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

Benjamin Kanagwa[1], Jenard Ntacyo[2], and Sam Orach[2]

[1] School of Computing and Informatics Technology
Makerere University, P.O.BOX 7062, Kampala, Uganda
bkanagwa@cis.mak.ac.ug
[2] Uganda Catholic Medical Bureau*
P.O.BOX 2886, Kampala, Uganda
jntacyo@ucmb.co.ug, sorach@ucmb.co.ug

Abstract. This paper presents action research results on critical features that impact the implementation and acceptance of Electronic Patient Records Management Systems (EPRMS) by health facilities. The paper also discusses automation approaches as well as initial benefits reported by health facilities. The EPRMS is in use by over 15 health facilities in Uganda. The goal is to create a paperless environment for a group of health facilities in a resource constrained environment. The EPRMS incorporates features for Electronic Patient Records (EPR), Electronic Medical Records (EMR) and Hospital Management. A phased-roll out approach was used as a way to ease challenges of insufficient resources such as computers, unstable local area network, frequent power outages and skills-gap among others. The first phase covered Outpatient Departments (OPD) for production deployment while Inpatients, Maternal and Child Health(MCH), HIV/AIDS care centres are setup in training mode awaiting the next phase of roll out. After a year of use, we administered a questionnaire to understand the impact and challenges of EPRMS. The respondents were hospital administrators and managers. In addition to the questionnaire, the Uganda Catholic Medical Bureau (UCMB) has its internal annual reporting process. The results reported are from the questionnaire, UCMB internal reporting, our observations and interactions with key stakeholders during implementation. Our finding indicate EMR and EPR functionality are not highly rated by hospital managers while Hospital Management features are considered important.

1 Introduction

Manual hospital management, manual patient and electronic records 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, 18, 16]. 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. 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]. Despite evidence that EPR is crucial in provision of quality medical services [9], most hospitals in Uganda are still manual. Barriers that hinder implementation of EPRMS include the

* This work was funded by CORDAID http://cordaid.org as part of funding to UCMB under the Connect for Change Consortium (C4C).

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 [10]. Other challenges also include the financial cost associated with purchasing the new EPR system and availability of technical support.

The Uganda Catholic Medical Bureau (UCMB) [19] is one of the key players in the Ugandan heath sector. 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.

UCMB envisages that the benefits of automation are much more than the cost and effort needed to address the challenges. With automation, UCMB aimed to help facilities to benefit from effective delivery of health services through fast access to information that supports planning, monitoring, and evaluation of healthcare programmes. The information includes patient bio-data, insurance records, as well as critical medical information. 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. The Hospital Information System that was deployed is a heavily customised version of Care2X [2] renamed HeleCare2x [4].

The health facilities under the UCMB network differ in size, capabilities, resources, location and are autonomous. Each facility is managed independently to best suit local needs and foster innovation by facility managers. For instance rural based facilities use different billing structures and offer community based medical services. Consequently, the facilities share common core EPRMS features but need a number of unique features and customisation. The rollout process also needed to appreciate local technical and human resources to operate and manage the EPRMS.

The rest of the paper is organised as follows: In section 2, we review related work, Section 3 describes the methodology used and Section 4 describe the key features prioritised by health facilities. Section **??** describes the challenges and initial benefits and a conclusion is given in Section 6.

2 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]. At the moment, there is no official EMR or EPR system recommended for use at the facility level.

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[3] specifically for HIV/AIDS care facilities. IQCare was adopted by PEPFAR funded

[3] www.futuresgroup.com

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 Mtrack[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.

3 Methodology

Our approach is based on action research process [17] in which we are monitoring and spearheading the implementation, deployment and use of EPRMS at 15 health facilities in Uganda. The implementation started in January 2013 and initially targeted five facilities for piloting and a phased roll-out to another 10 facilities before a future full-scale deployment to over 200 facilities under the UCMB 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. New facilities within the UCMB network were selected.

