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Using Personal Digital Assistants to Improve Healthcare Delivery in Uganda

Project

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Master of Communication for Development

By

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Acronyms

AIDS: Acquired Immune Deficiency Syndrome

APP: Africa Access Point

CME: Continuing Medical Education

DSS: Demographic Surveillance Site

HIV: Human Immunodeficiency Virus

HSSP: Health Sector Strategic Plan

HMIS: Health Management Information System

ICT: Information, Communication Technologies

PDA: Personal Digital Assistant

PHP: Private Health Practitioners

PNFP: Private not For Profit Providers

UHIN: Uganda Health Information Network

UCH: Uganda Chartered HealthNet

Abstract

Effective Health Systems make service provision easy for health workers, especially if they have access to the latest guidelines in a dynamic profession where new technologies are ever emerging. However, available data indicates that the health system in Uganda is constrained and still using old technologies despite the availability of newer technologies. As a result, this study sought to investigate the adoptability, cost effectiveness, and sustainability with regard to Personal Digital Assistants. The study, which was cross sectional in nature, was carried out in Mbale District in Eastern Uganda between 2008 and 2010. In depth interviews were conducted with health workers and key informants. Also, published and unpublished literature about the Uganda Health Information Network was reviewed.

The findings revealed that the use of Personal Digital Assistants also known as handheld computers can go a long way towards improving healthcare delivery in countryside health facilities. To health workers in remote places, the PDAs are a source of the latest clinical care guidelines for several diseases including HIV and AIDS as well as malaria. Health information systems have been improved and data collection and reporting have been eased by this technology. However, while evidence of viability of this technology exists, it still has challenges like power and delays in software updates among others.

CHAPTER ONE

(Background and Introduction)

1.1 Uganda overview

Uganda is located in Eastern Africa, bordered by Democratic Republic of the Congo in the west, Kenya to the east, Rwanda in the South West, Sudan in the north and Tanzania in the south. Uganda has a total surface area of 241,550.7 km2 and one hundred and eleven administrative districts. The population stood at 30.7 million by mid 2009 (UBOS, 2010).

The full country name is the Republic of Uganda, while the Capital is Kampala and the major languages spoken include English (official), Swahili (official), Luganda, and various Bantu and Nilotic languages. Christianity and Islam are the major religions. The Life expectancy is 52 years (men) and 53 years (women). The monetary unit is calculated as 1 Ugandan shilling equals 100 cents. The main exports include Coffee, fish and fish products, tea; tobacco, cotton, corn, beans, sesame. And GNI per capita is US $420 (World Bank, 2008). The Internet domain is .ug and the International dialing code is +256 (BBC, 2010)

1.2 Uganda Health System

The National Health System (NHS) in Uganda constitutes of institutions structures and actors whose actions have the primary purpose of achieving and sustaining good health. The system is made up of the public and the private sectors. The public sector includes all Government health facilities under the Ministry of Health, health services of the Ministries of Defence (army), Internal Affairs (Police and Prisons) and Ministry of Local Government (MoLG). The private health delivery system consists of Private Health Providers (PHPs), Private Not for Profit (PNFPs) providers and the Traditional and Complimentary Medicine Practitioners (TCMPs).

This section describes the organisation and management of the health sector and delivery of health services in Uganda (MoH, 2009).

The Uganda Government owns 2242 health centres and59 hospitals compared to 613 health Facilities; 46 hospitals by PNFPs; 269 health centres; 8 hospitals by the PHPs. Because of the limited resource envelope with which the health sector operates, a minimum package of health services has been developed for all levels of health care for both the private and the public sector; and health services provision is based on this package. The public sector is one which in most cases is always largely under scrutiny given that it is funded by the tax payer.

The Government health system consists of the district health system (village health teams (VHTs), Health Centres II, III and IV and district general hospitals) and regional referral hospitals (RRH) and national referral hospitals (NRH), which are self-accounting and autonomous institutions, respectively.

According to the National Health Policy, District health services are managed by the Ministry of Local Government. The district health system is further divided into health sub districts (HSDs). In general, district management capacity is still very limited in many districts: leadership, management and specialist skills are in short supply at all levels of healthcare and high levels of attrition tend to curtail capacity building initiatives. While Community Health Departments (CHDs) exist at RRH to provide support to districts, this has not been fully implemented. The increase in the number of districts over the last decade has overstretched the capacity of the MoH to manage the districts to the edge (MoH, 2009).

Although 72 percent of the households in Uganda live within 5km from a health facility (public or Private and Not For Profit), utilisation of the health facilities is limited due to poor infrastructure, lack of drugs and other health supplies and the shortage and low motivation of human resource in the public sector. The functionality of the health system in Uganda is a challenge; strengthening the system especially at district level will be required to effectively deliver services.

None-the-less, Uganda's Health system has been plagued by inefficient service delivery. Services have frequently failed to meet the needs of majority of the people, who are predominantly very poor, many of them living on less than a dollar a day. With Government's per capita expenditure on health a mere $8 and without any social insurance, the poor have subsequently been plunged deeper into poverty and more ill health (Kakaire 2008). In light of this, innovative approaches that will reduce operational costs and make health systems to work for the poor are required.

1.3 'Medical Digital Divide'

While the most known digital divide is the uneven distribution of technologies between the Global North and the Global South, in Uganda there is also some sort of digital divide between urban based and rural based medical practitioners. For years, the health sector has lagged behind in the field of technology. For instance data management in healthcare delivery has been done

mostly on paper. Records compiled by healthcare workers, including patient medical and administrative records, are filed and piled in shelves placed in record stores at hospitals and health centres. Physicians and health care workers working in rural locations without telephone/internet services or regular access to electricity face serious problems sharing and accessing critical medical and public health information. Also acquisition of the latest knowledge, especially by health workers in far flung areas has not been easy. Not only do they often lack access to information, but even when they can get information, it may be out of date since new developments may have occurred daily.(source)

In Mugumya (undated) analysis of a two-year project (2005 – 2007) in western Uganda which intended to address challenges rural health workers encounter in pursuing Continuing Medical Education, Mugumya wrote that information sources and resources are not adequate in the rural based institutions due to lack of institutional libraries and personal materials. This meant that many rural health workers cannot access latest medical information and developments. In his analysis Mugumya quoted a Project official saying:

> "… When health workers complete their training and are posted to work in rural areas, they tend to become real villagers". They do not read because of the work overload or due to the fact that the environment within which they operate is simply not conducive. As a result, some resort to drinking or they go into private practice." This subsequently impacts on their work in a negative way.

1.4 Uganda Health Information Network Project

Against a background of these difficulties, in 2003, a project that incorporates Personal Digital Assistants (PDAs), Access Points (Jacks) and the Cellular Phone Network was introduced in selected rural districts to explore electronic knowledge acquisition, data collection and transmission in healthcare delivery. On inception of the project, only two districts of Rakai and Mbale were to be covered. But the two have further been divided. Rakai has split into two districts, namely, Rakai and Lyantonde. Likewise, Mbale has split into Manafwa and Bududa districts. Thus, UHIN is currently operational in five districts: Rakai, Lyantonde, Mbale, Manafwa, and Bududa districts. Currently there are about 500 health workers in the five districts using handhelds for capturing and transmitting Health Management Information System (HMIS) data and accessing health content relevant for their practice. Two hundred six health workers in Rakai, 140 in Mbale, and 40 from Marie Stopes Uganda (MSU) and the Joint Clinical Research Centre (JCRC) were trained to use handhelds for data collection and transmission over the UHIN.

Uganda's well-established cellular network was used to create a new platform that allowed healthcare workers to access, record, and transmit data. SATELLIFE: The Global Health Information Network, a non-profit organization focused on improving health in developing Countries; and Uganda Chartered Health Net (UCH) located at the Makerere University Medical School, have been implementing a wireless system that uses handheld computers, wireless servers (initially jacks now replaced by the Africa Access Points due to technical challenges with

the former) and battery-powered Linux computers. The technology allows health care workers to access and share critical information in remote facilities without fixed telephone lines or regular access to electricity. The aim of the project was to provide health practitioners in the field with tools that were previously unavailable or outdated. "This is going to be a giant leap forward for Ugandan health care. It could save thousands of lives and have significant benefits in health outcomes for Uganda's citizens," said Holly Ladd, Executive Director of SATELLIFE in apdacortex.com news release. Though, it has not yet been transferred to other parts of the country.

1.5 How the UHIN Works

The Uganda Health Information Network is comprised of three major components. These include handheld computers or PDAs (personal digital assistants) distributed to health workers at the facility level, relay devices known as Jacks (now called Africa Access Points or AAPs) installed at the facility level, and a central server at the Uganda Chattered Healthnet office in Kampala. The connection between the PDAs and the AAPs is made via infrared beam, and between the AAPs and the central server via the GSM cellular telephone network and Internet Service Providers. The network is illustrated in the following diagram A adapted from a UHIN technical report.

