South Africa’s District Health Information System:  
Case Study

EQUITY Project
Initial report by: Randy Wilson, Calle Hedberg, Jon Rohde
Updated March 2003 by: Jon Rohde, Vincent Shaw

Table of contents

BACKGROUND.......................................................................................................................................................2
HIS in South Africa since the Apartheid era:........................................................................................................2
Definition of HIS:................................................................................................................................................3
HIS EVOLUTION IN EASTERN CAPE PROVINCE ...............................................................................................4
CURRENT STATUS ...............................................................................................................................................8
LESSONS LEARNED............................................................................................................................................12
FUTURE DIRECTIONS.........................................................................................................................................14
South Africa’s District Health Information System: 
Case Study from Eastern Cape Province

This case study describes efforts to support improvements to health services in South Africa through the development of a flexible yet comprehensive Health Information System. It describes the context of health systems reform in which these enhancements were made, key characteristics of the information system, the process undertaken by many players at different levels of the health systems, and identifies a variety of lessons learned that should prove useful for similar efforts in other countries.

This study will illustrate the philosophy of the design of routine health information systems in South Africa, emphasizing a core standard of data with flexibility at each level to add both data elements and derived indicators, use of open software for processing, and open access to information across the country. The design of the DHIS has allowed incremental expansion to embrace many elements of managing the health care system. The expansion of the system to the entire country has involved a large effort in standardised training, on-site mentoring and communication with hundreds of information officers, more recently extending to the orientation of thousands of managers at all levels of the health system. The lessons of design and expansion have relevance to many other countries currently adopting the DHIS to their health systems.

One of the most interesting aspects of the work highlighted in this case study is the fact that the system was introduced into a rapidly changing health care system – and the system’s implementation has helped both to monitor that change and to shape the change process. During discussions to gather information for this case study many examples of this inter-relationship were discovered. To cite just a few: district health workers have been using the system to help monitor priority health problem trends and the coverage of services such a EPI, TB and STI contact tracing in specific geographic areas. This has allowed allocation of increased resources to those facilities lagging behind. Analysis of certain indicators, such as workload, has assisted in the reallocation of staff and the determination of new locales for introduction of health services. Tracking selected supplies/drug stock-outs monthly has resulted in dramatic improvement in essential drug availability at clinics, with the average percentage out of stock dropping from 13.2% in 1998 to 8.0% in 2000. At the same time, the introduction of the system has led to the determination of new functions and staffing requirements to support data management at the district and regional levels. The system, initially designed for use by Primary Health Care facilities, has now expanded to embrace information management in hospitals, environmental health services, ambulances, and personnel as well as to track notifiable diseases, and other conditions requiring specific confidential patient records.

For public health professionals and multi-disciplinary teams involved in developing health management information systems, the South African experience is rich in innovation and lessons learned.

Background

HIS in South Africa since the Apartheid era:

South Africa (SA) has seen significant change in its health system since the end of apartheid. During the apartheid era, there were stark inequities in access to public health services. Health services were fragmented and there was a multi-tiered public sector system for whites and three other ‘racial’ groups. Whereas this systematic discrimination has been abolished, there are still significant differences in public health services between historically advantaged and historically disadvantaged areas, both within and between provinces.

Another major cause of continued inequities in access to health services is the large and technically advanced private health sector, which continues to account for around 60% of overall health expenditure. The private sector only caters for the 20% with Medical Insurance, largely those employed within the formal sector.
The SA health sector was, and to some extent still is, very hospital- and curative-care oriented. Eastern Cape province, as an example, was typical of this pattern, with 92 public sector hospitals and over 600 small and often specialised clinics. Much of the land was part of the Republic of South Africa, but a large proportion of the population (some 6 million in 1994) lived in two homelands (Transkei and Ciskei). Without a uniform national health service, health information systems varied greatly depending upon the local initiative of the health authority providing the services. These systems generally focussed on hospital/practice management and to a lesser extent epidemiological surveillance.

“The economical and political focus on hospitals and hospital information systems, as opposed to primary health care, has made it difficult to (re)-direct funds and resources to district-based information system development. [It is estimated that], 90-95% of all development expenditure for new health care information systems today are spent on Hospital Information Systems (this excludes the cost of stationary, transport, and staff time used for existing data collection mechanisms).”

There were limited guidelines as to what information should be collected and reported to the central level. Each province and homeland (14 such areas) and most vertical programs (including TB, EPI, STDs, FP, MCH, nutrition, chronic and mental illness), had developed and deployed their own information systems independently. Health workers at all levels were faced with multiple reporting formats in which massive amounts of data were recorded.

With the end of apartheid in 1994, this pattern began to change. The National Health Bill provided for the development of a district health system covering defined populations and responsible for all public health services in those areas. At the same time, the Ministry of Health became more conscious of the need to monitor health status and health service performance. This led to the publication of a document entitled “Year 2000 Health Indicators: Definitions and Data Sources”. This mandated the collection of a more limited yet still large set of standardised data elements.

**Definition of HIS:**

A health information system\(^2\) is a set of tools and procedures that a health program uses to collect, process, transmit, and use data for monitoring, evaluation and control. The DHIS in South Africa is the acronym used to describe both the District Health Information System in the broad sense, and the District Health Information Software (used to manage the data collected by this system). The emphasis on District in both terms was chosen to encourage the decentralised design and control of information management and use. Nevertheless, the data collected are also available and used at Provincial and National levels. The system includes the procedures and formats used in all health facilities to collect and report the data, as well as the roles and authority enabling health workers to use their data to improve health service performance.

