

E-Health at Outpatient Clinics in Uganda

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E-Health at Outpatient Clinics in Uganda

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Royal Institute of Technology
School of Computer Science and Communication

KTH CSC
SE-100 44 Stockholm, Sweden

URL: www.kth.se/csc

Abstract

Health Care in developing countries faces many issues, ranging from overburden to lack of funding and poor infrastructure. The use of information and communications technology (ICT) in health care, eHealth, has been seen by many as the remedy to the ills befalling health care in developing countries. Uganda has been the host of a large number of eHealth projects the last couple of years. However, few seem to have taken the infrastructural issues plaguing Ugandan health care into consideration. This report presents the result of an ethnographically inspired field study and considers how the lack of infrastructure and computer training of the local medical staff impact the use of eHealth applications at three different clinics, two public and one private. The lack of Internet, secure storage locations and electricity severely impacts the sustainability of eHealth at the public institution, as does medical personnel's lack of computer proficiency. However, these problems can be overcome with training and the right equipment. Due to the multitude of non-compatible eHealth projects in Uganda, the report calls for a consolidation of efforts and sharing of information amongst the eHealth application developers of Uganda. Also, it might be time to reconsider if the public sector is the best partner for eHealth application developers, maybe the private sector could have more use of and help develop more usable eHealth applications.

Sammanfattning

E-HÄLSA PÅ VÅRDCENTRALER I UGANDA

Sjukvård i u-länder står inför många utmaningar, allt från brist på resurser och dålig infrastruktur till överanvändning. Användningen av ICT inom sjukvården, eHealth, har setts av många som en lösning på de utmaningar som sjukvården i utvecklingsländerna står inför. Uganda har varit värd för ett stort antal av eHealth-projekt de senaste åren. Tyvärr verkar få ha tagit de infrastrukturproblem som präglar den Ugandiska sjukvården i beaktning. Denna rapport handlar om hur bristen på infrastruktur och datautbildning av den lokala sjukvårdspersonalen påverkar användningen av eHealth vid två offentliga vårdcentraler och en privat. Bristen på Internet, säkra lagringsutrymmen samt el påverkar allvarligt hållbarheten av eHealth vid offentliga institutioner, detsamma gäller den medicinska personalens bristande datorvana. Emellertid kan dessa problem lösas med utbildning och rätt utrustning. På grund av de många icke-kompatibla eHealth-projekt som genomförs i Uganda efterlyser rapporten en konsolidering av insatser och informationsspridning bland de hälsorelaterade applikationsutvecklarna i Uganda. Dessutom kan det vara dags att ompröva om den offentliga sektorn är den bästa partnern för eHealth-applikationsutvecklare, kanske den privata sektorn skulle ha mer användning av samt bidra mer till utveckling av mer användbara eHealth-applikationer.

Keywords

eHealth, ICT, Health Care, Uganda, Usability, EMR, Outpatient Clinics

Wordlist

ICT – Information and Communication Technology

GoU – Government of Uganda

HC – Health Centre

HSK – Health Centre IV in Kasangati

HSM – Health Centre IV in Mukono

MoH – Ministry of Health

MFS – Minor Field Study

OPD – Outpatient clinic

EHR – Electronic Health Records

EMR – Electronic Medical Records

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1. Introduction

In sub-Saharan Africa, there is a persistent lack of access to primary health care. Estimates state that four in ten people have no access to medical facilities or personnel. The problems are evident. The average life expectancy is 51 years of age, one in six children die before the age of five and mothers are a 100 times larger risk of maternal mortality than women in the developed world. There is a lack of traditional clinics in Africa, a vast continent with a large rural population (Knapp, Richardson, & Viranna, 2010). However, supplying rural Africans with access to medical care does not necessarily need to involve the construction of new clinics in rural areas, which is an expensive process. In a country like Uganda, the government already has severe difficulty funding upkeep on the clinics it controls (Knapp, Richardson, & Viranna, 2010, Government of Uganda, 2010).

Technology, specifically information and communication technology (ICT), enables a new approach to supplying rural areas in Africa with access to medical services. The combination of village health workers, telemedicine through mobile phones and mobile rather than stationary health clinics enables a new way to deliver health care services to rural populations in sub-Saharan countries (Knapp, Richardson, & Viranna, 2010). ICT technology is the enabler that makes such strategies viable and is spreading quickly through sub-Saharan Africa, mobile phone coverage and mobile broadband especially (Colao & Coyle, 2011).

With a public health budget under heavy strain, where large portions of the budget come from donors and foreign aid, the private health sector is taking a significant and growing role, and not only for the wealthy. A growing demand for health care, the result of improving macroeconomic conditions, will increase the strain on the public sector and open up for more investment in private health care to lessen the burden (Ghatak, Hazlewood, & Lee, 2008). The combined growth of ICT technology and private health service suppliers enables a new market for innovative companies supplying health care to the African people. But in the public health care, what limitations does the infrastructure level in a country like Uganda place on utilizing ICT in health care? In the midst of this technological revolution, how is the work situation for the end users, the medical personnel, affected? How should ICT projects be implemented without ending up in the graveyard of small-scale ICT projects and without putting an extra strain on the already overburdened public health sector? These are questions I tried to find answers to during the writing of this report, and hopefully in some way touch upon here.

1.1 Project Background

This report is part of a project called Shifoclub. Shifoclub was developed as a conceptual idea to distribute health care applications to developing countries through a multi-sided distribution platform where health care personnel can browse and find applications that suite their needs. Applications that are implemented by the help of local Shifoclub partners in the vicinity. Also, it aimed to change how applications where developed, promoting collaboration between medicine practitioners and developers to cater medical practitioners needs, with Shifoclub being the common meeting ground.

Shifoclub grew from a project called ICT4MPOWER, a SPIDER project initiated by the Ministry of Health (MoH), Uganda Communications Commission (UCC) and Ministry of ICT. *“The overall goal of the project is to improve the information flow from the community to the district and the regional levels of the health care system. This should empower rural healthcare communities, for better health outcomes for the rural population in Uganda using information and communication technology (ICT)”* (ICT4MPOWER).

Three students conducted the research of this project, with focus on Shifoclub. All three had a background in Industrial Engineering and Management and studied Human Computer Interaction at the Royal Institute of Technology (KTH) in Stockholm. Each student had his/her own research question and wrote a separate master thesis. The field study presented in this report was conducted in Uganda and funded through a minor field study scholarship from SIDA. Research was conducted mainly at two Health Centre IVs, one in Mukono and one in Kasangati, two towns on the outskirts of Kampala, as well as at the private health clinic The Surgery and the private Nakasero Hospital, both in inner city Kampala. The team members of ICT4MPOWER were present in Uganda during the research, implementing their ICT system at Health Centre IV in Mukono.

1.2 Research Question

If, as stated above, ICT is to become an integral part of health care services delivery, how should development of such applications take place and how should said applications be designed? Developing usable applications that help medical personnel is no easy feat and if the developers come from a western context, the foreign context of an African country does not make it easier. Also, medical personnel can be a difficult end user group to work with, their Hippocratic oath limiting the amount of time they have to participate in usability exercises (HCI Higher Seminar, October 2011). Apart from these limiting factors, it is uncertain if the infrastructure at clinics in Uganda enables integrating ICT in their workflow.

The main research area for this report concerned whether or not infrastructure of health care institutions in Uganda supported incorporation of ICT into the workflow, i.e. eHealth. If the infrastructure of health institutions in Uganda does not support eHealth, what steps can be taken to side-step or solve the factors slowing down or hindering eHealths' diffusion? It is the aim of this report to shed light on what infrastructure and usability issues eHealth faces, as well as which possibilities eHealth has for improving health service delivery, all the while taking the limitations of the context, health care institutions in Uganda, into consideration. Additionally, the report aims to compare the results with previous research to find similarities and differences and try to understand how the developer and medical community can improve their work processes for the good of the patients. As such, I had three research questions:

1. *How does the infrastructure of health care institutions in Uganda affect the implementation of eHealth.*
2. *How does usability related issues affect the development and implementation of eHealth applications in health care institutions in Uganda.*
3. *How can the developer and medical community alter their work processes to deliver more usable applications to health care institutions in Uganda.*

The report presents the infrastructural limitations to using eHealth in Uganda as well as user response to the incorporation of an ICT system in a health care clinic. From the study I aim to find out how a multi-sided distribution platform can aid the development and diffusion of ICT applications for health care in Uganda. Also, I aim to touch upon on how the context affects the development of eHealth applications that adhere to usability requirements and help medical personnel, the end users, deliver health care services.

2. Background

The aim of this section is to answer the three following questions:

- In what context do the end users conduct their work?
- What is eHealth and mHealth?
- Which lessons can be learned from prior ICT projects within health care in Uganda?

The general idea was to gain an understanding of the situation facing ICT in Health Care in Uganda before conducting the field study. The background is the result of the literature review conducted before the field study. Additional literature was read during the field study to help place the findings in context. The literature review aims to describe health care and ICT technology in Uganda, as well as presenting the findings of other research concerning ICT, HCI, health care and the developing world. Articles were found using Google Scholar, the KTH electronic database of scientific journals and tips from experts and my supervisor.

2.1 E-Health and M-Health

A literature review from 2005 attempted to categorize the term e-health, only to discover 51 distinct definitions (Oh, Rizo, Enkin, & Jaded, 2005). One definition of the term, from the World Health Organisation (WHO) 2004, is that eHealth:

“... is the use, in the health sector, of digital data - transmitted, stored and retrieved electronically- in support of health care, both at local site and at a distance” (WHO, 2004, p. 2)

However, according to Curtis (2007), the most common definition of eHealth comes from Eysenbach (2001):

“e-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.”

This can be interpreted as using information and communication technology (ICT) in health care operations. The subcategory Mobile eHealth, or mHealth, is defined by Iluyemi and Briggs (2008) as using wireless technologies to transmit eHealth data and facilitate services.

Another application of eHealth is Telemedicine, a branch of eHealth broadly described by Perednia et al. as the use of telecommunications to provide medical information and services (Perednia & Allen, 1995). Telemedicine involves delivering health care over a geographical distance, using communications technology such as phone, fax, and computers connected to the Internet (Huston & Huston, 2000). One example of telemedicine is remote electronic clinical consultation (Perednia & Allen, 1995).

In this report the definition of eHealth is the one given by the WHO, and it will be used in this report as using ICT in health care.

2.2 Health Care in Uganda

The health sector in Uganda includes a wide variety of organisations classified into three categories, the public sector, private health providers (PHP) and private not for profit (PNFP) providers. The public sector is the largest health provider, though both PNFPs and PHPs stand for a large portion of Uganda's health care delivery. Health facilities in Uganda are divided into two categories, hospitals and health centres. Table 2.1 presents the ownership share of health centres and hospitals of each actor in the health care sector. Health care in Uganda is delivered through a minimum package of health services and health services provisions are based on this package. All curative, preventive, rehabilitative and promotive health services are supposed to be free of charge in the public sector, while PNFPs take charges to cover the cost of running the health service and PHPs take charges to cover the cost of running the health service as well as earning a profit. However, unofficial fees are known to take place in the public health sector (Government of Uganda, 2010).

Ownership distribution of health institutions in Uganda		
Actor	Hospitals (113 in total)	Health Centres (3125 in total)
Public Sector	59 (52%)	2242 (72 %)
Private not for Profit	46 (41%)	614 (20%)
Private Health Providers	8 (7%)	269 (8%)

Table 2.1: Ownership distribution of health institutions in Uganda (Government of Uganda, 2010).

In the public sector each category of health care facilities is further classified into sub-categories. Hospitals are divided into general hospitals, regional referral hospitals (RRH), and national referral hospitals (NRH) while health centres are classified into HC I, HC II, HC, III and HC IV. Each level should handle a specified series of tasks, including all tasks conducted by the health facilities of lower levels. If confronted with a condition the facility cannot treat, the facility refers the patient upwards to a health facility of the next level. Table 2.2 presents the characteristics of the sub-categories of hospitals within public health care in Uganda (Government of Uganda, 2010, Kavuma, 2009).

Characteristics of Hospital Sub-Categories in Uganda			
Level (in descending order)	Provide care for (# people)	Managed By	Provides
National Referral Hospital	30 million	Fully Autonomous	Comprehensive specialist services as well as those provided by RRH
Regional Referral Hospital	2 million	Ministry of Health	Specialist clinical services as well as those provided by general hospitals
General Hospital	500 000	Ministry of Local Governance	Maternity care, in-patient health services, surgery, blood transfusion, laboratory and imaging services

Table 2.2: Characteristics of Hospital sub-categories in Uganda (Government of Uganda, 2010).

2.2.1 Health Centres in Uganda

The Health Sector Strategic Plan III lacks a clear description of the characteristics of each level of health centres. HC I consists of village health teams (VHT) who are volunteers lacking formal training. Every parish in Uganda should have a HC II lead by a nurse that treats common diseases. However, far from all parishes have an HC II (Kavuma, 2009). HC

III serves a sub-county. If a sub-county has a health facility of level HC IV or higher it rarely hosts a HC III (Kavuma, 2009). Facilities of the highest HC level, HC IV, serve a county or a parliamentary constituency. As with hospitals, every health centre should also be able to handle the same tasks as those handled by facilities of lower levels. A health centre unit also provides support and supervision of lower health centre units under its jurisdiction. The roles associated with a health centre level are listed in table 2.3 (Kavuma, 2009, Government of Uganda, 2010).

Characteristics of Health Centre sub-categories		
Level	Equipment and Employees	Role
HC I (VHT)	Volunteers, no basic drugs, no equipment	Advice and patient referral
HC II	Midwife, Health Assistant, two nurses	Outpatient and treating common diseases
HC III	Senior Clinical Officer with 18 staff	Outpatient clinic, maternity ward and laboratory
HC IV	Senior medical officer and an extra physician	Wards for men, women and children, admit patients and conduct emergency operations

Table 2.3: Characteristics of Health Centre sub-categories in Uganda (Kavuma 2009).

The Village Health Teams (VHT) are part of an effort to facilitate health promotion, service delivery, community participation and empowerment in access to and utilization of health services (Government of Uganda, 2010). Currently, VHTs have been established in 75% of the districts. However, only in 31% of the districts have the VHTs received a formal VHT education (Government of Uganda, 2010). The responsibilities of a VHT are listed in table 2.4.