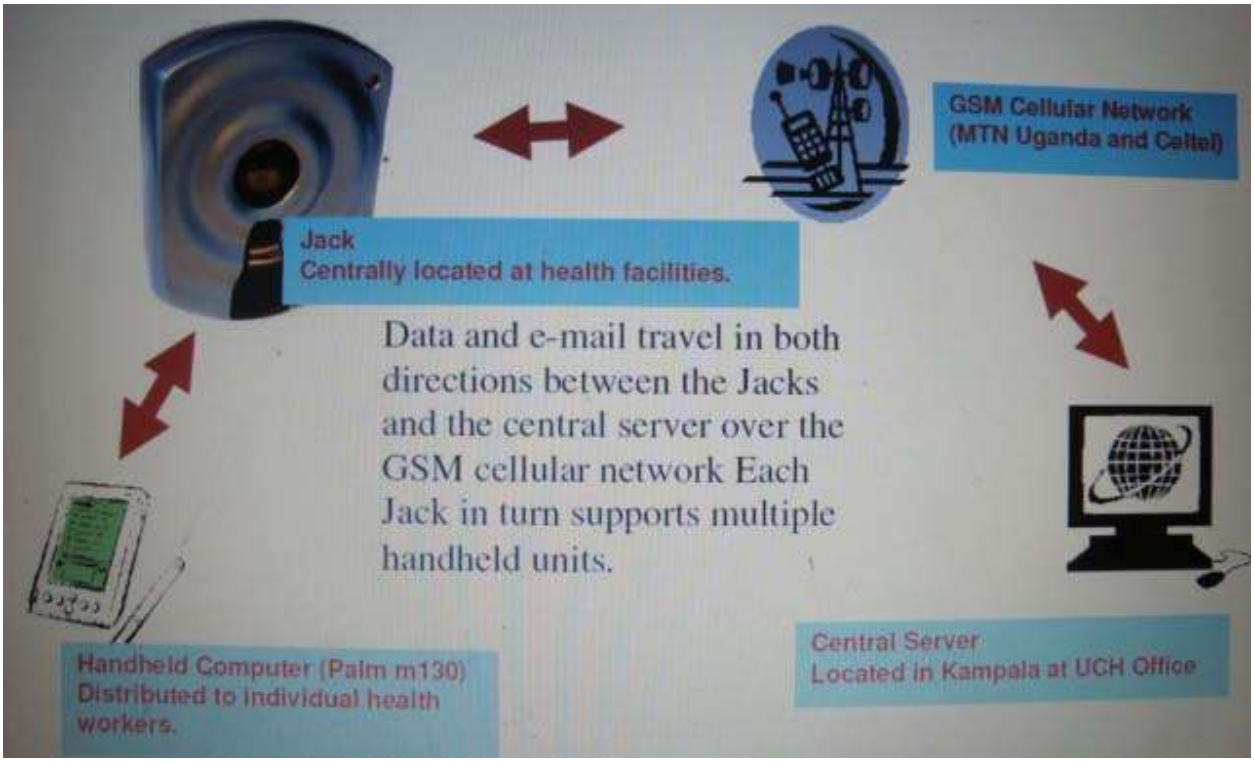

Diagram A: The Components of Uganda Health Information Network

It is through this network that medical information including disease treatment guidelines, continuing education materials, newsletters, and essential drug lists and databases are delivered. Health workers also receive national and international news articles on their devices. The software has also been customized for data collection on the handhelds.

The results of this study are expected to provide information that will give a better understanding of the context in which health services are provided and lead to innovations that can be used to improve health service delivery with the help of cost effective technology.

1.6 The Policy and Legislative Environment

The government of Uganda has recognised the fundamental importance of ICT in any policy for development, and is creating the conditions for the fullest participation by all sections of the population (Goo, 2003). As a result the Government of Uganda in 2003 came up with the National Information and Communications Technology Policy. The scope of the policy ranges from perceiving information as a resource for development, sets out mechanisms for accessing information and covers ICT as an industry.

At Health ministry level, the National Telemedicine / Telehealth Steering Committee is developing an implementation strategy for the ICT Health Sector Policy to facilitate efficient information and communication services across the entire sector. The identified priority areas include access to health services, healthcare delivery, district health management, telemedicine, and Continuing Medical Education (CME). The strategy is expected to function as a guide for future investment in ICT in relation to its particular benefits in the health sector It was this policy environment that easily enabled the use of ICTs like Personal Digital Assistants being employed by the Uganda Health Information Network Project. Other technologies that have been adopted as a result of the policy environment include: cellular and mobile telephone networks, mobile radio communication, paging services, courier services, multi-purpose community tele-centres (which offer a broad range of communication services such as fax, telephone, computer services, e-mail and internet, media services, books and other reading materials, etc.). However, many of these technologies are limited to a small section of the population.

1.7 Statement of the Problem

Technologies such as the Personal Digital Assistants can generate health improvement in developing countries. They can work as an instrument for continuing education and lifelong learning that will enable health workers to be informed about and trained in the use of advances in knowledge. These technologies can also be used as a delivery mechanism to poor and remote locations of a wide variety of services varying from improved public health education to emergency advice, including advice on dealing with and mitigating the consequences of natural disasters. at the same time, the technological advances have the potential use as a mechanism to increase the transparency and efficiency of governance which would, in turn, improve the available and delivery of publicly provided health services (Chandrasekhar, C.P & Ghosh J 1994). In Uganda, the Uganda Health Information Network project which would have brought about a revolution in health care delivery only remains in five districts after seven years of piloting it. Therefore, an evaluation of whether the new innovation is viable and sustainable is important in determining whether the PDA technology can be extended to other areas.

1.8 Study Objectives

The main purpose of this project was to analyse if the usage of Personal Digital Assistants in improving the delivery of health services in Uganda is viable.

The specific objectives were to:

-assess how easily the PDAs can be adopted by health workers

-assess the financial costs involved in setting up the PDA technology

-assess sustainability of the PDA technology promoted by UHIN

-find out if UHIN‟’s PDAs technology is cost effective

CHAPTER TWO

This chapter introduces the PDA concept and definition, presents context for the discussion of PDAs in Uganda, the theoretical and conceptual frameworks.

2.1 Understanding PDAs

The birth of handheld computer technology for general use is not older than 14 years, with the first Palm device, Pilot 1000, coming into operation in 1996 (Johnson & Broida, 2003). According to Freudenrich and Carmack (2009), the main purpose of a Personal Digital Assistant (PDA) is to act as an electronic organizer or day planner that is portable, easy to use and capable of sharing information with your PC. The gadget is supposed to be an extension of the PC, not a replacement. Also called handhelds or palmtops, PDAs have evolved over the years. They not only manage personal information, such as contacts, appointments, and to-do lists, today's devices can also connect to the Internet, act as global positioning system (GPS) devices, and run multimedia software. Manufacturers have also combined PDAs with cell phones, multimedia players and other electronic gadgetry. (Freudenrich, and Carmack, (2009).

Health Research Institutions such as the Makerere University School of Public Health, the Iganga Mayuge Demographic Surveillance Site (DSS), the Rakai Health Sciences Programme and several donor funded projects in Uganda are increasingly embracing the use of PDAs. This follows a growing consensus that the impact of information and communications technologies on health systems could be substantial or even revolutionary.

What can PDAs do?