Initiatives to enhance health information systems typically deal with several or all of the following data management steps:

1. **Collection:** This typically includes rationalising the amount and types of data that is collected, improving formats and procedures for data recording and reporting and improving quality in terms of timeliness and accuracy of the figures.
2. **Processing:** Among the improvements in this area are: computerisation of data capture, various internal checks to improve validity of data, analysis, feedback reporting, and the production of graphs for visual display of information.
3. **Use:** This step is often the most difficult to influence because it requires a change in attitudes and behaviour in addition to the availability of new information and procedures. Efforts to introduce an ‘information culture’ (in which people base their decision-making on evidence rather than intuition or habit) typically focus on:

---

1. Developing District-based Health Care Information Systems: The South African Experience; Jørn Braa, University of Oslo (jbraa@ifi.uio.no); Calle Hedberg, University of the Western Cape & University of Cape Town (chedberg@mweb.co.za).
2. Note: this is also often referred to as a Health Management Information System (HMIS) when data is collected and used to improve health system management in addition to meeting conventional disease surveillance objectives.
A health information system typically includes a variety of sub-systems. The illustration in figure 1, below, provides an overview of the various components of the Health Information System in Eastern Cape Province. The elements highlighted in bold are currently included in the DHIS.

**HIS Evolution in Eastern Cape Province**

Eastern Cape Province, one of South Africa’s 9 provinces, has a population of around 7 million, initially organised administratively into 5 Health Regions and 21 Health Districts, and redemarcated in 2000 to 7 Health Districts (municipalities) and 25 Health Sub-districts (called Local Service Areas or LSAs in some documents). The province has a network of 700 clinics, 130 mobile routes, and 64 district/community hospitals that also provide some primary health care services. It has another 28 regional and provincial tertiary hospitals, providing secondary and tertiary care.

Since 1994, a number of abortive top-down initiatives were undertaken at the national level to improve primary health care related information systems, but it wasn’t until about 1999 that a number of bottom-up initiatives mostly on a pilot basis began to gain wider acceptance. In the Drakensberg area nurses helped define the data items they used most to measure their own work and performance and these were printed in standardised tick registers that simplified the recording and tallying of data on different types of patient visits. Patient held records replaced clinic cards which were often lost or misfiled. A major push to enhance the health information systems in Eastern Cape province began in 1997 with support from the USAID-funded EQUITY project. At least nine different information systems were in use in the province, few if any providing useful or timely data. Initial steps during that year included detailed discussion with all programme managers to select a very small set of indicators that would be valid and sensitive to change in relation to...
key elements of each health service area. These indicators helped to define a minimum data set of 20 items (later increased to 25) with precise definitions to be captured at each of the around 900 PHC facilities. No data items where included unless they were required to calculate a defined indicator. Thus, the DHIS is in principle an “indicator driven” information system, even if some other provinces initially focused exclusively on defining data elements. Computers with 16MB of RAM were purchased in 1996/97 and installed in all 21 health district offices. A computer program was initially designed using Clipper (a DOS-based dBase compiler) to enable data capture of this data set, but this system lacked the flexibility desired for reporting and for enabling districts, and even individual health facilities, to capture additional data elements of their own choosing. Bugs resulting in incorrect calculations of indicators created problems. An effort to port this to a Windows environment using Delphi was later abandoned, since it became apparent that other open source software was already available.

Furthermore, as the provincial health team planned the system’s roll out, it became clear that human resources available locally were not adequate to support both software development and to meet the training needs of staff throughout all 21 districts. In October 1998, after 9 months of data collection and capture but negligible output and feedback from the existing system, the team sought support from the Health Information Systems Programme (HISP) team based in Western Cape. This team had already developed a District Health Information Software (DHIS) application for use in Western Cape province (see box), and their ties to the University of Western Cape provided a convenient environment for organising many of the training activities required. The 8-9 months of data available was converted and imported into DHIS within 2-3 days, enabling analysis and reports through Excel pivot tables and graphs. The HISP team was also contracted to modify and further develop their software (developed in Microsoft Access) to cover Eastern Cape requirements, install the system in all districts and train staff in its use.

It should be noted here that the Health Information Systems Programme, a collaborative Research & Development effort currently involving four universities as well as the health administration in South Africa and Mozambique, already had established ties with several provincial administrations and with the national Department of Health through it’s National Health Information Systems / South Africa (NHIS/SA) committee. Expanding HISP activities into the Eastern Cape was thus relatively easy, and just a few months later the NHIS/SA committee adopted the DHIS software as a national standard.

In mid-1998 the Eastern Cape recruited a new cadre of personnel called District information officers, posting one in each of the 21 health districts to oversee information generation and dissemination. These supplemented the 5 Regional information officers bringing a true district focus to the collection, analysis and use of information. In addition to providing ongoing training and support to operational staff responsible for data capture and data management at the district level, the major focus in 1999 was on

---

**Initial PHC Minimum data set indicators:**
- Workload (1)
- Tracer drug availability (1)
- Maternal Health/Family Planning (7)
- Child Health (3)
- STD (2)
- Mental Health/Chronic Care (3)
- Referrals (1)
- Information system (2)
enhancing the computer system: adding new hardware in the districts, creating a more user friendly report generator to develop standard reports for each major program, and developing a more systematic mechanism for feedback reporting. Members of the HISP team made repeated visits to each of the regions and most of the district offices to provide continuing training and to support efforts to enhance the use of data from the DHIS.

Efforts in the year 2000 focused on managers and improving their access to and use of information for decision-making. This proved to be a far larger job than expected because health workers were not used to having reliable and timely data, let alone using such information as the basis for resource allocation. Training and mentoring have continued through 2002 with District managers (most are professional nurses by training) receiving on the job support for hands-on work extracting information from pivot tables and making their own graphs, as well as through courses in various subjects of public health that emphasize the use of data. Today, discussion of information is a standing topic in all District meetings, and District level personnel use monthly reports in routine supervision of clinics as well as for annual planning.

