A study of the preconditions for a sustainable implementation of a digital health system in Uganda

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Abstract ENG

The purpose of this thesis is to investigate the preconditions for an implemented and 100% financed aid project within the healthcare in Uganda. The project is a digital medical record system developed with ICT to facilitate and improve the different tasks performed in the healthcare.

Focus has been on future development and how to properly adapt the system to fit the preconditions in order to achieve self-sufficiency and less reliability on support from abroad.

Research has been made on how the preconditions found in Uganda can be utilized for a sustainable project.

The main source of information for this thesis comes from conducted field studies in Uganda consisting of observations at a health clinic, general observations of the country, its inhabitants and interviews with experts within the field of ICT4D in Uganda.

Conclusions from the results points out modern technology as a less important key-factor in the achievement of a sustainable ICT-project within the healthcare in Uganda.

Abstract SWE

Syftet med denna undersökning är att utreda förutsättningarna för ett implementerat och 100% finansierat biståndsprojekt inom sjukvården i Uganda. Projektet är ett digitalt journalsystem utvecklat med ICT för att underlätta och förbättra de olika uppgifter som utförs inom vården.

Fokus har legat på framtida utveckling och hur man korrekt kan anpassa systemet efter förutsättningarna i syfte att uppnå självförsörjning och självständighet.

Undersökning har gjorts för att förstå hur förutsättningarna som finns i Uganda bäst kan utnyttjas för ett hållbart projekt.

Den främsta informationskällan för denna avhandling kommer från genomförda fältstudier i Uganda bestående av observationer vid en vårdcentral, allmänna iakttagelser av landet, dess invånare och intervjuer med experter inom området ICT4D i Uganda.

Slutsatser av resultaten pekar ut modern teknik som en mindre viktig nyckel-faktor för att uppnå ett hållbart ICT-projekt inom sjukvården i Uganda.

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1. INTRODUCTION

In this chapter an introduction to the subject of this thesis will be presented. A short briefing about the background will introduce the reader to the exciting subject of ICT and ICT4D followed by the purpose and research question. The chapter ends with the delimitations.

1.1 Background

Here a short background will be presented. It explains some of the interesting aspects of the subject ICT.

Information and Communication Technologies for Development (hereafter referred to as ICT4D) is a rapidly growing subject in the aid sector (Mekonnen, 2012). Simple and easy technology brings new possibilities for an improvement within the healthcare in low-resource countries.

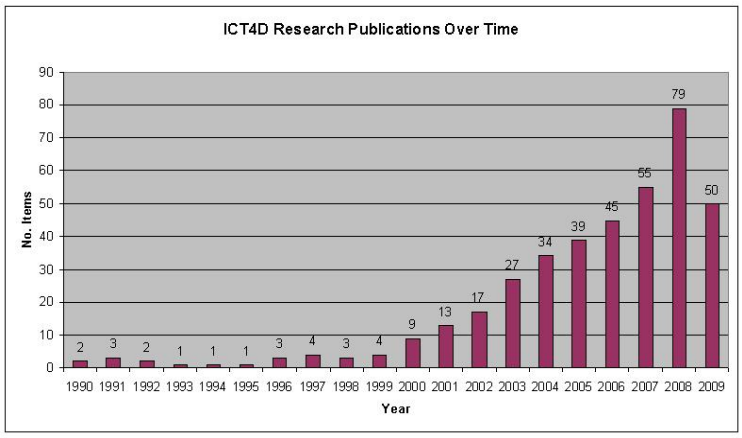


Fig. 1 Compilation of texts regarding "ICT4D" in ThomsonReuters Web of Knowledge. *source: http://wokinfo.com/*

United Nations pays particular attention to the future possibilities of Information and Communication Technologies (hereafter referred to as ICT) in the healthcare and believes that with the help of ICT the advancing towards the Millennium Development Goals will greatly improve (UNDESA-GAID 2009).

ICTs have a strong influence on the African economy and properly adjusted it can have many advantages. Measured result shows that 10 extra phones for every 100 people in an average developing country could boost GDP growth in the respective country by as much as 0.8 percentage points (Harding, 2011).

For technologies, integrated in ICT-systems, to properly work in development countries it is crucial to take certain preconditions into consideration to make the system sustainable. The preconditions for implementation of digital systems in low resource countries differ a lot from the western countries. It makes the process of designing such a system far more complex than one might think.

Since three out of four projects fails due to the fact that the projects are governed from the outside (Tost, 2013). It seems like many projects fail to adapt their technologies to the implementation environment. ICT4D has grown greatly in a short period of time and new technologies are developed more rapidly than ever. There is a great need for better research about which preconditions that affects an ICT4D implementation. To get a closer look and deeper knowledge on the situation in Uganda a months field studies have been performed on a newly developed E-health program in Uganda.

1.2 Purpose

The purpose of this thesis is to investigate how a better awareness of the preconditions in a low resource country can improve the implementation of an ICT4D-project and why this also is a key factor for the project to remain sustainable.

- Which different types of preconditions exist and how are they linked together in an ICT4D-project?
- What changes could be made to the development process to suit the technical knowledge of the end-user in Uganda?
- How could our result help the development of future similar systems in low-resource countries?

1.3 Research question

There could be many reasons to why ICT4D-projects fail to succeed and maintain sustainability. All our research is focused on the preconditions for implementation of a sustainable ICT4D-project in low-resource countries and why technology may not be the most important factor. Our research question is as follows:

Does technology alone have the possibility to maintain sustainability when implementing an ICT-system within the healthcare in Uganda?

To answer this question a thorough investigation of the preconditions in Uganda will be performed.

1.4 Studies range and delimitations

Since there are many possible ways of describing the problems regarding healthcare in low resource countries. It is sometimes difficult to point out which one to address. Therefore some delimitations been made throughout the text.

Our study is concentrated to one health center in Uganda, which has been chosen to carry out the pilot system and is also where it is operating at the moment.

The field studies are conducted on the users of the system and not on the patients in the HC.

This study concentrates on implementation through aid from a Swedish model of implementation and with a few local participating organizations. There are also some interaction with technicians/engineers and other system developers in the relevant area, although their participation is very limited.

Because the English language is widespread all over the country no account has been taken to any of the present indigenous languages.

Some independent people have been influential to our study. These were believed to give a broad understanding of different possibilities to implementation of this kind of system in Uganda. They were also considered enough expert help for the study conducted.

When looking at the preconditions in Uganda we have chosen not to look deeper into the political aspects of the country.

2. THEORY

In this chapter, the relevant theory for this thesis will be presented. The large subject of ICT and ICT4D has a strong influence in many areas. Therefore, many theories that are of interest in order to provide a more comprehensive response to the research question have been taken into consideration. Also the chapter gives the reader a crash course about Uganda to gain a better perception of the country. Information that is important for a better understanding of the results from the field studies that have been performed for this thesis. The ICT4MPOWER project will also be introduced as a subchapter to this chapter.

2.1 List of acronyms

Here follows a list of acronyms.

ICT	Information and Communication Technology
ICT4D	Information and communication technology for development
VHT	Village Health Teams
E-health	ICT within the healthcare
EHR	Electronic Health Record
ECG/EKG	Electrocardiogram
H.C IV	A clinic offering basic health care in a county in Uganda.
UCC	Uganda Communications Commission
MOH	Ministry of Health (Uganda)
KS	Karolinska Hospital in Huddinge

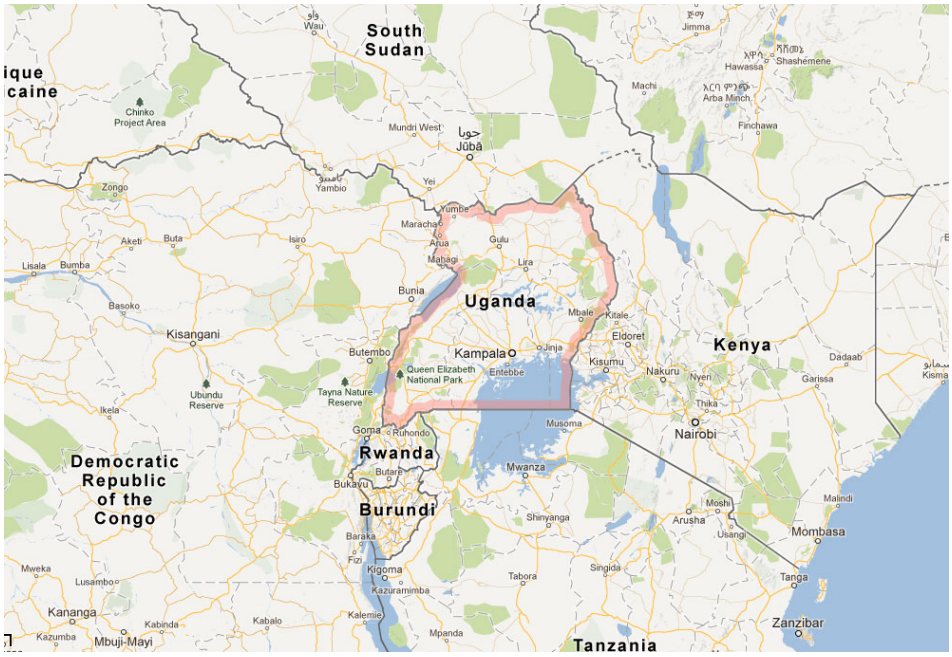
2.2 Uganda abbreviated

Uganda is probably best known for the notorious dictator Idi Amin who ruled the country in the 70's. Despite this horror, Uganda is a beautiful country with a lot of potential. Winston Churchill once called it "The pearl of Africa".

2.2.1 Fast facts

Geographic

Uganda is located on the equator in the middle of Africa. The country has borders to Kenya in the east, South Sudan in the north, The Democratic republic of Congo in the west and Rwanda and Tanzania in the south.



The map of East Africa. Source: Google Maps

The whole country has a total area of 241 551 km^2. Uganda has no coastline so most of the transportation and shipment goes by road. The capital city of Uganda is Kampala with around 1.5 million residents and is located in the middle of the country.

Demographic

Population:	34.5 million
Birth registration (children under 5):	30 %
Young population:	53 %
Under five mortality rate:	90 per 1000 births
Maternal mortality rate :	430 per 100, 000 live births
Life expectancy at birth:	54.1 years
Population growth (annual):	3.2 %

Percentage of population living in rural areas:	87 %
Children per women:	6.2 (2nd highest in the world)

Economic

GDP (billions):	$16.8
GDP per capita	$487
GDP growth (annual):	6.7 %
People living below the poverty line:	29 %

HIV/AIDS

Adult HIV prevalence rate:	6.5 %
Children under age 15 living with HIV:	150, 000
Children orphaned by AIDS (ages 0-17):	1.2 million

Education (facts from enrolment 2007-2010)

Net primary school enrolment ratio:	94% of girls; 91% of boys
Net secondary school enrolment ratio:	21% of girls; 22% of boys
Literacy rate among youth	85% of females; 90% of males
Percentage of people with access to Internet:	13%
Mobile phone usage:	38/100 of the population

(UNICEF, 2012)

2.2.2 The history of Uganda - a time of colonization, war and dictatorship

In 1894 Uganda became colonized by Britain (BBC, 2012). At that time Uganda were divided into different kingdoms. The Britons favored the Buganda Kingdom and supported them with weapons and technology, which turned Buganda into the most powerful Kingdom.