Responsibilities of a Village Health Team

Identifying the community's health needs and taking appropriate action

Mobilizing community resources and monitoring utilisation of all resources for their health;

Mobilizing communities for health interventions such as immunisation, malaria control, sanitation and promoting health seeking behaviour;

Maintaining a register of members of households and their health status;

Maintaining birth and death registration;

Serving as the first link between the community and formal health providers.

Community based management of common childhood illnesses including malaria, diarrhoea, and pneumonia; as well as distribution of any health commodities availed from time to time

Table 2.4: Responsibilities of a Village Health Team
(*Health sector Strategic Plan III, 2010*).

2.2.2 Private Sector

As stated previously, the private sector is divided into two parts, private not for profit (PNFP) and private health practices (PHP). Reportedly the private sector covers about 50% of the reported outputs (Government of Uganda, 2010). The PNFP provide all types of care, complementing government facilities especially in rural areas, as well as operating 70% of health training institutions. PNFPs finance their operations through a subsidy from the Government of Uganda (GoU), donors and by charging user fees. PHPs have a large presence in urban or peri-urban areas and focus mainly on curative services. Dual employment in the private and public sector is common, 54% of the physicians working in the private sector also work in the public sector (Government of Uganda, 2010).

2.2.3 ICT Equipment in Ugandan Public Health Care

Seeking treatment at a government health centre can often imply walking 10 km, with no certainty of the centre being open or knowing if the HC has medication in stock (Densmore, 2010). According to HSSP III 72% of the population of Uganda lives within 5km of a health care facility, but utilization is poor, due to lack of medicine, poor infrastructure and shortage of human resources (Government of Uganda, 2010). HSSP III states that the prevalence of ICT equipment amongst health facilities, i.e. the percentage of health centres with ICT equipment, is 6.4%. ICT equipment consists of televisions, mobile phones, radio, and, to a lesser extent, computers. Current plans involve installing adequate ICT in hospitals and lower level facilities as well as implementing ICT infrastructure for human resource operations. There is, however, a lack of basic infrastructure in the health sector, only 40% of all available equipment is in good condition and 17% needs to be repaired (Government of Uganda, 2010).

2.3 ICT projects in health care in Uganda

E-Health and mHealth is not a new concept in Uganda. Figure 2.1 displays a number of projects active in Uganda until the Ministry of Health issued a moratorium on mHealth projects in January 2012 (McCann, 2012). Karin Källander, an expert working for the malaria consortium in Kampala, Uganda, conducted a survey in 2011 and discovered around 40 different projects concerning eHealth and mHealth in Uganda (Opportunities for eHealth companies in Africa, February 2012).

In a report to the WHO in 2006 the Government of Uganda (GoU) report that Uganda is well suited for the development and use of eHealth according to the determining factors defined by the WHO,

- Environment
- Infrastructure
- Cultural linguistic diversity
- Content
- Capacity

All, by the WHO defined, listed actions to promote an enabling environment have been taken as well as plans to improve infrastructure and reduce costs have been implemented (including connecting every health centre with broadband by 2010). The listed actions defined by the WHO to promote the development of electronic multicultural health centres have been successfully implemented, medical personnel have been given access to international and national electronic journals and ICT skills courses had been incorporated as an integral part of

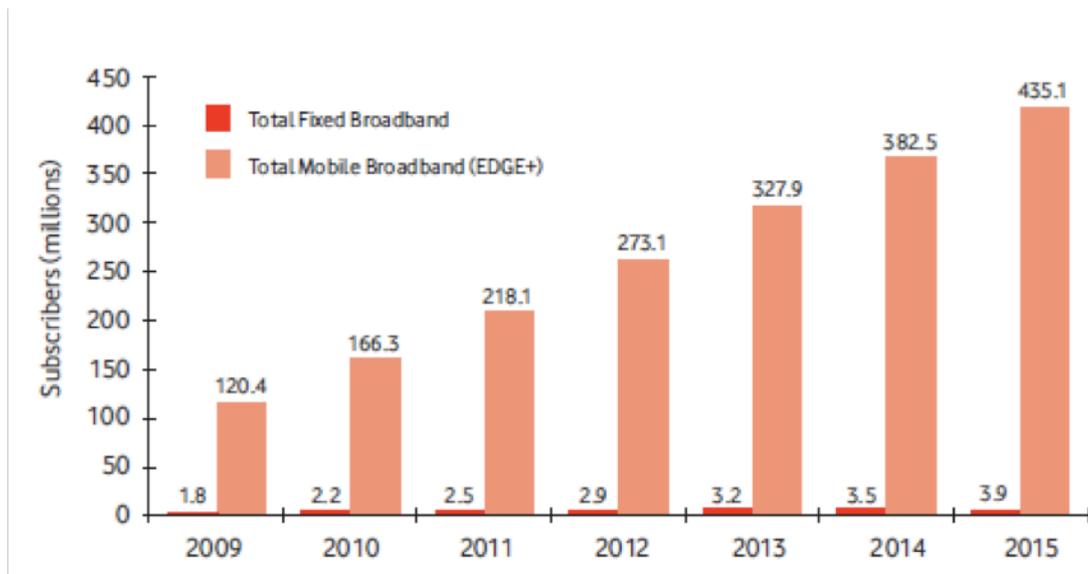


Figure 2.2: Internet Subscriptions by access network, Sub-Saharan Africa (Making Broadband Accessible for All, 2011)

Mobile phones available in Africa range from inexpensive phones with SMS capabilities to more expensive smartphones (Densmore, 2010). In a pilot project, Densmore (2010) attempted to partly replace a paper-based processing system within the health sector with ICT technology as well as increase communication between the various stakeholders of the system. Her team discovered that very few Health Service Providers (HSP) involved in the project had prior experience with computers, but almost all were willing to purchase one on a leasing plan. In her study, Densmore categorized computer knowledge as using email twice a month or having prior experience with Microsoft Office (Densmore, 2010). The HSPs expressed a primary need for clinic information management and accounting. However, all HSPs were not connected to a power grid. This is also discussed in the SWOT analysis of the HSSP III, where one weakness is stated as “*many facilities lack basic utilities such as water and electricity*” (Health Sector Strategic Plan III, 2010). In order to set up the pilot project, Densmore’s team equipped the HSP with solar power cells. However, during the course of the project, Densmore’s team discovered that although their original focus was to introduce an SMS communication system, they discovered that what the HSPs needed was laptops with a mobile Internet connection (Densmore, 2010).

A combined effort by Makerere University Medical School, HealthNet Uganda and SATELLIFE, called UHIN, incorporated personal digital assistants (PDA) into the Uganda health care system to capture, store, interpret and retrieve patient information, as well as to manage pharmaceutical, financial, logistical and epidemiological information (Kintu, Obot, & Elder, 2005). Despite positive results from the pilot, the Ministry of Health (MoH) were

unwilling to embrace the network (Lucas, 2008). According to Lucas a primary reason was high operating costs. Lucas poses the question:

“Should the government commit the implied annual expenditure (probably around US\$5m), given other demands on the overall government health budget of some 150\$m?” (Lucas, 2008, p. 2124).

Once committed, the MoH would be unable to back out without causing substantial damage to the health information system (Lucas, 2008). Currently, some 600 health workers use the UHIN (UHIN).

2.4 Theories on ICT diffusion in Health Care in the Developing Countries

The use of ICT in health care has the potential to change the delivery and management of health care services. However, using ICT in health care is not only a technological breakthrough, it also involves creating a new state of mind, i.e. a new way of thinking about health care services' (Ruxwana, Herselman, & Conradie, 2010). As stated in section 2.1, a literature review discovered 51 distinct definitions of eHealth (Oh, Rizo, Enkin, & Jaded, 2005). With a clear definition of eHealth lacking, a proposed different solution is to distinguish between innovations that reinforce existing health systems and innovations that have a potential to transform said health systems (Lucas, 2008). Based upon this categorization, Lucas presents a series of guidelines for innovation deployment. For systems that reinforce existing behaviour, it is important to remember that although attractive, pilot projects need to provide evidence that they allow effective scaling-up, and that ICT projects typically cost more, take longer and deliver less than expected. The innovations which possess the potential to transform existing health systems face other issues. Especially important is to avoid limiting options to specific technologies (Lucas, 2008).

Attempting to improve health care delivery in the developing world through the use of ICT is no new idea. In 2001, during the conference on *eHealth in Developing Countries* at Harvard University, several issues were raised that needed to be addressed. Hamish Fraser stated that computer training of the staff is often a bottleneck for effective use of ICT systems, and that success of software requires a dedicated and knowledgeable local staff. He also included a lack of common medical standards, a reduplication of efforts, and a lack of evaluation tools as factors that lessened the effect of software. Alexander Jaded claimed that much of the work was being done in the dark, there was a lack of good data for internet and email access amongst health care staff and that many of the basics behind health in general, and eHealth in

particular were unclear and poorly understood. The discussion called for better understanding of users' needs and workflow, more focus on the needs of the community not the whims of the donors, working with the government was a time waster and technical support infrastructure needed to be in place, as local physicians were extremely overburdened (eHealth in Developing Countries: The Future of Health Care?, 2001).

An example of using ICT in health care is using electronic health record (EHR) system. EHRs are known to decrease medical errors, facilitate the detection of adverse health events, increase safety of the process of giving medication, enable more appropriate use of healthcare services and potentially lower health care costs (Lobach & Detmer, 2007). When reviewing the implementation of an electronic medical record (EMR) system at an Indian Eye Hospital, Jeremiah Scholl et al (2011) discovered a number of challenges facing EMR systems in a developing country. The system was implemented to achieve above-mentioned gains and make the hospital eligible for research grants. Challenges discovered included a hierarchical organization, staff with little or no computer experience as well as a large number and variety of actors having interest in and placing demands on the system. That the system was deemed successful resulted from using an interactive design process led by a key member of staff, as well as by taking the staffs' lack of computer skills into account (Scholl, Syed-Abdul, & Ahmed, 2011). The lack of computer skills was taken into account through an effective user interface and organisational solutions to promote the use of computers in the hospital and at home. An effective user interface was based on mimicking the paper records in use. Also, the hospital made use of the system optional but provided an incentive system to promote its use. To increase computer proficiency, the hospital provided training programs, demo versions of the system through CDs and via the Internet, helped staff buy and install computers for home use and based a step wise implementation on staffs computer knowledge, i.e. when the system was made available to a member of the staff depended on the staff members computer knowledge. The most computer proficient staff started to use the system first and could thereafter help less proficient colleagues (Scholl, Syed-Abdul, & Ahmed, 2011).

Meso et al. (2009) present a conceptual framework on issues for ICT technology transfer to Sub-Saharan Africa (SSA). In the paper the authors focus on Telemedicine, an e-Health solution. However, the model put forward by Meso et al. (2009) is not purely limited to Telemedicine. The four critical determinants presented in the paper are:

1. National ICT policies
2. ICT implementation factors
3. ICT infrastructure

4. The cultural differences between the makers and the users of ICT technologies.
(Meso, Mbarika, & Sood, 2009)

National ICT policies reflect how a government prioritizes ICT for national development, and reflects both general ICT policies and the policies associated to a single technology. Transfer of ICT technology is affected by national policies, institutional linkages and regulatory frameworks pertaining to ICT, as well as by the efficacy of ICT policy implementation. The implementation of an ICT technology is influenced by the quality and maintenance of ICT infrastructure. The cost of IT services is another important factor affecting a successful migration. Fostering local expertise and minimizing dependency on foreign research will improve the chances of a successful transferral of ICT technology to SSA (Meso, Mbarika, & Sood, 2009).

3. Method

3.1 Introduction

The aim of this report is to establish how the interaction between health care professionals and the ICT tools at their disposal in Uganda influences a distribution platform of health care applications. To achieve this aim I conducted a minor field study (MFS) with a methodology inspired by ethnographic methods. In the report I present the needs that health care practitioners, i.e. the end users, have on ICT and how the multi-sided distribution platform can be adapted to suit these needs. The research was conducted in the field of Human Computer Interaction (HCI). In this section of the report I describe how my research fits into field of HCI, the methods I utilized in my research and how the research was conducted.

3.2 Human Computer Interaction

Human Computer Interaction is a research field focusing on the interaction between humans and technological artefacts. According to Carroll (1997) HCI is the visible part of computer science. In HCI the end users are in focus. Interaction between humans and technology can be a one-sided affair, with much of the structure of the interaction deriving from the technology (Carroll, 1997). Therefore, in the field of HCI one seeks to understand human beings interacting with the technology. By understanding the users of a technology, the design of the technology can be altered to aid said users when interacting with said technology. HCI researchers have several tasks, ranging from designing user interfaces to studying and improving technology development processes to developing and evaluating new applications of technology (Carroll, 1997).