The evolution of the system has not always been without a hitch. There were at times heated discussions with national and provincial health authorities concerning the development approach, the purpose of the system, and even the software development environment. Staff at the central level had traditionally relied on their own rather simple EPI Info 6 (DOS) applications, whereas the DHIS software had been developed using Microsoft Access and Excel pivot tables. There was a strong tendency to demand huge amounts of data, little of which was ever analysed or used, but which reflected the exhaustive statistics demanded by many vertical programs. SA-EPI (the South Africa Enhanced Programme for Immunisation) initially collected 44 data items monthly – DHIS proposed only 5 – they compromised on 13 items enabling calculation of six useful immunisation indicators. Recognising that fewer data items lead to better quality data, recently the EPI program reduced the data requirements by dropping all second dose reports (they are now calculated from 1st and 3rd dose averages by the program).

By contrast, the World Health Organisation’s (WHO) “requirements” for TB data by many have been viewed as an obstacle to use of data by nurses and district managers in the TB program because there are so many indicators and data elements that local users get lost. Brainstorming with TB nurses on their requirements, the Eastern Cape Department of Health developed a 12-item data list for TB to replace the 160 items that “WHO required,” but this was not acceptable due to the WHO requirements. While much of this data may be useful for international comparisons, (over half of the items had to do with race and age breakdowns, and unusual types of TB) it confuses the user and obscures the important information on which management decisions at the clinic should be taken. WHO does not clearly distinguish between its own needs and data that is recorded for local use and decision making. More recently, an electronic computerised TB register has been introduced to capture all the information on each patient – some 40,000 new cases in Eastern Cape and 150,000 in South Africa annually. This will provide all the detailed information national and international managers could want, leaving space for a few simple indicators to drive case finding, sputum exams and early identification of dropouts in the monthly routine data set.

Similarly, different provinces had different priorities for investing their information systems budgets – most preferring to focus on patient centered hospital information systems of far greater complexity and cost while others began by emphasising district level primary health care services. Ironically, the Health Information Systems Programme was considering winding up its activities in late 1998 due to limited funding when the Equity project stepped in to support the extension of the system to Eastern Cape province. The Western Cape province had adopted the software, but its entire health information system budget had been allocated to a large Hospital Information System for three academic hospitals – a system that is still not functioning correctly. Large and complex systems often will not provide the basic data needed for managers. Provincial Health Department, HISP and Equity Project staff have found it better to start small, and especially with limited data requirements and expand as and when demand for more information is demonstrated. Interestingly, while many managers complained at the outset that our data sets were too limited, those same managers often find that even this “limited” number of indicators is more than they can use effectively to manage.
In spite of these obstacles, others bought into the approach. The British NGO TransAID, working with health transport managers in 8 provinces, has developed software and made it available using the open source approach. That software is currently distributed together with the DHIS, and the HISP team are working to ensure full compatibility (e.g. by use of the same facility coding system). Other similar linkages have begun to take shape, including: (a) The National Health Laboratory Services is very positive towards interfacing their laboratory information system (used in 8 of the 9 provinces) to the DHIS; (b) staff from the Cape Metropolitan Council developed a geographic information system (GIS) interface between DHIS and the free desktop GIS viewer ArcExplorer, and (c) the National Dept of Health and the Health Systems Trust (largest health-oriented NGO in SA) decided to integrate their Client Satisfaction Survey tool with the DHIS.

The DHIS software was successfully rolled out in Malawi in 2002 (partially as a result of contacts established during the RHINO meeting in 2001), and is currently being piloted or tested in a range of other countries, including Mozambique, Nigeria, Ghana, Cuba, Mongolia, China and India.

**District Health Information Software: An overview**

The DHIS software has been developed since early 1998, as part of a larger effort to enhance use of data and information within the public health sector, by the Health Information Systems Programme (HISP). The HISP pilot phase 1 from mid-96 to the end of 1998 was a collaborative research project between the University of Cape Town (UCT), the University of Western Cape (UWC), the Norwegian Computing Centre (NCC), and the Provincial Administration of the Western Cape (PAWC). Phase 1 was funded by the Norwegian Agency for Development Co-operation (NORAD) with around USD 0.4 mill. The overall research objective was to find ways to empower and give a voice to the community of end users, local management structures and deprived communities in the process of developing new health information systems to support the proposed new decentralised health structures. Phase 2 of HISP (1999-2001) had until the end of 2000 been funded by the Norwegian University Council (NUFU) with approximately USD 0.4 mill and by EQUITY with approximately USD 0.2 million, in addition to financial and manpower resources provided by health authorities in South Africa and Mozambique. Since 2000, HISP has been contracted by EQUITY Project (USAID funded) to further develop the software and to train information officers, supervisors and managers in all nine provinces of South Africa. Significant funding for research collaboration 2002-2006 is also provided by NUFU and the Norway-South Africa Research Fund.

The software development approach is characterised by participation and cyclical prototyping -- an iterative software development process, where initial specifications are quickly developed into a working model. This model is then implemented in live conditions where users play an active role in testing and defining what further enhancements are needed. This is an excellent approach for this type of software application, where the information needs and uses evolve over time. It also promotes shared ownership and enables end-users to provide a high degree of input into the design specification process. However, it has also lead to unanticipated problems as the system grew in directions (and in size) that were not originally expected.