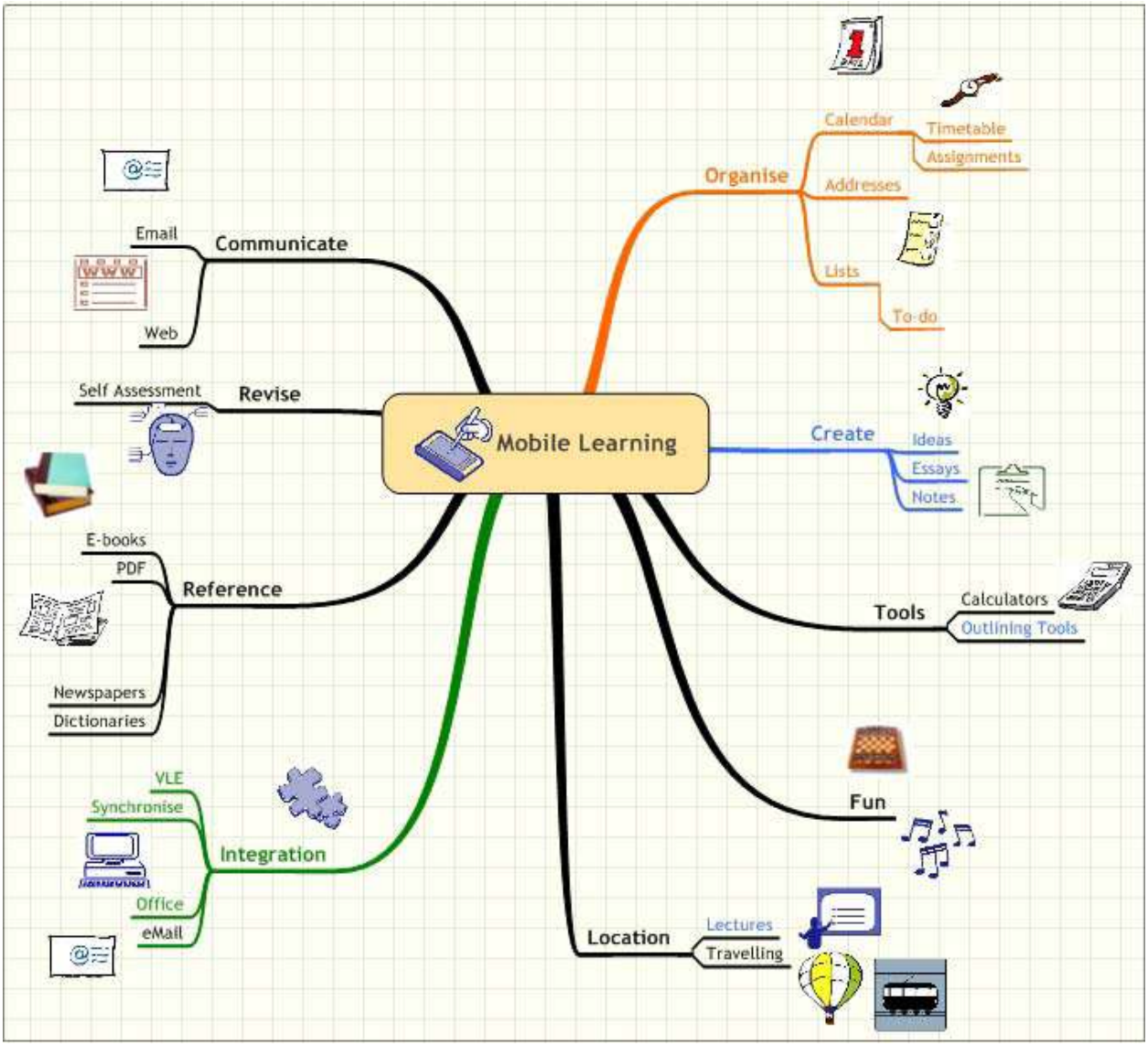

Diagram B: adapted from < http://www.engsc.ac.uk/downloads/miniproject/pda.pdf>

While the PDA was originally intended to act as a replacement for personal organisers, developers have produced a rich variety of other innovative solutions. Some PDA uses:

• Diary/Address book

• Note Taking

• Read eBooks/eMagazines/eNews

• Read/Edit „Office“ Documents

• Reading PDF Documents

• Send/Receive Email

• Download Web pages

• A specialised Calculator

• Self assessment

2.2 Theoretical Background

With funding from the International Development Research Centre (IDRC) of Canada to help developing countries use science and technology to find practical, long-term solutions to the social, economic, and environmental problems they face, the Uganda Health Information Network is a Development Communication Project.

The field of Development Communication dates back to the 1950s when it was mainly associated with a systems model of communication. This model functioned as a science to produce effective messages as an add-on to agricultural extension programmes, and was conceived primarily as a tool of top-down development programmes. But nowadays it is strategic oriented and more theoretically diversified (Waisbord 2000). This diversity is seen in several development communication projects tagged under „Communication for Development; Communication for Social Change; Information, Education, and Communication; Behaviour Change Communication; and Strategic Communication among others.

In the same paradigm, participation and empowerment can be considered as the two major pillars of communication for sustainable development. Research conducted on the concept of participation confirms that it has been highly praised and misused. Mefalopulos 2003 as cited in (Hemer and Tufte, 2005) confirms that participation is not only used in vague and often contradictory ways but it can also be conceptualized and applied in different ways within the same project or programmes. In the operational routines of development projects and programmes, the term participation can be encountered in various contexts, of which none may actually carry the genuine sense of participation, i.e. play an active role in the decision –making process. Defining precisely what is implied by a "genuine application of participation" is certainly a major challenge.

However, what matters here is that social change is the ultimate goal of development communication (Servaes, Jacobson and White 1996; Wilkins, 2000) as articulated in (Oscar and Hemer, 2005). In this context, social change serves as a general term for a multiplicity of communication initiatives and actions that set transformations in motion. Development Communication, however, is said to be facing two challenges, according to one scholar. Waisbord writes, (in Oscar and Hemer, 2005), that the first set of challenges –and this happens to be the only one of concern to this paper- deals with scale and sustainability, which are critical aspects of development projects. He argues that "because there are persuasive explanations and findings about what works in small scale community projects, yet a shortage of convincing results at the national level, scaling up projects has become an important concern, particularly for donors."

Sustainability of development projects is another preoccupation. Waisbord further explained thiswith reference to (Michael Edwards, 1999) who was quoted saying that:

> "Winning short term gains on the basis of heavy external inputs is not difficult; what is difficult is sustaining them against the background of weak politics, fragile economies and limited capacities for implementation."

But to Mefalapulos (in Hemer and Tufte, 2005), one of the challenges faced by communication in the field of sustainable development is finding ways of assessing the impact of communication for sustainable development. The impact needs to be measured in both quantitative and qualitative terms. For consistence with the new conception of development, evaluation should be rooted in a participatory model which would have implication on various issues, such as, what should be measured, which indicators should be adopted, and in the end, who should be in control of the design related to evaluation. If people's participation is the basis of development, it is pertinent that the degree of success is also assessed according to criteria selected by those very same people, i.e. „beneficiaries". For instance, when we assess the impact of a programme aimed at reducing deforestation, the evaluation cannot focus only on progress made in reducing the rate of deforestation, but should also assess how that change has affected people in the area

2.3 Theoretical framework: Diffusion of Innovations Theory

This study was largely guided by an abridged version of the Diffusion of Innovations Theory to provide an analytical framework through which to assess the potential of the Uganda Health Information Network. Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. Meanwhile, an innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption (Everett Rogers, 1983)

Research based on diffusion centers on the conditions which increase or decrease the likelihood that a new idea, product, or practice will be adopted by members of a given culture. And in studying the process of innovation, . Rogers (1995) argued that it consists of four stages:

Invention, Diffusion (or communication) through the social system, Time and Consequences. In explaining the four stages, . Rogers and Scott (1997) said say that characteristics which determine an innovation's rate of adoption are: Relative advantage (the degree to which an innovation is perceived as better than the idea it supersedes), Compatibility (the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters), Complexity (the degree to which an innovation is perceived as difficult to understand and use), Trialability (degree to which an innovation may be experimented with on a limited basis), and Observability (the degree to which the results of an innovation are visible to others).

Regarding the communication channel used under this theory the authors asserted that Mass media channels are more effective in creating knowledge of innovations, whereas interpersonal channels are more effective in forming and changing attitudes toward a new idea, and thus in influencing the decision to adopt or reject a new idea. Most individuals evaluate an innovation, not on the basis of scientific research by experts, but through the subjective evaluations of near peers who have adopted the innovation. The time dimension is involved in diffusion in three ways but for purposes of this study, the Innovation-Decision Process was of interest. Innovation-Decision is the mental process through which an individual (or other decision making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. In the innovation-decision process in order to decrease uncertainty about an innovation's expected consequences, an individual seeks information at various stages. This is the 5-Step Process:

(1) **Knowledge** – person becomes aware of an innovation and has some idea of how it functions

(2) **Persuasion** – person forms a favorable or unfavorable attitude toward the innovation

(3) **Decision** – person engages in activities that lead to a choice to adopt or reject the innovation

(4) **Implementation** – person puts an innovation into use

(5) **Confirmation** – person evaluates the results of an innovation-decision already made.

The fourth main element in the diffusion theory is the social system. A social system is a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal

(Rogers and Scott, 1997). “The members or units of a social system may be individuals, informal groups, organizations, and/or subsystems. The social system constitutes a boundary within which an innovation diffuses.”

The Diffusion of Innovations Theory is therefore a helpful tool to analyse the potential of the Uganda Health Information Network because the project, at its inception was a new innovation to the Uganda health sector and a development communication project.

There may be arguments on the practicality, limitations and potential usefulness of the diffusion model. For example (Wolfe, 1994) observes that in most studies where the diffusion theory has been used, there has been lack of specificity concerning the innovation stage upon which investigations focus; inadequate consideration has been given to innovation characteristics and how these change over time; and research has been limited to single-organisational-type studies. However, this project does not seek to engage in any debate but rather adopt part of it as a tool to critically analyse the UHIN.

