Towards Paperless Hospitals: Lessons Learned From 15 Health Facilities in Uganda

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***Abstract*—In this paper we share and explore the key features we have found to be critical for different health facilities with regard to automation of hospital processes and Electronic Patient Records (EPR). We have deployed an Electronic Patient Record Management System (EPRMS) in a total of 15 hospital facilities in Uganda albeit with varying levels of success. The goal was to create a paperless environment for a group of health facilities and provide centralised support and training. We discuss automation approaches in these facilities and highlight the current experiences. The EPRMS is based on a heavily customized version of care2x called Helcare to support the unique challenges of hospitals in Uganda. The current deployments are limited to Outpatient Departments (OPD) with future plans to extend to Inpatients, Maternal and Child Health units and HIV/AIDS care centres among others.**[1]

I. Introduction

Manual hospital services are time consuming especially during collating and coding of data for local government and national reporting requirements. Automation of hospital processes has seen increased attempts in the recent years[14], [5] but most have been limited to billing and post-dated entry of aggregated data to support decision making with in the Hospitals. We have noticed that the use of EPR saves lots of effort for different facilities allowing them concentrate on the core activities of health service provision. Despite evidence that EPR is crucial in provision of quality medical services[9], most hospitals in Uganda are still manual. EPR and automation of hospital processes relate to the management of hospital transactions including patients through capture and use of electronic data as the patient consumes services. Our approach was to capture all patient and moved to different service points.

There is consensus that automation of hospital facilities can breed efficiency and improve patient satisfaction[3]. Indeed Governments and Non-government Organisations are willing to invest in ICT-enabled Health care [10]. Several barriers that hinder implementation are highlighted by [10] and include the time involved for a practice to convert to EPRs from paper records, the training of health care professionals on the new systems, and computer literacy. Other challenges also include the

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financial cost associated with purchasing the new EPR system and availability of technical support.

Despite the challenges, the Uganda Catholic Medical Bureau (UCMB)[18] envisages that the benefits of automation are much more that the cost and effort needed to address the challenges. UCMB coordinates Catholic health units in Uganda, assists in personnel training and the evaluation of facilities, and represents and advocates for Roman Catholic health care services nationally and internationally. At the moment UCMB counts 32 hospitals (2 of them are specialised service providers) with 12 training schools, 2 laboratory training school and 252 Lower Lever Units (LLU), with over 8,225 health workers. The UCMB health service infrastructure constitutes a sizeable component (about 40%) of the public health system in Uganda. To facilitate the operation of these heath centres UCMB considered a robust management information system that can operate under the varying environments across different parts of the country.

With automation, UCMB hospitals are expected to benefit from effective delivery of health services through fast access to information that supports planning, monitoring, and evaluation of healthcare programmes [17]. The information includes patient bio-data, insurance records, as well as critical medical information [16]. Initial results on benefits of EPR indicate that in some of the facilities,management has been able to cut costs and increase revenue collection. Some facilities such as Pope John Paul Aber and St Joseph's Kitgum hospitals have reported at least 3% increment in user fees.

The Hospital Information System that was deployed in a modular approach for the UCMB network is a heavily customised version of Care2X renamed HeleCare[4]. Care2x [2] is a Integrated Hospital Information System including Surgery, Nursing, Outpatient, Wards, Labs, Pharmacy, Security, Admission, Schedulers, Repair, Communication & more. It is Multilanguage, with WYSIWYG forms, Modular & scalable among others. Care2x is a mature product and has been implemented in other countries including Kenya[6]. The customisation followed a detailed requirements gathering process from a representative set of hospitals. The hospitals were selected based on the location, nature of services provided and type of patients catchment. The catchment targeted is a combination of rural, peri-urban and urban health facilities. A comprehensive requirement analysis was undertaken to understand the current practices within the hospital facilities.

The automation initially targeted five facilities for piloting and a phased roll-out to another 15 facilities before a full-scale deployment to over 200 facilities under the UCM network. However, our efforts at 2 of the pilot facilities and 3 of the 15 roll-out facilities were met with administrative and skill-gap challenges. At some facilities the systems administrators frustrated our efforts while there was no management support by hospital authorities other facilities. To promote continuous usage by physicians, the UCMB network currently uses service level agreements between UCMB and hospital facilities. As part of the service level agreement, UCMB provides funding and technical support to facilitate transition from paper-based records to EPR.