The DHIS software was developed using Microsoft Access 97.2000/XP database management software. This was an obvious choice, given the widespread use of that software in South Africa and it’s integration with other Microsoft Office products (Excel, Word, and PowerPoint) for use in reporting. The system’s file structure is designed around 2 user-modifiable data dictionaries (one for data elements and the other for indicators). These provide excellent control of data quality and considerable flexibility in defining what data is collected and how it is used to calculate indicators (‘meta-data’ in database parlance). As a result, districts can easily modify the system to collect the data they want and define their indicators (numerators, denominators and method of calculations) as they please. In the Eastern Cape this capacity has enabled the system to evolve from storing only data on primary health care services to including data from the TB Control Programme, environmental health activities, annual health facility audit, semi permanent data on staffing, finance and infrastructure and monthly reports from all hospitals.
A key principle of the software development approach was that it should be free and open source. This means that the software is distributed free of charge and that the source code (programming) and database structure are open to modification by anyone. While this does involve an element of risk – in that users could make modifications to the system that could have unanticipated consequences – this philosophy has also made it extremely easy to promote the use of the software. Not only do potential users incur no financial risk in trying out the software, but there is the potential for them to adapt it as they see fit and copy it onto as many computers as they wish. This had certainly not been the experience with most commercially marketed software that provincial health authorities have dealt with at the hospital level.

The software, as implemented in the Eastern Cape Province, consists of the following modules (see annex 1 for a schematic overview):

- **Monthly Data** – data entry for PHC monthly reports (now with 54 required data items) and annual audit (far more detailed information on services provided, quality measures, infrastructure & staff) and production of standard reports
- **TB** – Quarterly TB data entry and standard reports conforming to the WHO requirements
- **Report Generator** – This module is using temporary tables, referred to as a Data Mart, to store processed indicator data. Raw data is linked directly in from the other modules. This enables reports from any time period and any raw data or indicators to be tailored to the user requirements. Data can be selected for a cluster of facilities (used by the supervisor), for one district or several, by one program area, or across different programme areas for managers with a variety of interests. Figures can be averaged over periods, aggregated for a given time period and compared to a previous year. The data mart also helps put together “exception reports” for any indicator. These reports list outliers – values above or below a given value that users can easily change according to their own assumptions. This is a very powerful tool for managers to see who is “out of line” – for example which facilities have immunisation coverage above or below a certain value, or whose workload is above or below local norms.

In addition, the system features links to other tools, including:

- a very user friendly set of Excel pivot tables that make it easy for users to cross tabulate, filter and graph data
- Thematic maps displayed using ArcExplorer map display software.
- A web-browser based Data Dictionary that stores official names and precise definitions for all Data Elements included in national and provincial Minimum Data Sets. This Data Dictionary, as well as the Web Shell and other HTML/XML/Java tools under development, is all running on top of the HISF Application Server (a local web-server). A Data Dictionary version that covers concepts and indicators will be released and web-enabled in the 2nd quarter of 2003. It will be hosted on a website run by the national Department of Health, allowing general browsing as well as automatic downloading of updated versions (functionality similar to e.g. Officeupdate.Microsoft.com).

A new module called “Special Patient Data” module is web-enabled, but aimed at providing a simple but flexible tool for collecting individualised patient data for certain important patient categories. Patient-identifiable data items can be encrypted using strong (128-bits) encryption to safeguard confidentiality. Minimum hardware requirements are 16 MB of RAM (32 MB if the HISF Application Server is running) and 200 MB of free space – the latter due to the installation of MDAC 2.5, Jet 4.0, DAO 3.6, and other system software as well as ArcExplorer 2.0, WinZip 8.0, and other applications together with the DHIS (the basic DHIS files with no data is around 20 MB). Indicator calculations are CPU intensive, so performance is largely CPU dependent as long as a user doesn’t run out of RAM. Windows 2000 and XP demands in practice 32-128MB of RAM, so all such systems can run the DHIS. Note, though, that hardware requirements obviously grow with the amount of data captured/analysed – the combined data file for South Africa is actually approaching the maximum database file size limit of 1GB for MS Access. Efforts are under way to make the DHIS Database Management System independent, so that DHIS data files can reside on any SQL-compliant system (e.g. ORACLE, MySQL, SQL Server, DB2, etc)
Recommended hardware is a “small business” PC for the district level (currently 1.8-2.0 GHz CPU, 256 MB RAM, 40 GB hard disk, 17-19” monitor, Windows 2000/XP) and a “technical workstation” for higher levels (2.2-2.6 GHz CPU, 256-1,024 MB RAM, 60-80 GB hard disk, 19-21” monitor, Windows 2000/XP). A scanner and an A3 inkjet are recommended, bringing the total cost per “unit” to between USD 2,000 and USD 4,000. High RAM requirements with large data sets are largely attributable to Excel pivot tables, which need a lot of memory.

During the course of its development a variety of interesting and unusual features have been added to the system - usually based on requests from users. For example, there are options to print out the monthly reporting forms and even the tick registers used to record the data manually in health centres. Similarly, tally sheets can be printed out with the size of cells automatically adjusted based upon data reported historically.

On the analysis side, the system has made innovative use of 1996 census data for calculating population denominators. This has included the development of an algorithm to impute catchment area populations based on the proportion of headcounts to the entire headcount per census district. This gives a reasonable estimate of the population actually served from which denominators can be calculated for coverage of services for any age group.

Current Status

As a way to monitor the status of the DHIS, the HISP team developed a tool to evaluate the degree to which a health information system is being used effectively. This tool, called TALI (Tool for the Assessment of Levels of Information), uses a checklist approach with objectively verifiable observations to help managers rank the effectiveness of information use at different levels of the health system on a 3 point scale.