2.4 Conceptual Model

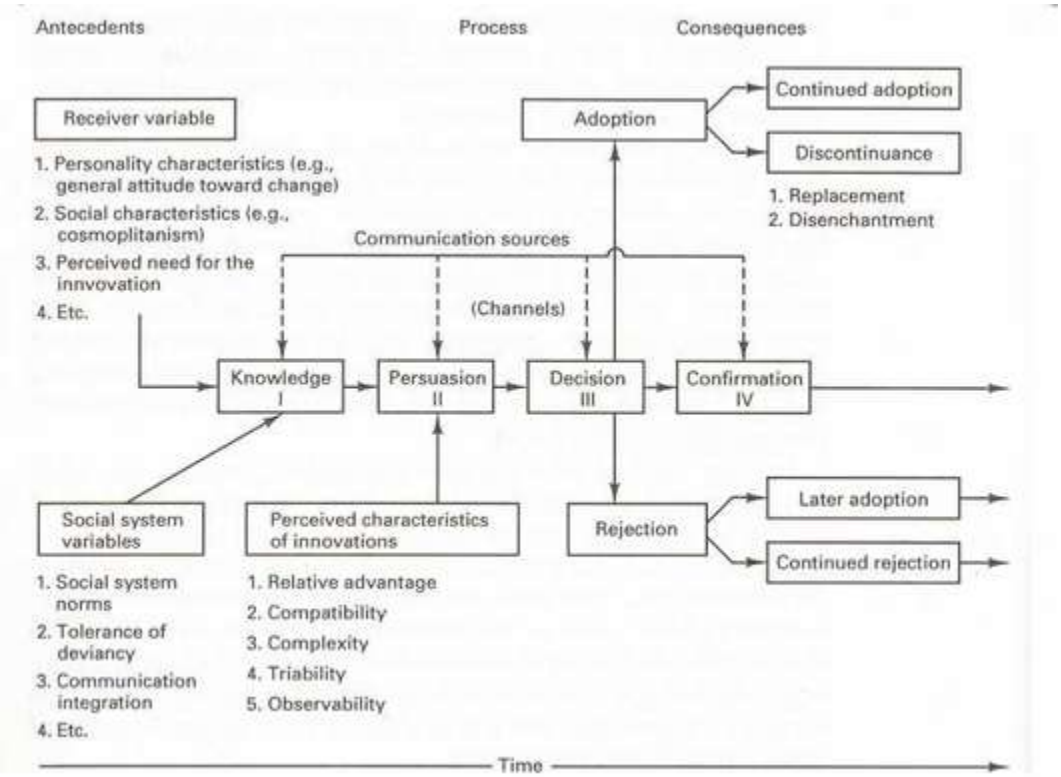

Diagram C: Sourced from Rogers (1995)

What is deduced from the above is that diffusion of innovation occurs through learning. This means that an individual learns about an innovation by replicating someone else's adoption of the innovation, implying that diffusion is a social process of interpersonal communication processes. Consequently, diffusion of innovation has a number of fundamentals, among which is the motivation to learn, demonstration of the process or knowledge about the potential benefits, and the social process of communication.

CHAPTER THREE

(Overview of Existing Literature)

3.1 The PDA Experience

Health workers today face many challenges among them being the effective and efficient management of an ever increasing amount of clinically related health information (Doran, 2009). Doran further writes that an important dimension of this challenge is the accessibility of information at times of decision making. But,

> "Mobile information terminals, such as personal digital assistants (PDAs), have the potential to address this challenge by bringing the most relevant information directly to the point of care. Providing information through convenient electronic sources may address some of the barriers that inhibit access and clinical use of new and relevant research by nurses."

One wonders why it has not been fully employed to help in rural areas for example.

Citing a study which assessed the effectiveness of PDAs and mobile tablet PCs in improving nurses‟ access to various information resources, in which Doran participated in Canada, she pointed out that nurses‟ accounts of using PDAs in practice, which showed the power of chance, opportunity, and necessity to transform their learning:

> "There are so many new drugs out there, like BP [blood pressure] medications, etc, and quite an increasing acuity in the community. This is just right there for you.with PDA's it would be very easy to access the necessary information."

> "One member of a family had a tooth infection and started on …antibiotics. To check, because he has a history of heart problems [and is taking] a lot of meds, I checked the interaction. I know it will come in handy when I am at the bedside.
>
> "I was working with a home care client who had questions about side effects and possible interactions with her many medications. I used my Blackberry to look up her meds using PEPID and was able to reassure her that it was okay to take all of her medications. I also went over what each one was for so she was aware of the importance of each medication"
>
> "I was orientating an RPN new to our long term care setting and she had a question in regards to an injection she was about to give. I was able to look up the requested information at the resident's bed side to determine the appropriate information."

The above shows that PDA comes in very handy for medical personnel who have patients and need to give them proper treatment that she/he could have probably forgotten. This still leaves us wondering why it has not really been employed all over the world.

Out of Uganda, as quoted in George, L. & Davidson, L. (June, 2005), results from the Canadian Medical Association Physician Resource Questionnaire (Martin, 2003) indicated that a third of Canadian physicians were using some type of hand held device in their practice. The two further cite a 2004 Forrester's Technology Survey indicated that 47 percent of U. S. physicians used PDAs in their practice. This may still be a low percentage compared to the effectiveness of

PDAs. The device has a lot of roles that it can play in the community."Physicians who use handheld devices indicate that the devices boost efficiency by helping to track patient data and capture reimbursement information" (Miller, 2003) They also report using them for prescribing medications and reviewing dosaging. (Rothschild, J.M., Lee, T.H., Bae, T.,& Bates, D.W., 2002). The variety of point-of-care uses is vast and growing daily. They included the patient tracking information mentioned above as well as applications for data collection and measurement (Ault, 1998). The applications are also not confined to any particular clinical specialty with examples of utilization from the Geriatrics to Pediatrics." (George, L. & Davidson, L. June, 2005) The Forrester's Technology Survey also indicated that nursing usethem, though lagging behind physician use, is increasing.

Aziz and others (2005) have looked at a heterogeneous team of doctors working in a busy surgical setting at St. Mary's Hospital in London and compared the use of a personal digital assistant with mobile phone and web-browsing facilities to the existing pager system.
The study found that doctors equipped with a personal digital assistant rather than a pager, responded more quickly to a call and had a lower failure to respond rate. The user clinicians also found this technology easy to adopt as seen by a significant reduction in perceptions of nervousness to the technology over the six-week study period. Therefore, the authors concluded that:
"The results of this pilot study show the possible effects of replacing the current hospital pager with a newer, more technologically advanced device, and suggest that a combined personal digital assistant and mobile phone device may improve communication between doctors."

With improved communication among clinicians, healthcare users also stand to benefit from such an improvement. But the question still remains about how it can be current hospital pager with a new one, why is it not as common as one would think?

Lindquist A.M, et al in their article, "The Use of the Personal Digital Assistant (PDA) among Personnel and Students in Health Care: a Review", sought to obtain an overview of existing research on the use of PDAs among personnel and students in health care. The literature search included original peer-reviewed research articles written in English and published from 1996 to 2008. They excluded reviews and studies focusing on the use of PDAs in classroom situations. Between March 2006 and May 2008, the team searched PubMed, CINAHL, Cochrane, IngentaConnect, and a local search engine
(ELIN@Kalmar). The findings from the studies showed that health care personnel and students used PDAs in patient care with varied frequency.

> "Most of the users were physicians. There is some evidence that the use of a PDA in health care settings might improve decision-making, reduce the numbers of medical errors, and enhance learning for both students and professionals, but the evidence is not strong, with most studies being descriptive, and only 6 randomized controlled trials. Several special software programs have been created and tested for PDAs, and a wide range of situations for their use have been reported for different patient groups. Drug and medical information were commonly accessed by PDA users, and the PDA was often viewed as the preferred tool when compared to paper-based documents. Some users regarded the PDA easy to operate, while others found it difficult in the beginning." (Lindquist, et al 2008)

As a result, the research team concluded that this overview of the use of PDAs revealed a positive attitude towards the PDA, which was regarded as a feasible and convenient tool.

A study at the Iganga - Mayuge DSS in eastern Uganda indicated an improvement in data collection following the introduction of PDAs. The number of households visited per day with a PDA was almost double the number of households visited with paper. Fewer errors were found during editing and an experienced paper based interviewer could easily adapt to the use of the PDA. (Nabukalu D et el, 2005). The authors concluded in their research paper that The PDA data collection systems are the way to go for Health Demographic Surveillance Sites.