The republic of Uganda became independent from Britain in 1962 and celebrated its 50th anniversary in 2012. Since its independence Uganda has been involved in wars with Sudan, Democratic Republic of Congo and Rwanda. During the time of the dictator Idi Amin(1971-1979) about 300 000 Ugandans lost their lives and most of the population with Asian origin were given 90 days to leave the country. Due to the Asian influence on local business this lead to a collapse of the economy. The exotic wildlife was slaughtered by military, making the tourism to evaporate and the inflation to hit the 1000% mark.

When the Tanzanian army defeated Idi Amin in 1979 the country was in a bad condition and the economic infrastructure had been heavily damaged. The current president Yusuf Museveni became president 1986 after some chaotic years under the successor of Amin, president Milton Obote. The new regime benefited from a big international support and the former damaged economy slowly started to recover.

In Year 1995 the Ugandan Constitution decreed a limit of two terms, a total of eight years, for the sitting president. Museveni has now been the Ugandan president for 25 years and have changed the constitution to be able to remain as

sitting president. Efforts to amend the constitution and alleged attempts to suppress the oppositional political forces have attracted criticism from domestic commentators, the international community and Uganda's aid donors. This led to many countries limiting their assistance to Uganda and withdrawing their aid mainly due to embezzlement (Sida, 2012). This is where Uganda is today and the people continue to question Museveni as Uganda's president (CIA, 2013).

Uganda claims to be a democratic country but lacks a common faith towards the government because of greed, corruption and despotism (Daily Monitor 2013). In Uganda it is being considered to be good manner to help the people voting for you. One effect is that western Uganda, where Museveni has his roots, is far more developed than other parts of Uganda and this keeps the distribution of economic wealth between different parts of the country radically unequal.

2.2.3 Development of ICTs in Uganda

In 1996, as the Ugandan government decided to change the policy framework for the telecommunications sector, the state monopoly was dissolved and the market was opened up which enabled large companies to enter the market. This led to major changes within the ICT in Uganda.

The number of telephone lines increased with 2600 % from 0.25 lines per 100 inhabitants in 1996 to 6.5 lines per 100 inhabitants in 2006 (Ssewanyana, 2007).

The bulk of the investments expenditure was in the rollout of broadband and other Internet related infrastructure. The post and telecommunication service activities grew by 30 percent year 2009/2010 and accounted for 3,3 percent of GDP. The ICT growth has a profound impact on the whole Ugandan economy, which makes the ICT sector very important for the further development of the Ugandan economy (Uganda Investment Authority, 2011). The last three years the expansion of telecoms has doubled and at the moment there is about 16-17 million active sim cards, which corresponds to about half the population of Uganda (Cameron, 2013).

2.2.4 The Health Care in Uganda

The health care in Uganda is heavily underfinanced and ranked as one of the worst in the world, the country is ranked 186th out of 191 nations (The Guardian, 2009), so improvement to the Ugandan Health Care are very much needed.

The health facilities are divided in different types of Health Centers (hereafter referred to as HC). The most local HC, the HC - 1, 2 and 3 are all small and primitive. It is a lack of medical equipment, staff and medicine due to the fact that the majority of funds from the government go to the hospitals in the cities (*Ssengooba Et Al., 2004)*. This makes the HC I, HC II and HC III very inefficient in providing actual health care and most of the times the patient will not find any suitable treatment at the clinics. Because of this, most people who lives close to any of the HC - I,II,II choose to travel further away to reach any of the bigger HC IV clinics. At the HC IV there are different clinics, a few persons with medical education and a better supply of drugs, which altogether make the HC IV more reliable for obtaining medical care. Hospitals in major cities have better medical

equipment due to higher priority by the state. On average, 49 percent of the Ugandans are within a 5 km distance from a health facility (Ssengooba Et Al., 2004). This turns the travel to the bigger HCs into a complex task, forcing a lot of the people to skip their treatments.

Level		Health Centre	Population (approx.)	Services Provided
District	Health Sub-District	I	Village - 1,000	Community-based preventive and promotive health services. Village Health Committee or similar status.
		II	Parish - 5,000	Preventive, promotive and out-patient curative health services, and outreach care.
		III	Sub-county - 20,000	Preventive, promotive, out-patient curative, maternity and in-patient health services and laboratory services.
		IV	County - 100,000	Preventive, promotive, out-patient curative, maternity, in-patient health services, emergency surgery, blood transfusion and laboratory services.
		V	General Hospital – 500,000	In addition to services offered at health centre level IV, other general services are provided including in-service training, consultation and research for community-based health care programmes.
Regional		VI	Regional Referral Hospital - 2,000,000	In addition to services offered at the general hospital, specialist services are offered, such as psychiatry, Ear, Nose and Throat (ENT), ophthalmology, dentistry, intensive care, radiology, pathology, higher level surgical and medical services.
National		VII	National Referral Hospital – 24,700,000	These provide comprehensive specialist services and are also involved in teaching and research.

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Fig. 2 Explanation of the different clinics in Uganda. (Source: Ssengooba et al., 2004)

2.2.5 Economical position of Uganda

International donors provide the major source of development assistance to Uganda (Ssengooba Et Al, 2006). It is probably the lack of professionals in all areas that helps to retain difficulties for sustainable development. There is more than 1.5 million newborn each year in Uganda, one of the highest in the world, and with the fact that Uganda still is being an agricultural country it is a challenge to find other labor for all people. The situation is more or less a perpetual spiral, where the majority of the children help out on the family farm, which keep the them outside welfare systems such as higher education simply because they do not yet demand it.

Right now Uganda is struggling with the obstacles that come with modernization. The most important thing is the desire to improve equitable human development but also the need of increasing efficiency, productivity, competitiveness and transparency in private and public enterprises. Today Uganda has diverse

strategies in the modernization. One of these strategies is the use of ICT (Tashobya Et Al, 2003).

2.3 Technology – a social construction

The theory of socio-technical systems are very important for this thesis and brings valuable knowledge that will explain much of what will be discussed later on.

Modern technology could be seen as a complex system of bits and pieces (Summerton 1998). Looking at the most common technologies such as the phone, it is important to remember what it is that makes the phone work. The phone itself is just a device and can be either mobile or stationary. What is it that makes the phone such a valuable gadget?

Looking at the bigger picture one can quickly realize that the value of owning a phone is because other people also have phones and owning one makes you able to connect with them. But for this phone to work properly certain preconditions must be met. A power grid has to be available to provide the phone with electricity. There has to be a phone network present and an operator that can provide this service. Financial support is crucial to maintain the power grid and without money the operator will go bankrupt and probably close down the network.

Knowing this, the phone could be viewed as a system of different artifacts that creates an amazing technology. Without the different pieces the phone will not work properly. Humans are a part of this technology because without users the phone gets useless since there is none to call. Without an operator there is no network to connect to and this also makes the phone useless. Technical systems thus consist of far more factors than just technical components (Summerton 1998). A more accurate view of technical systems is perhaps that they are socio-technical systems in which technology and society unite into one complete system (Hård 1990).

It is not technology that develops society but rather the society that develops technology and how it is used. If technology is a socio technical system it means that the technology is adapted to work in a certain community.

There should not be any sharp distinction between technology and society and it is a very important realization that a so-called clean technology on its own cannot solve all our problems (Hård 1990).

2.4 ICT4D - Information and Communication Technologies for Development

This subchapter presents what ICT and ICT4D means and the definition of ICT and why it is important.

A simple definition of ICT is that ICT is a generic term that includes all kind of technologies that are being used in the collecting, storing, editing and passing of information in various forms. (Jagger Et Al, 1999) It is mainly associated with the use of mobile, Internet and computer technology for sharing information. ICT is widely used in several different areas of the society and is believed to play an important role in which way the people do businesses, perform their task and communicate with each other (Mekonnen, 2012).

ICT4D is a relatively new and highly dynamic field of development intervention and today it is a big topic within the field of aid-work. It is not just about technology but also about helping poor and marginalized communities across the world to benefit from technological development to improve the quality of their lives (Spider, 2012). One can say that ICT4D is the application of ICT within the field of socio-economic development (Online Education Institute, 2008). While in many other areas of ICT, where people solve problems with the latest technology, the aim for researchers and developers of ICT4D is to develop technologies that actually work where the circumstances are different from those in richer countries. For example it can be the lack of electricity or when the primary factor of deciding is the major cost of a project (Magnusson Et Al, 2011).

ICT4D can be divided into three phases as the technologies have evolved throughout the history (Heeks, 2008). In the first phase, before the 1980s, the ICT was used as an administration tool in the public sector. The next phase started with the introduction and growth of the Internet, creating an upsurge of interest of applying ICTs in developing countries. The best example of this is all the telecenter[1] projects that were started throughout the low-resource countries. Unfortunately most of the ICT4D projects failed which lead to the creation of the following watchwords within the ICT4D sector (Heeks, 2008):

Sustainability - Many ICT4D projects failed at an early stage and prompted a new emphasis on ensuring the longevity of ICT4D projects.

Scalability - Individual telecenters projects had a limited reach which motivated the need for more scalable solution for ICT4D projects.

Evaluation - ICT4D was often held by aloft hype and uncorroborated stories that fostered a new interest in objective impact evaluation of the projects.

[1] A **telecentre** is a public place where people can access computers, the Internet, and other digital technologies that enable them to gather information.

A large part of the current stage for ICT4D, according to Heeks, is the evolvement from telecenters to mobile devices. There is a big demand for ICT's in low resource countries, and there is much improvement that needs to be done. A lot of the research also points out the telecommunication as essential for economic regeneration as it impacts the economic growth and attracts foreign investment. This since telecommunications investment is regarded as one of the most strategic industries and also the one that has potential to improve the overall productivity for a country (Batuo, 2008). The real benefit of Telecommunications investment are expected to be much higher due to the multiplier effect it provide in other areas (Chavula, 2013).

The opportunities must be carefully weighed against the risks of implementing an ICT4D program since more of the economic, social and political living is run with the help of ICT. This makes the people without ICTs increasingly excluded and eventually all left out (Heeks, 2008). Studies shows that ICT can increase the inequalities, even in industrialized countries, and this has been shown to be determined by the level of education and income of that particular country (NTIA, 1999). Probably the implementation issues could be more dependent on the background of the user instead of the technology itself. If ICT is not used strategically to strengthen the development and poverty reduction efforts, there is a great risk that ICT instead widens the inequalities between the societies and helps to increase the digital divide (Spider, 2012).

2.5 The Digital Divide

Definition: The digital divide mirrors the technology gap separating the rich countries from the poor – a gap that opened up during the industrial revolution and has yet to be fully bridged. (Ishaq, 2000)

A major problem in the implementation of different types of ICT systems is that the gap between poor and rich countries is increasing. As modern technology steadily develops in the western world the low resource countries falls more and more behind in the progress. This means that unless something is done about the digital divide the gap will grow even larger relative to the how fast the technology is developing.

This does however come with strict requirements on what should be prioritized otherwise it can be counterproductive. It can put the developments to a hold and in fact even impede progress. There is a need for ideas on a coherent regulatory framework to guarantee transparency, data protection and respect for data integrity (Maaref, 2012). Positive effects with more investments in cloud services can contribute to a better exchange of health care assistance in east Africa and hopefully reduce the differences between urban and rural areas. As it is now the expansion of bandwidth are mainly within the mobile sector (see the small upturn in Figure 3).

