software.
The approximate price per system would be around R 12-16,000.

Peripherals
- Printer A3: A3 colour inkjet, at least 600dpi, with 3m cable. Approximate price R 4,000
- Printer A4: A4 colour laser or phaser, at least 600dpi, preferably with a network connection. Approximate price R 8,000-10,000 for higher volume printers.
- Scanner: 30-36 bits colour A4 flatbed scanner, min. 1200x1200 real optical resolution, with necessary interface card and bundled graphics/OCR software. Approximate price R 1,500.
- Digital camera: Compact model, 1280x1024 resolution or better. Approximate price: R 3,000
- Digital projector: Portable, at least 1024x768 resolution, 2,000-3,000 lumen, not more than 3 kg. Approximate price, including 1 spare lamp: R 9,000-14,000

Notebooks

Provincial/national/district teams, information officers, and people involved with on-the-job training, need notebooks to be able to move around to different venues easily to demonstrate the use of the databases and to easily extract information during meetings etc. Interactive use of the database requires a powerful notebook. Also note the USB thumb drive and mobile disks – highly suitable for rapid data transfer and data base synchronisation between e.g. District desktop computers and provincial/national/district notebooks.

All District Information Officers in KwaZulu-Natal were for instance equipped with new notebooks in late 2003 – a tremendous improvement over the previous desktop mess, especially during training and workshops. Other provinces are slowly following suit.

A high-end Notebook PC with

- CPU: Pentium M 1.7-2.0 GHz with 1-2MB cache
- Memory: 512MB – 1 GB DDR RAM, expandable to at least 2 GB
- Screen: 15" or 17" active matrix TFT XGA display (1024x768 resolution or better)
- Graphics Accelerator: 64-128MB Graphics Accelerator
- Hard Drive: 60-100 GB removable hard drive
- Floppy Drive: 3.5inch 1.44MB diskette drive or compatible SuperDisk drive
- DVD/CD-ROM/writer: At least 16X-32X-48X writer/reader
- Fax/Modem: Usually on motherboard (56-90Kb)
- Network Adapter: Usually on motherboard – Ethernet 100Mbit or 1 Gigabit
- Mouse: Extra external *optical* mouse and a mouse pad
- USB thumb drive: Recommended for users transferring data often – preferably min 512MB (if transferring *large* amount of data, use external USB 2.0 mobile disk).
- Carrying case: Standard
- Battery charger: 90-260V external battery adapter.
- Operating System: Microsoft Windows XP Pro with SP2 (usually bundled)
- Application Software: MS Office 2003 Professional (bundled or extra)
- Additional Software: File compression utility (e.g. the free 7-zip) and anti-virus software.

The approximate price per notebook would be R 10-17,000, mainly depending on LCD panel choice and amount/type of RAM (1 GB RAM modules for notebooks are still a bit pricey).

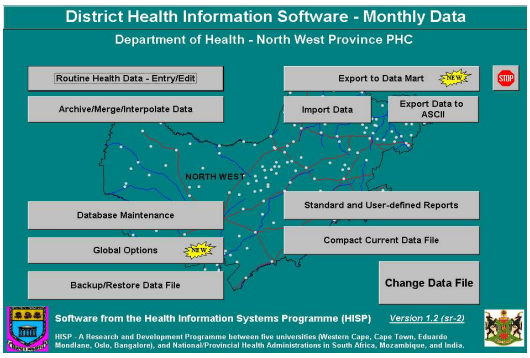
Appendix 4: Description of the District Health Information System Software

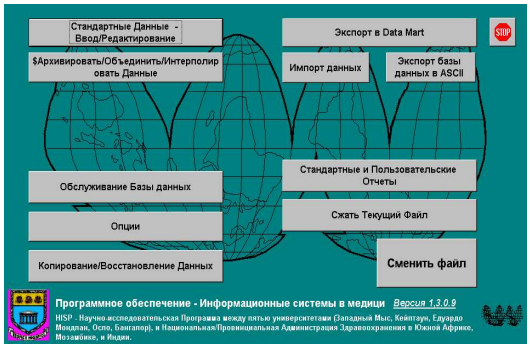
Introduction:

The District Health Information Software, developed by the HISP team is developed in accordance with the principles espoused by the “Free and Open Source Software” philosophy, and is therefore freely available to anyone who wishes to use it, as long as it is not abused for commercial purposes. Furthermore, open software may be freely probed, customised and modified. This is the cheapest way of generating software suited to the country’s needs. Whether the software has been used in South Africa or other countries, any one with programming skills and who wishes to make changes is encouraged to do so. All such developers are encouraged to in turn share their improvements as Open Source.