The rest of the paper is organised as follows: In section II, we review related work, in Section III, we describe the key features prioritised by health facilities and we conclude in Section IV.

II. Related Work

In Uganda, many systems have been proposed by the Ministry of Health. Currently the ministry health operates a comprehensive manual Health Medical Information System (HMIS)[12], [7]. Each hospital facility is required to fill a given set of reports on a daily basis, monthly, quarterly or annual. Some of the information is sent to the local government authorities while the other is sent to the Ministry of Health Headquarters. Some of the nation wide automated systems focusing of specific aspects include DHIS2[1], IQCare[8].

DHIS2 was adopted at the Uganda National national level in January 2011. The system was initially piloted in 4 districts, before it was rolled out to all the 112 districts by July 2012. As part of the roll-out

process, 35 training workshops targeting 972 users were conducted throughout the country[11]

IQCare is a robust electronic medical records (EMR) package designed by the Futures Group International[2] specifically for HIV/AIDS care facilities. IQCare was adopted by PEPFAR funded project under the AIDS relief. It has been deployed in over 100 locations in Kenya, Uganda, Nigeria and Zimbabwe. IQCare is flexible and scalable with features to create multiple departments and forms; set up facility and patient home page reports and queries.

Through the Uganda National eHealth Technology framework[13] over 50 e-health related initiatives were reported by the Ugandan Ministry of Health. The initiatives include mobile enabled tools such as mtMtrack[15], web-based, decision support systems and surveillance tools. However, most initiatives especially those related to EPR have not seen wide-adoptability or sustained usage for by health facilities.

III. Core features and services

A hospital has several operations that need to be automated. Each operation involves a set of processes. Therefore a hospital system is a set of inter-related processes. Due to training challenges, lack of resources such as computers, unstable local area network, frequent power outages, current deployments are limited to the Outpatient Department (OPD) and related services such as laboratories, billing, pharmacy and reception/triage. Below we discuss some of the top requirements for hospitals and our approach to satisfying these requirements.

A. Existing process and patient flow

Figure III.1 is a high level view of the common flow of patients as they move from one service point to another. It is expected that all patients flow from the registration desk to cashiers, clinicians and so on. In the majority of the OPD cases the flow will include: Entry $A \rightarrow$ Registration, $B \rightarrow$ pay consultation, $C \rightarrow$ go for examination by Clinicians/Doctors, $D \rightarrow$ Pay for Investigation, $E \rightarrow$ go for investigation, $F \rightarrow$ interpretation of results, Diagnosis, prescription by Clinicians/Doctors $D \rightarrow$ pay for Medicine, $G \rightarrow$ Receive Drugs from Pharmacy, $H \rightarrow$. However in a number of cases, a patient may skip the registration desk and proceed to the doctors. This is common for emergence cases where no time must be wasted at the registration. In other scenarios, patients may just walk in for lab tests recommended by clinicians from other facilities. In all these scenarios, the system must be able to take critical data at the first point where it interfaces with the patient.

Other categories of patients such as Pregnant Mothers, HIV patients and Maternity cases are usually managed separately from the rest of patients and there data needs to be captured at the first point of contact with the hospital staff for subsequent use in the rest of the patients visit.

To enforce data capture, no billing is possible unless a patient has a minimal set of data records. In normal usage, the bill is generated as the patient moves from service points such as lab tests, consultations at physicians desk, prescriptions and so on. We have discovered that staff manning some of the service points may not enter the data immediately either due to electricity/power challenges or inefficiency by the staff thereby making it hard for other tasks to proceed. The billing points and server and well facilitated with power backups even in scenarios where backups may not be available for all service points. Because of this challenge, we enable to system capture varying levels of data at each of the possible service points including the billing point where basic information such as bio-data and service consumed may be captured if not already in the system.