Within Eastern Cape Province, the DHIS (including the software) has now been implemented in all 24 Health sub-districts. Even if the districts reached activity level 1 (data captured, at least partially validated, and submitted upwards) within 3-4 months, the whole process has so far taken 4 years. Some districts are still not stable at level 2 (routinely turning data into information and disseminating it to all relevant parties) and only a few districts have reached level 3 (using information for actual decision-making). The software is also installed in a number of individual health facilities and is used at the Department of Health office in the provincial capital Bisho (as well as by EQUITY project).

As the amount of data captured into the DHIS kept growing, it soon became clear that the 16 MB PCs in the district offices were inadequate (Access 97 itself needs 16 MB to run). Notebooks with 32MB used by the regional and provincial information officers were also getting sluggish, in particular due to the extensive use of Excel pivot tables for analysis and reporting (MS Excel is a memory hog). The EQUITY project therefore decided in mid-99 to purchase computer equipment for all district and regional offices, as well as some equipment for the Department of Health Each district received a “small business” PC (Pentium III 450, 128MB RAM), an A4 scanner and an A3 inkjet printer. The five regional offices and the provincial office received a “workstation” PC (512MB RAM) in order to handle much larger amounts of data. Two notebooks and two digital projectors were included for training purposes.

US government procurement regulations demanded that this equipment was purchased in the United States, with significant consequences. Firstly, whereas competitive bidding for this relatively standard equipment would have taken 2-4 weeks in South Africa, it took nearly 8 months from specification of the tender to its distribution to the recipients. Secondly, the people drawing up the tender specifications were told – rightly or wrongly – that the tender could not be limited to global suppliers that would be able to provide local support. The cheapest supplier that seemed to fulfil the specs would have to be chosen. Thirdly, various other factors resulted in several changes in the actual components used after the tender was awarded, with final PCs that proved highly prone to hard disk crashes.
One year later, nearly all the 28 PCs had at some point broken down. EQUITY project staff had to handle repairs and try to squeeze spares under warranty out of the US supplier, resulting in turn-around times of 4-7 months. Some equipment, like a monitor defective on arrival, has never been repaired/replaced at all. Most districts have been forced to look for other PCs or parts to be able to cope. USAID purchasing regulations have thus turned out to be highly counterproductive, disempowering, and a considerable embarrassment to both EQUITY and USAID.

In 2002, the Eastern Cape Department of Health purchased new PCs according to the “small business PC” specs outlined in the box above for all district offices. The old computers still functioning have been used for less demanding functions in the districts or small hospitals. Hardware budgets continue to plague the roll-out of the DHIS is many provinces as the demands of the software, both from Microsoft’s constantly growing software suite and from the increasingly large data sets in the provinces, calls for ever faster and larger capacity machines at least at provincial and national levels. This is not always easy to get, and HISP has developed various tools to make DHIS access easier – including the automatic extraction and aggregation to sub-district level of all provincial data. This national, aggregated data file is only 5% of the equivalent national data file with facility-level data.

The HISP team continues to provide significant support, since local capacity for software development and design of specialised analytical reports is still not in place at the provincial level. This support has increasingly focused using information for management and action in general, but does also include general computer troubleshooting and maintenance, configuration and use of the DHIS software. In addition, the EQUITY project has provided support through the Department of Health for the training of district health supervisors in use of data for planning and service performance monitoring and evaluation. Eight training courses that have been organised by HISP team members at the University of Western Cape include:

- Certificate in District Information
- Introductory, Intermediate and Advanced level DHIS
- Using GIS for Health Data analysis and display
- Use of information for management
- Using DHIS for management
- Using information for hospital management

While this case study has largely focussed on experience in the Eastern Cape Province it should be noted the DHIS has been introduced in all the 9 Provinces of South Africa as well as at the National Dept. of Health. Initially, interested information mangers have attended courses at UWC lasting 1 to 2 weeks and offered once every 6 months. For those Provinces with a larger number of interested staff the UWC HISP team conducts tailored training on site including the installation of DHIS software on local computers and its initialisation for the Province’s chosen data set. Individual HISP facilitators have taken responsibility for 1 or 2 Provinces and return periodically to help troubleshoot problems and extend the training to new users. It has been difficult however, to rapidly introduce the system everywhere because of the large number of staff in need of training as well as requirement for computer hardware.

Transfer of data electronically to the national dept of Health in Pretoria is still irregular, despite a nationally agreed upon data flow policy. This erratic submission is partially fuelled by lack of capacity at national level to provide rapid feedback to the provinces and districts – many provincial officers are quicker to provide data to HISP than to the National Dept of Health because they want feedback and assistance in addressing issues of quality, cross-border flows, etc. Hence the full power of DHIS to provide up-to-date and meaningful nationwide reports has yet to be fully realised, even if there is steady progress in most areas.. During 2000, Provincial and National authorities made the decision to extend DHIS to all health facilities in the country. This places heavy demands on the system especially the HISP trainers.

The HISP team is now fielding around 10 people to roll the system out and a Microsoft Project work plan is being used to track responsibility of HISP, EQUITY and govt staff and provide support and systematic training. Nearly 100 people are involved in the roll-out that should be essentially complete by the end of 2003. A big challenge is to see how the system will continue to evolve and be maintained after EQUITY
funding ends – but most of the actual roll-out is done by the provinces themselves without external funding which is reserved for consultant trainers and training courses.

During the visit to prepare this case study plenty of anecdotal information was gathered about innovative uses of the system by health workers and managers alike. Some of the highlights are included in the box below. Such experiences need to be shared widely so that they become part of standard practice throughout South Africa.

