Improving Health Care at EHHC with SAP IS-H and i.s.h.med

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ABSTRACT

The use and application of information technology in health care world wide is lagging behind other industries, even though research indicates that information technology can be an important tool for improving safety and quality in clinical environments.

In this paper, we present the case study of an implementation of a SAP health care solution at the eThekwini Hospital and Heart Centre (EHHC) in Durban, South Africa. EHHC is owned by Capensis Management (Pty) Ltd a company that is dedicated to the provision of excellence in healthcare and which is planning to roll out the same IT model as at EHHC in all other new hospitals that are in the process of development.

The implementation of SAP (IS-H and i.s.h.med) makes EHHC a forerunner in the adoption of information technology for the improvement of safety and quality in health care in South Africa.

Keywords

SAP, SAP IS-H, i.s.h.med, eThekwini Hospital and Heart Centre, EMR (Electronic medical record), digital hospital, T-Systems South Africa

1. Introduction

Health care internationally is struggling with escalating costs, unsatisfactory care and a high error rate in treatment. A study by the Institute of Medicine attributes approximately 98 0000 deaths in the US per year to medical errors [11]. Overall the quality of health care seems to be lacking. Good quality in health care is defined by more accurate diagnoses, fewer treatment errors, faster recovery rates, less invasive procedures and reduced need for treatment [2].

International research indicates clearly that the use information technology in health care could significantly improve safety and quality in the clinical sector [1], [4], [7]. Bates et al. [4] concluded that information technology applied in the areas of clinical decision support and integration between separate clinical systems could reduce the complexity and result in substantial improvement in patient safety. Gugliemo [8] mentions the example whereby the tracking of a patient's case by means of an electronic medical record Monika Calitz, M.Comm T-Systems South Africa New Road, International Business Gateway, Midrand, South Africa +27 11 254 7400 (Telephone) mcalitz@absamail.co.za.

(EMR) facilitates communication amongst collaborating care givers and health care practitioners.

Despite this, the adoption of information technology in health care is lagging behind other

industries such as manufacturing or banking, where information technology has become the backbone of operations [1] [5]. Spend on information technology in health care is significantly less than other informationintensive industries [4]. In a survey about the use of EMR's in US hospitals, only 1.5 % of US hospitals surveyed had a comprehensive electronic records system [7]. Statistics for adoption of information technology in South African hospitals seems to be lacking, however recent newspaper reports highlight a struggling national health care industry, plagued by misdiagnoses, some resulting in death, constant shortage of drugs and supplies, a striking workforce and failing equipment [12]. The situation in South Africa seems to reflect the international state of affairs. A project by the Department of National Health to develop an integrated health information system (HIS) and a district health information system (DHIS) for public sector health care is an attempt at addressing some of these problems. However an audit conducted during 2006/7 indicates that the system is not as successful and effective as it should be, this is due to lack of training, staff turnover, access to facilities and adequate hardware [9] [10].

Some of the challenges facing health care institutions are cost reduction, improved services to patients and reduction of errors leading to injury or death in the treatment of patients. The role of information technology in health care therefore should be to deliver high quality systems that offer a wide range of clinical and economic benefits [3].

In an unprecedented move in South Africa, the eThekwini Hospital and Heart Centre (EHHC) in Durban opted to establish a fully digital hospital with support of all necessary high tech technology. In this paper, we present the case study of the implementation of an SAP health care solution at EHHC in Durban, South Africa. The implementation of SAP (IS-H and i.s.h.med) makes EHHC a forerunner in the adoption of information technology for the improvement of safety and quality in health care in South Africa.

2. OVERVIEW OF INFORMATION TECHNOLOGY IN HEALTH CARE

Applications in health care can be divided into the following categories:

- Administrative systems. Patient admission, transfer and discharge, case management and billing.
- **Monitoring systems**. Highly specialized systems for real-time monitoring patients' data and sending alerts to a care giver when dangerous levels have been reached.
- Clinical systems; systems designed to enhance the global clinical view for the patients stay, thereby improving communication about a patients condition and boosting the quality and safety of patient care
- **Decision support systems** Systems which support humans in decision making, for example calculating the correct dosage and type medication to administer, diagnosis and selection of treatment, etc.

