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### The Winner of the IT@Networking Awards 2012

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**It is globally recognised that the only way to effectively support continuity of care is to implement an electronic health record (EHR) system on a large scale. The implementation of a national EHR is a high priority in the e-health strategies of most countries, regardless of whether they are first world or low- and middle-income countries. In South Africa, this has been successfully achieved in the Western Cape province.**

Although South Africa has had some active health information systems implementations, only about a third of all public sector hospitals have some form of electronic medical record system. There is little or no integration between these systems and network and Internet access is not commonly found in public health facilities, especially primary healthcare facilities (community health centres and clinics).

Prior to 2004 in the Western Cape, none of these primary healthcare facilities were computerised. In 2004, there was an initiative to connect the fifteen largest community health centres to the provincial WAN. Computers were also installed but only provided email capability. For registry staff who were struggling to process more than 1,000 patients a day, for doctors who had to see up to 100 patients a day and for patients, who had queued outside from 4am, ill and often collapsing, this was of little help. Registry staff battled under chaotic circumstances, often using up to four different filing systems in the same facility.

#### PHCIS

A small team within the provincial government had designed and implemented a successful centralised system called CRADLE for use in the midwife obstetrics units (MOUs), public sector facilities where women receive ante-natal care and deliver their babies. It was proposed that CRADLE be adapted for use in all primary healthcare facilities, particularly making use of the patient registration functionality. The resulting system would be known as PHCIS (Primary Healthcare Information System). In 2003, the South African cabinet announced that anti-retroviral treatment (ART) for HIV/AIDS would be introduced in the public sector. It would be essential to monitor the roll-out of ART and to provide regular reports to the national Department of Health. The decision was taken to use the same CRADLE patient registration capability and to develop this ART module in-house, with guidance from the University of Cape Town Health Sciences Faculty. The ART module, called eKapa, was therefore to be part of the PHCIS suite and the development was done in parallel. The decision to enhance the CRADLE system was taken because it had the necessary foundations to suit the unique requirements and the cultural context. The CRADLE system had already been proven in the MOUs. Several commercially available systems were investigated but it was felt that, besides being very expensive, they were generally not suitable. There was considerable pressure at the time to use an open-source database and development tools. However, it was felt that the existing CRADLE team was skilled in the development language and it would be easier to find reliable skills in this language. The CRADLE system already used a commercial database management system and there were economies of scale in expanding this. From the outset the vision was to take a step-wise approach, i.e. not to proceed to the next level until the foundations were in place. This is illustrated in Figure 1.

**Step 1.** Connecting facilities to the WAN, giving staff basic computer literacy training and enabling them to use the computers to support administration of the facilities, e.g. email, access to the transversal financial system, BAS.

**Step 2.** Providing the capability of registering the patients on a centralised database, recording and updating demographic details, both on the PHCIS database and the provincial Patient Master Index (PMI) which is maintained in the Clinicom system (a centralised system used in provincial hospitals). At this stage staff could print labels that could be used by the pharmacy and to label specimen containers.

**Step 3.** Allowing more details to be recorded so that specialised registers could be maintained, e.g. for ART or TB treatment.

**Step 4.** Begin to add clinical details onto the patient record and proceed gradually until a comprehensive, longitudinal health record is maintained.

**Step 5.** Use the PHCIS database as a source for management reporting and business intelligence applications.

#### An Agile Tailor-Made Solution

The philosophy and methodology used for the design and development of PHCIS can be described as "agile". The development team worked very closely with the project manager and the business analyst, who in turn, dealt with the users on a daily basis. The roll-out began in 2006, using the approach previously described. Two weeks after each "golive" an on-site review was held where the users communicated openly about the system with the entire team, giving useful feedback to the developers. Besides regular project meetings, the project manager and business analyst met regularly with facility staff and managers in a forum where they discussed the project, the system and its impact on clinic workflows. The team also spent a considerable amount of time visiting the facilities and speaking to staff and patients. This close relationship with the users and the patients continues and the result is that the "design reality gap" for PHCIS is very small, i.e. it is tailored to the needs of the users, the patients and the managers, closely fits the socio-cultural context, and has an improved chance of being adopted and retained.

## The System

The hardware used for this system is very basic. All hardware procured must conform to the standards laid down for the provincial government, must be affordable as the budget is constrained and must be easy to support. Equipment used consists of standard network cabling for the LAN and WAN, compact workstations with flat screens, specialised high-speed label printers and laser printers for reports. In addition, barcode scanners are used in the registry to scan the patient's card on arrival in order to open the electronic record. Barcode scanners are also used to record details about a patient visit, with minimum effort on the part of the clinician or clerk.