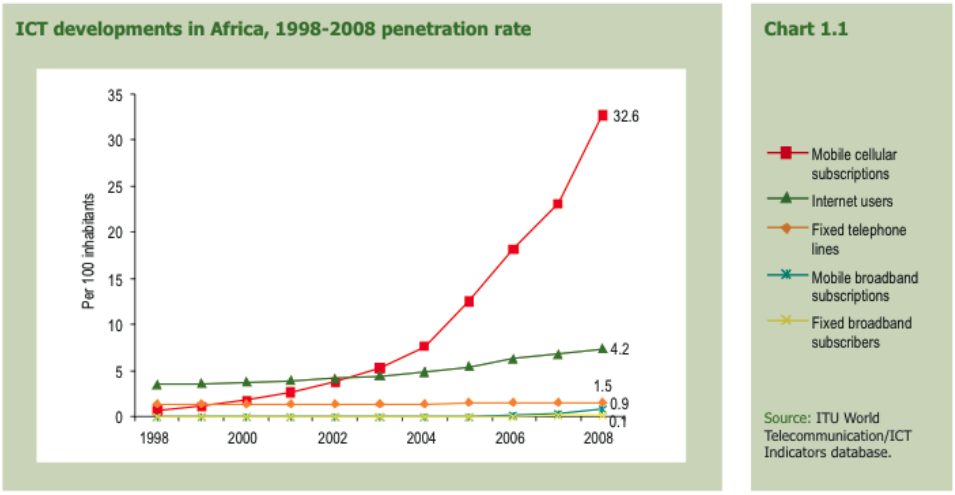


Fig. 3. Graph that shows the ICT development in Africa 1998-2008. ITU, 2009

In the area of cloud computing the cost still remains high and this threatens to reverse the positive trend as more and more systems are put in the cloud.

The producers of technologies impact on the reinforcement of the digital divide cannot be ignored. As for profit companies, small and large, they naturally cater their products toward larger groups of richer customers, who are more likely to buy. Technology amplifies shareholders interest in profit and globally this means hardware tends to be designed for people working in offices with stable AC power, software tends to be developed in languages understood by the world's wealthiest populations and the content tends to be developed for audiences with the greatest disposable income. This pattern also appears in products that are free, for example, commercial Television or Google. Advertisers who seek consumers with more disposable income, which does not include the people in low research countries, mainly support these products. The result is again that the disadvantaged are further disadvantaged in the low-resource countries and this helps to keep the development down.

The digital divide is, when compared to other producing and social sectors, widest in the health care. This may largely be due to the harsh privatization of healthcare that has occurred in Africa and this may have fueled the already existing structural injustice already present in these countries (Rodriguez, 2003). Managing to reduce the digital divide in the long term will help to fill an extreme need for more long-term follow-up of patients. In many countries they do not use digital technology in the health care and have tremendous difficulties to keep patient records. This has been a challenge especially for chronic diseases such as HIV and Hepatitis. Drugs has been distributed at the wrong time and therefore it becomes difficult to determine if new symptoms that occur are because of diseases or medication errors, which altogether results in a poorer adherence. A reduction and new ideas around how to solve the problems around the digital divide will make all the changes that has to be done much easier and also help to make the future systems become more sustainable.

"If a technology is not designed for someone, she won't buy it; and if she does not buy it, the producers won't design it for her" (Boston Review, 2010). Because of the lack of deeper understanding of technology and the growing gap between those who can use technology and those who do not have the knowledge, the digital divide will only get wider (Rodriguez, 2003).

One can say that developing African countries are experiencing a Catch-22 situation. If they not use these new technologies, future generations will fall further behind and maybe find themselves even poorer. On the other hand, by using these technologies without addressing some of the concerns and needs in the society, the progress can instead stagnate (Obijiofor Et Al, 2005).

To use the words of Kentaro Toyama in an attempt to address these things in an even broader perspective:
"Technology—no matter how well designed—is only a magnifier of human intent and capacity. It is not a substitute. If you have a foundation of competent, well-intentioned people, then the appropriate technology can amplify their capacity and lead to amazing achievements. But, in circumstances with negative human intent, as in the case of corrupt government bureaucrats, or minimal capacity, as in the case of people who have been denied a basic education, no amount of technology will turn things around." (Boston Review, 2010)

2.6 E-Health

This subchapter discusses the role of ICT within the healthcare and how it plays a major role in the development of low resource countries.

E-Health is defined as:
"The use of information and communication technologies (ICT) in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research." (Joaquin Et Al., 2010)

An example of areas where E-Health is used includes treating patients, conducting research, educating the health workforce, tracking diseases and monitoring public health. (World Health Organization, 2013) In short E-Health is a useful term to describe the combined use of electronic communication and information technology within the healthcare sector (Mitchell, 2009). E-health has its origin in telemedicine of which was mostly developed during the mid 1900's. The development of telemedicine was not only so that the individual could easier seek medical advice over the phone but also for hospitals demand for sending Electrocardiograms over the telephone lines. This meant that the distances decreased and medical care was facilitated. Due to the bandwidth problem of the telephone network the development stopped for a while but with the digital boom came new technology that allowed sending information via the data network, which expanded significantly.

With today's advanced information and communications technology the distances between the inhabitants of the country, countryside as urban dwellers, is reduced

and information for people in rural areas have become much more accessible (Chavula, 2013). Basically, in the current situation it can be expected that all the inhabitants of our planet, wherever they are located, in 2015 will be able to get access to the information needed to get the treatment he or she needs for their illness (Healy, 2008). In reality, this goal will probably be reached later than 2015.

E-health, when it is used with mobile phones and handheld computers, is called M-health. Both these versions of E-Health can contribute with information systems that can be of enormous value in providing health care. They can support health workers during their work in the clinics when there is no doctor around and also helps the workers to keep track of patients and accessing their patient history. In recent years this has helped technologies for information delivery within healthcare systems to be proliferated (Chan Et Al, 2010). But without electricity, a good infrastructure and a constant flow of money it will be difficult to maintain a successful technical system. Countries such as Uganda have been through thousands of E-Health projects that have subsequently come to nothing because financiers pulled out (Cameron, 2013). Users of these systems will somehow have to try to find new funders or discontinue the project which again points out the economy as the biggest issue (Healy, 2008).

According to Karolinska Hospital (hereafter referred to as KS) the communities are a bit suspicious to the use of new gadgets. People in rural areas would probably not be so alien for the use of technology if they get properly informed on how the technology would help them. More targeted information to patients by the doctors would also make the transition easier. Nearly all of the communities have access to a phone for SMS and receiving calls so the adaption is expected to go much faster today.

2.7 ICT4MPOWER

Here the project ICT4MPOWER will be introduced and the ones involved.

ICT4MPOWER stands for Information and Communication Technology for Medical Empowerment and is a digital healthcare management system for delivery of public healthcare in rural areas in low resource settings. The overall goal of the project is to improve the information flow from the community to the district and the regional levels of the healthcare system, empowerment of rural health care communities and for better health outcomes of rural population in Uganda using ICT (Karolinska Institutet, 2009).

ICT4MPOWER is a project conducted by a research group at KS in Stockholm on behalf of SPIDER - the Swedish program for ICT in Development Regions and funded by Biståndsmyndigheten - SIDA. The core of the ICT4MPOWER system is the OPD, The Outpatient App, which is a web-based program for patient records and recordkeeping of physical examination. The program is exclusively developed for use in low resource countries and you register the patient into the system together with name, area of residence and date of birth (If no birth certificate is present the receptionist will rate the age as good as possible). The different clinics at the HC are connected to the system through a local network that make it possible to communicate patient information, stock of drugs

and other important information amongst the clinics as well as handling queues and priority of emergency patients. These are the functions that are included in the outpatient app:

- Easily creating digital patient records;
- Managing treatment flows with a triage queue;
- Helping doctors to enter diagnosis directly into the patient record;
- Ordering lab tests and automatically incorporating results;
- Handling referrals through a single system;
- Digital prescriptions communicated directly to the pharmacy;
- Statistical tracking and information management at every step;

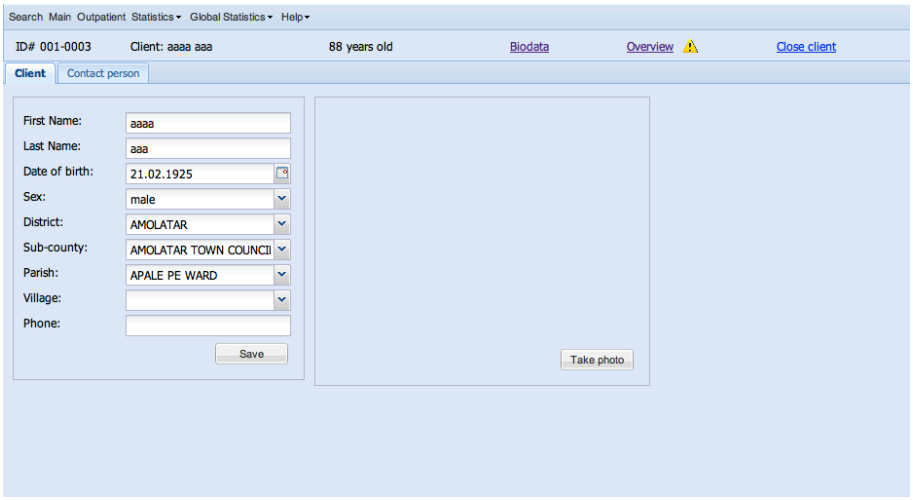


Fig 4 A screenshot of the registration page from the ICT4MPOWER system Source: ICT4MPOWER

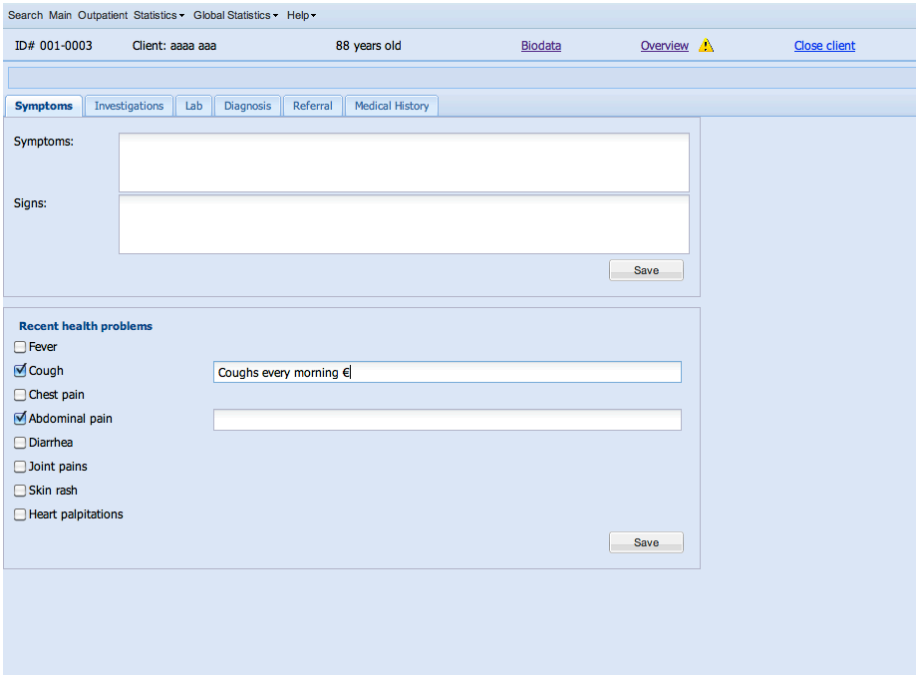


Fig 5. Screen shot at the diagnosis page from the ICT4MPOWER system. Source : ICT4MPOWER

ICT4MPOWER aims to provide outreach solutions to make it possible for people who are unavailable to go to a HC to seek medical attention. The outreach system will use the same web application but instead of laptops they will use smartphones to operate the system. The system aims to provide transparency through all the steps of the program. This is an important factor for tracking failures and bottlenecks in the system. All the users have their own personal digital-signature, which they use to sign their tasks with.