General recommendations on the implementation of health care systems made by Bates et al. [4] include:

- Promote standards for data and systems in drugs and allergies
- Develop systems that communicate with one another seamlessly
- Adopt enterprise database standards
- Promote electronic records
- Improve measuring and reporting of quality
- Implement computerized order entry, specifically automated prescription
- Implement bar coding to reduce errors
- Use modern technology to communicate asynchronous data (e.g. markedly abnormal laboratory test results).

Recommendations, specifically within the South African context include [12]:

- Addressing the human resources problems;
- Addressing infrastructure problems especially in terms of hospitals;
- Establishing an effective procurement and supply chain;
- Implementing a proper IT system;
- Putting proper monitoring and evaluation systems in place in order to understand the disease burden;
- Finding an effective system through which to collect revenue; and
- Ensuring that the proposed system meets constitutional obligations.

Information technology can be used as an enabler in transformation in the health care sector. The focus should be not simply to automate existing processes, but instead to change the delivery of care in such a way that the application of ICT adds value to the patient and care giver [2].

3. IMPLEMETATION OF SAP IS-H AND I.S.H.MED AT EHHC

3.1 eThekwini Hospital and Heart Centre (EHHC)

The eThekwini Hospital and Heart Centre (EHHC) is a private hospital specializing in cardiac care and surgery, but also hosts all other major casualties. It is located in Durban and consists of 250 beds and has approximately 12000 admissions per year. Jha et al [8] list the potential markers for a high-technology health care institution are the presence of a dedicated coronary unit, a burn unit, or a positron-emission tomography scanner. In terms of this classification, EHHC is a high-technology health care institution.

Everything in the hospital from the ward design to the sophisticated software and medical technology is designed to contribute towards the twin goals of superior health care and maximum efficiency. This requires a reliable administrative back office solution. EHHC chose SAP IS-H, an enterprise resource (ERP) system including planning specialized healthcare components. It was implemented in conjunction with its localized best practices for the back office ERP modules. SAP IS-H is a worldwide renowned healthcare component since it provides a fully integrated solution. The other major portion of the solution included the i.s.h.med component, which constitutes the clinical system component of the solution. i.s.h.med was developed by T-Systems and Gesellschaft für Systemforschung und Dienstleistungen im Gesundheitswesen mbH (GSD). This development is an extension to the standard SAP IS-H system. A seamless integration exists between all SAP modules used, from Financials and Controlling (FI/CO), Human Capital Management (HCM) and Materials Management (MM) to the clinical components, thus ensuring real-time and accurate information available throughout the different hospital departments at all times.

EHHC chose T-Systems and their team of industry specialized SAP consultants as an implementation partner to design, implement and support the solution.

The information technology project was unique, as the physical structure of EHHC was still under construction. The timing for the ERP solution therefore had to match the time-lines for the construction and the set-up of the physical hospital and had to be ready in time for the hospital opening. The entire project for EHHC, from signing the contract to go live, consisted of implementing the complete back office and the clinical solution within a time period of 9 months. The project was able to deliver the complete SAP solution at the time EHHC opened its doors.

Some of the challenges of implementing a solution in such an environment included not having a physical hospital yet and having a very limited set of process owners and end-users to participate in the solution design. This environment proved to have its own set of advantages and disadvantages. On the one hand, a small set of end-users ensured that communication was easy, fast and direct which resulted in a quick and adequate decisions making process. On the other hand the implementation was hindered because of the absence of set routines, administrative processes and other patient related (work-) processes.

The project used the ASAP methodology, which is a set of tools, standards and techniques to roll out SAP projects in a structured manner. The methodology follows a roadmap grouped into 5 major phases: 1 project preparation, 2 Blueprint, 3 Realization, 4 Final Preparation and 5 Go-Live and Support.

During the Blueprint phase, EHHC processes were defined, documented and validated by the process owners. Also the high-level organizational structures were agreed. Once these processes and structures were agreed, the Realization phase commenced. During this phase, the blueprint processes were built by the T-Systems consultants by means of customizing the SAP system, developing ABAP (SAP Programming language) solutions for documented gaps, creating interfaces to external parties and comprehensive testing. One of the milestones of the Realization phase is user acceptance test after which the go-ahead was given for taking the solution live. In the Final Preparation phase, the startup data was taken on, the end-user training was conducted and a final volume and system test were conducted to obtain a Go/No-Go decision.