The implementation started with an open source EPRMS that was customised and extended to fit the needs of health facilities in Uganda. To speed up implementation, requirement elicitation and initial training were combined. The training started with the open source EPRMS as the first version. Care2x was chosen as the starting platform because is a Integrated Hospital Information System including Surgery, Nursing, Outpatient, Wards, Labs, Pharmacy, Security, Admission, Schedulers, Repair and Communication among others. 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]. In addition there is a large number of programmers in Uganda familiar with key technologies such as Php and MySQL used in the development of care2x.

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 training and requirements elicitation were group based and in some cases one-on-one. The training was in two parts: - one on the use of EPRMS and the other for systems administrators. The systems administrators were considered as key stakeholders and their training including Linux systems administration. The first round of training lasted between 3 to 4 days per facility. The initial training allowed intimate interaction with key stakeholders such as nurses, clinicians, doctors, pharmacists, managers and systems administrators in oder to understand their needs. Before launch another round of 1 week training was conducted at UCMB headquarters for systems administrators. After the initial training, two setups we made, one for production and another for training.

A phased-roll out approach was used both on the number of the health facilities to be automated and the number of departments to automated at each facility. The pilot started with five facilities, and later scaled to10 health facilities. Within each facility, the EPRMS was first installed at the OPD which accounts for a larger percentage of the patients. The OPD deployment covers EPR, EMR, and related services such as laboratories, billing, pharmacy and reception/triage.

After a year of use, we administered a questionnaire to understand the impact and challenges of EPRMS. The respondents were hospital administrators and managers. In addition to the questionnaire, UCMB has its internal annual reporting process. The results reported are from the questionnaire, UCMB internal reporting, our observations and interactions with key stakeholders during implementation.

4 Core Features and Services

Health facility administrators are among the key stakeholders required for successful implementation and sustainability of EPRMS. In all facilities, hospital managers ranked patient and resource management features above EPR and EMR features. Key issues of concern included minimising revenue loses and increasing patient satisfaction through faster service delivery.

4.1 Existing Process and Patient Flow

Figure 4.1 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 the 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 room are installed with power backups and this ensures billing functionality to continue even when other points have no power. Because of this challenge, the system is designed to capture varying levels of data at each of the possible service points. For instance, the billing point allows capture basic information such as bio-data and service consumed in case they are not already in the system. Hospital managers required that the system supported all existing patient flows. However some facilities have been able to find optimal path that speed up service delivery.

4.2 Drug Distribution Framework

Drugs and other consumables are a critical resource in hospitals. Their acquisition, management, and tracking must be monitored and audited for hospital managers to realize the benefits of automated hospital management information.