In another study, EpiHandy, a new tool for collection and handling of data using handheld computer was in 2004, was tested at the Department of Paediatrics and Child Health, Makerere University. The study showed that handheld computers are a feasible, cost efficient and beneficial tool for data collection and handling. (Jørn Ivar Klungsøyr, 2004).

3.2 The Bigger ICT Picture

The term "Information and Communication Technologies" (ICTs) refers to the broad range of hardware, software, network infrastructure and media that enable the processing, storage and sharing of information, and communication both among humans and computers, locally and globally. It includes more established technologies such as radios, telephone networks and

computers as well as newer technologies such as mobile phones and global networks such as the Internet.

As indicated earlier, the use of new ICTs such as the UHIN package continues to be limited in healthcare particularly in developing countries. Healthcare systems are mainly using stand-alone computers for storage and transportation of textual information (Rwashana and Ddembe, 2008). Yet some of the healthcare systems that have been developed go beyond the basic computer to include billing, financial systems, patient registration, computer based record systems and pharmacy systems. The duo further writes that most of lab equipment and radiology equipment are now computerized and linked through data networks. Telemedicine which uses telecommunication and multimedia technologies is now increasingly used for remote consultation, diagnostics and examination of patients over the internet. And as far as improving education in health is concerned, National ICTs are being used for sharing documents, simulations of health scenario planning, training, interactive environments and self managed e-learning."

ICT remains a challenge with prevalence among health facilities being at 6.4 percent comprising of mobile phone, radio, TV and computers to a smaller extent.

However, the use of classy emerging technologies shows that the situation is changing. There is an increasing use of all sorts of gadgets from electronic health records on handheld computers to cellular phone based systems of ensuring drug adherence especially in an era of HIV and AIDS, and Tuberculosis. According to Granqvist, ICTs have become major players on the development

arena. ICT strategies are now incorporated into the programmes of most foreign aid agencies and many NGOs are focusing on the issue of information technology. This is because they have seen the importance of ICT in development. Governments of economically weak countries which do not wish to appear as backward are readily joining in and so, with the help of development banks and multinational companies are on the lookout for new markets, the new technologies are spreading to all corners of the world. (in Hemer and Tufte, 2005)

According to Rao as cited in Hemer and Tufte (2005), despite recent confusion in the so-called "New economy", one cannot deny that new ICTs like can with apt conditions, change learning and knowledge-sharing, generate global information flows, empower citizens and communities in new ways that redefine governance, and create significant wealth and economic growth in many countries.

Several projects across Africa have showed that ICT can play a major role in healthcare delivery. The Cell-Life project in South Africa is one of these projects. Backed by local mobile phone giant Vodacom, the project developed software and data management systems that let clinic workers use their mobile phones to monitor patients' treatment and spot health problems before they become life-threatening. (Kahn, T. 2004). The phones were equipped with a special menu that enables HIV counselors to record data on a patient's symptoms and whether they are sticking to drug regimes, as well as other factors that might affect their health - such as a lack of money to pay for transport to the clinic, or a shortage of food. The information collected is instantly

relayed over Vodacom's network to a central database, which clinic staff can access over a secure Internet connection. If this was practical here, it is possible that it can be applied elsewhere.

Another project by Lee and others (2005) looked at the role of low bandwidth telemedicine in surgical pre-screening at a Kenyan hospital. The project saw a group of surgeons and nurses travel to Mombasa to provide surgical assistance at the Coast Province General Hospital (CPGH). But before the visit of the surgical team, surgeons evaluated patients via low-bandwidth telemedicine. Pre-screening was performed through use of an Internet-based desktop computer system that was supported technically by the Virginia Commonwealth University. Conclusions were that low-bandwidth; Internet-based telemedicine is a cost-effective technology that can efficiently and effectively pre-screen surgical patients in remote areas. The success of this project through a low bandwidth internet has good implications for the UHIN project.

According to the Organisation for Economic Cooperation and Development, today, there is no lack of agreement on the quality benefits that might derive from widespread adoption of information and communication technologies (ICT) in the health sector. Health ICTs are increasingly seen as part of an inevitable process of modernisation of the health care system and "e-health as the cost of doing business in the 21st century health care". The technology has progressed significantly and many estimate that ICT implementation can result in care that is higher in quality, safer, and more responsive to patients'" needs, and at the same time, more efficient (appropriate, available, and less wasteful). Advocates, in particular, point to the potential of ICTs to enable health system transformation.

For President Paul Kagame of Rwanda, ICT is an "enabler" because it provides an enabling environment for efficient delivery of social and economic services. (Dentzer 2008). He says it makes a lot of sense to therefore focus on e-health. An example of an e-health technology cited by Kagame which his country is already using is TRACNet, developed as a partnership with Voxiva and Rwanda, with PEPFAR (the US President's Emergency Plan for Aids Relief) support. "Really, all it does is building on a simple two-line mobile telephone, and uses this to track drugs, patients, and what is going on between them. It helps us monitor and evaluate what's going on with drugs even in remote areas of our country, and the progress as it relates to the patient. Normally, people do not understand it until they see it work, and in Rwanda this is now working for real-time delivery of information and enabling the system to make the appropriate response depending on the patient."

In Uganda's second Health Sector Strategic Plan (2005/06 – 2009/2010), it is asserted that ICT mainstreaming/integration in healthcare delivery will facilitate the implementation of the National Health Policy and help in co-ordination of health information for planning and decision making, as well as effective sharing of the scarce resources for optimal health care delivery for all Ugandans Yet not all Ugandans have benefited from this.

None-the-less, according to Rao (2005), the failure of many very good ICT projects in developing countries have attributed their failure on being too technology-centric or because they stopped at the installation phase of computers. What is ignored here is that the information society is not just about being connected to the global information infrastructure, but about accessibility of content, the communities that congregate online and offline, the embedded and

emerging cultural attitudes, the commercial and other motives behind such activities, an attitude of cooperation and lifelong learning, and a capacity for creating and governing such information spaces. The information society is not a passive one that is just using the "black box" technologies; it helps to shape the underlying technical, information and service infrastructure (in Hemer and Tufte, 2005).

3.3 Viability, Sustainability and Cost Effectiveness

3.3.1 Viability

In trying to understand the viability of a project, a couple of questions may come up: Will the project take to the air, or will it crash and go up in flames? Each of the questions represents a very crucial point that has the potential of dire consequences. These may include resources, costs, justification, skills, client needs, results, concerns, strategic goals and deadlines, among others. Therefore if the intended project cannot answer any of the aforementioned, chances are that it is destined for failure (Gantthead, u/d).

In *Viability of an ICT Project*, by Francommunautés Virtuelles (2005), it is argued that previously, organization leaders accepted a certain margin of error and even failure when implementing an ICT project but the situation has changed. Nowadays, a project must show good potential for financial viability, be capable of evolution and expansion, provide ongoing benefit and, above all, be useful and used.

3.3.2 Sustainability

Debate on the term sustainability is immense. But the sustainable livelihoods framework developed and used in abridged versions by a number of agencies has as its focus on four capital assets. These include the financial, human, social and physical between which a balance has to be sought (Ashley and Carney 1999). Within this framework, Batchelor and Norrish (2004) observe that

> "It is considered that sustainable systems – whether livelihoods, communities or national economies -accumulate stocks of assets; they increase the capital base over time. Unsustainable systems deplete or run down capital, spending assets as if they were income, and so leaving less for future generations."

According to Batchelor and Norrish the approach differentiates between different kinds of sustainability which are useful in relation to ICTs. They argue that economic sustainability is achievable when a given level of expenditure can be maintained over time, while social sustainability is achieved when social exclusion is minimised and social equity maximised. And institutional sustainability, they add, is achieved when prevailing structures and processes have the capacity to continue to perform their functions over the long term. But Batchelor and Norrish observe that for institutional sustainability to be achieved it is important to have in place well-defined laws, participatory policy-making processes, and effective public and private sector organisations that create a framework within which the livelihoods of the poor can be continuously improved.

3.3.3 Cost Effectiveness

Identifying the cost effective interventions and determining how to deliver those interventions effectively, efficiently, and equitably is a priority in health care delivery (Jamison et al, 2006). This argument is premised on the fact that science and medicine have shown that many interventions can be effective. Therefore, Jamison and others further explain that combining this knowledge with economic analyses of cost-effectiveness identifies which interventions can achieve the greatest health gains with a given level of resources. However, they note that making such health gains a reality requires implementing the selected interventions, a challenge that countries with effective health systems are better able to handle, but one that countries without effective health systems can deal with by improving their existing health systems or constructing them where they are lacking. Question is, is the Uganda Health Information Network such an intervention that Jamison and others allude to?