In HCI, focus lies on the user of a technology, and how the users' needs can be integrated into the entire lifecycle of the technology. The goal of interaction design, a human-centred design process, is to design for a good user experience (Rogers, Sharp, & Preece, 2007). A user experience is difficult to measure, as it is a subjective experience. Instead, a key word amongst HCI is usability, an ISO-standard defined as:

"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." (UsabilityNet, 1998)

In order to develop a product that meets the usability requirements, human-centred design processes should follow the steps presented in ISO 13407, presented in figure 3.1. An implementation of ISO 13407 is interaction design as described by Rogers et al (2007). For Preece et al interaction design consists of four basic activities:

1. Identifying needs and establishing requirements for the user experience
2. Developing alternative designs that meet those requirements
3. Building interactive versions of the designs so that they can be communicated and assessed
4. Evaluating what is being built throughout the process and the user experience it offers (Rogers, Sharp, & Preece, 2007)

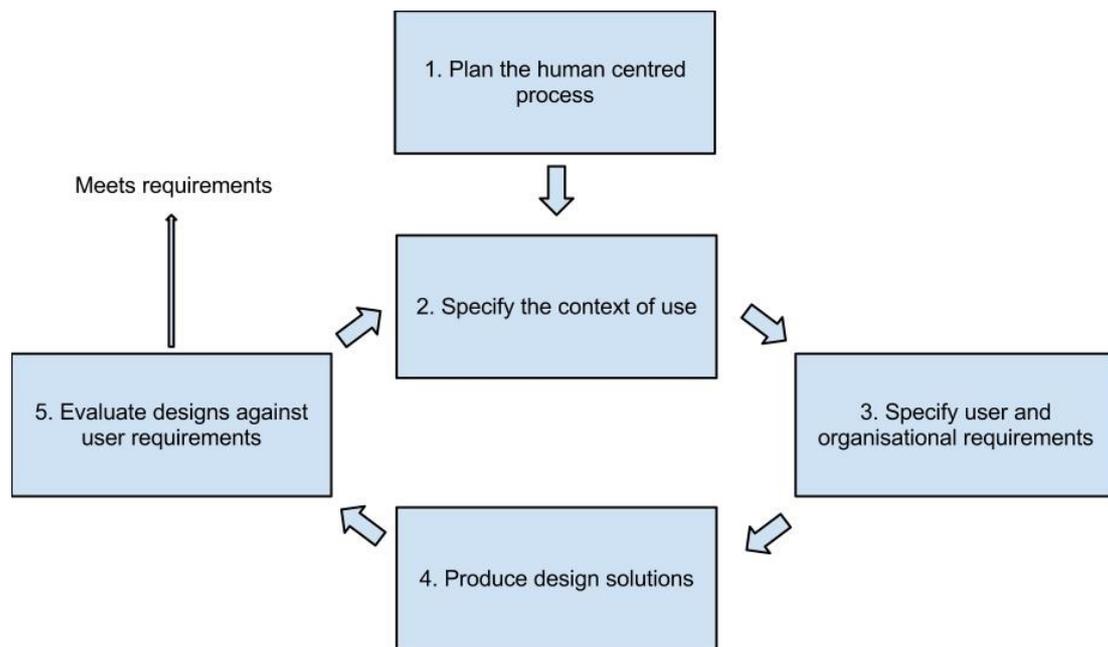


Figure 3.1: ISO 13407, human-centred design processes for interactive systems (UsabilityNet, 1999)

In this report the focus is not on creating or improving the design of an interface, nor on studying or improving development processes, though these topics will be touched upon. There was, at the time of writing, no product whose usability could be tested. Rather, I have investigate how eHealth is limited by infrastructural and usability issues. Also, focus lies on the role of the multisided distribution platform, how it can aid implementation of eHealth in Uganda and if general UI guidelines for eHealth applications in Uganda can be developed. The aim was to conduct the second and third step presented in ISO 13407, specify the context of use and specify the user and organizational requirements. To do so, I conducted an ethnographically inspired field study.

3.3 Methods

During the course of this master thesis I utilized several different methods within HCI, while keeping true to the ethnographic school. Below I give the theoretical background of ethnography and the methods I utilized during the research.

3.3.1 Ethnography

A field study approach to characterizing users' real needs and circumstances is known as "contextual design" (Wixon et al, Carroll 1997). Field studies reveal facts related to context of use, which often the users themselves are unaware of. Contextual design converged with ethnographic research in the 1990's and spawned ethnographically informed design (Carroll, 1997). Ethnographically informed design has several aims, amongst others characterizing unarticulated power relations, organisational assumptions and the practical know-how that organize the workplace (Carroll, 1997). According to Rogers et al (2007):

"Its [ethnography's] main distinguishing feature compare to other approaches to data gathering is that it aims to observe a situation without imposing any a priori structure or framework upon it, and to view everything as strange". (Rogers, Sharp, & Preece, 2007, p. 330)

Ethnographic studies consist largely of direct observation, but also of interviews, questionnaires and studying artefacts used in various activities. In direct observation the observer takes the role of a participant observer, i.e. aiming to become a full member of the group he is covering. This can be difficult to accomplish, as it requires the observer to have knowledge of the task at hand, for the group to be prepared to take the observer into their activities, and for the timescale to be sufficient (Rogers, Sharp, & Preece, 2007).

To be deemed a useful approach to data gathering in the field of HCI, ethnography has been adopted from its original premises. Dourish calls this approach "scenic fieldwork" - while the methods utilized by ethnographers have been readily embraced, the analytical and philosophical foundation of ethnography has been overlooked or cast aside (Dourish, 2006). Removing the ethnographic methods from the academic background in which they were developed has had several implications. These implications are grounded in the fact that HCI and ethnography spring from two different scientific backgrounds, HCI from computer science, cognitive psychology and engineering, while ethnography belongs to the social sciences (Dourish, 2006). Common misunderstandings that result from using ethnography in HCI are:

1. The degradation of the ethnographer into a “walking tape recorder” (Forsythe, 1999)
2. Results of an ethnographic study are often hardboiled down to “implications for design” (Dourish, 2006)
3. HCI-practitioners undervalue the experience and training necessary to conduct an ethnographic study (Forsythe, 1999).

These three factors not only damage the credibility of ethnographic studies in the field on HCI, they also mean that the results of ethnographic field studies in HCI are not always utilized to their full potential or completely understood by the design team.

Millen presents rapid ethnography as an approach to deal with the critique, of how ethnography is utilized in HCI (Millen, 2000). The time needed to conduct a full ethnographic study is often not available in a design process, while many HCI practitioners lack the proper training to perform such a study. In order to take these factors into consideration, rapid ethnography includes three key ideas to aid ethnographic work in HCI:

- Narrow the focus of the field research appropriately before entering the field. Zoom in on the important activities. Use key informants such as community guidelines or liminal group members
- Use multiple interactive observation techniques to increase the likelihood of discovering exceptional and useful user behaviour
- User collaborative and computerized iterative data analyze methods

According to Millen (2000), rapid ethnography allows HCI teams to better understand users, the user environments, and the interaction between the two in a shorter time frame.

3.3.2 Contextual Inquiry

How well a design team understands end users’ problems depends on the relationship between the designers and the end users. Contextual Inquiry in HCI is a method that allows researchers without a formal training in ethnography or significant time and ability to study end users outside the laboratory environment (Dourish, 2006). A Contextual Inquiry generates largely interview data. For Beyer et al (1995) it is a method that solves the problem:

"How do designers learn enough about the customers' work to design well?" (Beyer & Holtzblatt, 1995, p. 2)

To conduct a contextual inquiry a designer takes a role similar to that of the apprentice, learning the end users trade from the end user in the end users working environment. However, the designer does not need to learn the trade, but design a system to facilitate the

end users work context. Therefore, the role of the designer is to see work structure, articulate their understanding, improve work and remember that they have a specific focus area. In practice this entails the designer observing the end user working, while the designer looks for patterns, structure, and things he or she does not understand. It is also important for the designer to interrupt the end user to ask questions while he or she is conducting her work. This serves two purposes. Foremost, the designer can validate that he or she understands what is happening, and secondly, the end user starts to question certain work routines, creating a discussion about the end user's work strategy. Once the end user starts questioning their own work habits, time consuming habits can be broken, allowing for the design of a new, more efficient system (Beyer & Holtzblatt, 1995).

3.3.3 Observations

Observation is a method used to gather information on users' context, tasks and goals conducted either in the field or in a controlled environment. The person conducting the observations have a varying degree of participation, ranging from the participant observer interacting with the observation subjects to the passive observer that does not interfere with the subjects workflow (Rogers, Sharp, & Preece, 2007). Observation in the field can help gather data that a questionnaire or interview never could, especially details and nuances concerning the context of use. In this report, focus lies on field observations, i.e. observations conducted in the context where the subjects conduct their work. Three things to look for when conducting the field observations are:

1. The Person: who is using the technology or conducting an activity at any particular time?
2. The Place: where are they using it?
3. The Thing: what are they doing with it? (Rogers, Sharp, & Preece, 2007)

Conducting observations in a team can have several benefits, e.g. focus on different people or parts of the context and generate more reliable data (Rogers, Sharp, & Preece, 2007).

3.3.4 Context of Use Analysis

Much HCI-related work is often thought to be conducted late in the development phase, involving usability testing of prototypes and software. However, as important it is to test the usability of prototypes and software, it is also necessary to create a specification of sorts, to understand who the users are, what the users will do with the software and where the software will be used. In HCI, this can be done with a context of use analysis. A context of use analysis

is conducted during a meeting of project stakeholders, with the aim gaining an overview of the project at hand. (UCC, 1999, UsabilityNet)

3.3.5 Ad-hoc Interviews

During the course of the research several informal discussions about the health care, use of ICT, and foreign aid in Uganda were conducted. These discussions often took place by mere chance, and as such no a-priori framework, i.e. interview guide, could be imposed upon it. During an ethnographic study the researchers can be considered working at all times, in order to understand the greater context, i.e. the society, and not only the context of use. The result of these informal discussions was insight into the problem area from individuals with expertise within the research field and/or with a strong connection to Uganda. Ad-hoc interviews were conducted with individuals ranging from my landlord, foreign aid workers, taxi drivers and SIDA personnel.

3.4 The Research Processes

Presented above is the theoretical background to the methods I utilized when conducting the research for this report. Originally I had planned to conduct a rapid ethnographic field study, but once in Uganda this proved to not be feasible. Gaining access to health centres was often more difficult than thought during planning of the field study. Instead I conducted three context of use analysis, one at Health Centre IV Kasangati, one at Health Centre IV in Mukono, and one at the private clinic The Surgery. Thereafter, I conducted three observation sessions and three sessions of contextual inquiries at the Health Centre IV in Mukono, each lasting for a half or full day. I also participated in an observation session at The Surgery to study their work processes and tools. During the research I focused only on the Outpatient Clinic (OPD). As the staff was overburdened, time to conduct interviews was severely limited. Therefore all interview material was gathered during the contextual inquiries rather than conducting structured, semi-structured or unstructured one-on-one interviews.

Despite several attempts to organize visits to another ten private hospitals, only two other meetings were arranged, both at Nakasero Hospital. The first meeting at Nakasero took two weeks to arrange and was moved repeatedly, ending up as a 30 minute, largely fruitless meeting with the chief of administration. The second was a presentation of the EMR system supplied by ICT4MPOWER that delivered little of use to this report. Therefore, the data gathered came from two sides of the health care spectrum, the local HC IV's and the high-end private clinic the Surgery. I did not have the possibility of conducting research at a private clinic for the local populace and the middle class.

The purpose of the context of use analysis at the health centres was to understand the users and their relationship to computers and other ICT technologies. Also, the research team attempted to find out what needs the personnel had with regards to the system developed by ICT4MPOWER, described more thoroughly in chapter 3.5. During the observations I attempted to understand the work patterns and tools of the medical staff at Mukono before the computer system was implemented. The aim of the contextual inquiry was to gain knowledge about the medical personnel's computer proficiency, how they interacted with computer systems and what problems they encountered, as well as how these could be lessened by changing the design of the systems user interface, making it more usable. Design changes to the ICT system ICT4MPOWER installed at Mukono were implemented after each contextual inquiry, which made it possible for me to see how the system adapted and how changes to the design affected the users' perception of its ease of use. The visit to The Surgery gave insight into how computer systems were currently in use at a health clinic in Uganda, and the context of use analysis gathered data on what demands the medical personnel at the Surgery had on a computer system.

The analysis was conducted via gathering of data into specific fields of interest, namely usability issues, infrastructural issues, functionality issues and organisational issues. Thereafter I compared my findings to the findings found in the literary review. I attempted to draw parallels to earlier research and find ways in which Shifoclub can aid the medical community improve health care in Uganda.

Ethnography was used as a guide to how to conduct the research. I focused on the context in which the users conducted the work and tried to get as complete a picture as possible of the overall organisational and work related issues. Primarily the focus was on the needs of the medical personnel and their problems interacting with the system. This included ad-hoc interviews that helped me gain a broader picture of the problems facing not only ICT in health care but foreign aid and NGO projects in general.

3.5 ICT4MPOWER'S Electronic Medical Records System

The system implemented at health centre IV in Mukono was developed by ICT4MPOWER for the Ministry of Health. It consisted of an outpatient application, a child health application and a HIV application. For the purpose of this report only the outpatient application is described.

The system was based on modules, where each module could be used in all of the applications. For the outpatient application, the modules consisted of the reception, outpatient

clinic, laboratory, and pharmacy modules. The aim of the system is to improve patient data security, improve oversight of patient activity, use graphic visualization to aid clinic officers in making diagnosis and improve health service delivery. All orders for drugs and laboratory tests are sent internally from the clinic module to the pharmacy and laboratory module. The reception and clinic module share the patient queue, though only the reception registers patients. In the clinic module the clinical officer makes a note of patients' problems, orders tests, makes a diagnosis, and writes a prescription. A statistics module generates statistics. Using an administration module it is possible to adapt the system to a clinic's needs. The system is web-based, i.e. run through a web-browser. Though the system was developed for use in Uganda, the development of the system took place in Sweden with help from Swedish medical experts.

The system had a separate module for each department at the OPD - the reception, the clinical officer, the laboratory and the pharmacy. In the reception module the receptionist registers patient's bio data, takes a photo of the patient, makes a judgement of the patients' medical condition and places them in the queue. Bio data of a patient is comprised of gender, district, sub-county, parish, village and phone. The clinical officer makes a note of the problems, schedules visits to the laboratory, makes a diagnosis and sends the prescriptions to the pharmacy. At the laboratory the staff receives the orders for the tests, conducts the test and sends the result back to the clinical officer through the system. The pharmacy receives the orders for drugs in the system and sees the current stock of the drug in the inventory.

4. Findings

The findings are the results from the research conducted at Health Centre IV in Mukono, Health Centre IV in Kasangati and the private health clinic The Surgery. All research locations are situated in or around Kampala. The locations of the research areas are displayed in figure 4.1. Foremost the context of the research, i.e. the health centres and The Surgery, is presented, including their work processes and tools. Thereafter I describe what happened to computers installed at the health centres over a year ago, and follow up with the result of the contextual inquiries conducted during the implementation of the ICT4MPOWER's EMR system at Mukono. I was present at Mukono as part of the team implementing the system, aiding the end users in navigating the user interface and helping them conduct their work with as little intrusion as possible. The main focus of the findings lie in issues facing ICT systems to be utilized in Ugandan health care.