A brief description of the programme:

Its high degree of user definability (based on the premise that the information system must contain data relevant to the smallest organizational unit if they are going to use the system to evaluate their services) has lead to it being translated into other languages for use in those countries. Currently, supported languages include Spanish (Cuba), Portuguese (Mozambique, Angola), Mongolian, Russian, and Chinese. Efforts are underway to complete the translation into Swahili (Tanzania), Telugu (Andra Pradesh, India), Kannada (Karnataka, India), and Norwegian. The screenshots below show the English, and Russian versions of the routine/monthly data module:

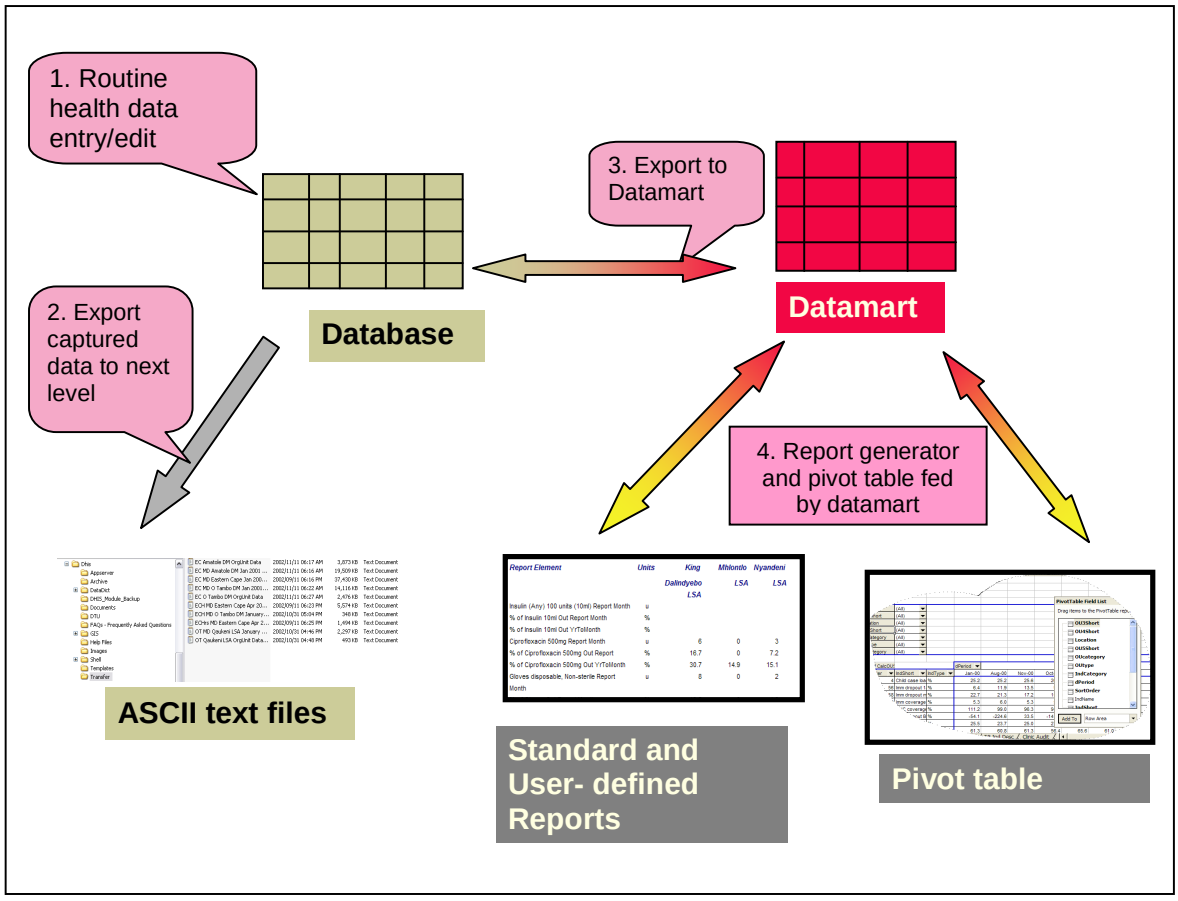




The software allows clinics and hospitals to enter data relating to their services if they have access to a computer. However, because not all facilities have a computer on site, the data is usually entered into a computer system in Health District or Sub-district offices and then transmitted electronically to Provincial and National Departments. Some of the principles used in the development of the software are:

1. That users at a local level should be able to adapt the software system to suite their needs.
   Hence, in addition to data entry (Step 1 of diagram below), the system allows users to:
   - Add new facilities (organisational units);
   - Define new data elements and indicators, define new validation rules, set maximum and minimum limits for data entry;

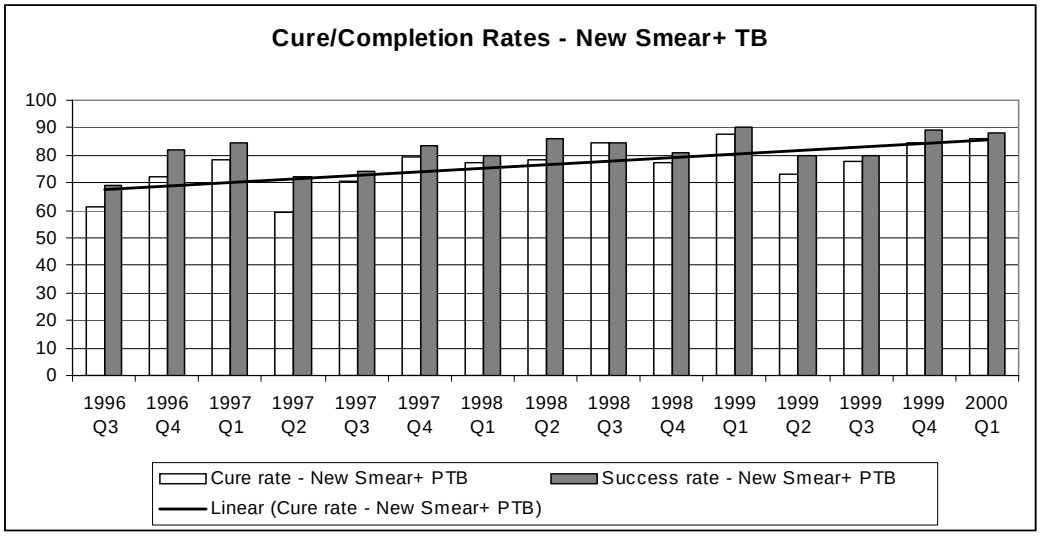
   Once data has been entered, it needs to be exported to the nest level in the health system (District Municipality or Province). When data is exported (step 2 in diagram) the system allows the user to determine which data elements and indicators need to be exported. Thus, the principle of the information pyramid (whereby not all information is needed or relevant to all levels) can be applied by the software. On the other hand, if facilities are added, these are included in the exports so that data integrity at higher levels of aggregation is maintained.



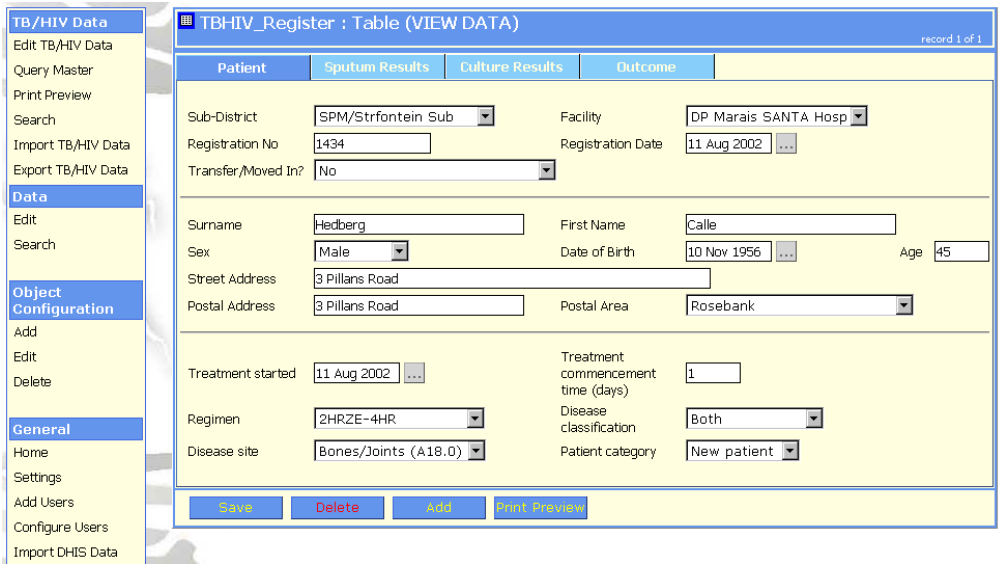
2. That users at all levels should be given feedback on the data that is entered into the system. To this end the system uses a transient database (data mart – step 3 in diagram) from which users can generate reports (step 4 of diagram). Reports can be tailored to include certain data elements or indicators, from various sources (monthly data or routine survey data). Health indicator sets can also be interfaced with the free ArcExplorer software that allows data to be presented as thematic maps or analysed further in Geographical Information System software. The generation of pivot tables is another tool that allows data to be presented in various ways.