CHAPTER FOUR

(Methods and Limitations)

4.1 Methodology

This section mainly focuses on the methodology employed by the researcher. Primary and secondary sources of data were used. The researcher read the available literature on PDAs and health care delivery. Observations were made about one health worker using PDAs at one health centre; interview guides were designed and a document review was done in order to get the needed information. Contacts and appointments were made for interviews and the collected data was categorized into different themes that were related to the research questions. The information obtained was to aid in providing a better understanding of the perceptions of the health workers about service with or without the PDAs.

4.2 Research Design

Under Descriptive design, semi structured interviews were used to get the desired information. The individuals to be surveyed were identified, means by which the survey was to be conducted and the data was summarized to provide the desired descriptive information. Descriptive design was valid because the research aimed at describing how PDAs can be used to improve health care delivery in Uganda.

4.3 Study Area

The study was conducted in the eastern Uganda District of Mbale, one of the five districts in the country that are using PDAs under UHIN project. Mbale, a district of 300,000 people in eastern Uganda was chosen because the study author worked in the district before. This would ease the process of fixing appointments and reaching out to the interviewees. Similarly, conducting research in familiar territory helped in minimizing financial resources, something that would not have been possible in the case of unfamiliar territory.

4.4 Study Population

Selection of respondents took into consideration aspects of field and desk users of the PDAs. Three field health workers were selected from different settings: a rural setting, a peri urban setting and an urban setting. The Mbale District Health Management Information System officer, the UHIN Project Manager and the Site Manager of the Iganga- Mayuge DSS were the other Key Informants.

4.5 Sampling Procedure

The researcher used non-probability sampling because he was interested in a small representative group that uses PDA, this was for purposes of illustration. Under non-probability sampling the researcher used purposive sampling because the target group was that of those that had used the PDA. Finally the researcher zeroed down on extreme case sampling because it focuses on cases that are rich in information as observed by (Berg 2007)

4.6 Research Instruments

In order to collect data from the above subjects, the tools that were used were observation, interview schedules, and documents written in the past that had a bearing on the study.

4.6.1 Interview schedule

A semi structured interview was designed to strengthen observation. Interviewing was seen as vital because it helped the researcher probe beyond the answers as noted by (Bruce 2007). The above instrument is reliable because the interview was carried out by the researcher and he was able to check on consistence of information given. Interviews were easier to administer because the skill in interviewing was already available and it is comprehensive enough as observed by (Kombe and Delho, 2006; Huberman and Miles, 2002).

4.7 Data Collection

Primary and secondary sources of data were used. The researcher used observation and an interview guide to get information on use of PDAs to improve health care delivery in Uganda. The interviews with health workers using the same guide and questions lasted 15 minutes each, while those with the three Key Informants, who each had a different interview guide and different set of questions lasted 20 minutes each. The researcher read the available literature from Makerere University Medical School where the Uganda Health Information Network is coordinated, and those on different web sites about the UHIN project. The documents were all authored by the Project team a part from the cost effectiveness study which was done by a

consultant independent of the project team. The data was collected between October 2009 and May 2010.

4.8 Data Processing and Analysis

Data was collected from the notes made from the recorded interview. The data was categorized into different thematic concerns in relation to the research objectives/questions and a report written. This helped because the analysis was based on the needed information as noted by (Patton 1990). In analyzing the data, the research in some cases compared primary and secondary data to establish any differences, while in some cases one complimented the other.

4.9 Data presentation

The collected data was coded based on the samples collected and later placed under different themes and a summary developed. Data was presented in relation to the research questions and objectives that were used. The data was analysed as the research progressed, continually refining and reorganising in light of the emerging details as observed by (Huberman& Miles 2002).

4.10 Quality Assurance

In order to ensure quality, the researcher took the following measures: Both the key informant and in depth interviews with the field workers were recorded in order to minimize loss of information. The researcher personally did the transcribing to ensure efficiency. The small sample also did not necessitate bringing in a third party.

4.11 Study Limitations

The study was not funded making the researcher to do limited work. Otherwise in order to have fully evaluated the Uganda Health Information Network Project, it would have been important to sample at least two or three districts in the two regions of the country where it is being implemented. It is for this reason that a major study that also would include the public in the study sample should be done.

Although it was quite easy to establish the potential of the project, fully establishing the viability was challenging due to the amorphous nature of viability. Getting the right theory to look at viability was quite challenging.

4.12 Personal Reflections

And as a researcher who had lived in Mbale before, for a period of seven years as a journalist with special interest in health issues, it is not surprising that I took on studying the UHIN Project. Although this somehow influenced me in undertaking, it did not in any way affect my objectivity because I had no conflict of interest in the project

CHAPTER FIVE

(Results)

5.1 Adopting the New Technologies

Like most innovations, new technologies come with challenges to those who are using them for the very first time. Therefore, the introduction of personal digital assistants to health workers in the rural district of Mbale was bound to come with its challenges, among them their user friendliness. How easy did the health workers or users find it to familiarize oneself with, understand, and use the new gadgets?

Easy Adaptability

The findings indicated that those who were computer literate found that the introduction of PDAs was not problematic and adapted easily to the new technology. They adapted easily because the functions on the handheld gadget had some similarities with those on the desktop computers they had used elsewhere. At Namakwekwe Health Centre, for instance, the lead user of the PDA did not have difficulty in adapting to the new technology. The health worker was computer literate and often accessed one in any of the many internet cafés in Mbale town. She said,

> "Personally I did not have problems although my colleagues had a few challenges here and there. This is probably because I had some background computer knowledge. And I was interested because I had seen PDAs being used before. So this made it much easier for me to learn. (Interview, Namakwekwe Health Centre)

Another interviewee had similar observation:

> "As for me, by the time those PDAs came in, I was already computer literate. I did not find many difficulties in using it. But at one time it had a fault somehow. I tried to reset but it failed." (Interview, St Austin Health Centre).

Having prior computer knowledge was very important for those who adapted easily to the use of PDAs

Difficulty in Adapting PDAs

Some for whom the technology represented a whole new experience, learning the new technology took time. As one described it:

> "At first it was a new thing and as you know, new things have their own challenges. This was right from the software, anticipation on improvement of information flow. But as time went on, through training, we were able to learn and they trained us, in some basics which we are applying and at least this has helped us." (Interview, Wanale Health Centre).

A district official appreciated the two experiences saying the situation was the same across the district when the PDAs were introduced. He said,

> "Very many got the interest including the elderly. You see, having a new machine and going with it back to the villages was seen as pride by some. However beginning to use a computer sometimes has its challenges; it keeps teasing the users. But those who had the interest found it very easy and were ready to use it." (Interview, District Health

Official)

Similarly, this is what a UHIN self evaluation found after the first phase of the project at the end of 2004. Ladd (2008) describes how personal digital assistants have been adopted are delivering vital information as cited in Verclas and Kinkade (2008):

> "We have seen changes in practice, particularly around treatment for diarrhea. We emphasize in the medical treatment alerts that we send to the handheld devices in the clinics that rehydration therapy is strongly recommended as a first course of action, particularly with kids. We have evidence that this is now used much more often as a first course of action in those clinics."

Ladd, Verclas and Kinkade write that PDAs are streamlining health data collection from remote areas. Ladd describes a past typhoid outbreak that was detected early because clinics regularly reported cases with PDAs."The outbreak was contained because we could see that something was amiss. This would not have been possible with paper and pencil reporting, which is, much more time consuming."

5.2 Set up Financial Costs

According to Rao (in Oscar and Hemer, 2005) the best chance, for such initiatives as UHIN to survive, are if they are at least economically self sustaining. So it was important to look at the costs involved in setting up the PDA technology in Uganda and establish if it is affordable to enable replication across the country.

The major goal of the launch of a wireless network was to improve Uganda's ability to treat

patients and combat the spread of disease in the most affordable way possible. The initial grant to start up the system came from Connectivity Africa, a Canadian government initiative managed by IDRC and funded from Canada's Fund for Africa, which contributed $761,000 Canadian Dollar to the development of this information network.

> "The convergence of new technologies low-cost handhelds, broad and reliable wireless coverage and WideRay's (wireless technology company) innovative use of it have made applications that once seemed impossible in Africa a reality. This project will be a powerful example to the rest of the world of what is possible with wireless technology."
> Richard Fuchs, Director of IDRC's Information and Communication Technologies for Development (ICT4D) program area.

At present, for a health centre to have this technology, one PDA costs USD150, the Access Point goes for USD600, while the periodical subscription to the telecommunication company for internet access for the 17 AAPs serving dozens of facilities in the project covered districts is USD$ 25 per month.