At the time of writing of this thesis the outreach program were still under development and that is why the thesis will be focused on the part of the system that is already implemented at the HC. The ongoing pilot program in Mukono HC IV uses the EHR from the ICT4MPOWER project in their clinical work. The hardware for the programs is laptops and a stationary server provided by KS while power supply of the health clinic is funded by the Uganda Communications Commission (UCC) and the Ministry of ICT. The development of ICT4MPOWER was initiated in collaboration between stakeholders in Uganda and Sweden, with the majority of the developing of the system, taking place in Sweden.

One of the pros with this particular system, and which have also been shown in earlier studies, is the fact that it is network-based. Network services and internet-based ICT solutions have had a great impact and are changing the way stakeholders within the healthcare communicate with each other (Rodrigues, 2003).

2.8 Preconditions

This subchapter is about the preconditions and if any of them differs in the achievement to create a sustainable ICT system.

To make it possible for ICTs to be implemented within the healthcare there are certain preconditions that affects the success of the implementation and the sustainability of the ICT-system. An electronic device needs a constant supply of electricity to work and telecommunication infrastructure is necessary for full use of the Internet and mobile phones. Similarly, basic literacy and the understanding of software functioning are needed for minimally competent use of these technologies (Lötter, 2007).

Technology itself plays an important role. Poor telecommunications infrastructure, limited number of Internet service providers and lack of access to international bandwidth are major issues for Internet applications to work just as a computer needs power to run. The technical standards of a low-resource country may vary from the ones that exist in industrial countries and therefore the technological infrastructure of low-resource countries is a helpful exercise in the selection of appropriate E-Health design and deployment strategies (Rodrigues, 2003). According to research from IBM the technical influence only stands for 3% of the total area influencing project success or failure (Gulla, 2012). This points at the fact that technology itself is not the most important factor for a successful implementation of an ICT-system.

Some important social factors to take into account when developing and designing a system are the cognitive, behavioral, anthropometric, and attitudinal approach of the end-users (Gould & Lewis, 1985). The implementation of ICTs is often occurring in a context where the cultural and institutional barriers are not well addressed. People are in the position as consumers and thus in a position where they cannot yet define the media in their terms. A retrospective of experiences also shows that sustainability of information system projects continue to be a major problem in low-resource countries.

Externally funded projects frequently collapse when the funding is terminated and this fact demonstrates that all projects need justification in terms of cost benefit and long-term financial sustainability (Rodrigues, 2003). It goes without saying that in a system where money is the chosen engine, the lack of it becomes the most significant factor. At the same time conservative attitudes entrenched in African countries and concern over basic needs inhibit the appreciation and the importance of new ICTs.

3. METHOD

In this chapter the used methods will be presented. Why they were chosen and how they were executed throughout the process.

The empirical investigation in this report includes different elements for a broader perspective of the subject and the research question. The underlying literature study was mainly focused on theory concerning the subject only. Information about the methodology was also taken into consideration in the literature study.

During a one-month stay in Uganda two weeks were spent performing a field study at the Mukono HC. The field study consisted of collecting surveys, interviews and observations from the clinic as well as other healthcare environments.

Because of the lack of reliable information about the Ugandan health care system and its economic priorities, the performing of a field study seemed to be the best way to gather the proper information to answer the research question. A questionnaire, made by KI, that investigates the users opinions about the system have been included as a part of the research.

To get better information about the field of ICT4D in Uganda an interview was carried out with Hugh Cameron, professor at the Department of Innovations and Software Development at Makerere University.

3.1 Literature Studies

The literature study was mainly focused for the theoretical framework in this thesis but also to find information about how to perform our empirical investigations.

There has been a lot of research made within the field of ICT and there is a lot of information to be found. The expansion of ICTs has led to big investments from major companies and aid organizations. However, the information to be found about Uganda is scarcer and often the articles and reports about the health care do not have the reliable scientific documentation that is needed. Therefore it is hard to find a larger quantity of reliable academic and scientific literature regarding Uganda.

To gather the theoretical material for this thesis, scientific studies about ICT4D in other low-resource countries has been used. The different theories and models developed for these countries can also be applied to the health care in Uganda due to the similarities that exists between these countries.

The literature study contains both E-documents, such as PDF's, and traditional literature. Online material has mainly been collected through KTH's electronic library, Primo, and Google Scholar. The main keywords used in the search were: "ICT", "ICT4D", "preconditions", "Uganda", "healthcare and sustainability". Search have also been made within the related fields from which literature has references including key words such as "E-health", "IT Africa" and "Economical Development East Africa".

The books that has been used throughout this report, especially for empirical studies, are *User Centred system design* by Jan Gulliksen and Bengt Göransson and *Interaction Design*, written by Reece, Rogers and Sharp.

3.2 Empirical Methods

Observing preconditions in real life is necessary to be able to discover why ICT4D-projects fail and which problems that arises during implementation. These are the empirical methods that have been used to answer the research question of this thesis.

3.2.1 Field Studies - observation and unstructured interviews

Field studies is the empirical method that has the most connection with reality and gives the best opportunity to evaluate the system in a realistic user environment (Gulliksen Et Al, 2011). To do a proper field study the evaluator spends time together with the user of the system, asking questions and observing as he or she uses the system (Gulliksen Et Al, 2011).

Observations were carried out during daily sessions for two weeks and in which the staff at the clinic used the implemented ICT-system. Notes were taken during the sessions and with a camera the users was recorded while working in their natural environment. The computer screens were also recorded to see how the users used the system. This made it easy to go back and investigate what kind of different problems and errors that occurred during the session and what the personnel did to solve these issues. Problems such as: Technical issues, mistakes by the users and misunderstandings. Also problems that were not expected to happen in the extent that was experienced for example power blackouts. During the recorded sessions questions were asked, for example: *What are you doing now? Why do you do like that? What does that mean?* In this way the user has to explain what he or she actually does. This helps to get a better insight to the thoughts of the users.

Field studies will often yield the most accurate results but can be problematic because sometimes the evaluator sometimes may disturb the user in the daily workflow (Gulliksen Et Al, 2011). This was something that was important to have in mind throughout the whole process of the field study. It can be difficult to not intervene in the events that are observed, the very presence of the investigator may cause interference. During the observations the HC was looked at from a preconditional point of view. Things like technical and social standards, power

supply, economic infrastructure, administration and technical knowledge were taken into consideration.

3.2.2 Questionnaire Survey

The development team at KS did a questionnaire survey a couple of months after the implementation of the pilot ICT4MPOWER program. The purpose of the questionnaire was to evaluate how the system was performing and what kind of problems the clinic had been struggling with since the implementation of the system. This survey was used in combination with the other methods to get a better perspective and an idea of what the users thought of the system and how they experience it to be to work with a digital system (Preece Et Al, 2002). The survey had a qualitative character with simple and open questions to give room for the users own reflections, thoughts and ideas. The survey was also used to in a simple way, gather the demographic facts about the users such as profession and gender and also to get the users opinions about the systems usability. (Preece Et Al, 2002)

These were the questions presented in the survey:
1) How was the trial implementation at Mukono and how did the staff react to the new system?
2) What difference has ICT4MPOWER made at the clinic?
3) What in your opinion has been the biggest benefit?
4) Have you had any major interruptions, what is the uptime of the system? (hopefully 100%?)

Since this system have different workstations on the same system it is preferred to have a representative for each workstation to get full information about how the system is performing (Preece Et Al, 2002). The survey had been answered by one participant representative to every workstation in the system, being a total of five, which represents all the different users of the system in Mukono. The team at KS allowed for the questionnaire to be used in this thesis, and it was decided it would be unnecessary to do a new questionnaire survey. Instead focus should be put on the field observations.

3.2.3 Expert Interviews

An interview was conducted with the Ugandan supervisor of this thesis. His name is Hugh Cameron and works as a professor in the ICT department at Makerere University in Kampala. He is an expert within the ICT4D in Uganda and has been involved in different ICT projects during the last years and he provided us with a lot of information about the subject. The interview was carried out for two hours on the 19th of February.

Cameron gave a good insight on how aid and ICT works in Uganda which gave a better and a much deeper understanding on how the economical and social structures are shaped in the country. In the Interview the questions about the preconditions in Uganda were highlighted and especially what he, with 20 years of experience, considered were the biggest problems.

An unstructured interview was carried out with the General manager of the HC IV, Dr. Kasirye. This interview took place in the HC IV during a tour of the facilities where Dr. Kasirye informed on the daily work at the HC and also how the health care are intended to work in Uganda. This interview gave an overview of how the implementation of the system had gone so far and what Dr Kasirye thinks about the preconditions for ICT systems in Uganda.

4. RESULTS

In this chapter the results and findings from the empirical work will be presented. The results show some new findings as well as some predicted results and together they reflect important preconditions for ICT. Some results address the development of the ICT4MPOWER system and in which the development team has been asked questions about their project. Since different methods have been used such as regular discussions, short meetings and cases, the data extracted may be different and hard to compare to each other. The chapter is structured to make it easier for the reader to follow what has been done within each organization.

4.1 The Mukono Health Center IV

This is a short overview of Mukono Health Center.

The Mukono HC IV consists of several houses spread over a large area. Each house has its own clinic that is specialized in different fields of medicine. The different houses are Reception with a waiting room and a pharmacy, a Laboratory, a Maternity clinic, an Infants clinic, a HIV clinic, an office for the doctors and furthest away is the Tuberculosis clinic due to infection hazards. The general manager of the HC is Dr. Jeffrey Kasirye.

An overview of the HC in Mukono (Photographer: Noa Julin).

Most of the facilities have examination rooms for doctors to carry out their work. The geographical structure of the HC makes it very suitable for ICT to improve communication between different clinics. This is especially important for the reception to coordinate patients to the appropriate clinics and for the clinics to get a good overview over the current 'patient situation'.