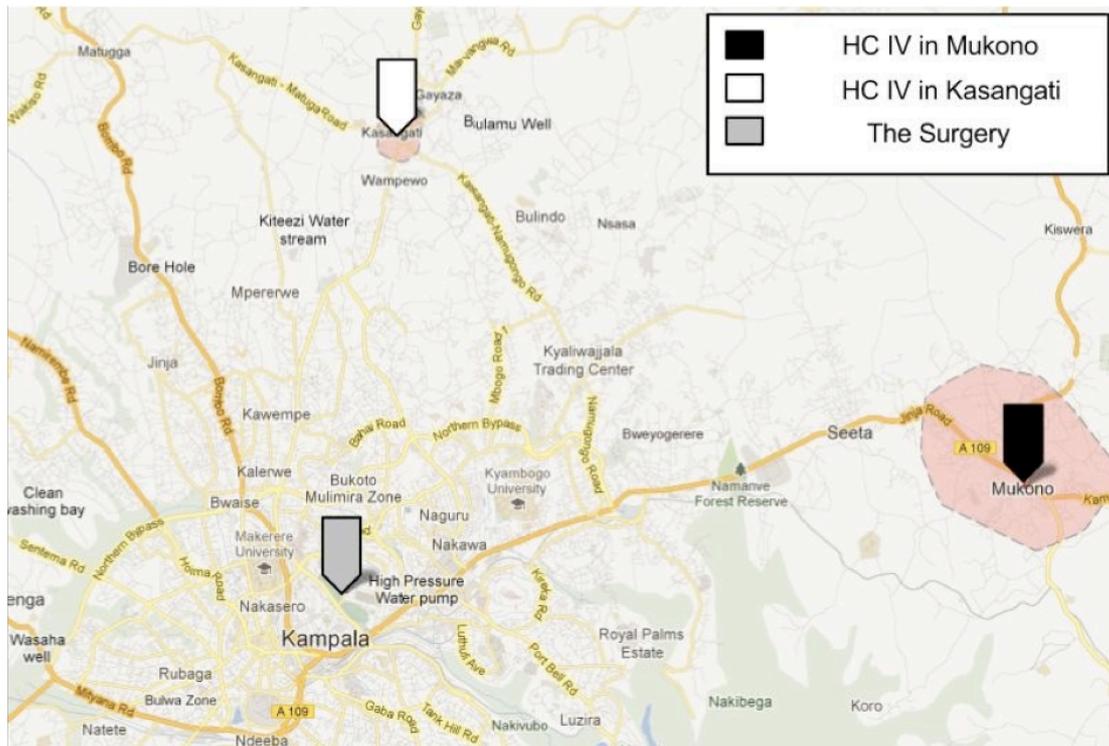


Figure 4.1: Where the fieldwork was conducted

4.1 The Context

To gain an understanding of the context in which the research was conducted the health clinics are presented below. The context description provides an incite into the overall working condition for the medical personnel and challenges facing the health care in Uganda as a whole.

4.1.1 HC IV Mukono

The health centre IV in Mukono (HCM) is situated on the heavily congested Jinja Road, 22 kilometres from Kampala. Due to the high number of patients the HC treats, it had recently been promoted to a hospital but still had the funding of a HC IV. Its entrance is marked with signs stating "Conduct your circumcison here" and "HIV clinic", the entrance itself is a steep downward slope onto the dirt parking lot. Patients lie on the grass outside the various houses, keeping to the shade. Some patients walk slowly between the various clinics, but most sit around and wait. The majority of the patients are women who are with children, are pregnant or both. All windows are open to hinder the spread of tuberculosis and cool the interior of the buildings, where every bench is packed with patients, all waiting silently but for a single crying child. Inside there is no lighting, and at least at the outpatient clinic (OPD) there seemed to be no need for it, as the clinic closed at five pm. The sun rose at 7am and sets at 7pm, providing sufficient lighting. Funding was limited, and with frequent power cuts, electricity can be viewed as scarce, according to the manager. Not all doors in the clinic could be locked, rooms that could be locked where used to store valuable equipment.

HCM contained an OPD, a maternity ward (MW), a laboratory (L), a pharmacy, an operation theatre, an inward department, and a child health department (CH). The OPD, MW, L and CH all had different layouts but contained similar interior infrastructure. The concrete walls where plastered with fading signs and information charts about diseases and prevention methods. These houses also contained statistics in the form of graphs pinned on the walls, covering, amongst others, the number of patients per month, diseases treated and number of deliveries. The laboratory was an exception, having been constructed one year ago. It was funded by the American Department of Health and Human Services through the Centre for Disease Control (CDC). The laboratory contained solar panels on the roof, though the inverter had broken. So far, the manager had been unable to find someone who could fix it; the solar panels were too complex for the local engineers. Also, fixing the solar panels would have to come from the health centres already strained budget, a budget that consisted of 4400 US\$ per

year, according to the management. A diesel back up generator supplied electricity during power cuts to parts of the health centre. Photos 4.1-4.4 presents the environment at HCM.



Photo 4.1: Sign showing the way into HCM

Photo 4.2: HCM, the building that is different in style is the Laboratory

Photo 4.3: Inside the laboratory

Photo 4.4: Typical statistics that line the OPD at HCM

4.1.2 HC IV Kasangati

HC IV in Kasangati (HCK) belongs to the Wakiso district bordering Kampala. It is a HC IV recently promoted from an HC III and easily accessible lying directly off a major road. The HC had contained more buildings on its premises, but had recently been forced to move as these buildings had been taken over by a governmental agency. Therefore, the administration had been forced to begin to use older buildings formerly written off. At Kasangati I visited the outpatient clinic (OPD) and the Maternity Ward. The OPD in Kasangati contained the laboratory, the administrative office, the pharmacy, drug storage and the rooms for clinicians

to receive patients. Patients are received by a nurse on the terrace belonging to the OPD, the terrace where the majority of the patients waited for their turn to see a clinical officer. At the time of our visit, at 10am, the clinical officers had yet to arrive and the terrace was filling up. The terrace was divided into two parts, one for vaccinations and one for reception and waiting room. HCK also contained an operation theatre and a HIV clinic.

There was no electric lighting, the sun provided lighting during open hours. However, I noticed that the switches on the powerstrip were lit, indicating that there was electricity. According to management, black outs were frequent. A generator supplied back up electricity during power cuts, but it needed to be rewired, which was to be done soon according to the manager. The HC contained an operation theatre that conducted male circumcision, as a preventive care against HIV. It had not started performing caesareans, though this was planned. Re-stocking of the dispensary (pharmacy) was done every two months. The staff of the dispensary counted current stock, predicted consumption and added a buffer, before sending the order to the MoH. Security was to be improved through fencing and the addition of locks to offices. Photo 4.5 and 4.6 show the reception area at HCK and a typical medical informative sign at HCM and HCK.

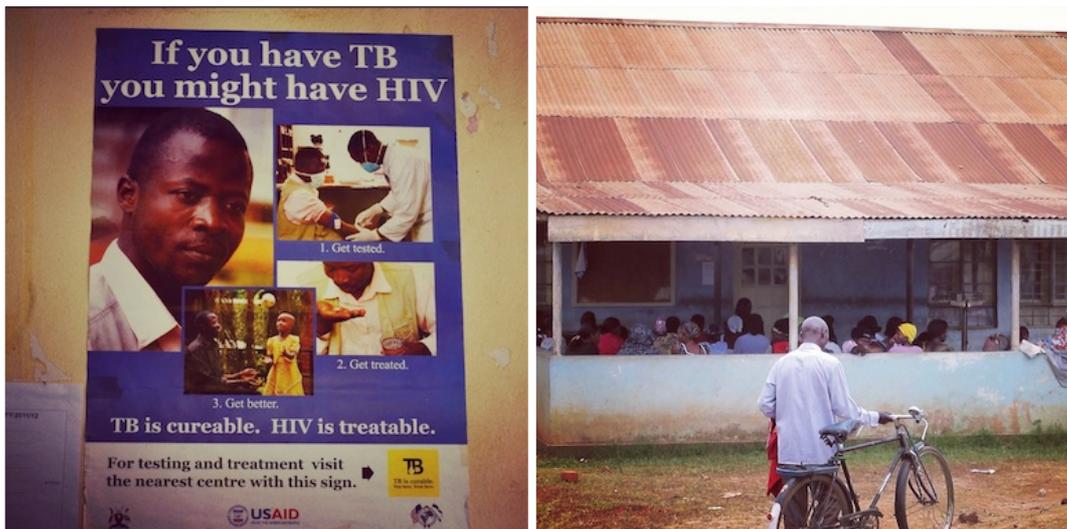


Photo 4.5: Typical medical information signs found inside HCM and HCK

Photo 4.6: The reception area of HCK

4.1.3 The Surgery

The Surgery is a private clinic situated in Kampala of Acacia Avenue, with a soothing atmosphere that is a stark contrast to the busy Kampala traffic. Except for the clinic the area also contains a hair saloon, a second hand bookstore and a café. Located in the expatriate

heavy part of Kampala, the patients and staff are predominately of western descent. Where the Health Centres of Mukono and Kasangati border on the brink of chaos, The Surgery is organized, three receptionists receiving patients and admitting them in the queue. Medical history of all patients is kept using paper records. A diesel generator supplies back up power during power cuts. The Surgery contains an operation theatre, an in ward, an outpatient clinic, x-ray machine and two ambulances, one of which can be rented. Three types of visits are possible: scheduled, drop in and emergency. There is a 1:1 ratio between scheduled visits and drop-ins. The clinic has its own phone line and each department has their own phone, while the clinic shares one email account. As it is a private clinic each patient funds their own visit, either via cash payments or insurance. Photos 4.7-4.10 represents the environment at The Surgery, a stark contrast to HCM and HCK.



Foto 4.7: The entrance to the emergency unit at The Surgery

Foto 4.8: A treatment room at The Surgery

Foto 4.9: One of The Surgery's two ambulances

Foto 4.10: The book shop second hand book shop at The Surgery

4.2 Current Work Processes in Health Centre IV in Mukono

Before ICT4MPOWER implemented the EMR system at Mukono, the health centre did not utilize computers in when treating patients. Therefore, I had the opportunity of observing the work process at the outpatient clinic in Health Centre IV in Mukono when they were relying solely on paper records. These findings present how the medical personnel are used to working, and is valuable to understand how their situation changes when presented with computers.

4.2.1 A Patient's Visit

The outpatient clinic in Mukono contains four different departments: the reception, the consultation offices, the laboratory and the pharmacy. Each patient that visits the HC will not necessarily visit each department, though that is often the case. The patients' visit is depicted in figure 4.1. A patient registers at the reception, and then proceeds to a consultation with a clinical officer who records the patient's problems. The clinical officer has four different options: refer to a different hospital/physician, make a diagnosis, send the patient to the laboratory or conduct an investigation. However, during the course of the study no patients were submitted for a more detailed investigation. Each patient consultation takes approximately two and a half minutes. If the patient is sent to the laboratory, the clinical officer receives the patient a second time when the results from the laboratory test have been received, and proceeds to make a diagnosis. Depending on the diagnosis, the clinical officer writes out a prescription for the patient, who proceeds to the pharmacy. In the pharmacy the patient receives the prescribed drugs before leaving the HC. If the patient is referred, has received medication or has been diagnosed and not given a prescription the patient leaves the HC. There is rarely a follow up and during the observations no follow up was scheduled, though the staff claimed that it could happen. A patient visits the clinic at two separate occasions as part of one appointment only if a laboratory test required two samples to be taken with a time interval in between. During a visit to the HC a patient receives a paper slip that is filled out after every visit to one of the departments in the outpatient clinic.

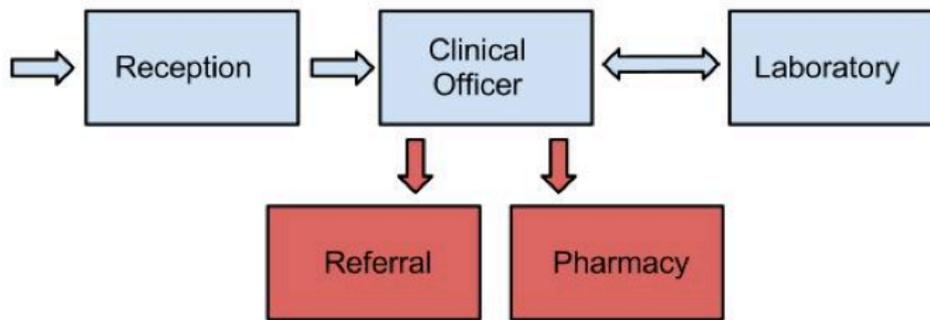


Figure 4.1: Steps taken by a patient during a visit to HCM

4.2.2 The Departments

Each department has different responsibilities, work patterns and artefacts to fulfil their responsibilities. More often than not the workflow is interrupted due to complications. Certain complications, such as lack of pharmaceutical drugs and tests, occur at a frequency that warrants their inclusion as part of the standard work processes. A complication is a situation that hinders the department from fulfilling their responsibilities towards the patient. Below I present each department, their responsibilities, the tools utilized in that department, the complications that often occur and the departments work patterns.

4.2.3 The Reception

The reception is the first point of interaction between a patient and the health clinic. The workflow of the receptionist is depicted in figure 4.2. It is the role of the receptionist to deem the current state of the patient, record the patient's bio data, and call the next patient to be received by the clinical officer. The patients' bio data consists of their name, age, address and contact details. Each patient is recorded in books received from the Ministry of Health. The patient is sorted into one of three categories according to the risk to their health, high, medium or low. In each category a first come first serve approach is adopted. The next patient to be seen by the clinical officer is the first patient that arrived in the highest category. As the receptionist conducts this sorting, the receptionist is the first medical personnel to make a judgement of the patient's medical condition. Using the books from the ministry of health the receptionist keeps control over the queue and calls the next patient to be seen by the clinical officer. The receptionist records all the steps, i.e. visit to the laboratory, if pharmaceutical drugs are prescribed, that are taken during the diagnosis and treatment of a patient. Figure 4.2 shows the workflow of the receptionist.



Figure 4.2: The workflow of the receptionist

Work patterns for a receptionist involve handling two different books (one for the maternity clinic, one for the outpatient clinic), deciphering the clinical officer's notes, and using the book to keep control over the queue. A copy of the book is displayed in photo 4.11. The receptionist had to deal with several issues, foremost concerning the apparent lack of knowledge patients had of their own bio data. Patients were often unwilling to inform of earlier diagnosis and often lacked knowledge of their birthday (a cultural phenomena). Understandably, patients were keen on jumping ahead in the queue. With as many as 250 patients a day and a waiting room filled beyond capacity visiting the health centre could be a full day affair for patients. When the HC received 250 patients during the course of one day, not every patient would receive consultation.



Photo 4.11: Out Patient Register used by the Receptionist

4.2.4 The Clinical Officer

The clinical officer in the outpatient clinic is responsible for the diagnosis of and drug prescriptions for patients. Each visit to the HC for a patient is centred on consultation with the clinical officer, as the consultation is a prerequisite for drug prescription and for laboratory

testing. Due to financial reasons, most often there is only one clinical officer, conducting consultations for over 100 patients during one workday, an average consultation session lasting for two and a half minutes. Consultations can be sorted into two categories, initial and follow-up. The initial consultation takes place after the patient has registered and called by the receptionist, while the follow-up consultation takes place after the patient has received the results from a laboratory test. The work patterns for both types are depicted in the figures 4.3 and 4.4.