B. Drug distribution framework

Drugs and other consumables are a critical resource in hospitals. Their acquisition, management, and

[2]www.futuresgroup.com

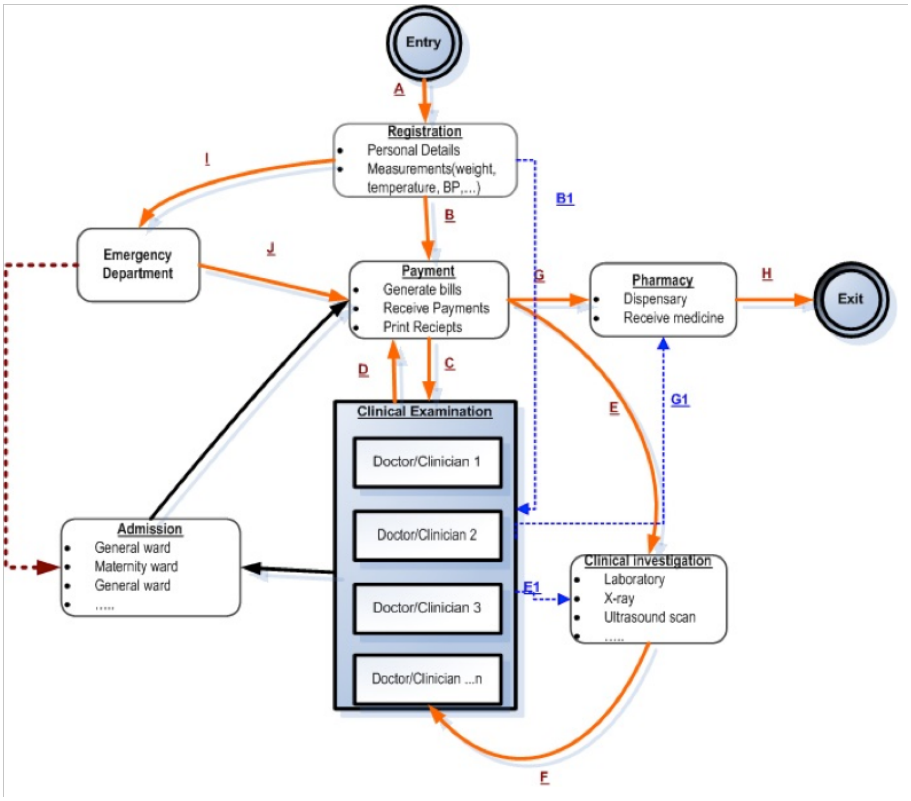

Fig. III.1: Standard Flow of patients in health facility. .

tracking must be monitored and audited for hospital managers to realize the benefits of automated hospital management information.

In most hospitals, when drugs are purchased, they are first stored and recorded in the main pharmacy or medical deport. From the main pharmacy, drugs are then distributed to the dispensing departments. A dispensing department may serve or more medical units. However, some dispensing units can also provide drugs to other dispensing units. At the same time, drugs can be lost through damages and as such there is a need for a reconciliation between stocks in the dispensaries and those in the main pharmacy.

Tracking of batches is one important aspect. It would be nice to have code readers at the dispensing units to track batches up-to the patient. However due to cost implications, a provision for manual capture of such information is provided. A key design decisions was taken to enable or disable strong coupling between pharmacy inventory, ability to prescribe or dispense drugs on the system in case of low inventory levels in pharmacy/dispensaries. This design decision was based on need to capture medical data without strong emphasis on drug auditing logs.

C. Knowledge Management

During pilot deployments use keyboard as the main data capture device proved to be time consuming for physicians and draw attention away from the patients during consultations. Also the typing speed of most users was still low. A design decision was taken to minimise typing by users. Information such

as drugs and their dosages, symptoms, diagnosis, lab tests and interpretation of findings, test result ranges among others are part of the system initialisation with provision for the systems administrator to add, remove and edit the details. Whereas there was a temptation to allow clinicians or doctors to edit these lists, a decision to allow centralized control of the list through the systems admin was considered. The advantages allows consistence in data analysis for symptoms, diagnosis, allergies and other medical information. Also a centralized list improves the speed of data capture since users just pick without typing as indicated in III.2 that shows part of the interface for prescription of drugs. The knowledge on drugs is already captured and managed within the system. To speed up data entry, a browser based search was implemented.

D. Familiar and fast interfaces

Through practice, medical personnel are accustomed to specific documents such as Form 5 to capture treatment details for a given patients' visit. Data capture cards for outpatients, inpatients, antenatal and many other documents are well understood by most medical personnel. Paper-like interfaces such as in Figure III.3 were developed to ensure smoother transition from paper to electronic. Despite similarity between paper-based forms and the electronic versions, users mainly from rural facilities still required more time and patience to train them to use computer and appreciate the interfaces. The Ugandan Ministry of Health in its HMIS manual [12], [7] specifies over 200 paper-based templates for data capture and reporting. Our automation efforts started with the Out Patient Department (OPD) and all forms related to OPD have been automated.