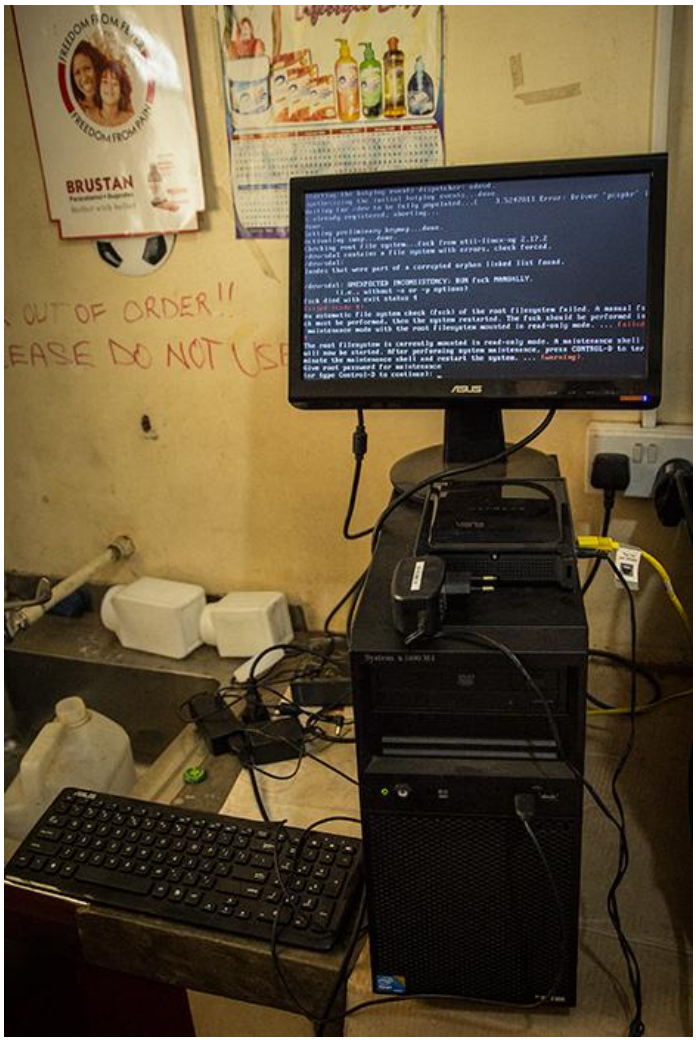
View over the health care center IV (Source: Google maps).
1. Reception/pharmacy, 2 Laboratory, 3 Maternity clinic, 4 Infants clinic, 5 HIV clinic, 6 Doctors office, 7 Tuberculosis clinic.

4.2 Technical standards and issues

Here follows the results from the observations made at the clinic from a technological perspective. What kind of technology that already exists and what technology that has been implemented for the ICT4MPOWER project has been taken into consideration.

4.2.1 Equipment

The technical standards at the Mukono HC are not very similar to the standards of the clinics in modern countries. Many of the procedures in the HC are performed without the necessary equipment that affects the outcome of the examination. The lack of equipment is mostly because of the lack of funding and this seems to be a problem in many of the clinics in Uganda. The major part of digital equipment's in the HC is located in the laboratory in form of a stationary computer and a blood analyzer. For the ICT4MPOWER project, KS provided 5 laptops with chargers and a stationary server with a WIFI-modem.



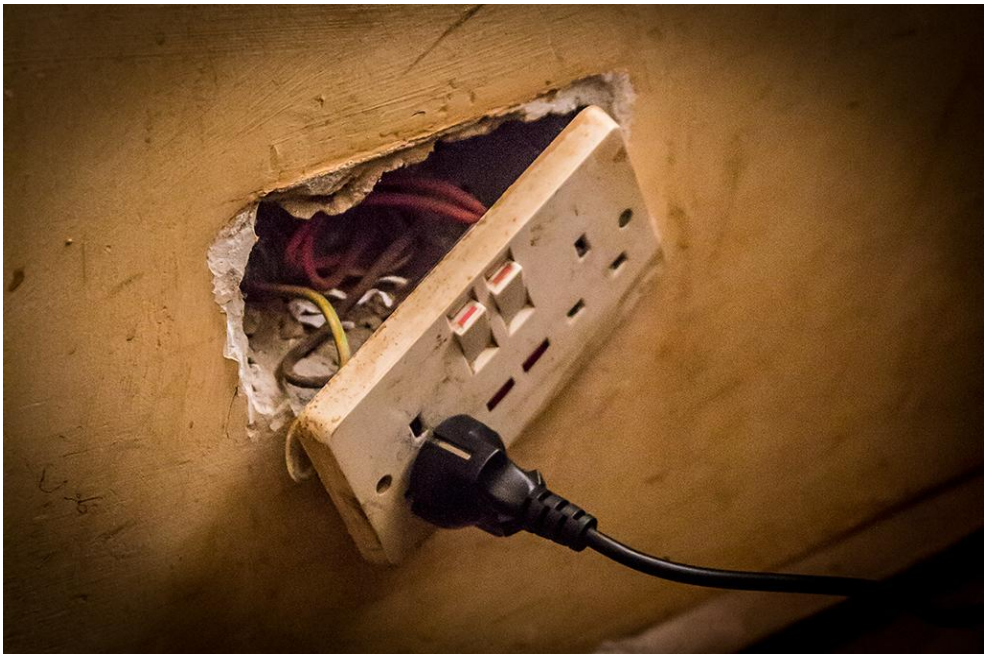
The ICT4MPOWER server located in the storage room. photographer: Noa Julin

4.2.2 Network and Internet Connections

There is a network of Ethernet cables at the HC connecting the different clinics but at the time of this research there was no system using this network. The cables had been put there to provide the health workers with Internet connection, however the HC had not been provided with any Internet connection by the government.

The ICT4MPOWER system uses a WIFI signal distributed from a router connected to a stationary server that runs the ICT4MPOWER server program. The server is basically the technical core to the whole system. Additionally they have five laptops that are all connected to the local WIFI network but the signal from the server is not strong enough to reach all of the clinics. This leaves the HIV, maternity, infants and TB clinic without the ICT4MPOWER system and all the benefits that the system provides.

4.2.3 Power Supply



The Socket that the receptionists computer was connected to (Photographer: Noa Julin)

The Mukono HCs receives their electronic power supply from the main power station in Mukono and the Uganda Communications Commission (UCC) and Ministry of ICT provide it. There is a lack of backup generators and at the time of our presence there was not a single generator that was working as intended.

Power blackouts are a very common thing in Uganda and during the period of two weeks there were only one day without any blackouts. The longest time without power was for a whole day. Sometimes there could even be several blackouts during one day. The duration of the blackouts ranged between minutes to hours and there was not really anyway to tell how long it would take for the power to come back. When there is a major power shutdown of the whole Mukono District the health center gets informed in advance.

The HC does have solar panels on the roof of the laboratory but they have not been installed because the shortage of money and no one at the HC possess the knowledge to perform the installation.

During the last 18 months the national electrical grid have seen an upswing due to construction of a new power system close to Kampala but the power blackouts are still a severe issue for ICT-systems.

4.2.4 When the Lights Go Out - The consequences of a power blackout

The reception of the HC in Mukono, when the digital system was down (Photographer: Noa Julin).

Constant power supply is crucial for the ICT4MPOWER server to be able to run. If the power goes out the server immediately crashes, which in some cases can cause the server to fail to reboot properly when the power comes back. If the server fails to reboot properly there is no one at the clinic who can fix this problem. This means that the system needs maintenance from an IT-Technician but in most times the clinic cannot afford to hire one.

When the power goes out the whole ICT4MPOWER system goes down even though the laptops runs on battery power and stays on. This causes a lot of issues at the clinic since they have to switch back to the old system based on pen and paper. The patient information that are registered in the digital system is temporarily unavailable for the staff and therefore they can not do much but either re-register the patients in the pen and paper system or wait for the digital system to get back online. Since they have not come up with a way of mixing the old and the new system the patient history and information might get divided between different systems causing unnecessary double diagnosing and medication prescriptions. This is creating a situation that is very inconvenient for both the health workers and the patients.

The Reception at the HC in Mukono, when the digital system was down (Photographer: Noa Julin)

When the power returns someone from the staff has to go into the server room and restart the server manually. The system does not automatically come online. At the time of our arrival the system had been down for about two weeks, due to a server crash, where the server could not reboot by itself and none of the HC staff had the knowledge of how to solve the problem. The ICT4MPOWER team in Sweden contacted an IT-technician to have a look at the problem. The IT-technician needed an Internet connection at the HC to be able to find a solution but there was no Internet connection available. Since a 3G-modem had been brought the technician asked to borrow it. The issue was finally solved with the help of the ICT4MPOWER support team. By video call communication, to walk the IT-technician through the problem, they finally found the solution. This was one of the first things that were experienced upon the arrival at the HC and highlights some of the problems with the lack of resources.

IT -Technician, Brian Shitaka, during a skype conference with the support team (in Sweden) trying to solve the problem with the failing server . Note: The Macbook belongs to one of the writers (Photographer: Noa Julin).

4.3 The Economical Situation

The results from the field studies in an economical point of view show the severity of the economical situation in Uganda.

During the times without regional power blackout, two of the facilities - The lab and the HIV clinic were still out of power due to unpaid electric bills. The HC did not have money to get a backup generator for the hospital and as mentioned before the development of a new more reliable system is still far behind. According to Dr. Kasirye almost everything at the HC are paid by distributed aid money.

Since the HC literally have no money at all and there is no income from the patients or drugs. They have to heavily rely on money from the government and other contributors. Because of this they cannot pay for installation and maintenance for their technical equipment, which leads to unused dust-collecting solar panels and unused Internet cables.

4.4 Being patient as a patient - The Mukono patient experience

The results from the field study mainly focus on the users of the system. Although in this chapter a quick view of the patients of the Mukono HC will be presented.

At the Mukono HC there is an average of 700 patients every day. Most of them are coming from rural areas. Since there are a huge number of patients who needs medical attention, everyone arrives early to get a good spot in the reception queue. The clinic opens at 7:AM and the line to the waiting area is packed at 8:AM.

Image from the waiting area at the HC in Mukono(Photographer: Noa Julin).

Being a patient at Mukono means a lot of waiting time, some patients complained that it could take up 8 hours to get a simple prescription of medication. Even though registration is easier with the new digital system the waiting time to see a doctor has not changed much. Mainly due to the high number of patients that needs medical attention. Even though the waiting time is still long the digital system has improved the waiting experience. With ICT4MPOWER the patients do not have to compete in line to see the doctors, they just have to wait for their name to be called. Also the patients do not have to carry around their medical record or have to keep track of the test results from the laboratory.

The patients complained about the confusion that arose between the ICT4MPOWER system and the old system during the blackouts (See chapter 4.2.4).

Generally one can say the ICT4MPOWER system improves the conditions for patients, and the main bottleneck to improve the patient waiting time seems to be the lack of resources and doctors.

4.5 Employees of Mukono Health Center

This subchapter presents the observations of the staff while they were interacting with the ICT4MPOWER system.

None of the HC staff seem to have basic computer literacy. For example there was a lack of knowledge of how to connect to a WIFI-network and how the server actually works and affects the system. The younger generation of the staff is not in the same need of ICT training as the elderly, due to better access to technology along young people, as the younger generation seems to have easier to adapt to new technologies.

The users of the system did not try to discover other features of the system than the ones they had been educated in. Since users did not use all of the features of the system the system did not run with its full capacity. There were also some glitches in various parts of the system where the staff did not use it properly. For example, some users used the same login ID because they did not know how to create a new user profile. This makes it harder to achieve 100% transparency.

The employees on the other hand were really excited about the ICT4MPOWER system and even though the users do not know all the features the system improves their workload tremendously compared to the old system. This made the demanding to make the ICT4MPOWER to work properly a great desire from the employees.

The receptionist are using the ICT4MPOWER system to register a new patient at the HC in Mukono (Photographer: Noa Julin).

4.5.1 Being a Doctor at the Health Center

The doctors are supposed to manage the system but lack earlier experience with ICTs. Using the existing systems would possibly be much cheaper but the mobile solution is still good due to its intuitiveness and simplicity compared with the more complex operation of using a camera and a computer.

A doctor, on an average day, has around 700 patients so the doctor's ability to maintain and spend time on the system is very limited. In the HC the doctor is more or less responsible for supplies, treatment and other administrative tasks to keep the hospital running. These doctors are already very busy and this is affecting the division of labor so that nurses, with less experience, may take on greater responsibility. The reboot of the system also steals time from doctors.