3. The DHIS supports not only routine monthly or quarterly data, but also the capture and analysis of semi-permanent data (population estimates, equipment, infrastructure, number of personnel, services provided per facility, etc) and survey/audit data. This stems from the premise that not all information needs to be collected on a routine basis – some can be collected annually or six-monthly through regular surveys, and some semi-permanent data can be updated whenever changes are occurring. It is important to recognise that surveys or research project often are conducted in certain areas for limited periods, and our experience is that most of this data is later lost because it is not linked to existing data collection tools or an integrated HMIS. It is also our experience that for instance population mid-year estimates, which is crucial for population based indicators and public health strategies in general, often might exist but in a format and location where health managers have no easy access.

One clear success story is from the South Peninsula Administration in Cape Town – SPA used the DHIS as a core tool for bringing their TB cure rates up from 61% in late 1995 to a stable 85% in 2001. Their approach is spreading to other areas.

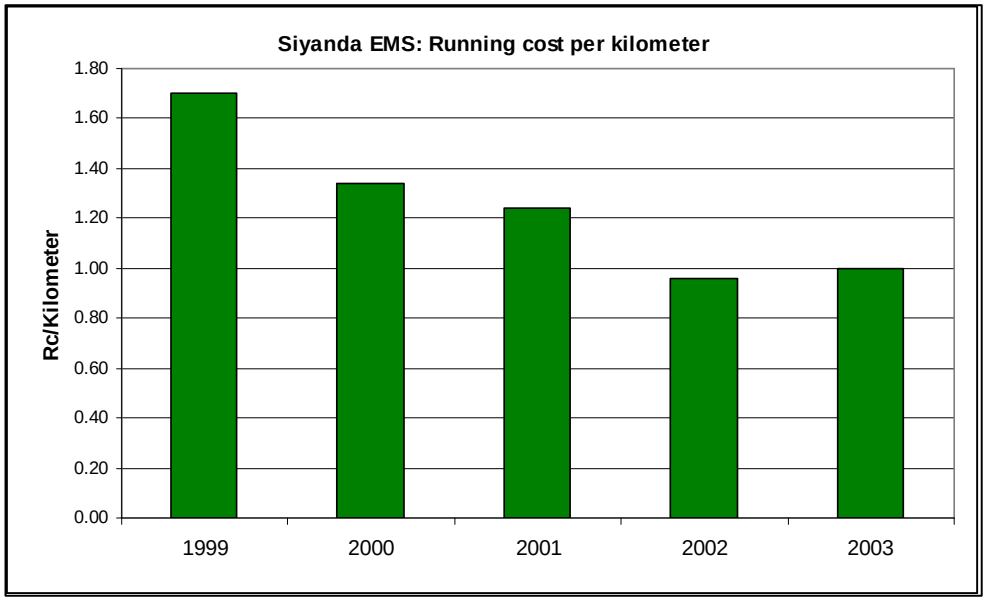


4. That the system should incorporate patient data where appropriate, either by interfacing to other Patient Record systems or through a web-based Special Patient (SP) Module linked to the Routine Data Module. The illustration below shows an integrated TB/HIV register based on the SP module which is still under development.



5. We view the DHIS as a Management Information System which will include financial and personnel data as well. This will provide managers with a user friendly tool to access integrated management information. The financial and personnel modules are expected to be incorporated during the course of this year.