It emerged that the capital costs are reasonable and affordable if other districts decided to embrace the project. Even the monthly wireless internet charges that used to be as high as $1000 per month in the late 1990s when internet was beginning to take root in Uganda have gone down to such affordable rates of $25. At the start of the UHIN project in 2003, the monthly connection cost was $75 per access point. This is a positive trend and there is even more optimism with the increasing number of Internet Service Providers and mobile telephone companies. At the close of

2009 there were six companies operating cellular networks in the country. Also with the country now connected to three undersea fibre-optic cable connecting eastern and southern Africa to Europe and Asia internet speeds have increased and prices reduced by more than 75 percent, a trend likely to even further go down. This gives an indication that PDA can be adapted by the whole country.

5.3 Sustainability

The Uganda Health Information Network project is donor funded. But a time may come when donor fatigue could lead to an end to foreign funding. If this situation arose, would the beneficiaries be in position to sustain the innovation? Therefore it was important to find out how the project was planning for the future.

It emerged that at Uganda Chartered Health net and the Makerere University Medical School where the Uganda Health Information Network is hosted and coordinated, a lot of capacity building has and is still being done. One key informant said,

> "Satellife is still with us and helping. However we have been building capacity. One of the things we do is to pass on technical knowledge to the districts. But even for us here, we have trained and also done the same with District Support Teams." (Interview, Key Informant at UHIN)

At the district, there seems to be support for the project and plans are under way to support it in the post donor support period.

> "Sustainability is one of our priority issues in the budget because the District Health

> Officer accepted saying that at least when these machines are there, they could buy more and re-enforce at some Health Centres where there are two or three. We need about five of them in every health facility at level 2, 3 and then at level 4 we could have may be like 20 PDAs. The district is very much willing to continue from where the project ends." (Interview, District Official)

And UCH has not only acquired new staff and new technical and training capabilities, but also developed realistic strategic and business plans that forecast sustainability based on its ability to deliver connectivity, training, and content on a fee-for-service basis to other NGOs, government agencies, and institutions. End users are also determined to sustain the project. All the health workers interviewed said that they would set aside money to purchase their own PDAs in case the ones supplied by the project were withdrawn. However, at UHIN, they assessed sustainability through a better understanding of the operating costs of the system related to cellular airtime for connectivity of Jacks (AAPs), operation and maintenance of network related to equipment, and personnel related costs. From the initial days of the project, cellular airtime expenses emerged as one of the highest operating costs of the network. The average monthly connectivity cost per Jack was about US$70 by the end of 2004.

Expenses related to personnel constituted the most significant portion of operational costs. The need for trainers and user support technicians was particularly high during the early phases of the project, but the partners were able to reduce operating costs by avoiding staff redundancy through continuous review of staffing requirement and corresponding staff reductions.

Regarding equipment maintenance, all network equipment performed reasonably well and there was no maintenance cost with the exception of one G20 WideRay Jack that had a malfunctioning infrared port and was repaired by WideRay (UHIN, u/d).

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Throughout the project, emphasis has been put on ensuring that project staff acquires the skills required to manage the network and all aspects of PDA hardware and software deployment. WideRay personnel, the initial suppliers of some of the startup equipment, provided ongoing training and support, including on-site visits. And UCH has built a team of five trainers who are capable of troubleshooting the full range of hardware and software issues that an end-user in the field is likely to encounter.

In a related outcome, UCH staff has over the years closely engaged with district level information managers. This aims at ensuring that they are conversant with the functionality of the network and the potential it holds for their districts. This capacity building enables them to be fully engaged partners in determining how the network should be utilized and expanded. In addition, personnel at various health facilities have themselves become PDA trainers, successfully transferring skills to their co-workers.

Because sustainability is a multi-faceted issue involving money, skills and moderation, the way UHIN handled this was reasonable. While the need for money and skills is obvious, moderation is required, because growth that is too fast, or too ambitious may be impossible to sustain with sufficiently high quality. Perhaps this explains the multiyear experimentation of the project in just a few districts. The training of both project staff and potential end users was visionary on the

part of the implementers of the innovation.

5.4 Cost Effectiveness

After the first six months, the project implementers did carry out a cost effectiveness analysis. But during this time only two of the fourteen paper forms used by the districts had been converted to the electronic format. Of the 14 forms that are prioritized by the country's health system it was further agreed that the most used 8 be uploaded immediately and these have since been uploaded on the network. And by the end of 2008 these forms had been uploaded to ease data collection for easy planning.

Findings of this study concurred with results of the UHIN cost effective analysis showing that the network delivered a 24 per cent savings per unit of spending over the traditional manual data collection and transmission approaches, a figure likely to increase when the six additional paper forms are converted. A team of experts from Makerere University concluded that the PDA project was less expensive by about 25 percent than the traditional paper-and-pen approach for data collection. The Uganda Ministry of Health has said it is now interested in providing PDAs throughout the health sector, according to a 2009 IDRC report.

Similarly, Mbale District Health Services reported obtaining close to a 100 per cent compliance rate with their weekly Disease Surveillance, reporting using the network, whereas the national average was 63 per cent. Also observed is the improved data quality at point of collection, more timely access to data for analysis, decision-making and more rapid response to emerging situations. A comment from one of the respondents was,

> "This is actually helping us in our interventions. We had some dysentery in Bungokho South where we saw abnormal figures compared to previous weeks. Within that very week when I saw the figures rising, I went straight to the surveillance focal person. There and then we got in touch with the health inspector to go and establish what was happening on the ground. And indeed there was a problem. So we believe through that timely reporting, it helped us identify a problem and we acted."
>
> (Interview, District Official)

The project has also seen health workers at remote sites, including those with no fixed telephone lines or regular supply of electricity, routinely access critical information, and continuing medical education materials, which had previously been unavailable to them. They also no longer have to travel long distances to the district headquarters to deliver data or to receive feedback, conserving time and resources for the health system. A health worker in an interview said,

> "There are books, indices, which we can refer to make diagnosis, prescriptions and many things like that. Unlike in the past where you had to wait for a colleague or make a phone call, now you just tap the PDA and the information is there. Also it is a handy thing because you keep your diary there. And when you are bored, as you know our healthcare system, the PDA can be a source of entertainment." (Health worker interview)

Similarly another observed

> "We usually have what we call Continuing Medical Education in the health centre's. Those days we would have to sit on a round table and teach the subordinate staff or other colleagues. But now

> you just tap on the PDA and give them to read. When you have time later, you explain if there is need. So it is easier and saves a lot of time." (Health worker interview)

The UHIN Phase III Technical Report has similar findings. Health workers acknowledged that there has been a commendable improvement of content broadcasts. However content broadcasts were sometimes affected by rationing of electricity to power the access points. Majority (72%) of the health workers felt that broadcast of content 3 times a week with daily news broadcasts was adequate and should be continued. Most health workers acknowledged that content received has improved their day-to-day management of patients by improving on their knowledge and skills as evidenced below;

> "I received a child of 7 months with Diarrhea and severe dehydration and I did not know how much fluids to give because the clinical officer was away, but I remembered I had my PDA which I consulted and I calculated the volume using weight of the child and I gave the correct volume of Normal saline", Nurse at a Health centre II in Mbale

However it also emerged that for some reason unknown to the field health workers, some of the information they are accessing with their PDAs is not updated. They were having old information at the time of this research investigation. But a follow up on the matter with the project headquarters at Makerere University Medical School showed that two technicalities were responsible for this mishap which they described as "intermittent."

> "It was software on the infrared pot whereby the AAPs could not connect with some PDAs. But this has since been worked on in most areas and only a few are remaining to be fixed. The other

problem is that when there is little sunshine for the solar panels to charge the APPs, they cannot work and this could be the time when some PDA users want to download or and upload new information." (Key Informant Interview)

5.5 Unplanned/ Chance findings

The Uganda Health Information Network offers a unique opportunity for large numbers of Uganda health professionals to access locally generated content that might otherwise be inaccessible. However, this can only be possible if increased emphasis is put on expanding the capacity within UCH to identify, edit, adapt and disseminate such content.

The network has potential to support staff retention. Health workers at remote facilities now have the ability to communicate with friends and relatives. This type of subsidiary but highly valuable benefit from the network is something worth exploring.

CHAPTER SIX

(Discussion, Conclusions and Recommendations)

6.1 Discussion

The Uganda Government through the second Health Sector Strategic Plan (HSSP II) recognises ICT to be of strategic importance as it facilitates the sharing of health data, information, knowledge and resources between the different stakeholders and the delivery of appropriate health services to the population (MoH, 2005). According to HSSP II, the mainstreaming/integration of ICT in healthcare delivery would facilitate the implementation of the National Health Policy and help in co-ordination of health information for planning and decision making, as well as effective sharing of the scarce resources for optimal health care delivery for all Ugandans. While at a national level these dreams are far from being realized, the results showed a positive development for a district like Mbale. Across all the specific objectives, interviews with the health workers and key informants, as well as the reviewed project documents indicated that the PDA project had greatly improved the way health workers in Mbale do their work amid a resource constrained setting.