The uniqueness of the project also lay in the fact that the project had two different timelines and go live dates. The first go live date with the related timelines regarded switching on the SAP back-office solution based on the best practices for HCM and FI/CO. The second go live date regarded switching on MM and the healthcare components.

As a result the entire SAP system was ready for operation on the 1st of June 2008, a full month before the first patient would walk through the door. From this moment onwards T-Systems' consultants were on standby to assist the newly trained staff in all aspects of the operations involving the new ERP System for 3 months. During this extensive support phase, T-Systems provided an additional support team to ensure that sufficient assistance was available to new users of the system and any errors could be quickly corrected. This support team continued providing support under a support Service Level Agreement (SLA) from the T-Systems offices in Midrand and is still doing so to this date. [13]

3.2 The challenges

The main challenges for the project team during the implementation of the fully integrated solution were:

• Very aggressive and strict time-lines due to the constraints of the hospital's physical

opening date.

- Absence of administrative processes. As the hospital had not yet started up, knowledge of these processes was not available to the team.
- The absence of patient related (work) processes. Business processes whose purpose it was to provide superior health care and maximum efficiency had to be designed without reference, but solely based on the consultants' experience.
- The magnitude of initiatives to coordinate created challenges for the program manager and as a result also for the information systems implementation team. The physical setup of the hospital included many projects, e.g. construction, procurement of equipment and hiring of staff, all of these dependent on one another.
- Close integration to 3rd parties. EHHC required the ERP solution to integrate to systems of various key business partners. Interfacing to these systems was handled by international resources, scattered all over the world, over the different time zones, spoke different languages and were managed by their own project management.
- Scarcity of i.s.h.med expertise. I.s.h.med is an in-house solution developed by T-Systems Austria and GSD Germany. For the duration of the project, the availability of international i.s.h.med experts was limited to a part-time basis, which meant that the team was not always fully supported on site.
- Unresolved business partnerships during the project. During the project, contracts with prospective business partners were still being negotiated. Some of the key contracts with other partners that were still pending on the time of project start were :
 - Preferred bank to set up the electronic banking details with SAP Financials Module,
 - Preferred DOR system to interface for orders and results
 - Radiology partner
- First time in South Africa. A green-fields SAP health care implementation of this scale and with this level of clinical integration was never before accomplished in South Africa.
- Computer literacy of staff. During project planning the lack of computer literacy of prospective staff was anticipated, however, during training this was found to be worse than anticipated and stretched the timelines dangerously.

3.3 The team

The project was kick started by a team of dedicated SAP Functional Consultants specializing in the areas of Financials and Controlling (FI/CO), Materials Management (MM) and Human Capital Management (HCM) including payroll. The SAP FI/CO and SAP HCM consultants managed to successfully implement the best practice solutions within the limited time period of 6 months. At this stage EHHC was able to start implementing their administrative processes and financial structures as well as hiring and paying staff.

Overlapping this period a team of T-Systems SAP health care consultants started the blueprint phase of the first fully integrated health care solution in South Africa. The health care team consisted of five functional and two technical specialists. Team work was the key during both design and realization of the solution.

The i.s.h.med part of the implementation was handled by two international T-Systems resources, who were based in Vienna, but joined the project team in South Africa on a regular basis. The expertise of these two resources outweighed the inconvenience of not having them available on site full time.

3.4 The Scope

The requirement for EHHC was to have a fully integrated system, supporting both back-office processes as well as clinical processes in a seamlessly integrated environment.

The following main health care processes were targeted for automation and support by the SAP IS-H and i.s.h.med solution: [14] [15]

- Strategic Service Offering
 - Health-care specific analyses, reporting and statistics;
 - Financial budgeting and planning;
 - Resources and Supply Chain Planning
 - Staff management (including time management and payroll);
 - Logistics support;
 - Case costing and controlling
 - Patient Management and accounting
 - Coding and pricing controlling
 - Invoicing and payment handling
 - o Patient administration and services
 - Resource planning and scheduling
 - Enterprise management and support
 - Analytics
 - o Financials
 - Human capital management
 - Corporate services
 - Operations support
- Patient administration Consists of all functionality regarding the creation of the patient file and the recording of the patients' movements in the system, supported by system based documentation. As the decision to admit a patient is usually made in the doctor's offices, this process included providing part of this functionality as well as connectivity to the doctors' room.