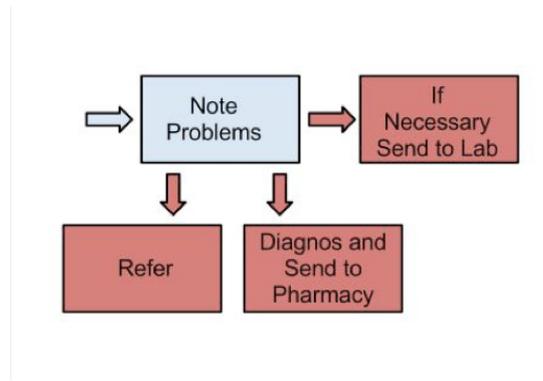


Figure 4.3: Workflow of Initial Consultation

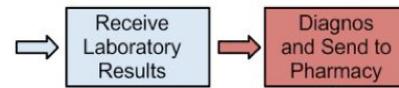


Figure 4.4: Workflow of Follow-up Consultation

During the initial consultation, the clinical officer began by questioning the patient about his or her problems. The most common problems were cough, fever, headaches and stomach pains. Other observed problems included eye problems, swollen stomach and physical injuries. After making a note of the patient's problems, the clinical officer made a diagnosis, sent the patient to the laboratory, or referred the patient to another hospital or specialist. If the patient had a fever, the patient was sent to be tested for malaria and HIV. When a patient complained of stomach problems, a stool test was scheduled. Referral was the standard case for any problems that were not fever, cough, headaches and stomach pains, barring injuries. If the patient had a cough and a headache but no fever, patients were diagnosed with Upper Respiratory Tract Infections (URTI) and prescribed medication. Physical wounds were stitched up.

During the follow up consultation, the patient was diagnosed and medication subscribed. The most common case was that malaria tests came back negative, and the patient was diagnosed URTI and prescribed medication. During the observation, no clinic officer scheduled an investigation, and only once was a patient inspected more closely. This was the only instance when the bunk in the office was utilized.

Diagnosis, prescriptions of medication, referrals and orders for lab tests were written in a paper form supplied by the Ministry of Health, with carbon copies, showed in photo 4.12. The patient received both the carbon copy and the original, the carbonated copy to be handed over

which tests are to be performed. Laboratory personnel record the patient in a book, perform the test, and record the result on the paper slip the patient arrived with, as well as in the book. The patient receives the paper slip to return to the clinical officer, while the laboratory keeps the carbonated copy. In the laboratory, the work processes include recording each patient, the tests conducted and the result in the books supplied by the Ministry of Health, conducting tests and filling out the paper slips received from the patients. Observed complications included running out of tests and failure of patients to arrive at the laboratory. According to a laboratory technician, writing reports and filling out the paper slips takes between five to ten minutes per laboratory test. The entire test procedure can take between 20 minutes to 24 hours. For longer tests the patient left the premises to return later or the next day.

4.2.6 The Pharmacy

The pharmacy is responsible for supplying patients with medication. The clinical officer in the outpatient clinic, but also clinical officers in the maternity ward, the inpatient clinic, the operation theatre, and the dental clinic can prescribe medication. Patients arrive with a paper slip and a carbonated copy. The patients keep the paper slip while the carbonated copy is kept by the pharmacy. To receive the drugs the patients must have the carbonated copy, to make sure that patients cannot receive drugs from a prescription more than once. The clinical officer prescribes the type of drug, the duration and the dosage. From this information, the pharmacy personnel calculate number of pills to be received and the weight of each dose.

To keep an inventory, the personnel record the number of drugs given in a book. Unlike the other departments at the outpatient clinic, the pharmacy lacks an official book. Instead they use lined paper in a hardback book, in which they make their own columns. The columns are date, drug handed out, the amount handed out and how many are left in the inventory. On the paper slip kept by the patient, the personnel write down which drugs the patient has received and which were out of stock. If the drug is out of stock the personnel draw a star next to the drug and if it was handed out the personnel write a check mark next to the drug. Observed complications for the pharmacy were out of stock drugs.

4.2.7 Statistics and Reporting to the Ministry of Health

Separate from receiving and treating patients, the personnel at the Health Centres are responsible for reporting statistics to the Ministry of Health once a month. The personnel deliver statistics to a District Health Officer who compiles the information from all health facilities in the district and presents it to the ministry. There are two systems in which the statistics from the health facilities are stored, the older Health Management Information System (HMIS) and the new District Health Information System (DHIS). A transition from HMIS to DHIS is currently underway.

The gathering of statistical data is conducted by tallying the books. In the OPD the personnel count the number of patients, percentage of patients under five years of age, laboratory tests conducted and the result and diagnoses. The report also includes information from the other clinics at the Health Centres, but this was not taken into account during the research due to the focus being primarily on the OPD. The pharmacy did not need to report statistics, only control the inventory and keep an eye on consumption to order more drugs. Earlier, medication was ordered once a quarter year but that had recently been changed to once a month. To control the validity of the orders submitted by the pharmacy external personnel counted the carbon copies of the receipts.

4.3 The Infrastructure Problem: Where Telemedicine Failed

Through the context of use analysis at Health Centre IV in Mukono and Kasangati I discovered that both Health Centres had five stationary computers each, courtesy of Uganda Communication Commission. The intended purpose of the computers was to enable Telemedicine, explained more in section 2.1, a service provided by the state hospital in Mukono. One year later all of the computers had yet to be used for that original purpose. The reasons behind the failure of the Telemedicine project at Mukono and Kasangati and how the computers were adapted into the workflow at the Health Centres is described below. Here I aim to reveal the difficulties associated with to incorporating eHealth into a context where basic infrastructure is lacking and how management can find utilization areas of ICT technology despite the limitations that hinder eHealth. Also, these computers and how they were used revealed important information about the needs of the personnel at HC IV in Mukono.

4.3.1 Infrastructure failure to support Telemedicine

As stated above, the aim of the computers was to connect Mukono and Kasangati with the telemedicine centre in the state hospital in Mulago. Telemedicine was never realized at either of the HCs due to several reasons. Foremost, neither HC was connected to the Internet. The Internet connection was but one of the issues that hindered telemedicine at the HCs, staff at both health centres cited lack of security for ICT equipment as a major obstacle to using the computers to their full potential. There were a limited number of rooms at the HCs that could be locked and none of these where used for treating patients. In Telemedicine, medical personnel send patient information to medical personnel in distant areas using ICT technology. In order to enable Telemedicine, the medical personnel need to have access to both computer and patient. This was not feasible at either of the HCs' due to the security complication. In Kasangati all five computers stood unused in one room, in Mukono they where spread out over the premises in five different rooms, all with locks.

So far two factors, security and communication possibilities, hindering the adoption of Telemedicine at the two health centres have been presented. This is before taking electricity into account, which is a crucial, basic component for eHealth. Access to electricity was an issue when adopting eHealth at both health centres. While both health centres were connected to the power grid, black outs are frequent in Uganda. The power cuts are a result of a larger demand for electricity than the local power companies can supply. This demands sufficient back up power systems in place to fully incorporate ICT into the work processes at the HCs. As explained earlier, there were two backup systems at the Mukono HC, solar panels and a diesel generator. The solar panels' inverter was broken and the outpatient clinic was not connected to the diesel generator. As a result, during power cuts and cloudy skies the outpatient clinic and the lab were without electricity. At Kasangati, the manager claimed that, "the power is more often off than on", with a diesel generator as a backup system which was not connected to the outpatient clinic. As such, during power blackouts, which can last for a couple of hours, the OPD lacked power.

4.3.2 How The Computers Where Adapted into the Work Process

The complications that arose due to the context of use, in regard to the security, communication abilities and electricity, exemplify how integrating stationary ICT equipment into the work processes can be difficult and potentially hazardous to the service delivery at the Health Centres in Mukono and Kasangati. Stationary computers could not be used in the offices where interaction with patients takes place and creating a reliance on stationary ICT equipment in service delivery would result in a disruption of service delivery in case of power outs and unfavourable weather conditions. However, as described in the statistics section, reporting to the Ministry of Health is a large part of the workload, and here the computers came to some use.

Kasangati and Mukono adopted two different approaches to utilizing the computers in the work processes. At Kasangati the five computers stood unused in the office in the OPD, as shown in photo 4.13. An external intelligence officer who compiled the information from the paper forms and created a report for the Ministry of Health used a separate computer. The local staff did not utilize the computers and received no computer training. At Mukono the computers were spread out amongst the various clinics. One was in the OPD, two in the administrative office, one in the maternity ward and one in the operation theatre. Management had decided that the personnel should learn to use computers and given them the option of using the computers for reporting. Therefore the staff had started gathering statistics and writing reports on computers. However, their computer knowledge was still rudimentary, with the exception of a laboratory technician who owned a computer that he utilized at home.



Photo 4.13: The computers in Kasangati unused in the OPD

Currently, the statistics were gathered by tallying the books and recorded in paper forms supplied by the Ministry of Health, despite the availability of the computers. In the words of the manager: "My staff want to use the computers more in gathering statistics but I say to them 'how can you, you have no knowledge in creating spread sheets'". The manager's view was that if the computers were supplied with applications designed for the HC, the computers' use to the staff would increase. As the manager knew his staff lacked ICT proficiency, he believed that only applications specifically adapted to the work flow and the computer knowledge of the staff would be beneficial for the health service delivery at the HC.

4.4 First Interaction: A Computer System and Its Implications for the Work Processes

During the observation sessions the ICT4MPOWERS EMR system was implemented at the outpatient clinic at the Health Centre IV in Mukono. I, as part of the team aiding the implementation, observed how the medical personnel, most with limited computer knowledge and with no training, interacted with the system and how this affected the work processes and work flow of the staff. My role was to help the medical personnel use the computers and the system, and help them if they got stuck. Except for a run through of the system by ICT4MPOWERS project leader, the staff received no training before hand. My aim is to present how well different design solutions were accepted, the cultural aspects that affected the design of the interface and how the system impacted the work process. Photo 4.14 shows symbolizes the presentation of the system to the health care practitioners at HCM.



Photo 4.14: The ICT4MPOWER project leader presenting the system

4.4.1 Implementation of ICT4MPOWER's EMR System

The system, described in more detail in chapter 3.5, implemented at the OPD in Mukono was aimed at connecting the different departments within the OPD. From the manager and the staff's perspective the hope was that the system would eliminate the cumbersome need to tally the books for statistics and reduce or eliminate the process of filling out books and writing the paper slips that circulated the OPD. Statistics could be generated from the system directly. This would decrease the amount of time clinical officers needed to place on administrative duties and in turn give the clinical officer more time with patients and hopefully increase the service delivery of the Health Clinic. It also allowed for clinical officers to view the medical history of patients, which before depended on patients delivering their medical history to the clinic, an event that did not occur during the observation sessions. As all communication took place within the system, the physician no longer had to fill out the paper slips for the patients to carry around the health centre.

4.4.2 Reaction and Implications for Work Processes

The system was developed to increase the efficiency and quality of service delivery at Health Centres in Uganda, but as presented in chapter 4.3, Where Telemedicine Failed, implementing ICT into the Health Centres in Uganda is fraught with complicating factors. Precautions were taken against the infrastructure factors that hindered the adoption of Telemedicine. To deal with the power blackouts the health centre received laptops, whose batteries allowed usage during periods without electricity. As the laptops were mobile this allowed them to be used in the areas where interaction between patients and medical

personnel took place and then locked away during the night. The system was installed on a local server and run through a web browser to eliminate the need of Internet access.

Though the infrastructural problems described in chapter 4.3 were taken into account, other complicating factors emerged. The electricity was still a problem as the server, situated in the OPD, relied on electricity to function. During black outs and cloudy weather the server went down. However, this issue could be addressed by running a cable from the inward department to the OPD. Instead, problems occurred when the end users, the medical staff, interacted with the system. As the end users possessed little or no computer knowledge they were unable to deal with any "non-ordinary" situation, i.e. the system did not function; the computer went into sleep mode or when they managed to minimize the window. The end users' typing speed was low and the interaction between end-users and the system via track pads was problematic. They lacked knowledge of double clicking, often double clicking buttons, which resulted in the whole screen being highlighted in blue, and single clicking text field areas that should be double clicked. Their understanding of symbols, icons and text areas for writing was limited, but once the clinical officers were shown how to interact with an icon, such as a calendar or text area, the end users learned quickly and started using them continuously. However, as explained above, if something unexpected happened the end users often got confused and stressed. When an unexpected situation did occur some end users attempted to solve the situation but most gave up and automatically asked for help.

The attitude towards the system varied amongst the staff and the departments. Most positive was the laboratory, a laboratory technician claiming "now we must use paper and the system, but in a month we'll use only the system". The reception believed in the system, to a large extent due to the statistics it could generate (and thus decrease the receptionists' work load). The physicians, who stood for most of the typing, believed the system would be beneficial once they improved their typing speed as well as computer knowledge and confidence. Amongst the pharmacy the attitude was slightly negative, one member of staff claimed "the system makes us slower". The pharmacy at work with the computer is shown in photo 4.14.



Photo 4.14: The pharmacy staff with a computer supplied by ICT4MPOWER

The system did affect the work process at the OPD. Foremost, the system would eliminate the need to keep books in paper form, decrease the amount of handwriting necessary and eliminate the painstaking, time consuming, monthly occurring event of statistics compiling. Before the system was implemented, the physician wrote the prescriptions for medication on an official slip of paper the staff of the pharmacy could sign if a certain drug was out of stock. Therefore the patient could get the drugs somewhere else with the signed slip of paper. With the system the physician sent the prescription electronically. With no slip of paper to sign the pharmacy personnel had to write out a receipt for the missing drug themselves.

4.4.3 Different Design Solutions Conformity to the Context

The first interaction between the end users and the system did not occur without complications. Due to the widespread computer illiteracy of the end users, especially their unfamiliarity with typing, the systems interface had to be continuously developed to aid the end users. During the two-week observation session design of the UI was tweaked from text fields to auto-scroll menus with auto complete and checkboxes. The observations discovered patterns in the end users work which were utilized to increase the usability of the interface. Data input solutions which utilized visualization made the system more easy to use, i.e. for the clinical officers a calendar was easier to use than a text field to input dates. However, all input text fields were not removed from the design, as certain were necessary for special cases, i.e. open head wounds. The issues users had with track pads were solved by supplying the end users with a separate mouse.