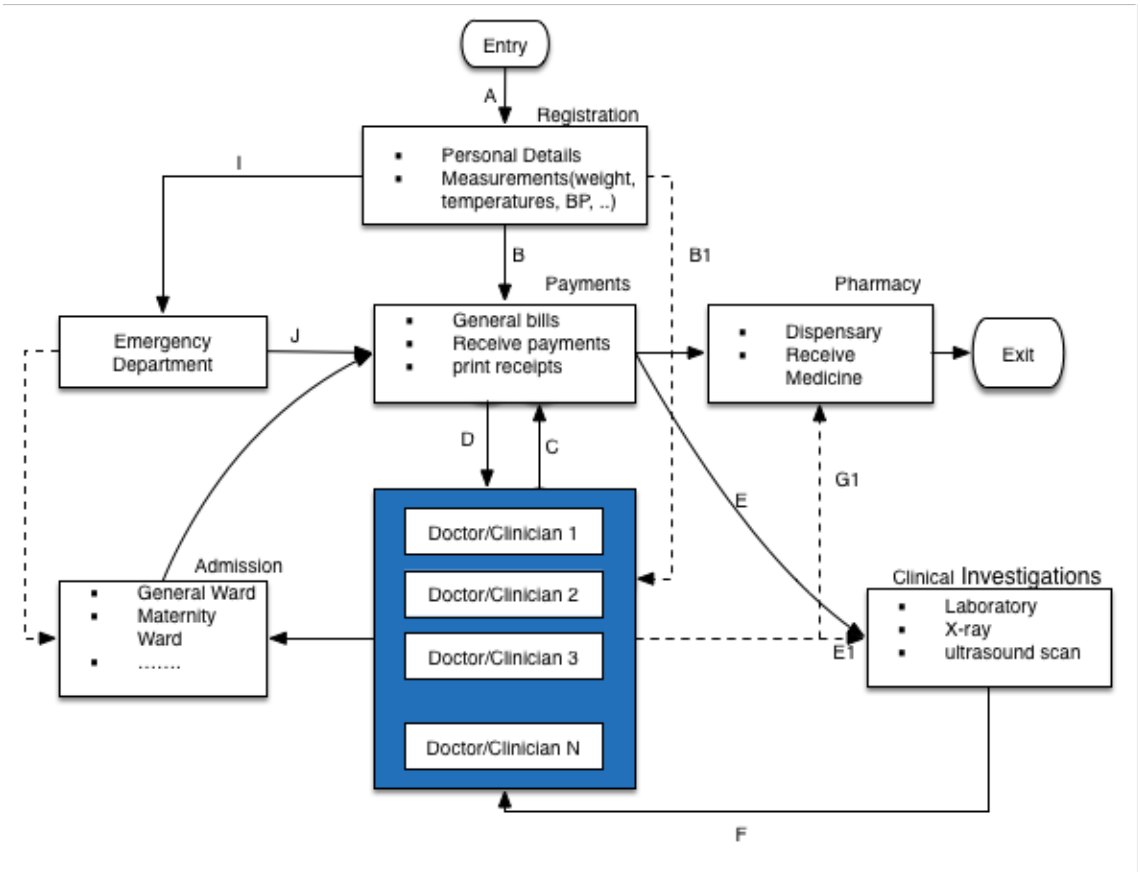

Fig. 4.1: Standard Flow of patients in health facility. .

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 one or more medical units. However, some dispensing units can also distribute 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. Drug management was needed as key feature to allow sustainable of the system by hospital administrators and managers.

4.3 Knowledge Management

During pilot deployments, the 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 improved the speed of data capture since users just pick without typing as indicated in Figure 4.2 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.

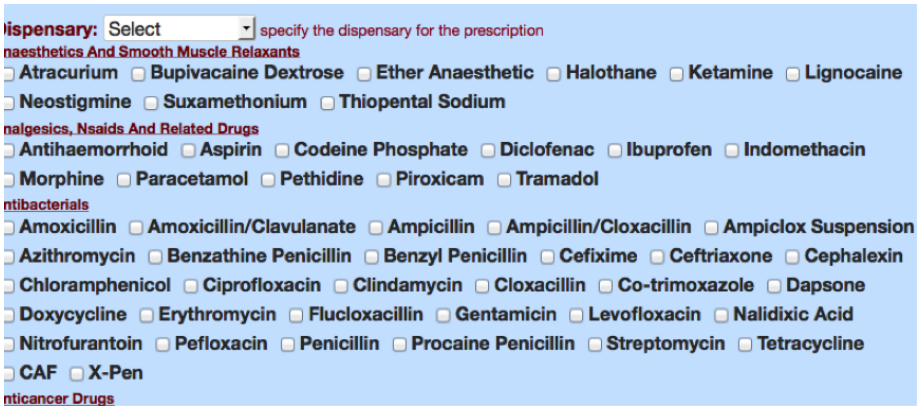

Fig. 4.2: Screen short of the drug prescription interface. The interface allows medical offers to select one or more drugs and proceed to provide additional prescription details. Typing of drugs by medical officers is eliminated to avoid mistakes and allow more precise analysis and reporting. Drugs missing on the list can be added by through a back end interface

One of the key concerns by clinicians was was that excessive typing districted them from attending to patients. Therefore any reduction on the time spent on the computer by adding features such as searching, drop-down options, and so grately increase acceptance.