- Patient billing this process requires gathering the data about each patient such as the length of stay at EHHC, the treatments applied, surgical supplies used and medication administered. EHHC is part of the National Hospital Network (NHN) an association of independent hospitals, joined together to provide superior health care at competitive prices. As part of NHN rules are configured in the system. For example the ward fees will be generated automatically, carve out rules for chargeable/non-chargeable items are applied automatically etc. The actual billing will take place in the SAP IS-H component of the solution where the invoice is generated. The SAP FI/CO modules will follow the financial handling of the invoice from this point onwards to produce i.e. accurate costing, financial reporting, age analysis reporting and dunning procedures;
- Case management and switching a special user interface was build for the case managers to attach all authorization related data to a patient's case. This user interface consists of a main screen where the case managers can track the progress of assigned patients. The system issues alerts for authorized number of days reached, authorized amount reached, wrong level of care etc. For sending clinical updates the system will automatically gather the related data available in the healthcare components IS-H and i.s.h.med. This minimizes the time that the case managers have to spend to physically search though the paper files before putting together a comprehensive report for the medial aids. The system takes care of most of that task now. EHHC uses a local company, DHS for their switching; therefore T-System has enabled EHHC to use all possible functionality that DHS has to offer in this regard.
- Management of all stock including medical supplies and medications. All supplies are tracked within the SAP MM Module. Issue of stock items triggers replenishment of supplies and the procurement process.
- Online ordering of medication plus inpatient drug dispensing and administration; all medication related processes have been designed in the system, which constitutes a unique solution. The visibility and the accuracy of the patient medication chart have reduced the room for errors in this specific area tremendously.
- On-line orders and results for lab and radiology; all necessary tests for lab and radiology can be ordered by the nursing staff in the wards. The 3rd party systems receive all patient data, plus diagnosis and the required

tests via the interface, thus making re-entering the data in their system redundant. As soon as the results are finalized, they are made accessible in the SAP healthcare system via the interface.

- On-line nursing documents and nursing plans; creating visibility and accessibility for nursing related documentations and activities to reduce hand over time and increase quality of patient care.
- Online ordering of surgery with related surgery planning and documentation; the surgery request is entered on-line, either as part of the admission request or directly from the ward. Based on these requests the theatre staff can start planning resources (team and rooms). After completion of surgery, documentation can be used to capture relevant data for all disciplines.
- Integration to all monitoring and supportive specialized systems. This integration is accomplished by using interfaces based on the HL7 standards. Since the interface landscape is quite comprehensive with many different
- interfaces, it was decided not to use point-to-

point integration, but to use middleware for handling the messages. The middleware EHHC choose for this project is Rhapsody.

The following interfaces were part of the solution and enabled the construction of a fully integrated EMR:

- CKS for retail pharmacy; stock and financial updates
- Lancet Laboratory systems; online orders and results- both structured and unstructured
- Jacques DuPlessis Centricity RIS; online orders and results – both the findings reports as the image itself
- Two digital operating rooms (DOR's); ADT data sent to DOR
- Centricity Anastesia; ADT and lab results send to Centricity and PDF summaries back into SAP
- Centricity Critical Care; ADT send to Centricity and PDF summaries send back into SAP
- Centricity Carddas; ADT send to Centricity and summary PDF send back to SAP
- MUSE; ADT send to MUSE



EHHC Integrated Systems Overview

Figure 1- EHHC Integration Overview

3.5 The Solution

SAP for health care solution has been developed as one of SAP's industry solutions. As shown in Figure 2 below, the IS-H component forms an intricate part of SAP ERP. It is important to understand that the Industry solution is applied on top of the core SAP ERP solution. This makes the solution a powerful one. There is seamless integration between IS-H and the core modules FI/CO and MM. The SAP IS-H solution has been designed to cater for state-of-the-art problem solving methodologies in an environment with specific standards, processes, and challenges like the healthcare industry.