Computer unfamiliarity was not the only complication that lessened the usability of the system. A prominent source of error arose from the cultural gap between the developers (Europeans) and the end users (local Ugandans). When prescribing drugs for children, especially very young children, knowing their age is essential for calculating their dosage. When registering patients' age was calculated from their birthday. In Uganda it is not

uncommon that patients are not aware of their birthday. Often, but not always, they are aware of the year. If asked for their birthday patients can sometimes guess and sometimes simply make up a date. It was common for parents to give their own age instead of their children's age. Therefore the system supplied the clinical officers with false information about young children's age. The clinical officers wanted to address the situation by replacing birthday with age and have the system calculate birthday. This was under consideration by the time the observation session ended. Another complication concerned dual or more accounts of patients. In Uganda there are neither ID cards nor social security numbers. If a patient failed to inform that he or she had visited the clinic at an earlier date he or she could be entered as a new patient. That the receptionist, who was responsible for registering new patients, neglected to ask for earlier visits did not aid in overcoming this issue is partly due to this being a new addition to the work processes of the receptionist, but a necessary one to enable and make use of electronic medical records.

4.5 The private Sector

Apart from the observation session at the Health Centre in Mukono and the context of use analysis at Kasangati we conducted a context of use analysis at the privately owned clinic The Surgery. The results, especially from the context of use analysis at The Surgery, are presented below with the aim of understanding their needs and approach towards ICT technology.

4.5.1 The Surgery

Being a private clinic, The Surgery had to incorporate payment and financial aspects into the workflow, as displayed in figure 4.5. At the OPD at the Surgery patients had to pay for every consultation and any laboratory test or drug. Payment took place after each consultation and before laboratory tests were conducted or drugs were handed out. There was one exception, if the patient had insurance. With insurance a patient filled out an insurance form and the Surgery submitted an insurance claim to the insurance company. During normal working hours the staff consisted of three trained physicians, two receptionists, four to five nurses, several laboratory technicians, one pharmacist and one cashier. Each consultation took between 10 and 15 minutes and a visit to the OPD took at most two to three hours. The figure of a patient's visit is shown below, in diagram 4.5.

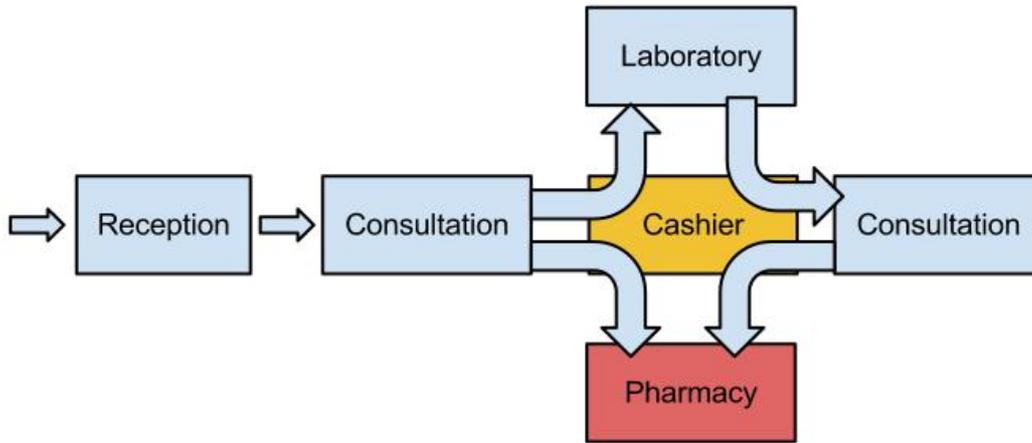


Figure 4.5: The Patient Flow at the Surgery

At

The Surgery each prior patient has a medical record in paper form. A patient is given an ID number to identify himself or herself with at the first visit to the clinic. During one visit a medical journal follows the patient through the entire visit and the journal is thereafter added to the medical record history. The patient also receives a slip of paper for payment purposes, after each payment the slip is stamped. No tests are conducted or drugs handed out unless a stamped payment slip has been presented. Before the patient leaves an invoice is filled out and a receipt is printed out and given to the patient. The medical records are shown in photo 4.15.



Photo 4.15: Some of the medical records of The Surgery

While the medical records are kept in paper form The Surgery keeps an electronic database of patients with their bio data, patient ID and payments. A software called The Patient Handling and Billing System (PHBS) that was developed for The Surgery, supports the electronic

database. The PHBS used at the Surgery has never been subject to revision or updates. The software is divided into two parts, a patient handling part used by the receptionists and a billing system used by the cashier. Using the patient handling part receptionists can find a patient's ID in case its been forgotten. PHBS can be used to generate statistics, though these statistics where not sufficient for the clinic. For example, it was not possible to see the number of patients who visited the clinic during a specific time frame. Apart from the PHBS the clinic uses a commercial accountant record system called Intuit QuickBook Accounting. In total The Surgery has three computers in the OPD department, one in the reception, one in the pharmacy and one by the cashier. These computers all have PHBS while one had QuickBook. There is one shared email address that can be accessed through two computers, one via webmail and one via Outlook.

4.5.2 A New System

At the time of writing, the staff at The Surgery had been looking at new systems to replace the PHBS and QuickBook. The goal was to find one system that suited all the needs of the clinic, including accounting. The staff at the clinic was involved with choosing the new system. By the time of the context of use analysis the staff had looked at several different systems. One nurse with considerable computer knowledge was responsible for choosing the system together with the aid of a physician from England. However, members from the rest of the staff were present when viewing and evaluating systems. For the staff it was essential that both the functionality and the design suited the needs of the clinic.

The Surgery wanted to remove all dependencies on paper journals. Registration, laboratory tests, prescriptions and diagnosis were to be stored within the system. The clinic wanted to transition communications with patients from telephone and verbal communication to email. In order to minimize waiting time for patients, a design solution for seeing which patients had waited the longest was essential. All the laboratory tests were not conducted in-house but outsourced to external laboratories, with the results delivered via email. The staff wanted results in the emails to be automatically added to the system. The possibility of adding free text to register patient details, i.e. smoker/non-smoker, diabetics, HIV, was another need raised by the staff. For chronic diseases the staff wanted visualisation of data, i.e. seeing data as graphs instead of text to quickly spot changes in condition. It was deemed essential that data could be audited, advanced statistics could be generated, and that all payment and financial related issues were incorporated into the system. Two examples of data that should be audited were percentage of patients afflicted by a certain disease and percentage of patients who took all their medication.

An important concern at the clinic is dual registrations resulting from patients having identical names and not remembering their patient ID. With the lack of social security numbers and IDs in Uganda a solution must depend on a unique physical feature. During a discussion two

viable solutions were discussed, fingerprints or face recognition. Between these two identification mechanisms face recognition was rejected, as certain patients wore clothing that covered all physical features due to religious and cultural reasons.

5. Analysis

The result of the research was a deeper understanding of the issues that plague ICT in health care in Uganda, both in the private and the public sector. Understanding these issues are of essence to be able to develop usable and effective applications for the health care sector. However, as ICT in health care in Uganda is still in its infant stages there is a large potential for ICT to improve Ugandan health care. Here I present the most prominent factors that influence the use of ICT in health care in Uganda and examples of areas where the ICT can positively influence the service delivery.

5.1 Issues

Most of the issues facing eHealth in Uganda can be traced back to a lack of basic ICT infrastructure. This makes reliance on ICT in service delivery difficult and potentially dangerous as black outs and bad weather can hinder the use of any ICT technology and as such effectively stopping service delivery. The lack of ICT in Ugandan society as a whole means that members of medical staff lack knowledge of using ICT and hindering effective use of applications and software. Also, the lack of knowledge of how health care in Uganda is delivered means that applications developed, including the one implemented at HC IV in Mukono, are often based on assumptions and best practices derived from western health care even though health care in Uganda faces other issues than those facing western health care.

5.1.1 Infrastructure Problems

ICT in health care in Uganda faces a series of issues related to infrastructure listed in table 5.1 below. Electricity is in short supply, communication possibilities are limited, secure storage of expensive technology is not always possible and health centres have limited budgets and have limited financial manoeuvrability. However, private and public clinics face different issues, which can be seen in a comparison between The Surgery and Health Centre IV in Mukono. The Surgery had functioning back up generators for power cuts supporting all parts of the clinic; the HC had a back up system with a broken inverter. As discovered by the context of use analysis in Kasangati, the OPD was not connected to the back up generator as it closed at 5pm, when the sun was still up. This was the result of electricity not being a necessity for service delivery at the OPD, and as running a back up generator is expensive, connecting the OPD to the generator was at some point not prioritized. For ICT to become integrated into the work processes at the HCs this situation has to be remedied.

Infrastructure	
Problems	Description
Electricity	Power cuts due to larger consumption than production lead to extended periods of power shortage.
Communication	Landline Internet connections are lacking. Wireless internet is widespread but requires infrastructure (modems and routers) and is expensive.
Security	ICT technology and equipment are valuable assets that must be stored safely. Most offices lack locks and the OPD can be accessed 24-hours even though clinical officers were only present at between 10am to 5pm.
Financial	The HC and the Ministry of Health lack funds to make any necessary infrastructure changes.

Table 5.1: Infrastructure Problems facing eHealth in Uganda

Security at the HCs was found lacking, which meant that expensive equipment had to be stored in specific locations, locations where patient medical staff interaction did not take place. This means that only mobile ICT equipment can be effectively implemented into the work processes, unless the security situation is remedied, i.e. the locks on the doors exchanged and the glass or bars are introduced to windows. The ICT equipment that has been integrated into the work processes, and has had the biggest diffusion in Uganda as a whole, is mobile technology, i.e. mobile phones and Internet supplied via 3G. At the HCs there was neither Internet nor phone supplied via cable. However, mobile technology, i.e. mobile phones, laptops and wireless Internet, has enabled a more widespread use of technology by limiting the reliance on landlines. Most Ugandans own a mobile phone but few own a computer. The HCs are also under great financial strain; the budget does not leave room for reparation of the broken inverter or improving the security situation. For these improvements to take place the HCs needed extra funds from the Ministry of Health, which means extra administration and takes time. Even though the HC in Mukono had been promoted to a regional hospital they still received funding as a HC IV.

5.1.2 System Interaction Difficulties

Both clinics had computers but where The Surgery had computers with medical software applications, a functioning internal network and an Internet connection, the Health Centre in Mukono had five computers that could only be used for writing reports. There was a difference in attitude towards ICT between the staff at the HC and the staff at The Surgery. While the staff at the HC wanted to utilize ICT more to decrease the amount of handwriting, they had little understanding of which functionality demands they could place on the system. Instead, they wanted a system that could generate statistics and minimize handwriting. There was little interest in how the system was designed and how it could improve service delivery.

ICT Problems	Description
Functionality ignored by end users	To achieve full benefit from an ICT system the end users must understand the functions the system delivers and why it has been included. Otherwise the end users might ignore important functionality and decrease the potential of the system. Vice versa, the developers must understand the needs of the end users to deliver the functionality the end-users want.
Lack of Computer Knowledge	A system run in a computer environment depends on the end users being able to utilize a computer. Without that knowledge the benefit of utilizing the system is decreased and the system can be interpreted as less usable by the end users.
Lack of knowledge of the UI language	The end users do not understand basic symbols (i.e. calendar icons) and language (i.e. Minimize). Also end users are not aware of how to interact with the interactive elements found in UI's (i.e. buttons and text areas).
Lack of Computer Utilization Skills	The end users lack knowledge of communicating with computers, i.e. typing, double/single/right clicking on interactive elements.

Table 5.2: Usability and ICT Related Issues facing eHealth in Uganda

At The Surgery the staff was involved in choosing a new system and had specific demands on what the system was to deliver and how it should be designed. The difference can be associated with a difference in computer experience and the possibility of choice. At the HC in Mukono choice was not an option. There was no discussion or comparison of different systems, as there was no possibility of paying for a different system. The staff at Mukono received a system and had to make the best of the situation.

As the observations and contextual inquiries were only conducted at Mukono I cannot comment on how proficient the personnel at The Surgery were at using computers. However, listed in table 5.2 are the problems encountered when the personnel at the HC in Mukono started using a computer system. These issues emphasise two things, first that the systems developed for health care in Uganda must be based on simplicity, systems must be designed to minimize typing and occurrence of non-expected behaviour. Second, implementation of such systems must be done with care. The successful implementation of an IT system at an eye hospital in India presented in chapter 2.4 supplies guidelines for how this can be achieved. However, it is important to remember that the eye hospital in India and the HC IV in Mukono are quite different, the eye hospital presiding over a larger budget. It is important to teach the staff at clinics such as the HC IV in Mukono how to use computers, and to understand that in the short term implementing a computer system can have a negative effect on the workflow. As presented at the Harvard conference (eHealth in Developing Countries: The Future of Health Care?, 2001), training is a bottleneck for successful implementation of eHealth.

5.2 Opportunities

The problems presented in this essay reveal issues that must be dealt with when implementing eHealth in Uganda. However, the lack of ICT infrastructure is not only a problem but also an opportunity. Systems can be developed catering to Ugandan health care's needs, well thought through implementations can teach valuable computer skills to medical personnel, time consuming work can be automatized and patient data security can be increased. A series of opportunities for health care in Uganda are presented in the table 5.3 below.

The observations at HC IV in Mukono revealed how the medical personnel lacked basic computer skills. However, it also revealed how they are quick to learn, understand and adapt. Once taught the basics of how a computer functions and the basic UI language the medical personnel started using shortcuts to overcome one of their main limitations, typing speed as well as using a mouse and/or track pad. This was only possible if such shortcuts were built

into the UI of the system. One example of this was the calendar function for clinical officers, checkboxes for most common problems and fields with auto fill and scroll down options.

Opportunities	Description
Bridging the gap in knowledge	The lack of computer skills is a hindrance, but can be overcome by teaching the end-users how to interact with the system. Once taught, the end users were quick to adapt. However, learning to utilize a track pad and increase typing speed had a longer learning curve.
Patient Data Security	Patient Data Security is not a prioritized field within health care in Uganda. Using an ICT based system with specified access rights can enable patient data security and aid in creating a medical record, something that clinical officers currently don't have time for.
Statistics	Using an ICT system to generating statistics will remove the need for medical personnel to spend valuable work time to tally the books and spend it on treating patients.
Improved Patient Care	By generating statistics, computerized pharmacy inventory and enabling medical history an ICT system can help improve patient care.
No Path Dependence	Due to only very limited system in place in the health care system in Uganda new systems can be developed from scratch, dependent on the latest technology available in the country with lessons learned from developing health care applications in the Western world.