4.6 Interview with the developers at Karolinska Hospital

This is the result of our interviews and field studies with the KS team and the answers to the questions that came up during the work of this thesis.

How much groundwork and research did you do at the Mukono Health Center IV before developing ICT4MPOWER?

We have done an investigation of the work processes, understanding clinical guidelines, and requirements of different end-users (Ministry of Health, District,

Doctors and Nurses, Lab Technicians, Pharmacies). However, we have done it in Isingiro District Health Units, and not in Mukono HC IV.

Which technical preconditions did you have in mind when developing the system?
1) Lack of internet connection: We wanted the system to work without necessarily having internet connection.
2) Lack of proper maintenance: We wanted the system to be easy to maintain by the health unit staff
3) Lack of constant power supply: We assumed that Uganda Communications Commission would supply the power backup necessary to constantly supply power to Mukono HC4

Which level of computer-knowledge is required for using the ICT4MPOWER system?
The objective was to develop a system that should be intuitively simple to use and navigate. End-users should be literate, but not necessarily computer literate. It helps if end-users know how to use computers and especially how to type on a keyboard, but otherwise, it is not a requirement that end-users should know this for using the system. Most of the end-users in Mukono did not know how to use computers, and it took them 1 week to know how to type properly.

How is the ICT4MPOWER system supposed to be funded? Will it be dependent on external fundings?
The objective was that Uganda Communications Commission and the Ministry of Health would establish a maintenance structure to properly maintain ICT4MPOWER system. We are still in discussion about how that maintenance structure should be setup.

In terms of implementing the ICT4MPOWER system in other clinics, UCC and MoH should fund the costs internally.

What are your solutions on the issues with the server crashing?
We have a cloud infrastructure as backup, where all updates from the health units gathers. In case server crashes, all the data can be restored from the cloud. However, for this to work, there should be GPRS/3G connection from the health unit's server to the cloud. Mukono HC IV does not have it yet and this should be done by MoH together with UCC.

For now, we made a function, where the Health Unit Manager can download the updated data to his computer. The Health Unit Manager is supposed to take backup of the data once a week.

If the server has crashed, then it should be replaced with a new one, and this responsibility lies on MoH and UCC through the maintenance structure. However, the maintenance structure is not setup yet.

How do you plan to get the system to run when there is a power blackout?
To get the system to always be up and running requires constant power supply. Our plan is to ensure that those health units where ICT4MPOWER will be implemented have a solution for constant power supply.

How will the staff be educated in using the ICT4MPOWER system for a sustainable future?
We have made educational modules and connected them to the system. Every interface will have a video tutorial that explains how to work with the system. Additionally, we expect that end-users will undergo a proper training before starting to
use a system. The training should be delivered by MoH.

Summary

The ICT4MPOWER team from Karolinska has come up with a plan for building a sustainable model for their system to work in Uganda. However, much of the responsibility are being put on external partners and for the system to work properly it is of great importance that everybody hold up their part of the agreement. The idea of the ICT4MPOWER is that it should be solely run and maintained by the end-user and the end-user should not be dependent on the developer. To achieve independence, more responsibility and sacrifice is demanded from the end-user. While it is important to make the end-user independent it is also important to make sure that the ICT-system will be able to work and run, otherwise it seems wasteful to implement a non working system.

4.7 Expert Interview

Hugh Cameron is a professor within ICT at Makerere University in Uganda. He is especially working with ICT4D in Uganda and has taken part in several different aid projects the last few years.

Hugh Cameron says that you can find three different kinds of preconditions for ICT projects within the healthcare in Uganda: Technical, economical and implementational (Social) preconditions. These three kinds of preconditions have to be combined and work together for an aid project to work in a low-resource country such as Uganda. Cameron had personally seen a lot of different aid projects fail due to one of these three following preconditions.

4.7.1 Economical

Cameron argues that the economical problems are the most urgent issue to take care of because the other two are built upon the economy. There is a shortage of money everywhere and mostly due to the fact that all of the money that has been allocated to different projects and areas always arrives late. This means that the money that aid organizations such as SIDA distributes will not be spent on what it was intended to be spent on in the first place. Instead the money is used to pay

the most urgent bills, such as last year's electricity bill. They are stuck in a perpetual spiral where they economically always will be one step behind.

Uganda communication commission is the organization that provides some of the money that is used to set up computers and power supplies in rural HC. Unfortunately their budget is not big enough to provide Internet access to all these computers. This means that a lot of HC's have computers that are covered up because they cannot use them for something that is useful for their business.

Cameron argues that the economical infrastructure is the first thing to change. This is where they have to start to achieve a sustainable future for ICT4D projects.

4.7.2 Technical

One problem that emerge because of the economical problems, and which also is the biggest technical problem in the country is the power blackouts that can occur a few times a day. They can last for between a few minutes to a day and it affects the whole country, especially the rural areas. Hugh Camerons claims that a stable power supply must be provided for an aid project like ICT4MPOWER project to work properly.

Another problem is that technical equipment fails. There are environmental issues, such as dust and heat that shortens the lifetime of the technical devices and makes it harder to maintain the technology in the country.

4.7.3 Implementational

He also talks about the implementation issues. Cameron claims that they do not have a lot of experience with computers in Uganda and that therefore HC's should hire at least one person who could handle the technical problems that could, and probably will, occur. One of many major problems that usually occurs is that the technology after implementation becomes too advanced for the local users in the country. This is partly because of the lack of resources within the educational system. It is a big reason of why these systems will not be sustainable in the long run and it seems like an external person with knowledge of the system will always be needed.

Another issue to address is the difficulty to perform an accurate evaluation of the implemented system. The users of a system in a low resource country knows that if they say that they are satisfied the people working at SIDA will also be satisfied and this subsequently generates more money to the system. The whole chain of people within the aid politic gains from positive feedback and in the end it is only the end user, in this case the patients, that experience the disadvantages of a not fully developed system.

4.7.4 Achieving sustainability

When it comes to the process of developing an ICT system, Cameron suggests that, the major part of the system should be developed within the country where it is going to be used. People from the same country have greater knowledge about what kind of system and technology that will work in their country.

Another important way of gaining a sustainable system, Cameron says, is the importance of getting the consumers to demand better technology for a service and expect the service to be there. It is at least as important as the development of improving technology. An example that points towards this is the *infant blood spot test* program at Mulago Hospital in Uganda. It is a program that has benefited from getting the message across to their target audience. Information about importance of vaccination of newborns has been broadcasted via radio to mothers around the country. This forces the system for child vaccination to be sustainable in the long run as the mothers now demand the system and technology to be available.

It is important however to note that this project has a steady supply of financial funds from U.S. Aid under authority of Bill Clinton. Without this supply of money this project would probably not be sustainable in the long run, which once again shows the importance of the economic conditions and the economic deadlock.

As mentioned before, it is not enough to solve neither of these areas that are addressed in this interview. According to Cameron to achieve a promising and sustainable system, you have to eradicate all of these problems, and the first area to start with is the economical infrastructure.

4.8 Questionnaire:

Despite that this questionnaire was carried out by the team from Karolinska the potential answers from the survey contains interesting information about the opinions of the participants. The result will be partially discussed from a social and behavioral aspect.

The participants were overall positive and satisfied with the system and what most of them pointed out was the improvement of time efficiency with the ICT4MPOWER system. Admissions and diagnoses are way faster and the process is much smoother now if compared to the old analog system. Other positive things they pointed out were less congestion for the patients in the clinical waiting room, everything in the clinic has become more structured and the follow up of patients has become much easier.

What the participants had most complaints about were the daily power blackouts, which is not a big surprise. This was the only shared complaint amongst the participants. They were saying in the questionnaire that the system works fine as long as power is supplied otherwise everything goes offline.

Other things that they had complaints about were that it is still two buildings on the HC area that are not connected to the system. They also need someone with computer skills that can repair the laptops when they are not working in case of a breakdown

The general opinion about the system is still positive.

5. DISCUSSION

In this chapter the results of this thesis will be discussed. There will also be an analysis of the empirical data from a critical point of view.

The result shows some of the preconditions that affect the implementation of an ICT-system. Hugh Cameron talked about dividing the preconditions into three different categories: Technical, economical and implementational (social) preconditions. This model seems to correspond to the real situation in Uganda. The discussion will have these three points of views as a base.

The chapter ends with the important discussion about why modern technology always will be "our" technology.

5.1 Analysis and criticism of empirical data

Here the empirical methods will be analyzed and also some of the critics concerning the empirical data.

During the field studies more specific questions could have been asked to the staff of the HC.

Being three people from another continent, working with the system in Sweden, made it harder for the local personnel to be critical about the system when visiting the HC. This made it difficult to actually discuss the issues on a deeper level with the employees of the HC. There could have been a better preparation on how aiming for fast results would affect the final outcome. How to avoid asking leading questions, not taking things for granted at each visit, to be patient and explain to the staff that there is no hurry to come up with their answers.

Responses from the staff can reflect their own education so spending time with the local personnel gave useful insights into what they actually know and what issues they would be able to solve.

The survey made by KS has some flaws in the way it was carried out. Some of the questions were not completely objective pledged but rather insisted for a positive answer from the participants. This is a very important issue to take into account when analyzing the results from the survey.

Another issue as Hugh Cameron mentions in the expert interview is the issue were the participants are benefitting from only making positive answers in the

survey. Since the users of the ICT4MPOWER system wanted to continue to use it there is a chance that the answers were given in a way to boost the positive approach towards the project. A better way of doing this kind of survey is pretending to not come from the same organization as the developers of the system. In that way the participants feel like they have nothing to lose if they tell what they really think.

The fact that a camera was used to collect data could have alienated the evaluation-team from the natural environment, which made people more likely to act in an abnormal way.

An unstructured interview makes it easier to lose focus from the theme and makes it harder to interpret the results. On the other hand it makes it easier to get a more nuanced and bigger picture of the underlying problems that the investigator tend to lose when working closer and closer to a project. Much of the thoughts around a successful project are to analyze and create as fast results as possible, which in this case may not be the way to go.

The interview with Hugh Cameron turned out to be very rewarding for the understanding about the issues of the economical infrastructure in Uganda. It made it easier to see the different problems with ICT-implementation from another perspective.

5.2 Three major preconditions

Hugh Cameron divided the preconditions for an ICT-implementation in three different categories. Looking at the theoretical work and the results from the field study it seems like this division can be made and it reflects the reality of the situation in Uganda in a rather good way.

5.2.1 Technical

The power blackouts are a major issue for projects such as ICT4MPOWER. This was the only complaint that was shared among all of the participants in the questionnaire.

Other technical issues such as getting a working Internet connection, connecting all the clinics to the same network and making sure that all technical equipment worked properly did not seem to get the same attention.

All of these issues are important to address to achieve a sustainable ICT-system. It seems they come in different levels of priority and that the most important issues are the ones that prevents the system from running. In the case of the ICT4MPOWER system in Mukono HC the biggest technical problem is the dependency of electricity. Since the clinic is not provided with constant power supply the system will not be able to run with 100% uptime and when the system is down there is no use the system at all.

Results of the field study clearly shows that even if the users do not know all the features of a system, they still benefit from it in such an extent that they continue to use it. Because of this it seems that the priority when developing a system should be put on getting the system to run at all times, minimizing the downtime, instead of tweaking various types of features to optimize system.