Supported by the SAP NetWeaver® platform, the SAP for healthcare solution will deliver diverse functionality while aiming to increase efficiency, transparency, accessibility and overall quality for both the healthcare organization and the patients. The basic components that are part of the SAP IS-H solution: [14]

- Patient management
- Patient accounting

• Medical Record management (paper record management functionality)

- Nursing Acuity
- Integration with FI/CO
- Integration with MM
- HCM component for dispatch functionality

For the EHHC solution all these components were implemented except for 'Medical record management' and 'Nursing Acuity'.

Figure 2 consist of two areas and they are marked in blue and yellow. The blue area shows the core SAP ERP requirements as well as the Healthcare industry solution components as discussed above. The yellow part in Figure 2 depicts the components comprising the clinical solution.

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Figure 2. SAP Solution Overview

For EHHC the modules used are highlighted:

I.s.h.med Basis; the solution component ensures the use of

- Orders and results
- Completely customized (care) documentation
- Core electronic medical record

I.s.h.med Nursing; adapting the nursing module in a hospital environment requires a very mature environment. All staff should accept and adapt to working with PC's as all care processes will be influenced and enforced by the system. For EHHC the following components of the nursing module were activated:

- Online nursing assessment forms
- Online nursing observation and vital signs registration forms
- Online Norton scale registration
- Online nursing reports
- Online nursing plans plus derived nursing activity work lists

I.s.h.med Radiology; the radiology module provides (combined with i.s.h.med basis functionality) a radiology information system (RIS) and Image connector. The radiology module integrates seamlessly (via HL7 and DICOM) into external RIS/PACS systems. There is some overlap in functionality with regards to the RIS component; scheduling of modalities can either be done in i.s.h.med or in the external RIS. For EHHC i.s.h.med Radiology is used for integration of the external RIS/PACS system and the Cath Lab system; the following components are used:

- Orders are placed in i.s.h.med and are sent to the external RIS/PACS system. The order workflow is part of the electronic medical record and it also allows doctors and nurses to track the status of the order (test ordered, test performed, report released)
- Pre-registration planning (Cath lab only) whereby cath lab is scheduled together with the admission appointment
- Result documents: reports from both Cath Lab and RIS/PACS systems are sent back to i.s.h.med (either as structured reports or PDF's) and are included in the electronic medical record
- Image connector: from the reports, the doctor can access and view the actual image (via DICOM viewer) while reading the report.

I.s.h.med Surgery;

- Online surgery request
- Procedure based resource planning (team and facilities)
- Online surgery documentation
- Online coding

The other modules are currently not used, but are available to support the already existing solution if

needed. The i.s.h.med components are very powerful solution components, since they are designed in very close partnership with the healthcare business representatives.

4. INNOVATIONS

By choosing the fully integrated hospital and clinical solution, EHHC showed that it opted for the solution of the future. EHHC management had always envisaged to be the first digitally integrated hospital with support of all necessary high-tech technology in South Africa. Many of these applications are therefore innovations in the South African health care industry.

4.1 Electronic Case Management

From the first contact at reception onwards the patient is followed by a digital trail instead of a paper trail, thus enabling all necessary hospital staff including nurses and doctors to access all data real-time.

To accomplish this, the T-Systems consultants designed a process whereby all possible patient data is captured real time, with the data entry at the point of action. This results in data entry not only by all administrative staff but by all staff that deals with patients, including the nursing staff, but also including the doctors' consulting rooms. Having these two groups participating was a very important step enforced by the EHHC management. The integration and central view of a patient's data allows all health care practitioners to have a complete view of all the relevant data relating to a patient and thereby empowers them to make more informed and accurate treatment decisions, thereby contributing to superior health care.

4.2 Paper-less Admission

A typical EHHC patient process is initiated during consultation with the doctor where the decision is taken to admit the patient. EHHC's SAP Solution enables the doctor's secretary to process the admission request at this early stage, with or without a related surgery request. The process provides for the doctor's administrative staff to enter all relevant patient data including personal details, the admitting diagnosis and if necessary any risk factors. This informationtechnology enabled process has completely eliminated the need for the usual paper pre-admission process required by the reception staff at a hospital.