Table 5.3: Usability and ICT Related Issues facing eHealth in Uganda

At the HC IV in Mukono there was no medical history and the patients carried orders for and results of laboratory tests between the different departments. In the private clinic, where patients did not carry around laboratory results and prescriptions, we as ICT and usability experts could view any information simply by asking the staff. Patient data security is a

luxury that seems to not yet be afforded in Ugandan Health Care. Computer systems can help introduce patient security by limiting access to patient data and sending laboratory test orders and prescriptions over the system.

Computer systems that generate statistics remove a heavy workload from the medical personnel. It can also remove the factor of human error from tallying statistics. A computer system can also generate statistics that the current work processes cannot, such as number of patients received at a certain time and average waiting time for patients. The staff at HC IV asked for this sort of functionality and the system used by The Surgery lacked support for this functionality, which hindered them from optimizing work procedures.

An example of how ICT can improve health care has been discussed here, and the findings are similar in nature to those presented by Lobach et al (2007). Examples of benefits to the health care delivery observed include removing possibilities of human error, remove time consuming administrative work, increase communication between health care centres and allow clinical officers to see which drugs are currently in stock via a computerized inventory, the later enabling clinical officers to optimize treatment of patients.

Software can take the role of path dependence. When developing new software for health care in the developed world, such as an EMR system, current EMR systems and the information stored in them must be taken into account. This has negative and positive implications. Lessons learned from existing EMR systems can be addressed, but standards developed for the existing EMR systems must be adhered to and the new systems should be compatible with the old. Without path dependence, compatibility is not an issue. However lessons learned from older systems in the developing world can be applied to new systems.

5.2.1 Wireless Internet

Infrastructure problems presented here included security, electricity and Internet connection. These problems severely impacted efficiency of eHealth in Uganda. However, as presented here, solutions to some of these problems can be partially circumvented, those of security and electricity. Internet access is a separate issue. As presented earlier, in figure 2.2 on page eleven, while fixed broadband is developing slowly in Sub-Saharan Africa, mobile broadband is growing quickly. Using mobile broadband from Orange, I only lacked Internet access at one point during the seven weeks in Uganda, in a remote lodge in a national park. Therefore, supplying Internet access to a HC (a HC that has the same or similar ICT equipment as that supplied to HC IV in Mukono) requires a subscription, a mobile broadband modem and a mobile broadband router. However, cost is an issue.

HC IV in Mukono had a yearly budget of 4400\$ US per year, which becomes 370\$ per month. Densmore (2010) quotes Internet subscriptions for 45\$ per month, which would be 12% of the monthly budget. For unlimited Internet with Orange the cost would be 101\$ per month, or 27% of the monthly budget. At such costs, cheaper solutions (pay-as-you-go or smaller packages) are to prefer. However this causes other issues, such as the HC running out of Internet and administrative work such as making sure only certain activities can be performed, for which an external IT expert must be brought in. Another option is for the Ministry of Health or UCC to negotiate with mobile broadband providers and provide the HC's with infrastructure. Problematically, the MoH is in a similar situation as the HC's. Their budget is limited and supplying every HC with Internet would remove funding from other important areas, as discussed by Lucas (2008). This leaves the NGO's and foreign aid. However, NGOs' wouldn't and probably shouldn't fund a basic need indefinitely. Certainly, NGO's can supply HC's with the necessary infrastructure, but paying for the upkeep is not as popular, nor is it sustainable. One example of this is the solar panels at HC IV in Mukono. Possibly it would make more sense for an NGO to fund a fixed broadband to the HCs. Therefore, the most viable solution is one or two, i.e. funding by the HC itself or the MoH. In either case, more research must be conducted to prove the need and benefits of Internet at the HCs are worth the costs, and to figure out how to best supply the HCs with internet, fixed or mobile.

6. Shifoclub – The Research Question Revisited

Here I aim to describe what implications the findings of the literature review and the research have on the multi-sided platform, focusing on collaboration and understanding of the stakeholders, mainly the deliverers of medical services and the developers of the medical informatics software.

6.1 The Black Hole – Lack of Communication between ICT Projects in Developing Countries

Many of the findings of this thesis correspond with the opinions and facts presented at the eHealth in Developing Countries held 2001 at Harvard, from here on referred to as Harvard Conference. Most notably there is a general lack of knowledge concerning most elements of development for eHealth in developing countries and a constant reduplication of efforts. That the Ministry of Health stopped most mHealth projects in Uganda in 2012 is a good example of this. During the course of this project I met with several actors, mostly in informal circumstances, involved in developing applications for eHealth, most developing for Ugandan health care but also some working in Rwanda and Kenya. Often these meetings occurred by chance, and almost all supplied me with valuable insight and ideas into our thesis work.

Though eleven years have passed since his presentation at the Harvard Conference, Alexander Jaded's insight that most development projects are working in the dark still holds true, the ICT4MPOWER project built heavily upon hypothesis rather than real data. There is a lack of information on current work practices, on the state and knowledge of ICT in developing countries and the basics of health and eHealth are poorly understood (eHealth in Developing Countries: The Future of Health Care?, 2001). Shifoclub could and should become a meeting and discussion place for system developers and medical professionals aiming to improve eHealth in developing countries. If the knowledge and insight from the members of all eHealth projects active in Uganda last year could be spread throughout the development community much unnecessary ground work would not need to be redone, to the greater gain of medical professionals of Uganda. Even if some of the developers would wish to refrain from publically presenting information concerning their projects, gathering their contact details and project aims would enable communication between developers and show developers what is being done, in order to prevent the reinvention of the wheel.

Concerning Shifoclub as a distribution platform, it is important to realize what Shifoclub actually is and could become. Lucas (2008) defines innovations into two categories; innovations that reinforce existing behaviour and innovations that possess the potential to

transform existing systems and changes behaviour. The EMR system developed by ICT4MPOWER is a reinforcing innovation and Shifoclub could and should become a transforming innovation. Being web based is a first step in becoming a transforming innovation, as it does not hinder Shifoclub to any specific technology. Web is a medium that can be accessed through a multitude of devices, including technologies currently only in development. However, the important question is which opportunities and interest medical personnel in developing countries currently have in searching for software to be used in the workplace. As of yet, the public health sector in Uganda lacks the basic infrastructure to support a computer based EMR system, and it is questionable if the MoH should or will relinquish their control over which systems are used in the public sector. The private sector is a different story. These contrasts will be discussed later on.

6.1.1 Sharing Information and Building a Common UI Language

The current infrastructural limitations that could hinder the effectiveness of Shifoclub as a distribution platform justifies that currently Shifoclub should aim at gathering information about ICT developers and eHealth projects in developing countries. Earlier I presented the problems experienced by the end users, much due to their lack of computer knowledge. I also presented how these problems could be addressed by making the UI more usable by incorporating graphic elements and auto complete functionality. Another problem encountered was the identifying and registering of patients with a lack of unique identifier (social security number). ICT4MPOWER is not the only project that has encountered these problems, we discussed the unique identifier problem and a potential solution with a physician working with mHealth in Kenya.

To increase the usability of eHealth applications in Uganda, Shifoclub should create a design pattern library for health care in Uganda that help developers produce more usable UI's. This, incorporated with developing developer guidelines, distributed through Shifoclub, could produce an incentive for eHealth developers in the developing world to utilize Shifoclub and share their own experiences.

6.2 The Private and Public Sector

The private sector is an important deliverer of health care services in Uganda. Certain issues concerning ICT in health care faced by the public sector are likewise faced by the private sector. However, the private sector hospitals and clinics also face other problems not faced by the public sector, partly due to slightly different work processes, more funding, and higher degree of technical sophistication. Here I present how Shifoclub can cater to both private and

public institutions needs, how applications can be used for both, and how the different realities faced by the different institutions places different demands on Shifoclub.

6.2.1 Opportunity of Choice

As displayed in figure 4.1 and 4.5 the workflow process at the OPD in Mukono and the OPD at the Surgery are similar in nature, with the exception of the payment procedure used at the Surgery. Both of these institutions have the same goal, to give patients the best possible care. However, there are differences. While the HC IV in Mukono doesn't have to take competition into account, the Surgery competes with a host of other private health care institutions. There is also a difference in the economic reality faced by the two institutions. Where Mukono has a budget of 11 million UGX per year, the Surgery has a budget of 280-300 million UGX per month. However, it is important to note that Mukono's budget does not include drugs, rent, vaccines and investments, which are handled by the Ministry of Health. Also interestingly, despite the astronomically larger budget, the Surgery barely makes a profit.

The goal of the HC IV in Mukono is to give patients the best possible care, but their ability to do so is highly restricted. The goal of The Surgery is to give best possible care to patients, and while they have the potential to achieve this, their price range excludes the majority of the Ugandan population from the list of possible patients. Where a consultation at the HC lasts for around three minutes, a consultation at The Surgery lasts for 15 to 20 minutes. Where the medical personnel at the HC had little or no interest or input into the system from ICT4MPOWER at first, the staff at the Surgery had seen and reviewed several new systems, they knew what they were looking for. The final point is an important one, a point that describes what I've come to call the opportunity of choice.

6.2.2 The Implications of Opportunity of Choice on Application Design and Shifoclub

Opportunity of choice is the medical staffs possibility of influencing what ICT tools they are working with, and the factors that influence this choice. The ICT4MPOWER system was presented at two occasions, once to the members of the staff at the HC IV in Mukono and once for the members of the staff at The Surgery. It was interesting to note how the system was received at the two different clinics. At the Health Centre in Mukono only the manager spoke, the personnel remained silent unless asked a specific question, and once the presentation was over the personnel stood up and left. At The Surgery the presentation developed into a heated debate about how the system could be adapted to solve certain problem areas. The former is an example of poor opportunity of choice, the later of good opportunity of choice.

According to Ruxwana et al (2010), using ICT in health care is not only a technological breakthrough, it also involves creating a new state of mind, i.e. a new way of thinking about health care services. Changing the way we think about health care services means promoting institutional change amongst the organisations working with health care services. According to Robert Common, executive of an NGO active in Uganda, “Institutional change requires at least five years and constant presence” (Common, Robert, April 2012). To achieve sustainable change it is important to focus on the needs of the community, not the whims of the donors, a point raised during the Harvard conference (2001).

How charity work should be conducted is a complex question with no answer, and is not what will be discussed here. Rather, the focus is on the multitude of projects active within eHealth last year, before the ban came into effect. A good many of them focused on the public health sector, and a good many of them had resulted in nothing more than a successful pilot. One reason for this is that presented by Lucas concerning SATELLIFE; “*Should the government commit the implied annual expenditure, given other demands on the overall government health budget of some 150\$m*” (Lucas, 2008, p. 2124). Once a pilot project has been conducted at a HC or with a VHT, someone has to pay for the project to scale. That someone would be the MoH, unless an NGO or research institution wishes to pay for it themselves. It is important to ask the question, can and should the already strained budget of MoH handle the extra costs? This rarely happens, which has resulted in a saying in Uganda that goes “*When white faces go leave, everything goes back to normal*”, according to a member of ICT4MPOWER.

Let’s follow the process through the eyes of a HC, such as the one in Mukono. A team of westerners appear at the HC’s doorstep, introduced to them by a member of the government, possessing a prototype or idea or finished system. The HCs’ manager and staff, who lack computer knowledge and understanding of the problems associated to implementing ICT systems, are happy to receive the ICT equipment and software. Lacking the opportunity of choice, i.e. the knowledge to make specifications, financial muscle to compare several different systems, the right to decide which systems they wish to use and the knowledge that all ICT implementations will demand organizational changes, the medical staff places unrealistic hopes on the effectiveness on the system. Two results from such ideas and projects are presented above, the telemedicine project collapsed before it began and the ICT4MPOWER system ran into problems developing a system usable enough to facilitate work processes for the medical personnel.

Of course, there are ways to facilitate the implementation, several explained by Scholl concerning the implementation of an EHR system at an eye hospital in India. The approach

taken by the hospital in India, however, requires funding and a strong position held by the medical staff. Supplying computers, for example, would be possible in Uganda as well, Densmore (2010) discovered that the medical staff were willing to buy computers with Internet connection on a leasing plan, though it was unclear if they had the ability to do so economically.

The staff at the Surgery was much more involved during the presentation of the system than the staff at Mukono. This could be attributed to higher degree of education and computer skill for the staff at the Surgery. With higher education and improved computer skill it is possible to place demands on a system, and having seen other, similar systems the staff can make comparisons and have an idea what is possible and what is not. More importantly, the staff at the Surgery has the option of rejecting a system, knowing they can find another one. The staff at the HC IV in Mukono don't, if something is order from above (i.e. MoH) they can do little but accept the decision. Also, if they refuse a system, the staff cannot simply contact a new NGO for a different ICT based system.

What implications does this have for Shifoclub and design of eHealth applications in developing countries? Foremost, an important part of HCI is collaboration in design between developers and end users. Establishing a good cooperation is easier with end users who have computer knowledge, who have an idea of what a system should accomplish and can come with constructive feedback. This enables a dialogue between developers and end users, and hopefully results in more usable software. Establishing a dialogue with the personnel at Mukono was difficult, the project team had observe and draw own conclusions as to what the users needed, a stark contrast to the meeting with the Surgery. For Shifoclub and HCI4D, it could be necessary to start rethinking partners for design. If better, more usable and intuitive software can be developed with private partners such as The Surgery, it might make more sense to first develop software with private clinics, hospitals and other health care service providers, and there after implement these systems in the public health care. From the argumentation presented above, this might lead to better more usable ICT systems within the health care sector.

7. Discussion

In this report I have presented the findings of a field study in Uganda, researching how the Ugandan health care system utilizes ICT technology. Research was conducted at two private health centres, at one private hospital and at one private health clinic. The aim of the research was to analyse how the Ugandan health care system utilized ICT technology, what infrastructural factors limited the use of the ICT technology, and how the computer proficiency of health care workers in Uganda impacted the usability of an electronic health record for an outpatient clinic at a local public health facility. This report was written partly for Shifoclub, an organization attempting to create a distribution platform for eHealth applications. During the writing of this report the term distribution platform was revised, as distribution of health care applications was but a small part of what the platform aimed to achieve. A more fitting description is the term multi-sided platform used throughout the course of this report.