4.4 Familiar and Faster 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 4.3 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.

Fig. 4.3: Paper like look and feel for patient registration with links to standard forms such as Form 5

Routine inspection by Ministry of Health Officials still require specific layouts of certain reports and registers. So for acceptance, all efforts were made to make electronic versions of reports and forms similar to paper versions

4.5 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.

5 Benefits and Challenges

This section contains preliminary findings on the benefits and challenges of using EPRMS.

5.1 Challenges Encountered

The main challenges encountered are lack of resources such as computers, unstable Local Area Network (LAN), and frequent power outages. All facilities are connected to national power grid, however the power grid is on and off. Alternative power sources such as generators or solar power are not yet affordable by most facilities.

The EPRMS runs on Local Area Network (LAN) and the perceived speed and availability of the EPRMS is much dependent on the quality of the LAN. One challenge that was noticed is that most LAN setups at the healthy facilities were very unstable mainly due to poor networking and low technical skills by IT staff. Some facilities try to cut cost and use indoor Cat 6 cables as outdoor cables to connect distant departments and wards.

Another challenge is that technical skills in computer use and maintenance, internet use are low in the health facilities. Despite the training it was noticed that it takes time for the training to translate into good level of skills. Related to computer skills, the new Windows 8 and office 2010 user interface was confusing for users trained using older versions. Fear of technology by some health workers also affected utilisation and adoption for routine activities.

Introduction of new costs to the facilities implementing EPRMS such as timely replacement of spoilt parts of equipment was another challenge. For instance, lightening affected/destroyed equipment in five of the fifteen facilities. Lightening arresters were installed at all facilities to avoid reoccurrence.

Last but not least, implementation of EPRMS was also face with a challenge of poor internet connectivity in many rural areas where the majority of the facilities are located. This affected the ability to download new updates, provision of online technical support and need to download virus definitions.

5.2 Initial Benefits Reported

During the June 2014 UCMB reporting, of the 14 hospitals that were asked to provide information on changes brought about by EPRMS, 60% noted that Patients receiving services from these facilities trust receipts produced by the system more and complained when issued with summary receipts from receipt books whenever there was an interruption to the system. Such interruptions are common due to power load shedding. Printed receipts have information for the patient to verify and this contributes to patients satisfaction because of the detailed breakdown of the charges such as consultation charges, lab tests requested, drugs prescribed. This improves patient to hospital relationship and eventually increases service utilization because of recommendations by satisfied patients to friends and relatives.

There is a reported increase in revenue collection by some facilities. St Johns Paul Aber and St Josephs Kitgum hospitals have reported at least 3% increase in user fees. The increment is attributed to the ability to capture and bill all patients that visit the facilities.

A reduction and reuse of stationary has been observed at some facilities. Receipts and other outputs such as treatment forms for patients are printed using ordinary ink and in some cases at the back of already used paper with minor prints.

6 Conclusion and Future Work

We have been able to deploy and monitor the EPRMS 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 usage of EPRMS other 200 health facilities in the country under the UCMB network. In addition, we plan to active EPRMS usage beyond the OPD to cover Inpatient department, Maternal and Child Health Units and HIV/AIDS care centres among others.

Observations and interactions at facilities indicated that preparation of reports for local authorities and national reporting is time consuming. Therefore integration of helecare2x with existing national reporting systems such as Dhis2 [1] is one of the future tasks to be carried out. More studies and support for decision making at hospital level will be carried out in order to increase the benefits of EPRMS for hospital managers who are the key drivers for sustainability of EPRMS.

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).
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. Reason, P., and Bradbury, H. *Handbook of action research: Participative inquiry and practice*. Sage, 2001.
18. 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.
19. ucmb.co.ug. History of uganda catholic medical bureau, May 2015. http://www.ucmb.co.ug/.