When the patient arrives at the reception desk on the day of admission, all information is ready in the system for verification and the patient only needs to sign the consensus forms. As a result, the receptionist needs far less time to complete the admission process, which has resulted in significantly reduced waiting period for patients, thus improving the patient satisfaction tremendously.

4.3 COW's

A study by Motorola indicates that the application of information technology, specifically mobile technology in health care can reduce errors by 31% [6]. At EHHC this has been realized by means of the concept Computer on Wheels (COW).

As soon as the patient has been assigned a bed and is settled in the ward, the nursing staff will process all nursing assessments and observation directly in the system by means of a COW. The design of the COW includes a fully wireless computer plus a tablet PC and a bar code scanner. The nursing staff uses the keyboard for completing the nursing assessment document online. This assessment is now part of the patients EMR and is accessible for all relevant caregivers who are authorized to access this information.

After completing the nursing assessment, the nursing staff can request a nursing plan proposal based on the outcome of the assessment. The nursing plans normally consist of nursing goals and objectives, nursing resources and nursing activities. The list of nursing activities generated by the system forms a nursing work list, which allows the nursing staff to capture the outcome of their activities in both a structured or non-structured way.

With all nursing data (assessment, reports and the vital signs records) available in the system, the nursing hand-over process has become much more efficient. The most important aspect to support this is that all documents plus the related recording methodology have been standardized throughout the hospital. This helps tremendously for staff that is assigned to work at different wards. Besides the obvious improvement in communication between the nursing staff, the communication with the doctors during the rounds is effortless and the data presented on the patient's case is accurate and timeous.

4.4 Integration between hospital units - Online medication ordering

The solution automates the ordering of drugs from the hospital pharmacy by allowing nursing staff and doctors to order drugs on-line. The nursing staff uses the tablet PC to enter the medications prescribed by the accompanying doctor. The nurse can enter the required medication as a prescription using a 'word' template incorporated in SAP IS-H. The doctor physically writes his/her signature on the tablet PC. By saving the prescription, the system stores the document and 'locks' it for security and auditing purposes.

After the document has been locked, it is automatically dispatched to the pharmacy work list. From there the pharmacists can immediately view the items, collect the prescription in the system and process the medication dispensing. During this process the pharmacist has a complete view of the patient's history, diagnosis, risk factors and allergies. If the pharmacists decide not to dispense any of the requested drugs, she/he will add an attachment to the original prescription which will trigger an alarm to show on the patients electronic file in the wards, thus alerting the nursing staff to act and contact the doctor. The entire process is tracked on the patient's EMR.

This pharmacy process and solution has reduced the turn around time for medication to reach the wards from an average of 2 hours to 30-45 minutes.

The method of letting a doctor sign for a prescription on a tablet differs from the standard SAP solution and was developed specifically for EHHC by T-Systems to accommodate for the fact that South African legislation does not yet allow digital signatures for prescriptions.

The automated process for ordering of medication significantly contributes toward eliminating inefficiencies and the related costs of medicine doses not being available, being administered too late or not at all and the time spent by nursing staff tracking down these medications [4].

4.5 Improving Safety by Reducing medication errors

Amongst the foremost safety risks faced by hospitals are errors arising from the administration of medications. The correct dosage and type of medicine is dependent on the patients history to the tolerance of specific medications, his/her weight and age. Many errors arise from information not being fully available to the caregiver [1].

The accuracy and reliability of information technology supported processes for prescription and administration of drugs is well documented. Bates, et al [1] therefore propose that automated of order entry can play a major role in the reduction of errors arising from incorrect transcriptions and illegible hand writing For example, computers are better at adjusting dosages and checking for interactions among patients' medications, tasks at which human prescribers without assistance perform poorly, by comparison. Catching errors, assisting with decisions and providing feedback can significantly reduce the risk of harm from medication errors [1].

At EHCC, these principles were applied by providing the pharmacist with all available information about the patient by means of the EMR as well as catching errors during the administration of drugs to the patient.