Attempts have been made at incorporating ICT in health care in Uganda, both via the government and via NGOs, research teams and large aid organisations. However, the actual diffusion of ICT technology has been limited, few projects have been scaled up after the pilot testing has been completed. Over one year ago the Uganda Communications Commission and the Ministry of Health supplied two health centres with five computers to be utilized for telemedicine. A telemedicine centre was erected in the national hospital Mulago, but one year later, the computers have still not been utilized for telemedicine. The literature review revealed that many ICT projects, once having completed the pilot study, failed to scale up.

Three infrastructural issues hindered the use of the computers for telemedicine, lack of security, lack of Internet and frequent power cuts with out sufficient back up generators. Few doors in the facilities could be locked, none of them doors to areas which where used to receive patients. There was no connection to the Internet, either via fixed broadband or mobile. Power cuts were frequent, and though there were two back up systems, one, the solar panels, had a broken inverter that was too technological for local engineers to fix and the other, the diesel generator was not connected to the OPD clinic. There were plans to solve these issues, but most required external funding from MoH or ICT4MPOWER, as the HC IV in Mukono was under financial strain. As anything involving the MoH takes a significant amount of time, using portable laptops and installing a local wireless network could bypass the infrastructural problems.

The computer proficiency at the health centres in particular and Ugandan health care in general are quite low, medical personnel had difficulty interacting with computer applications. It was discovered that it was important to minimize all interaction with computers that did not involve the specific application in use and to minimize typing. The medical personnel lacked sufficient computer proficiency to understand UI language, such as a calendar icon, but once taught were quick to grasp and start using extra functionality. To develop applications for these users, it is of utmost importance to study their work patterns and behaviour before designing the system. Failure to do so could lead to a system that hinders rather than helps the users perform their duties.

Research was conducted at both public and private health centres. From the results it was discovered that the private health institutions had higher demands on any system they would implement compared to the public institutions. This can be explained by the private institutions possessing something called opportunity of choice, which the public institutions do not possess. After finding too many mHealth projects currently active in Uganda, the MoH put a stop to all projects not specifically approved by the MoH. This is an opportunity for the ICT community in Uganda to find a common meeting place to share information, experiences and design solutions for the good of medical personnel and institutions in the country. Furthermore, it is important to reflect on if the public health sector is the right partner for e- and mHealth projects. Already under heavy financial strain it is legitimate to ask the MoH to invest in yet another ICT system with unknown potential. However, the growing private sector has more potential to participate in innovative health service delivery solutions. Also, due to the opportunity of choice, the private sector can place higher demands on systems, which should result in better, more usable systems.

I used several different methods to gather data, with the aim of answering different questions with each method. The context of use analysis delivered data on how the different clinics used ICT and what demands each clinic had on an ICT-system. To understand the work processes of HC IV in Mukono (and therefore HC IVs in general) I utilized observations. Finally, adapted contextual inquiries were used to research how the staff at a HC IV interacted with an ICT system and what problems they had. Therefore, using different methods allowed me to broaden the study and generate a larger amount of data covering more aspects of using ICT in health care. Using only one method would potentially have generated deeper, more in-depth results in one field of study, especially if it was combined with a larger amount of locations of research. For example, had I conducted an ethnographic study as planned before the field research commenced, the data gathered would probably have been different in nature. One of the problems I had conducting the research was gaining access to clinics to conduct research. In

this study I visited the two extremes of the outpatient clinics in the Kampala area, the public HC IVs and the high-end clinic The Surgery. It would have been beneficial for the study to visit a clinic that was in between these two extremes, e.g. a private not for profit clinic or a private clinic visited frequently by the local community. This might have affected the conclusions drawn in chapter six. It is also important to note that some of the sources used in the literary review are quite old, including one from 2001. The source in question, eHealth in developing countries, was included to emphasise how many of the problems presented at the conference still have not been solved, and how these problems continue to affect the development of eHealth tools in Uganda.

How transferable are these results? I've attempted to give a significant description of the process and the environment the research was conducted in. The issues discovered here are not unique to Ugandan health care, rather belong to any context in which basic infrastructure is lacking and end users significantly lack computer experience. Transferability is especially high within Ugandan health care, but also within East Africa, which shares cultural history, values, and where politicians are attempting to increase cooperation. However, special care should be taken when transferring the results to African settings in general. Africa is a continent with immense geographical and cultural differences. Also, researchers should avoid invoking transferability under the term developing countries as health care delivery in developing countries differ greatly.

Throughout the research I have discovered that there is a large need for more in-depth research. There is a lack of knowledge concerning the work processes of the medical staff, how computer and other ICT equipment influence the work situation and the best methods for conducting HCI research in the developing world. As important, more research needs to be conducted on the best way to implement ICT in Uganda to cause long lasting institutional change. A first step in achieving this is to make an analysis of all e- and mHealth projects in Uganda, in an attempt to figure out what works, what doesn't and how the ICT community in Uganda can cooperate to increase the benefit to the medical staff in particular and the local community in general. To help development of usable applications, a design patterns library should be established.

Sadly, Uganda seems to have become a playground for testing of technology without researchers having the patience to stick around to cause long lasting institutional change. Testing which would not be allowed in Sweden was permitted in Uganda. I myself was present in the room when the clinical officer delivered results, some of them life changing, to patients. By helping to implement the EHR system at the OPD clinic in Mukono under a non-controlled environment, I influenced people's lives. At one time I had to deliver the result of

an HIV test to the physician from the laboratory, what if I made a mistake? Also, we were at the health centre as advocates of ICT4MPOWERS system, as well as of eHealth in general. Should the system fail, the staff might become dissolute and reluctant to try a new, different system later that might be better for their needs and just stick to paper. However, there are positive side effects to the slightly ad-hoc implementation process and lax control. By standing with the clinical officers treating patients, we could see exactly where they were experiencing difficulties, come up with solutions and develop the system faster than would be possible in a controlled environment. The downside was a greater level of stress on developers, the research team and the medical staff, as all were dealing with an unfamiliar situation.

Currently, the infrastructure and lack of computer proficiency are limiting factors that hinder the development of ICT in health care. However, the medical personnel in Uganda would benefit from a sharing of information amongst the different ICT projects running in health care in Uganda. Knowledge of what projects are being conducted will help end reinvention of the wheel while UI design patterns can help shorten development time and lead to development of more usable applications that aid end users in their work processes. It is also important to ask the question, is the public sector truly the best partner for ICT projects? That is a question for the future, for now the medical personnel have most to gain from a convergence of knowledge and ideas that are found flying around the eHealth community in Uganda

8. Conclusion

This report has presented a series of issues that the use of ICT in health care, eHealth, face in Uganda. The findings are the result of three contexts of use analysis, observations and contextual inquiries at two public health care centres and one private. E-Health in Uganda face a number of infrastructural and usability related problems. Lack of basic facilities such as water, electricity, communication abilities and security place constrains on which ICT technologies can be used in the context. However, these issues can be partially sidestepped by using laptops and local servers and wireless networks. Also, connection to the Internet is possible using a mobile broadband, though this would place additional strain on an already low budget.

Many of the staff at the public health centres, and to a lesser degree those at the private health centres, lack computer proficiency, have problems typing, interacting with a user interface and understanding the language of computers and user interfaces, such as icons. It is important to develop simple UI's that minimize typing and eliminating interaction with the computer that is not application specific, i.e. the operating system and other programs installed on the computer. To do so, prior to any development taking place it is important to gain an understanding of work patterns and processes of the medical staff.

In recent years there has been an influx of e- and mHealth projects in Uganda, to such a degree that the Ministry of Health issued a moratorium on mHealth projects in 2012. This shows that there is a demand for consolidation of efforts in the community developing for eHealth in Uganda. There is a need for sharing of information between developers, of ideas and design solutions, and of more detailed information concerning the medical staffs work processes. Also, it might be time to reconsider if the public sector should be the main health care partner for ICT projects.

Expert References

Jeremiah Scholl – Medical Informatics Researcher, “*A case study of an EMR system at a large hospital in India: Challenges and strategies for successful adoption*”, HCI Higher Seminar, October 10th 2011, KTH,

Karin Källander – Physician and Health Care Worker at Malaria Consortium, “*Opportunities for eHealth companies in Africa*”, February 15th 2012, Exportrådet – Swedish Trade Council

Robert Common – Head of Programmes at Hope for Children, April 21:st 2012

Kristina Dans – Nurse at a HIV clinic, Uganda. April 30th 2012

References

- UCC. (1999 йил 29-September). *Context of Use Analysis*. Retrieved 2012 йил 20-Mars from University College Cork: <http://www.ucc.ie/hfrg/emmus/methods/CoU.html>
- UHN. (n.d.). *Home: UHN*. Retrieved 2012 йил 4-Mars from Health Net: <http://www.healthnet.org/uhin>
- UsabilityNet. (n.d.). *Analyse Context of Use*. Retrieved 2012 йил 20-Mars from Usability Net: <http://www.usabilitynet.org/tools/context.htm>
- UsabilityNet. (1999). *ISO 13407: Human-centred design processes for interactive systems*. Retrieved 2012 йил 10-March from UsabilityNet: http://www.usabilitynet.org/tools/r_international.htm#13407
- UsabilityNet. (1998). *ISO 9241-11: Guidance on Usability*. Retrieved 2012 йил 10-March from UsabilityNet: http://www.usabilitynet.org/tools/r_international.htm#9241-11
- WHO. (2004). *Strategy 2004-2007: eHealth for Health-care Delivery*. Department of Essential Health Technologies.
- World Health Organisation. (2006). *Building Foundations for eHealth: Uganda*. WHO.
- Beyer, H. R., & Holtzblatt, K. (1995 йил 5-May). Apprenticing with the Customer. *Communications of the ACM* , pp. 45-52.
- Curtis, R. (2007 йил 3-November). What is e-Health and why is it Important? *ADF Health* .
- Carroll, J. M. (1997). Human-Computer Interaction: Psychology as a Science of Design. *Annu. Rev. Psychol.* , 61-83.
- Colao, V., & Coyle, D. (2011). *Making Broadband Accessible for All*. Vodafone Group.
- Eysenbach, G. (2001). What is e-Health? *JMIR* .
- eHealth in Developing Countries: The Future of Health Care? (2001 йил 18-June). *Report/Minutes* . Harvard University: Center for International Development.
- Densmore, M. (2010 йил 22-October). The Case of the Interdisciplinary Researcher: Using Mixed Methods to Observe ICT in Healthcare in Uganda.

- Dourish, P. (2006). *Implications for Design*. Montreal: CHI 2006 Proceedings.
- Forsythe, D. E. (1999). “It’s Just a Matter of Common Sense”: Ethnography as Invisible Work . *Computer Supported Cooperative Work* , 127-145.
- Ghatak, A., Hazlewood, J. G., & Lee, T. M. (2008 йил March). How Private Health Care can help Africa. *The McKinsey Quarterly* .
- Government of Uganda. (2010). *Health Sector Strategic Plan III*. Government of Uganda.
- ICT4MPOWER. (n.d.). *Spider Center*. Retrieved 2012 йил 20-Май from ICT4MPOWER: ICT for Medical Community Empowerment:
<http://www.spidercenter.org/projects/ict4mpower-ict-medical-community-empowerment>
- Pluyemi, A., & Briggs, J. (2008). Technology matters! Sustaining eHealth in developing countries:: Analyses of mHealth innovations.
- Huston, T. L., & Huston, J. L. (2000 йил June). Is Telemedicine a Practical Reality. *Communications of the ACM* , 91-95.
- Kavuma, R. M. (2009 йил 1-April). *Uganda's Health Care System Explained*. Retrieved 2012 йил 5-Mars from The Guardian: <http://www.guardian.co.uk/katine/2009/apr/01/uganda-healthcare-system-explained>
- Kintu, F., Obot, D., & Elder, L. (2005). The Uganda Knowledge and Information Society: Early Lessons From ICT Projects. In F. E. Etta, & L. Elder, *At The Crossroads: ICT Policy Making in East Africa* (pp. 225-239). Kampala: East African Educational Publishers.
- Кнарп, Т., Richardson, В., & Viranna, S. (2010 йил June). Three Practical Steps to Better Health for Africans. *The McKinsey Quarterly* .
- Lucas, H. (2008). Information and Communications Technology for Future Health Systems in Developing Countries. *Socail Science & Medicine* , 2122-2132.
- Lobach, D. F., & Detmer, D. E. (2007). Research Challenges for Electronic Health Records. *Americal Journal for Preventive Health* , 104-111.
- McCann, D. (2012 йил 22-February). *A Ugandan mHealth Moratorium Is a Good Thing*. Retrieved 2012 йил 6-Mars from ICTworks:
<http://www.ictworks.org/news/2012/02/22/ugandan-mhealth-moratorium-good-thing>

Meso, P., Mbarika, V. W., & Sood, S. P. (2009 йил September). An Overview of Potential Factors for Effective Telemedicine Transfer to Sub-Saharan Africa. *IEEE* .

Millen, D. R. (2000). Rapid Ethnography: Time Deepening Strategies for HCI Field Research. *Proceedings of the 3rd conference on Designing interactive systems: processes, practices, methods, and techniques* (pp. 280-286). New York: ACM.

Oh, H., Rizo, C., Enkin, M., & Jaded, A. (2005). What Is eHealth: A Systematic Review of Published Definitions . *JMIR* .

Perednia, D. A., & Allen, A. (1995). Telemedicine Technology and Clinical Applications. *JAMA* , 483-488.

Scholl, J., Syed-Abdul, S., & Ahmed, L. A. (2011). A case study of an EMR system at a large hospital in India: Challenges and strategies for successful adoption . *Journal of Biomedical Informatics* .

Ruxwana, N. L., Herselman, M. E., & Conradie, D. P. (2010). ICT Applications as e-Health Solutions in Rural Healthcare in the Eastern Cape Province of South Africa. *Health Information Management Journal* .

Rogers, Y., Sharp, H., & Preece, J. (2007). *Interaction Design: Beyond Human-Computer Interaction*. Chichester: John Wiley & Sons Ltd.

The World Bank Group. (n.d.). *World Development Indicators Database*. Retrieved June 25, 2012 from The World Bank Group: http://ddp-ext.worldbank.org/ext/ddpreports/ViewSharedReport?&CF=&REPORT_ID=9147&REQUEST_TYPE=VIEWADVANCED&HF=N/CPProfile.asp&WSP=N

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