One of the impressive features of the system is that it accesses a central PMI via web services. This PMI is used for all patient-based systems in the province - at hospitals, MOUs, ART clinics and 100 clinics serviced by the City of Cape Town. The City of Cape Town system has also been developed inhouse by the city's ICT services.

PHCIS has an SMS capability which allows reminders to be sent e.g. to patients who have missed appointments, or to parents to bring their children in for their next immunisation dose. On-going work with facility managers and users has ensured that PHCIS is an integral part of clinic workflows. Most facilities are not modern and were not built with computerisation in mind. It has been challenging to adapt workspaces, already cramped and ergonomically unsuitable, for the use of computer technology while at the same time taking into account high volume workflows.

## Challenges

When roll-out of PHCIS began in 2006 the project team had to overcome several challenges:

- There was very little funding for this project;
- There was considerable resistance and lack of buy-in, especially at the outset. The behavioural patterns of staff and patients had to be changed. Staff were accustomed to chaotic workflows and facing long queues of frustrated patients. Patients were used to spending a full day in the facility each month in order to collect repeats of chronic medication;
- There was a shortage of skills for support of the system;
- The network infrastructure was not adequate and/or accessible;
- There was a lack of reliable and affordable connectivity;
- Processes for procurement of network infrastructure and hardware were complex and slow;
- Buildings were not designed for computerisation;
- Electrical supply to the facilities could be unstable;
- There were security and access issues. In some areas gang warfare raged outside the facilities at the time of "go-live", several sites had all computers stolen, electricity supplies were disrupted when underground cables were stolen for their copper content, and on more than one occasion workers were involved in national strikes;
- The organisational structure did not include the roles necessary for the success of this project, i.e. information officers and data capturers.
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Over the past five years these challenges have been overcome through innovation, teamwork and buy-in from the provincial department of health's top management. The original goal of the project, to implement a patient management system in 33 community health centres, has far been exceeded. Today PHCIS has been implemented at 113 facilities and the roll-out continues. The aim is to include 126 more sites within the next year. The system tracks more than 5.6 million folders and the PHCIS database alone (apart from the provincial PMI) holds information for over four million patients.

## Patients and Staff

This success has resulted in tremendous benefits for the patients, the users and the managers. Patients are benefiting from improved quality of care resulting from informational continuity, i.e. their records may be accessed at any PHCIS facility. Improved organisation and quicker throughput means that they do not have to queue for so long. They do not have to arrive early to secure a place in the line as those who must make repeat visits are given appointments. Patients who "walk in" for acute visits are also processed faster. Overall this gives the patients respect and dignity, the system knows them and recognises them, their files are retrieved rapidly. Patients can plan their time better and do not have to lose a day's work in order to pick up medicine.

The users can be divided into two groups – the clinicians and the administrative staff. The clinicians benefit because the environment is now generally less stressed. Their workload is better paced and, knowing their schedules ahead of time, they can plan their own time better. They are able to deliver a better quality of care because they have better information about the patient. The administrative staff has become empowered through computer literacy. The staff at the registry windows experience less stress as the patients are happier and the waiting room is less crowded. They have more job satisfaction as the job is more skilled and more is required of them.

Both user groups benefit from the simple but innovative use of barcode scanners to record visit details. By scanning three times – the patient's barcode, the clinician's barcode and the reason for the visit, the user triggers the rapid creation of an encounter within the patient's electronic health record. The patient encounter holds the following essential information – which patient was seen, when the patient was seen, where the patient was seen, who attended to the patient and what was the reason for the visit (e.g. BCG first dose).

Managers are benefiting from the easy availability of high quality and accurate information. They are able to base strategic planning and decision-making on information reported or extracted from the system. Regular reports with the indicators they are required to provide are also easily obtained. They are able to monitor staff activities and workload as well as perform patient profiling for improved chronic disease

management.

### **Conclusion**

There is no doubt that PHCIS is a major success. In 2008 the PHCIS project won the African ICT Achiever's Award for the best ICT project in Africa. In the same year the project won the silver award in the Premier's Service Excellence Awards. In South Africa, the ART module of PHCIS has been mandated as the national electronic medical record system for the monitoring of treatment of HIV/AIDS in public healthcare facilities.

Work on PHCIS is ongoing and the team is always looking for ways to improve the system. In the words of Claudette Ruiters, the dynamic PHCIS project manager: "The question you have to ask yourself is 'would you like to be a patient in this facility'? And if the answer is 'NO' – then you have to do something about it!"

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