As described before the pharmacist will collect the prescriptions from a work list. Dispensing the medication against the patient's case will immediately update the stock levels in the SAP MM component of the solution and will update the patient record both for billing purposes as for building the medication history. As part of the dispensing process the medication labels are printed with all 'normal' data like dosage instructions- with one extra important feature: a barcode to uniquely identify the

patient/case/medication combination. As soon as the nursing staff scans the patient's barcoded wristband and the barcode label on the medication, the system will either accept this combination or will produce an error alerting that this medication was not prescribed and/or dispensed for this patient. This development is a major step forwards in the attempt to reduce patientmedication errors.

The solution developed for EHHC has reduced these risks significantly by allowing the pharmacist to access all relevant data at the time of dispensing and by actively alerting if there are known risks for this patient at medicine dispatch. The system further increases safety to the patient by the additional check and alert at the time of the medication being administered.

4.6 Barcoding

In order to streamline the processes even more, it was decided to decentralize the data capturing process regarding billable items and to enhance it by using bar code scanning. All stock items kept in a ward are therefore labeled with barcode stickers for this purpose. When dispatching a stock item, for a patient, the nursing staff member peels of the sticker/label for the relevant ward stock item and sticks this onto the charge sheet. As a result, the nursing staff no longer has to write and/or describe the consumables used on each patient. This has vastly improved the accuracy in billing the account. For example, instead of writing down 'syringe' on the charge sheet, the barcode label will identify the exact syringe stock item that was actually used.

As soon as the data capturer scans the barcode labels on the charge sheet, two things happen:

- 1. The patient's service overview and invoice is immediately updated with the correct material; and
- 2. The material is immediately depleted from the stock for that specific ward location

This process has enhanced both the billing process and the stock movement accuracy. The process also makes the replenishment of stock more efficient and accurate. To support this process, all ward reception desks throughout EHHC were equipped with a dedicated PC and a barcode scanner.

Barcoding makes data entry easier and less error-prone. In the South African context, where there is relatively low computer literacy among staff as reported in the Health Information Audit Report, this could be an important factor in contributing to accuracy in data capture [11].

4.7 Electronic medical record

Modern connected health care systems can ensure tracking a patient's case by means of electronic medical records [8]. The EHHC project has been able to build a fully comprehensive electronic medical record for each patient's case for all relevant care givers to access. The integrated EMR contains the full patient history. It is possible to view per admission/ episode of care the following items:

- All patient's movements with related characteristics;
- Diagnosis (categorized; admission, surgery, nursing/working, discharge, hospital main);
- Risk factors/allergies;
- Documents; pre-admission assessment, patient notes ;
- Lab orders & results;
- Radiology orders & results; the actual image and the findings report;
- Surgery documents;
- Nursing documentation: observation, assessment, nursing report, Norton scale and vital signs graphs;
- Prescriptions; and
- Summaries form 3rd party monitoring devices in PDF format; e.g. Centricity Critical Care discharge summary

Not only does this fully integrated and easy accessible view help all care givers to communicate about a patient's case, it also supports the billing auditors and case managers tremendously.

All communication about a patient's case, whether it is with the medical aids or whether it is to support internal auditing processes, will retrieve the information from the same central integrated EMR in the system. This speeds up the billing auditing as well as the case managers' processes tremendously during the patient stay and while finalizing the patient's account. But even after the fact when the credit controllers take over the care of the case from a financial perspective, they can now have online access to all the information needed. No more searching for paper files in the archive rooms, no longer deciphering eligible handwriting etc, it is because of enhancements like those that time spent per case has been reduced and quality has increased throughout the whole hospital.

Furthermore, the central EMR has reduced the amount of (redundant) test tremendously. Since all results are clearly and easily accessible for all care givers, it is no longer necessary to perform the same tests twice or more. This is very beneficial from a care quality and from a cost reduction point of view.

5. CONCLUSIONS

The SAP IS-H and i.s.h.med solution for EHHC is a first for South Africa in the adoption of information technology to address some of the recommendations made by international researchers. In particular, the solution has demonstrated that seamless integration of back-office and clinical systems can speed up

processes, reduce paper work and the rate of errors, thereby delivering value to the patient as well as the care giving staff. The SAP IS-H and i.s.h.med system developed by T-Systems and deployed at EHHC, is a major contributor to making EHHC a world class health care provider and the first South African digitally integrated hospital with support of all necessary high technology. The successful implementation of SAP IS-H and i.s.h.med could be used as a template for other South African hospitals.

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