5.2.2 Social

Results from the study shows that it does not matter how developed the implemented technology is when the users that are going to use the system do not know how to use it. In the interview with Hugh Cameron he addresses this problem and says that there is a great lack of computer experience in Uganda, this was also observed during the field studies. It was clear that the staff lacked of knowledge about how to use the technology that was provided and how it was supposed to work. No one at the clinic could repair or analyze the provided technology when it failed or develop the system. Without knowledge of the implemented system it will be hard to gain sustainability. It would have been enough if just one of the staff had a basic education within the field to keep the system more sustainable, Hugh Cameron says.

Despite the lack of technical knowledge the users of the system really liked the system and wanted to use it in the future. They were excited about the technology and the possibilities it brings. This is consistent with what Hugh Cameron discusses about the importance of getting the user to demand a system. When the users really start to demand the technology then they will care about it and if it works properly. This is of really great importance for gaining sustainability.

5.2.3 Economical

Everything in the results is somehow connected to the economic situation in Uganda and the lack of funding that affects the health care in the country. It can be very hard to identify where the lack of resources are located, since it is very subjective because it is regarding non-material things. Before this study there were no thought that economics would play such a big role in a project like the ICT4MPOWER since it is mostly funded from Sweden. At the beginning of the field study the severe economic situation in Uganda and the impact it has on ICT-projects came as a hefty surprise.

Hugh Cameron says in the interview that fixing the economy is the cornerstone for these kinds of systems to get sustainable. Everything is built upon the economy and without that working everything else will be adversely affected. Big problems such as the lack of education will occur due to the absence of money. Without a stable economical infrastructure, the money from the government to the schools and hospitals will always be late. This is something that Hugh Cameron put most emphasis on during the interview.

Looking at theory it seems like there is a shared opinion about the impact of the economical infrastructure. There were many examples in the results of the field study that shows the consequences of a bad economical infrastructure such as the unpaid power bills at the clinic. That would rarely been seen as a problem in the countries where the technology is developed.

It does not matter how much equipment that is brought from Sweden when there is not enough money to buy, for us, basic things as electricity.

5.3 ICT-system a cooperation between different partners

In a project such as ICT4MPOWER there are many people involved from different organizations and companies. The results indicate that cooperation plays an important part in getting an ICT-system to work properly.

The development of the ICT4MPOWER is still going on and the project in Mukono is only a pilot, which means it is not strange if there are some flaws with the system. The results shows that many of the issues with the ICT4MPOWER project are issues where other organizations fail to provide the necessary parts for the system to work. For example, if the Uganda Communications Commission (UCC) and Ministry of ICT fail to provide a stable power supply, the ICT4MPOWER project will not work.

In a cooperation where the different parts of the project are linked together amongst different organizations it can be a risk to be dependent on others.

If no one takes the full responsibility there can never be any insurance that a system will work properly because some part of the cooperation may fail to fulfill their part of the project and so the system fails. Since it seems that implementation of ICT-systems has its Achilles heel in the financial part. It is of great importance that that the financing part of the system is reliable.

5.4 Modern technology - How it remains “our” technology

In this subchapter a discussion about technology will be held from a larger point of view with questions such as why it is so difficult to implement technology in low-resource countries. Many of the things that are mentioned in theory have also been witnessed during the stay in Uganda and the fact that society has a huge impact on the success of an ICT-system cannot be ignored.

Much of the results show that the implemented technology in Uganda does not work immediately and it should not always be expected to work as it was intended to do. The blackouts that occur in low-resource countries are no longer any surprise. Despite that, technology that is dependent on electricity is brought into projects carried out in these countries in many cases without a sustainable

solution to provide electricity. It is like bringing a car to a place where there is no fuel to fill the tank with, how will we manage to get the car to run?

In the modern countries the technology is developed and used throughout the development stage. This has led to a more widespread understanding of how the technology works and what it can be used for. Most of us from the west have grown up with computers and phones and today they are more or less manifested in our daily lives. Bringing modern technology to a low resource country constitutes a risk of jumping over a series of important steps in the technological development. This is mainly because of the lack of advanced technology in the everyday lives of the people in these low resource countries. Without any substantial training in the area, there will be a lack of basic technology-knowledge. This is not a sustainable way to go in the long run.

Most of the modern technology are developed and designed for those who can pay for it and since countries like Uganda do not have the money they get left out. This becomes a downwards spiral and makes the digital divide to get even wider. We have to look beyond our technology and try to see why the technology works for us. The results from the field study shows that the societies in Uganda are very different from the societies in Sweden. According to the different theories about socio technical systems, technology is a system made up of different parts where society is a part of this system. Technology that comes from Sweden will have a few missing parts when it is used in Uganda since the societies between these countries are fundamentally different from each other. If some parts of a system are missing then the system may not work properly.

There are no shortcuts to solving problems with technology since technology is dependent on fundamental factors in our society and they may not exist in a low resource country. Developers of ICT4D must learn to look beyond the first layer and see what really makes technology sustainable otherwise “our” technology will never succeed in a country where the preconditions are even slightly different from ours.

It is clear that technology on its own cannot solve the issues that arise in low resource countries but rather the system has to be developed together with the community where the system is intended to be in use.
It is still important to remember that even though most ventures fails, followed by disappointment, the new technologies still generates optimism among the users.

6. CONCLUSION

In this chapter the conclusions of what we have discussed in the previous chapters. We will also present suggestions for different changes for the implemented ICT system in the HC.

6.1 Technology is not the solution

This is the conclusion that can be drawn from looking at the theory and the results from the empirical work.

What has been concluded in this thesis is that it is not the technology that plays the important role when it comes to implementing a sustainable E-health system in a low-resource country. Most of the technological systems that exist today are dependent on a stream of financing that keeps the technology alive and maintained. Of course there is nothing like free technology. Today the technologies that are being implemented are too financially demanding for the country itself. A basic computer may not be expensive to buy but what about a stable power grid to supply the computer with electricity? We must realize that a technological system have many hidden costs which affects the success of implementation. If the business model for implementing ICT-systems can be changed beforehand, to fit the preconditions in a low-resource country better, then the chances of gaining sustainability will greatly improve.

Nurturing the existing technologies like telecoms and 3G networks make possibilities to build a solid foundation on and to continue to develop from. Sustainability greatly relies on a deeper knowledge of how technology works and that could only be achieved through living with technology and making sustainable solutions.

There is not enough education for the present technology and because of that the users of the technology will always be dependent on support from the developers to keep the technology working.

The system should be developed in the country where it is used. It is the only way to understand the social preconditions and to develop a future sustainable system.

6.2 Our Suggestions

Here we will present the suggestions we have for the ICT4MPOWER-project and other ICT4D-projects.

Non-External Financing
When you are implementing a new system you have to make it non reliable on external financing. In this way the bigger more chaotic, financial system will not have as much influence on their own system. Questions like what happens when the money runs out, should always be asked before developing a system.

Strip away as much technology as possible
Take advantage of the resources that already exists in the country, especially telecom network (3G network). It is not the technology that prevents the development it almost inhibits the opposite. In some way it can be more problematic when you try to implement too much at the same time.

Develop the system for phones
Phones have a longer battery life than laptops and stationary computers. They would then be able to have their backup electricity via solar cells or other backup generators when the power is gone due to their energy efficiency. The low amount of data exchanged in this ICT system makes the phones more suitable since they are connected via the already widespread 3G network.

Education
Educate the users of the system, at least some of the users. Learn them the basics of the technology implemented in the system. In this way, if some part of the system breaks down, there will be local abilities that can fix it and they do not need to call for assistance from abroad.

Future perspective
All the technology introduced and installed must be evaluated in a "future perspective" for the early detection of any problems that may arise with the technology. It is extremely important to not assume that something will work but instead ensure that the user independent of support can resolve any problems that may arise.

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APPENDIX #1

Interview with Hugh Cameron

Here is the transcription of the interview we conducted with Hugh Cameron - professor within ICT on Makerere University, in Uganda.

What do you think about the preconditions for ICT systems here in Uganda?

There are three different kinds of preconditions:
Technical, Economic and Implementation (social). These have to be met for a donation program to succeed. I have seen many programs that started with good intentions but failed because of a structural reason.
Economic:
There is a shortage of money everywhere, because all money that is allocated in the budget or getting paid to salaries in projects always arrives late. Always. Usually the financial systems are on paper. At most a spreadsheet. An example: When the University receives a loan from African development bank, that money is used to pay the most urgent bill. So when money comes in from Sida, the money is often used to pay the electricity bill from last year. So when the guy comes to the university to get his money for his project the university says that he has to wait until someone else gives them more money. So the money is always one step behind. It's like a dynamic queue. The money is always used to pay the most urgent bill. It's a huge problem, and it is systemic.

Another example: The lectures this semester haven't started yet(should have 4 weeks ago) because the universities haven't paid the lectures for December yet. So they say: We wont start working until you pay us for December. This is because: 40 % of the finance of the university comes from governmental funding's, and they are always at least 2 weeks late. The other 60% is the student fees that are even later. Result: The whole semester of content is squeezed in on just a few weeks.
It's a challenge to get the director of the healthcare to understand the importance of providing electricity. But they are usually not paid according to the number of patients treated. Finally, like in other businesses, it's important to let the customers pull the services through the system. Pulling through the system either by paying for the services or by using vouchers or by 'important problems acted by the government'. Then there is a better chance. This is a question of designing the business model.

For sustainability the economical preconditions are the most important. It is very important to see how the money flows through the system. How does the money flow one way and the delivery of healthcare flows the other way.

Most medicines are paid by NGOs and they are shipped here and have a high commercial value. Medicine will ”disappear” on the way here. Just so they could sell it in private stores here in Uganda.

Technical
Equipment fail. Operating conditions are quite harsh. A lot of dust and heat here. Even though people are cautious about the dust. When the computers are not used they are covered up. Even though you see dusty keyboards and computers.
System software is generally available but there is an implementation challenge, having a person around, which can deal with network and system software's. The resources are available but they have to be brought together.
The main technical problem is the power blackouts. One way to solve this is to install a backup power supply that gives some time to shutdown the system gracefully. Another backup is with solar energy, but when you talk about desktop computers you need a big solar installation to power those. That's why people have laptops here - they don't need as much power. But they get stolen. They have to lock them in otherwise they will be stolen.

Social (Implementation issues)
They don't have a lot of experience with computers. It has to be some university graduates available to the health care centers, to give them instructions and so on. It would be a good practice to the health center to hire a person with computer skills, for example the reception position. Because then they will have such a person there that could help them. Doesn't matter which position in the healthcare they work, could be as a driver, just so they could be around.
It has to be developed here in Uganda. Cause here the people understand the requirements, because they live through it everyday. In Sweden we take power for granted, Internet access for granted and system support for granted.

The solutions of these three preconditions are emerging and are combined.
For sustainability it won't be enough to just pin down the technical and social preconditions, you also need the economical. Otherwise it won't be sustainable.

- Is there a new way to think about donation?
Yes, I think there is a new change of mindset coming to aid. In British programs for example: Every program have to provide measurements from the receiving end to show the effectiveness of the program. If the measurements aren't high enough some changes has to be done within the program.
For example, there has been a lot of education, especially via radio on the country, to inform people about the importance of child vaccinations. So the mothers generally know that. And most of them take action. That is coming in to their culture. And I think it's because of that the infant blood spot test program is working fairly well. It is sustainable partly because they get a steady supply of money from Clinton health access initiative. So it's sustainable so long Clinton and his organization is alive. But also in this system, the mothers are pulling the services through the system, and the system is generally available. It's very important for a sustainable model that the consumers expect the ”product” to be there. The operations are partly computerized, so it's not ideal.