**Info to action: Innovative uses of DHIS data**

Nurses Warden and Hendry are health workers from different health facilities in Southern Peninsula municipality, just outside of Cape Town. They have been given the difficult task of agreeing upon which of their two PHC centres should be closed – and how their patients and staff can be merged to provide services more efficiently – perhaps in a completely new location. In the past, Department of Health managers would have just made the decision at a high level and the health workers would have had to live with it. Now they are gathered around the computer at the municipal office, pouring over various types of data they have printed out from the DHIS. They are comparing staffing patterns with headcounts at each facility over time to determine workload and examining data on the catchment population for different services. This helps them see the case-mix of patients that each facility is seeing and helps them determine which facility is already seeing a larger part of the combined population. The sisters decide that this is still not enough information to make a recommendation. They live in a semi-urban area, and they believe there is considerable crossover of patients who live in one catchment area to the other – perhaps because they work in the other area. They have decided to request a large scale map of the two zones and conduct a brief survey of patients for a week or so to confirm their belief – plotting the residences of the patients with different colored dots on the map. This should help them decide on the best location for the combined facility.

Kevin is the district information officer for Aliwal North Health District north of Queenstown. He has been trained to use the DHIS software to enter and analyze data coming from all the health facilities in his district. For the past several months he has printed out many pages of feedback reports covering all of the indicators in minimum data set and handed it out to each of the health programme managers and supervisors during district meetings. This has seemed like a waste of paper. There is too much paper to wade through, and the programme managers have many of other logistics and resource related issues that they feel are more important to discuss. This month he decided to use another approach, he works with the district health manager to identify one important theme, and produces a comprehensive analysis of recent DHIS data related to that theme alone. Instead of just handing out the printouts, he prepares PowerPoint slides on the topic and works with the responsible programme officer to present the tables, graphs and key observations to the rest of the team. This takes a lot less time and results in much more animated discussion. Members of the team decide on a list of themes they would like the information officer to research for future meetings.

Virginia is the Community Health Coordinator for Southern Peninsula Municipal Office. She is faced with a major dilemma about how to allocate reduced funding for tuberculosis services among the 18 clinics in the municipality. In the past funds were allocate strictly on the basis of the number of cases treated (around 4000 Rand per patient per year). This approach is no longer possible, because there are more cases than there is money to go around. During a meeting of all TB programme nurses, the group decides to see if the
data from the DHIS can help them. They ask Sylvia, the data entry clerk, to prepare a graph of the TB cure rates from the each facility. To their surprise they discover that these rates differ sharply between facilities. Most are quite high – around 80 or 90% -- but there are 4 or 5 health centres with low cure rates. Because of the risk of developing more resistant strains of TB when the cure rate is low, everyone agrees that proportionally more funds should be directed to those facilities. Interestingly, data gathered the following year supports the effectiveness of their approach. Nearly all the facilities lagging behind have closed the gap and most of the other facilities have maintained their cure rates. How much of the change is due to more resources and how much due to the heightened concern of the nurses who saw for the first time that they were lagging behind, is a matter of speculation.

Ivan is the Director of PHC for the City of Cape Town. The availability of data from the DHIS has helped him to revolutionise the process of developing the provincial business plan for health services. The new planning process results in a work plan that includes quantified outcomes and outputs anticipated for each activity – in addition to the resources required. Not only do the DHIS tools empower staff – who must agree together with their managers on reasonable targets for key indicators, but mid-level managers get a clear message that they must use the DHIS data to monitor the performance of their health facilities on more than just financial terms. To add further incentive, a new post of clinic manager has been created at the facility level. This individual is paid extra for being accountable for performance. Not everything works as well as Ivan would like, though. There is still no easy way to link the performance data generated in the DHIS – which is based on health facilities – with the “cost centres” used in the financial management system, since these cost centres sometimes cover many facilities (e.g. drug supplies to clinics) and sometimes only part of a facility (e.g. staff salary per ward in larger hospitals). Also, the city needs to establish a more effective procedure to ‘unpack’ the city business plan for each level of the health system. New challenges to use of data have also emerged with the transition of decision-making authority from health managers to municipal councils with limited health or medical training. The data and information will have to be presented in simpler ways that are understandable and convincing to this broader audience.

Mandisa is the provincial pharmacist in Eastern Cape. Two depots provide drugs to nearly 1000 public health facilities, expending over 300 million Rand per year. While most facilities have a reliable stock of essential drugs, some complain of persistent stock-outs and irregular supply. The DHIS initiated a simple monthly report of drugs out of stock, tracing 30 (now 23) items chosen to represent key classes of drugs and supplies. Each month, only those which ever ran out of stock (for one day or more) are recorded with a tick on a standard one page form. A monthly display of the clinics that ran out of more than 10% of the items, or consistently ran out of a given item (often broad spectrum antibiotics), revealed a small subset of facilities. Site visits showed that many were not ordering on time, some were grossly overusing certain drugs and in a few cases, the depot was not supplying the requested quantities. Remedial action in each case has improved drug availability in the clinics.