6. Some provinces are using the DHIS to track their transport services. The graph below indicates how through tracking vehicle use and expenses, using the DHIS, the cost of services has been reduced over the years.



Conclusion:

The brief outline of the DHIS software shows that we have an emerging global network aimed at fostering and sharing health information systems solutions on a Free and Open Source basis. Our South African team consists of professionals with lots of experience and a proven track record. This track record includes considerable work related to developing and implementing information systems.

We regard our over-arching vision of an integrated but modularised public health information system, based on free sharing of solutions and public access to all anonymous health data, as a crucial factor in combating HIV/AIDS with its many opportunistic infections and widespread damage to the social fabric of society. Our public health approach is reflected in our efforts to also interface health information systems to financial/personnel systems, physical infrastructure (water, sanitation), standard of living (poverty, welfare), and disease mapping & analysis particularly oriented towards cross-border flows of disease organisms and their hosts (patients).

Appendix 5: Tool for Assessing the Level of Information Use

Determining Levels of Information Usage for the Tanzanian PHC Dataset

Level 1:	Level 2	Level 3
Facility:		
Facility has an Essential Dataset defined (or uses that for the District) Has submitted all of the expected reports i the last year within the period set for the submission of reports (this period may var from district to district) Feedback reports (at a minimum a printout of the data entered into DHIS for this facility for the last few months – standard report) are received by the facility once data entered into DHIS within the timeframes set for feedback reports. The facility manager has validated 80% of the feedback reports (checked, signed, and sent back to DIO if any errors were noted).	At least 4 indicators are graphed for the year and up to date for the year and up to last reported month. At least 3 meetings were held in the last 6 months to evaluate the data elements/ indicators.	At least one problem has been identified and addressed through an action plan. The effect of the action has been monitored and can be shown. The actions are documented in a written report to the District, the clinic committee, or the annual report.
District:		
District has a Essential Dataset defined District has received 95% of expected reports1 from facilities for the last reporting month within the period set for the submission of reports. 100% of expected feedback reports have been issued within the timeframes set for feedback reports. Validation checks (data integrity checker, identify duplicate records, absolute and expert rule violations run on each monthly submission as entered2) have been run for each facility/district at least quarterly. Data range levels have been set for the district at least once in the last 6 months	District has determined which reports (detailing indicators with targets for their area of responsibility for the last reported month) are required for each manager. At least 80% of expected reports are made available within the expected timeframe. At least 4 indicators with targets are graphed in the district office for the year and up to the last reported month. The District office has held at least 3 meetings in the last 6	At least three problems have been identified and addressed through an action plan. The effect of the action has been monitored and can be shown. The actions are documented in the annual report or other written report.

[1] This is not data coverage which is a different indicator
[2] Evaluation of the data from a district will thus reveal that there are no absolute rule violations, and all expert validation rules have been commented on.

	months to evaluate the indicators.	

Region:		
Region has a Minimum Essential Dataset defined[3] Region has received reports from 95% of districts for the last reporting month within the period set for the submission of reports. 100% of expected feedback reports to districts have been issued within the timeframes set for feedback reports.	Region has determined which reports (detailing data / indicators and targets for their area of responsibility for the last reported month) are required for each manager At least 80% of expected reports are made available within the expected timeframe. At least 8 indicators are graphed in the provincial office for the year and last reported month. The Provincial office has held at least 3 meetings in the last 6 months to evaluate the indicators.	At least 5 problems have been identified and addressed through an action plan. The effect of the action has been monitored and can be shown. The actions are documented in the annual report or other written report.
Ministry:		
Ministry has a Minimum Essential Dataset defined Ministry has received reports from 95% of Regions for the last reporting month within the period set for the submission of reports. 100% of expected feedback reports to Regions have been issued within the timeframes set for feedback reports.	Ministry has determined which reports (detailing data / indicators and targets for their area of responsibility for the last reported month) are required for each manager. At least 80% of expected reports are received within the expected timeframe. At least 10 indicators are graphed in the Ministry office for the year and last reported month. The Ministry office has held at least 3 meetings in the last 6 months to evaluate the indicators.	At least 5 problems have been addressed through an action plan. The effect of the action has been monitored and can be shown. The actions are documented in the annual report or other written report.

[3] As determined by it having its own additional indicators, the data elements to determine these indicators, and validation rules to ensure data quality.