- Are there a lot of investments in ICT projects in Uganda (Africa), who is funding?

The Uganda Communication Commission is providing some of the money that is used to set up computers and power supplies in rural health centers.
Unfortunately their budget does not run to provide Internet access. That is one of the preconditions. I have seen a lot of health care centers with desktop computers covered because they don't have any Internet access.
There are very few ICT projects that have found a sustainable model. One that almost has made it is the testing of newborn children for genital disease. They mainly tests for HIV. They are not fully scaled up yet, but they are on their way. They are almost testing 100 000 children per month now.
Why it has been successful: There has been a lot of education, especially via radio on the country, to inform people (in this case mothers) about the importance of child vaccinations. So the mothers generally know that. And most of them take action. That is coming in to their culture. And I think it's because of that the infant blood spot test program is working fairly well. It is sustainable partly because they get a steady supply of money from Clinton health access initiative. So it's sustainable so long Clinton and his organization is alive. But also in this system, the mothers are pulling the services through the system, and the system is generally available. Its very important for a sustainable model that the consumers expect the "product" to be there.
The operations are partly computerized, so it's not ideal.

- Is the actual funding a problem or is a change of attitude needed?

The city and the countryside are very different. The people in the city are expecting more. They expect electricity, roads without potholes, transport. Since they have more expectations of the government they expect the government to work without corruption. They tend to vote opposition, because they think that the government isn't doing enough. The expectations will first rise in the cities and then branch out to the villages.
For a funding agency like Sida. People work at Sida. When a project is successful they can go on to a bigger project and gets promoted and get more responsibility and so on. If you see your career in Sida you want to report the good news not the failures. Now you come to the receiving end in Uganda, the people who is taking the money. They understand this very well about Sida. They won't report the bad news to Sida. Cause they know that they won't get the money if they do. Sometimes they personally benefit from bringing the money in to Uganda, and that's not good.
In the long term to get a system sustainable the people who benefits from the system has to pay for it. Otherwise they will need an organization such like Bill Clintons to get the money to make it sustainable. Right now it is impossible to get sustainable health systems everywhere in the country because of the lack of power supply. 18 months ago they built a new dam near Kampala with a result of a much more stable power system. To get sustainability they need to get a stable power supply everywhere in the country.

- Which are the biggest fields in which you use ICT (ICT4D) in Uganda (Africa)?

The big areas are: Construction, Education and then health care. Construction and education is the biggest ones.
What, according to you, is the most important with ICT4D in developing countries?

The telecoms are very important. It means that people everywhere in the country are getting better information. Ex: farmers can get better information about the market prices for their products. They don't have to travel anymore to get the information.
The telecoms have grown really rapidly, it started for about 10-12 years ago and it probably doubled in the last 3 years. Right now its about 16-17 million active simcards. Often 1 person has to simcards so around 10 million uses a phone in Uganda right now, which is half of the adult population. So everyone has access to a phone, even in the country. So the telecoms have been a very big enabler for implementation for any kind of ICT systems.
The Internet is following the same curve as the telecom. There is about 4 million devices that provide internet access. Smartphones is about 5-10 % of the phones in Uganda, but they are coming.

- Do you have any suggestions for the system in Mukono?
Because of the lack of power they should, In Mukono, start to use the system with a smartphone on the 3g networks. Then they won't have to fall back on the power all the time. They just have to optimize the interface to a smartphone.

Another suggestion:
To take advantage of the peaks and low points in the data traffic. You can use the low points in the network during the day. If they could program a phone to just use the network during the low points it will be a marginal cost of 0 $.

APPENDIX #2

Field studies

This is a short diary of our field studies in Uganda.

Sunday 3 February 2013
Our first visit to the Healthcare center IV in Mukono
Since about a month ago the ICT4MPOWER system has been offline due to a server crash at the clinic. What caused the server to crash was most likely a power outage which made the system unable to restart and several error messages were showing at the screen. No one from the staff at the clinic had knowledge of how to fix such a problem. In fact the most of them had no idea why the system wasn't working and lacked of basic computer knowledge like connecting to a Wi-Fi network. We went to Mukono together with an IT-technician from Kampala to try to solve this problem. It was crucial for the IT-technician to have an internet connection to be able to solve this problem using the internet and Skype calls to the ICT4MPOWER developing team, but there wasn't any available internet connection at the clinic and no one could afford a 3g modem(unlimited surf is 100$ a month). We were only supposed to observe and take notes, but since nothing could be done without an Internet connection and nothing had been done in a month, we feared for this project to fail so we borrowed the technician our 3g modem during his visit.
After about an hour of *googling* without any luck, the technician called the developers team calling for help. One issue that followed was the missing administration password to get access to configuring the server. When the password was retrieved the problem could be solved rather easily by using video call and by filming the server screen to show the development team the server problem. Restarting the server manually solved the problem.

Tuesday 5 February 2013
Today we took a look at the whole area of the clinic, the reception, the laboratory, the maternity clinic, the HIV clinic, the infant's clinic and the tuberculosis clinic. We discovered some technical issues with the system that had an easy solution but was causing a serious problem for the functionality of the system. Since the system is built to make it possible for the different clinics at the health care center to communicate with each other it is of greatest importance that everybody has a connection to the server system. This was not the case in reality, it turned out that the signal from the server modem wasn't strong enough to reach the different clinics. Only the reception, some of the doctor's offices and the laboratory had connection to the server. The other clinics didn't use the system at all even though special programs had been developed for these clinics.
Even though the laboratory had signal from the server, they had no power supply at this time due to unpaid electric-bills so they couldn't use the ICT4MPOWER

system. The government had promised them that this issue will be solved very soon.

Sunday 10 February 2013
Today we follow a nurse on an outreach session for immunization and child registration, as well as taking the blood pressure and giving vitamin A. These outreach sessions are for people who don't have the ability to go to the health care center.
Once a month the clinic sends their outreach schedule to the VHT and local council leaders who informs the public of the time and place.
The nurse packed a vaccine container, and the other medical equipment in different bags and then she took a boda-boda(motor-cycle taxi) without a helmet and proper motorcycle wear couple of kilometers to a church outside of Mukono where the outreach took place. Riding on these boda's are very dangerous (1,762 serious injuries only in Kampala 2011 according to the annual traffic report (NAKIYIMBA 2012)) and not a good way to travel with equipment. After the morning mass, people gathered outside to get the vaccination and to register. After the shot, the patient gets a note as a proof of the immunization. The Clinic doesn't keep any record of the vaccines given out. When all the people in the line was finished the nurses still had to wait for more people for vaccination and the nurses had no idea if they were going to show up or not. If they don't show up the vaccines might be ruined. This is very typical for Uganda, not knowing when people are going to show up.

Monday 11 February 2013
Today we observed the work in the reception. At 8.00 AM the waiting room was already packed with people who needed medical care. The patients registered themselves in the digital computer system, which the receptionist preferred against to old system where they register patients in a big register book by pen. Many patients carry their own journals in shape of a book where doctors write down diagnoses and prescriptions. In the new system all this information is stored in a database that can be used later on. There is a big gap between the old system and the new system when a patient with a history of sickness uses the new system since the information from the old diagnosis-book isn't put in the new system, the patient's medical history get's split up between the two systems. This can cause problems and inefficiency for the patient in the future.

When there was a power shortage and the server went down, the patient queue disappeared as well. This caused some problems and confusion at the clinic and the doctor had to wait for the digital system to be up and running to be able to treat the people who were standing in the digital queue. We also noted that almost all of the patient registration took place in the morning while in the afternoon it was not very busy at all.

Tuesday 12 February 2013
When we arrived to the clinic in the morning, the power was dead. The power was out for the whole day and the situation at the clinic was very different from when they had the ICT4MPOWER up and running.
At times like this the health care center goes back to using their old system, which is much less efficient. There wasn't any structured patient queue so no one really knows who is next to see the doctor that causes frustration and confusion.

Some patients didn't bring their personal book. Some patients had missing information in their personnel book, information that was stored in the digital database. This caused unnecessary 're-diagnosing' which the doctors had to make in order for the patients to get their medication. Even though the staff really needed the ICT4MPOWER system, they didn't try to solve this problem on their own by for example buying a generator (they don't have any money), instead they just went back to the old system, waiting for the power to come back.

Wednesday 13 February 2013
Today the power was back and all the facilities in the clinic were up and running. We had noticed that the users didn't use the entire feature of the ICT4MPOWER system. For example they didn't know how to create a new profile for an employee so most of the doctors used the same ID when they used the system.

The ICT4MPOWER team had only given a brief introduction of the system to the users and the users had not tried to explore the system on their own even though the system had many helpful features like a special program for HIV-patients.

Thursday 14 February 2013
Today we followed a doctor in his work when he was using the ICT4MPOWER program. With a camera we recorded the computer screen for about an hour. He said that the program made his work much easier at the administrational part. Now with the system all administrates at the clinic runs by itself and he as a doctor can focus more on treating the patients. But even though the system made administration easier it seems that there is still a deficit of doctors in the clinic which affects both the waiting time for patients and the workload for doctors.

APPENDIX #3

Questionnaire

This is a survey made by Karolinska to learn what the end users thought of the implemented digital system.

Questions

1) How was the trial implementation at Mukono and how did the staff react to the new system?

2) What difference has ICT4MPOWER made at the clinic?

3) What in your opinion has been the biggest benefit?

4) Have you had any major interruptions, what is the uptime of the system?(hopefully 100%?)

Participant nr 1 - Clinician

1) Reaction from the staff – was positive.

2) - Time management – improved
- Patient is identified by name and picture.
- High turn up by patients due to this new system.
- No more congestion for the patients at the clinical waiting room (in the reception)
- Less time spent on a patient because of the summarized clerking forms and treatment forms.
- Patient flow is improved.
- Easy follow-ups on patients due to the record keeping.

3) - Unstable electricity supply.
- Limited number of computers to clinicians.
- The uptime of the system would be 100% if not the challenge with unstable power supply were current.

Participant nr 2 – Drug department

1) The trial so good and staff reacted positive to it
2) Waiting time for patients has been reduced. In other words – saved time.
3) Workload eased.
4) No, but interruption comes when power Is off.

Participant nr 3 - Laboratory

1) Trial implementation has been excellent and staff reaction to the system has been positive.

2) – ICT4MPOWER has shortened the turn around time in the laboratory.

- It has decongested the laboratory waiting area.
- It has also made compiling and analysis of weekly and monthly reports a simple task.

3) Benefits, saving in term of time and money (laboratory registers, request form, medical form etc. cost money and time to fill out)

4) None, the system is very useful, I request you allow us continue using this system until the end of world.

Participant nr 4 – Receptionist

1) The system was slow in the beginning because most staff was green about using computers, so it took them some time to adapt to the new system.

2) The bureaucracy needed in paperwork disappeared so waiting time for clients is now shorter.

3) The benefit is that records can be appropriately kept and retrieved when they are needed.

4) Interruptions are all about the unstable power, system which has no back-up. So when the power goes off, the whole system is down.

Participant nr 5 – The Doctor in charge

1) – Organized patient flow

- Data quality improvement
- Timely reporting
- More economical, less time spent on administrative work.
- Statistics makes it easy to find essential key indicators.

Challenges:

- Power interruption
- Partial implementation leaves a few sections offline (TB and maternity clinic)
- Repair of computers are needed.