Lessons learned

Implementing a system of this size and scope provides a wonderful natural laboratory for testing different approaches and, hopefully, learning about what works and what doesn’t. Below are some of the most significant lessons learned from the Eastern Cape experience.

a) **District-level involvement in HIS development is not only possible, but it is critical for the success of information systems** aimed at enhancing health services at the district level. There are many examples of how input from district and health facility level staff led to new features and functionality in the system: choice of indicators from which data items were identified, design of registers, report formats. The success of this participatory approach in Eastern Cape province is reflected by a genuine feeling of ownership expressed by many district health staff while this case study was being prepared.

b) Whatever level is the primary focus of HIS enhancement activities even with a bottom-up development approach, **it is crucial to identify and involve all stakeholders or ‘actors’ in the process.** This includes individuals at all levels of the health system (potential users) as well as significant events and changes that are likely to influence the development of the system. It was
important to focus on high level staff as well. Only when the information officers started making reports and putting them on managers desks did anyone pay much attention to what the data were telling them. Then managers wanted to access the system themselves – to learn how to explore the data rather than wait for printed reports. Installing pivot table reports on all managers’ PCs resulted in far more frequent use of the information.

c) It is important to ‘walk before you try to run with information systems.’ Considerable effort was focused on helping staff use paper and pencil to master analytical skills before the system was computerised. This required a minimum data set that health workers could easily understand and analyse on the spot – without the need of a computer. Similarly, the use of hand-drawn catchment area maps and graphs was strongly encouraged as a key step in getting people to understand the populations they serve and to trust the data they collect. Later the computer can help them do it faster and better.

d) Several lessons were learned on the software development front:

i) A system of this complexity requires good linkages between users and a professional software development team. To this end, the prototyping approach has worked well in South Africa. It is also clear that the presence of extremely motivated and, in their own words “workaholic”, champions for the system within the department of health, the HISP team and the EQUITY project have played a crucial role in the rapid extension of the system.

ii) Efficient communication between the partners is crucial. The good fixed and cellular telephone infrastructure in South Africa has been an asset. Telephone support from HISP team members and Provincial DOH staff is available to users of the system almost any time of day. Bureaucratic rules and regulations and lack of infrastructure have actually been the major impediment to smooth communication – a manager in the provincial administration might wait months to get an email account or Internet connection, despite having a physical contact point one meter from his/her PC. The information officer in one Health District in the Western Cape was initially only permitted to receive emails and not to send (sic!) since it would save around USD 1 per month – getting permission to also send took nearly six months and much paperwork. Despite strong government support towards computerisation and to “bridge the digital divide”, Districts and Information Officers in some provinces and at the National Dept of Health still do not have reasonably reliable internet and email access. This has made the distribution of data and software updates via the Internet or Government Intranet very difficult in many areas, and distribution of files larger than a few MB are still predominantly done via CDs.

iii) Maximise data use by building links to off the shelf software for analysis and reporting such as Excel pivot tables. This lets managers use the analysis tools they are most comfortable with and reduces the software development work that would otherwise be required to reproduce this functionality in their application.

iv) Don’t underestimate the potential appeal of a specialised software application. Design database structures that can accommodate more records than you would have ever imagined. If database design is internally complex (e.g. highly normalized), establish mechanisms to provide users with simpler views of the data for their own ad hoc analysis. Many users expressed frustration at not being able to understand the manner in which data were stored in the system.

v) Look to find a balance between precision and approximation. This needs to take into account the expected quality of the data collected (including secondary data from census or other data sources, in addition to that controlled by the health sector itself) as well as the degree of precision required for decision-making. This was expressed several times using the adage: ‘It is better to be approximately correct than precisely wrong.’ In a similar vein, indicators that are too complicated to calculate are often also too difficult for mere mortals to interpret and use.

vi) Open source software that is distributed for free is easy to ‘sell’, but don’t underestimate the amount of training and technical support it requires. Health Information Systems based on open source software is as prone to under-estimating training and technical support as commercial systems. The database structure and many of the algorithms used for calculating indicators and generating reports are quite complex – even though they are well documented and, in theory, user-modifiable. In fact, it has been much
more effective for users to request most modifications from HISP team members, rather than trying to implement them alone. About 70% of overall HISP effort has been spent on training, support, and institutional development in general – only 10-15% on software development. In addition, open source software may be somewhat more expensive to support over the long term, since different versions may evolve making it much more complicated to introduce and test upgrades.

e) Health Departments and the teams that help them implement new computerized systems need to negotiate carefully but forcefully with donors to ensure that any hardware purchased meets national standards and can be effectively maintained and repaired locally. As was experienced in South Africa, importing equipment from afar often results in long delays and inability to obtain warranty support. It can also make it very difficult for large organizations to manage their fleet of computers because parts may not be interchangeable.

f) The implementation of new software can become a vehicle for change, including: standardisation, integration, and more widespread dissemination of health data/information. This experience once again underlines the chicken/egg nature of technical innovation in a health system. Although this is somewhat the corollary of the ‘walk don’t run’ principle cited above, in this case it was also true that the process of computerisation served as a catalyst for change, by requiring managers to prioritise what information was really necessary and to question standard operating procedures for data collection and use.

g) The indicator-based approach to determining information needs is an effective way to reduce the number of data elements collected and to ensure that data collected is relevant. Often managers cited “Pretoria requests it” as justification for including extensive data items on reports. Such apparently “simple” requests such as “age breakdown by 5 year intervals of clients” have huge implications not only for computer space, but more so for the poor data collector at the clinic or hospital level. Restricting data items to those required to calculate an indicator, and requiring that the indicator use be defined in terms of the management decisions it will facilitate, all help to limit data items to those most relevant and useful. A simplified indicator framework such as WHO’s health problem, service and critical resource indicator categories, might have been useful to ensure a more even distribution of indicator types and to clarify the linkages between them.

h) Improvements in data recording procedures deserve as much attention as reporting and data processing. In the Eastern Cape, it was decided to allow facilities and districts to evolve various approaches to record keeping and register design. The tick register was designed in one district and spread, slowly, across the province over 4 years as nurses tried and liked it. Had it been imposed, it is likely it would never have been properly used. Problems of time spent recording data, poor data quality, poor continuity of individuals’ records and limited use of the data at local level are likely to occur unless more emphasis is placed on this area to enable practical, affordable and efficient recording procedures.

i) It has been very hard to get people to make timely reports – many prefer annual reports – which some feel is HISTORY!! The old system was stressed to even provide a report once a year, months after it ended. The DHIS is capable of reporting monthly, enabling timely action to rectify deficiencies. Indeed, for less dynamic measures of the system, the annual clinic audit has proven to provide good data on a range of useful measures: personnel levels, service provision schedules, infrastructure, equipment and objective measures of quality. These supplement the monthly data on service provision, drug supplies, work loads and disease patterns that can change rapidly. The system is most useful if it can provide fast and up to date indicators of what the problems are and where they are localised.