E. Billing and Payments Automation

Most hospitals provide all or some services at a fee. The modes of billing vary from facility to facility. General billing systems charge according to what has been consumed. However, some hospital facilities provide for flat rate services. A flat rate is where a set of drugs and services require a single fixed fee regardless of the actual overall cost of the items consumed. 3 of the 15 facilities apply flat rate services.

Management of insurance schemes together with flat rate schemes poses another automation challenge. An account for each insurance scheme must be kept and patients must be properly identified to belong to the right insurance scheme. Some insurance schemes also cover dependants who must be identified and billed accordingly. Similar to flat rate schemes some insurance schemes have a limit on the amount to be consumed within a given period. The time periods for the ceiling range from a single visit, to daily, monthly or annual. The limit may be applied on specific services such dental or plastic surgery. This makes it important for the system to establish which medicines or services have to be paid for by the patient.

IV. Conclusion and Future Work

We have been able to deploy and monitor the EPR system for at least 15 facilities. Initial benefits include increased revenue, minimal stationary usage, improved decision making at the hospital level, and more trust by patients due to detailed information provided to them on the receipts. Our unique setup required a system with multiple configuration to allow flexibility especially during billing. As more options were provided to accommodate the variations, the system inevitably grew bigger and more complex requiring more training on the side of system administrators. We hope to extend the deployments to other facilities as well as include all other departments including Inpatients, Maternal and Child health units, HIV/AIDS care centres among others. The corresponding modules are already developed and being piloted at some facilities.

References

[1] Braa, J., and Humberto, M. Building collaborative networks in africa on health information systems and open source software development–experiences from the hisp/beanish network. *IST Africa 3* (2007).

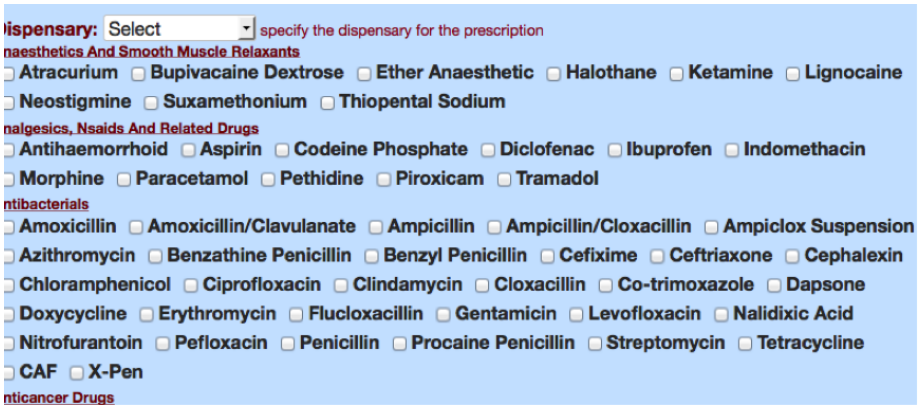

Fig. III.2: Screen short of the drug prescription interface. The interface allows medical offers to select one or more drugs and proceed to provide additional prescription details. Typing of drugs by medical officers is eliminated to avoid mistakes and allow more precise analysis and reporting. Drugs missing on the list can be added by through a back end interface

[2] CARE2X.ORG. The open source hospital information system, August 20015. http://care2x.org.

[3] CHETLEY, A., DAVIES, J., TRUDE, B., MCCONNELL, H., AND RAMIREZ, R. Improving health connecting people: the role of icts in the health sector of developing countries.

[4] DECIMALWORKS.COM. Helecare - hospital information system, August 20015. http://www.ucmb.co.ug/.

[5] DESROCHES, C. M., CHARLES, D., FURUKAWA, M. F., JOSHI, M. S., KRALOVEC, P., MOSTASHARI, F., WORZALA, C., AND JHA, A. K. Adoption of electronic health records grows rapidly, but fewer than half of us hospitals had at least a basic system in 2012. *Health Affairs* (2013), 10–1377.

[6] DRURY, P., AND DAHLMAN, B. Open source approaches to health information systems in kenya. *World Hospitals and Health Services 41*, 3 (2005), 36.

[7] GLADWIN, J., DIXON, R., AND WILSON, T. Implementing a new health management information system in uganda. *Health Policy and Planning 18*, 2 (2003), 214–224.