Future Directions

In spite of the great progress already made, there are a variety of areas where the DHIS can be further improved. Below are some of the key areas that are being worked on or explored at this time:

j) Use more sophisticated tools to manage the implementation process: The DHIS is currently being rolled-out to the entire country, that means 9 provinces, some 180 health districts and 6000 health facilities in South Africa. The implementation team has recently developed a Microsoft Project work plan that is guiding the roll-out for this complex process, with a huge number of modifications to fit local needs. This tool ended up being too cumbersome to maintain, and HISP is currently looking at other ways of tracking progress.
k) **Focus more attention on data interpretation and use.** This has begun with the development of some standard curricula for data-for-decision-making training of supervisors. In addition, certain Provincial and Municipal authorities are linking DHIS data to specific procedures such as work planning. District health workers are required to project how much change they expect in key indicators when they put together their work plans – and are then held accountable for the results. Quarterly reviews of financial expenditures in each cost centre are now using service data to justify many of the costs: drugs and supplies, patient loads, priority services conducted (TB, STIs, EPI etc).

l) **Further develop the capacity of Provincial Department of Health and National health authorities to maintain the system,** including: receiving and aggregating data from all districts/provinces, providing systematic feedback, adapting the software as information needs change and providing timely support for end-user software trouble-shooting support. The National Department of Health should maintain the data base on a central server making it available to authorised users both at National and in the provinces. Recently, a combined National data set had been created from the 9 provincial PHC and 9 provincial hospital data sets, enabling users to view data and indicators down to the health subdistrict level from a single data base or pivot table. This will facilitate ease of use at national level. National users with the need to drill down to facility level must acquire a powerful PC to do it and possibly select a sub-set of the total amount of data available in the provincial data files, or they can access the data directly in the provincial data files.

m) **Proceed with the development of a new version of the software.** Version 1.2 of the DHIS software was superceded by version 1.3 in late 2001 and Core modules have largely been kept stable to assure that users become fully familiar and comfortable with its features. Its current database structure, originally designed to provide maximum transparency for district users with limited knowledge of MS Access, is not efficient for the large data sets gradually emerging at provincial and national levels. The Eastern Cape data file, covering five years of PHC data, is for instance, over 400 MB in size and with individual tables reaching towards a million records or more. Even if Access formally has a maximum size of 1 GB, the practical limit is probably around 60-70% of that. Network installations are also on the increase, but it is not advisable to run the DHIS on Access (thick client) with more than around 10-15 concurrent users. Pivot tables, fully stored in memory when used, are also very RAM hungry with such large data sets. The new features of the software currently under development include:

- The development of a ‘DHIS light’, client-server or web-browser based system that will not have the same high computer resource requirements for end-users.
- Replace the current DAO³ interface between the application modules and the data files with OLE DB and ADO⁴, thereby allowing users to store their DHIS data on any SQL compliant Data Base Management System with an OLE DB driver (e.g. Oracle, DB2, SQL Server, Sybase, etc).
- Further improvements to the Report Generator and its temporary Data Mart tables, to make it easier for end users to understand the file structure and to use the data with other analysis tools and report writing tools (ArcExplorer, Crystal Reports, EpiInfo 2000, Excel, etc…).
- Bringing the user interface more in line with common graphics interface or internet browser standards. This includes, revising the placement and use of menus and control buttons, changing the layout of data entry screens so that paper reporting formats can be organised in a more user-friendly manner.
- Introducing multi-language support, so that the system can be easily translated into different languages (Spanish, Russian, Chinese, and Mongolian have been done. Several Indian languages, Swahili, and Norwegian are partially done).

---
³ Data Access Objects – the “linked tables” in MS Access is using this technology, which is being phased out and replaced by OLE DB and ADO.
⁴ ActiveX Data Objects (ADO) enables you to write a client application to access and manipulate data in a data source through a provider like OLE DB. ADO's primary benefits are ease of use, high speed, low memory overhead, and a small disk footprint.
• Implement a common coding system for health facilities and geographic areas that will enable linking of many more of the computerised sub-systems – lab results, finance, personnel and drug management, for example. The DHIS organisational unit structure has increasingly been used as the South African standard by other information systems, thereby allowing linking of the data bases and direct importation of relevant data.
DHIS Application Structure

Current interface: Object Linking and Embedding (OLE)

Pivot Generator

DHIS_SCT.xls
DHIS_SRE.xls
DHIS_SSH.xls
DHIS_SMA.xls

Current interface: Open Data Base Connectivity (ODBC) – Read Only!

Anti-Pivot Access Tools

Data Dictionary

DHIS_MD.mdb & DHIS_TB.mdb

Current interface: Data Access Objects (DAO). V. 2.0: Object Linking and Embedding (OLE DB) and ActiveX Data Objects (ADO)

DHIS_C.mdb
DHIS_RE.mdb
DHIS_SH.mdb
DHIS_MA.mdb

Geographical Information System (GIS)
ArcExplorer

Links to Internet