[8] INTERNATIONAL, F. G. Iqcare, 2015. Website. https://fgiqcare.codeplex.com/.

[9] JENSEN, P. B., JENSEN, L. J., AND BRUNAK, S. Mining electronic health records: towards better research applications and clinical care. *Nature Reviews Genetics 13*, 6 (2012), 395–405.

[10] KHAN, S. Z., SHAHID, Z., HEDSTROM, K., AND ANDERSSON, A. Hopes and fears in implementation of electronic health records in bangladesh. *The Electronic Journal of Information Systems in Developing Countries 54* (2012).

[11] KIBERU, V. M., MATOVU, J. K., MAKUMBI, F., KYOZIRA, C., MUKOOYO, E., AND WANYENZE, R. K. Strengthening district-based health reporting through the district health management information software system: the ugandan experience. *BMC medical informatics and decision making 14*, 1 (2014), 40.

[12] KINTU, P., NANYUNJA, M., NZABANITA, A., AND MAGOOLA, R. Development of hmis in poor countries: Uganda as a case study.

[13] LUTWAMA, A. K. Uganda national e-health technology framework, 2012. Website. http://library.health.go.ug.

[14] MCINNES, D. K., SALTMAN, D. C., AND KIDD, M. R. General practitioners' use of computers for prescribing and electronic health records: results from a national survey. *Medical Journal of Australia 185*, 2 (2006), 88.

[15] ORGANIZATION, W. H., ET AL. Strengthening accountability chains for maternal, newborn and child health in uganda–mtrac.

[16] RAGHUPATHI, W., AND TAN, J. Strategic it applications in health care. *Communications of the ACM 45*, 12 (2002), 56–61.

[17] RIBIÈRE, V., LASALLE, A. J., KHORRAMSHAHGOL, R., AND GOUSTY, Y. Hospital information systems quality: a customer satisfaction assessment tool. In *Systems Sciences, 1999. HICSS-32. Proceedings of the 32nd Annual Hawaii International Conference on* (1999), IEEE, pp. 7–pp.

[18] UCMB.CO.UG. History of uganda catholic medical bureau, May 2015. http://www.ucmb.co.ug/.

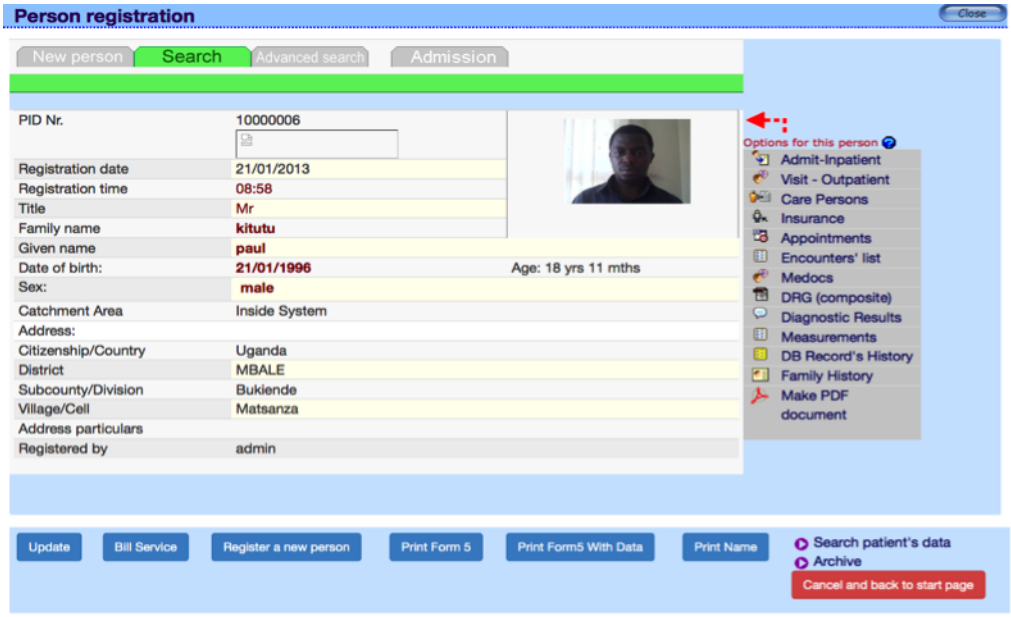

Fig. III.3: Paper like look and feel for patient registration with links to standard forms such as Form 5