With health workers even in the remotest parts of Mbale district now able to provide the latest clinical care to patients with common killer ailments like malaria and diarrhea as a result of receiving health information broadcast through the network, this is a significant achievement of the Uganda Health Information Network Project. All the users interviewed appreciated it as very useful the information accessed through their handhelds as useful at all stages of patient care, including diagnosis, treatment, and advising patients on home-care. In most Ugandan health

centres and hospitals, lower cadre health workers are the regular contacts with clients. Now with the majority of PDA users being the nursing cadres that includes midwives and nursing assistants located at community health centers (Levels IV, III & II), the advantages that come with these handhelds are even more apparent. However, the above development is undermined by the fact that information updates sometimes take long to be effected due to the sluggishness on the side of the project administrators. This is a potential cause of frustration among health workers and loss of confidence in the otherwise promising technology.

6.2 Adoptability

When health workers are confronted with questions in the course of their practice, often times, for reasons such as work pressure due to under staffing as is the case in resource limited settings such as Uganda, do not pursue the answers, sometimes resulting in fatal consequences for their clients. But learning to use new information tools such as personal digital assistants efficiently could potentially solve this problem and improve workplace learning without removing health workers from direct patient care (Doran, 2009).

> "Educational research supports the idea that the point of care is an optimal setting for care providers to learn and apply evidence-based information, leading to corresponding changes in provider behaviour and patient outcomes.
>
> While point of care may be an optimal setting in many respects for nurses, several barriers to information access and use have been documented in the literature. Recognizing the gap between information needs, time pressures, and research utilization, mobile information technologies are a potential solution for improving workplace

learning through increased access to information resources at the time of information need."

The testimonies of end users in the UHIN project showed that it does not take long to learn how to use and adopt PDAs. This minimizes fears that could affect the replication of the project. The users testimonies correspond to the project technical reports that conclude that trainees are now confidently using their handhelds, as demonstrated by their ability to integrate the technology into their daily work and routinely use applications for collecting HMIS data, including weekly reports and monthly summaries from all health facilities. Health workers trained by project staff were also able to successfully train their colleagues on the use and upkeep of PDAs.

Therefore, when Ladd as cited in Verclas and Kinkade (2008) asserts that the Project now knows what works given the response from the beneficiaries, it can only be concluded that the innovation has more or less gone through the five steps (knowledge; attitude; adoption; implementation and confirmation) of the diffusion on innovations theory. Ladd says:

"AED-Satellife [funders of UHIN] now knows what users like and do not like, what incentives they need to use the PDAs, where we need to cheerlead, support, and evangelize. It turns out that delivering news and popular content- including gossip columns- onto the nurses PDAs is a great way to get users used to using them

When this is further looked at in the context of the perceived characteristics of innovations that consist of relative advantage, compatibility, complexity, triability, and observability, the health workers have perceived the PDA innovation as new or useful and decided to adopt it.

6.3 Sustainability

While the project implementers and beneficiaries have appreciated the concept of sustainability as observed in the responses during the interviews, some challenges still exist. The training of project staff and district teams to manage the technicalities that came with the PDA was visionary on the side of the project managers. But the fact that even the change from the jacks to the AAPs has not completely solved the occasional interruption of data receipt and transmission should be cause for concern. As seen in the results, in some areas where there isn't enough sunlight, the AAPs cannot get enough energy to be fully functional- hence causing delays in data receipt and transmission. Without enough energy, data and information cannot be downloaded or uploaded. The sluggish updating of the infrared software that has seen delays in synchronizing of some PDAs and the access points too raises consistency issues. However, all these but one are solvable challenges with some higher level of efficiency. Most reporting is done on a monthly basis and the fact that clinical guidelines do not change overnight, a little delay in uploading or downloading cannot be based on to say that the project is not feasible. Regarding energy interruptions, it is an act of nature that brings distraction occasionally and not always. Although initial evidence as cited in the first three project technical reports published between

2004 and 2008, as well as responses from the interviewed PDA users, suggest that the project is cost effective, the final project report will offer the final findings on this. The report is expected to give a verdict regarding the cost effectiveness research question, which is part of the project.

6.4 A Basis for Replication

The simplicity of the technology- once it is up and running - convinces its implementers that it can be replicated elsewhere. Adapting to the technology took very little time; within two weeks users were able to get familiar with the gadgets.

Those using it also believe its potential replicability is immense, as meetings with other potential users in the district showed as shown below,

> "Onetime we invited the planning department, some council members, and they bought the idea. Even in education they admire that they should use the same system. But because of the several challenges here and there, we are yet to reach a time and say yes, let us roll it out elsewhere." (District Health Official interview)

The interest not only ends at district level. According to the project's Phase III technical report released towards the close of 2007 UCH staff plus representatives from the UCH Board met with the Ministry of Health to chart out a way forward on UHIN. At this meeting it was agreed that the UHIN concept was viable and the MoH was to take a lead role in preparing roll-out activities for its extension to 25 other districts in Uganda. The meeting culminated in the formation of a smaller group to look into the process of transitioning and formulating a proposal and

suggestions to be presented to the bigger team. Following this mandate, the appointed team had a retreat for two days, brainstorming on how to move the UHIN concept to other districts. Preliminary recommendations showed that the group had decided to begin the process of scaling up the UHIN network to 25 more districts. Funds were to be sought to support the process. But the continued under funding of the Health Sector in the country has continuously affected progress of the project.

The systematic implementation of UHIN offers Government the feasibility that would easily based on to replicate the technology to the rest of the country. Since the inception of the project in 2003, SATELLIFE, Uganda Chartered HealthNet, and the Makerere University Faculty of Medicine have successfully built a wireless network using handheld computers, wireless access points, and the GSM/GPRS telecommunications network for two-way communication and data exchange in Mbale, Bududa and Manafwa, Rakai, Lyantonde districts. The pilot phase, which ran from September 2003 to December 2004, proved the viability and cost-effectiveness of integrating handheld computers, WideRay Jacks, and cellular telephone into a network capable of supporting information dissemination and data collection in low-resource environments. Building on those accomplishments, UHIN Phase-II (January 2005 - March 2006) expanded to encompass 160 health centers in the five districts. Phases 3 and 4 have subsequently built on the first two phases. How the whole project has been implemented is a learning experience that can be built upon if the national health system decided to adapt it.

6.5 Lessons Learnt

The study found out that UHIN documented its lessons learned from years of using PDAs in delivering and collecting health information since the start of the experimentation of the personal digital assistants initiative. And AED Satellife, one of the two major funders of UHIN, has produced a PDA Toolkit which is complete with a step-by-step guide on how to deploy PDAs. The kit also includes information on the opportunities available and how to assess an organization's readiness for using handhelds.

The kind of technology being used by UHIN can deliver medical information including disease treatment guidelines, continuing education materials, newsletters, and essential drug lists and databases. Health workers can also receive national and international news articles on their devices.

New technologies like personal digital assistants work effectively when training is an inherent component of the project. Skill development ensures rapid diffusion of innovation through interactions and communication.Projects that provide for the participation of the beneficiary upfront enhance the effective functioning of new technology innovations.

The Uganda Health Information Network project has demonstrated the substantial benefits that such innovations can accrue to the disadvantaged health workers. This occurs only when the beneficiaries are identified and involved at the project right from start. As UHIN has demonstrated with its regular end of phase technical reports, successful projects are the ones that have regular review systems to assess the realization of the results across the board.

A network integrating handheld computers, access points, and cellular telephony to improve communication, information access, and data exchange in resource limited settings is technologically viable. Given the necessary technical support, an indigenous organisation is fully capable of managing the network server and Jacks, and enable end users to successfully adopt the handheld units into their existing day today work schedules.

The Uganda Health Information Network has demonstrated that such innovations can have real, short-term benefits at many levels, including a direct benefit to patients. The other benefits include reductions in medical error, the realization of costs savings, real-time monitoring of public health incidents and the provision of validated data and information for health systems decision and policy-making.

Up until recently, most cellular networks have been too slow and expensive for connecting computers to the Internet. But UHIN brought in low bandwidth communication applications using personal digital assistants (PDAs) such as Palm Pilots to connect via mobile networks. Although information designed and formatted for the World Wide Web is generally too bandwidth intensive to be transmitted over mobile networks, UHIN enabled its formatting in such a way that it took up very little bandwidth and its intended users were able to access it. This has continued even after the coming of faster internet speeds.

In summary, the Uganda Health Information Network project has demonstrated enormous potential to transform health services, create new forms of service delivery and create new interaction spaces.

6.6 Conclusion and Recommendations

The PDA technology has proven to be robust and easily adoptable by the end users, and has yielded measurable cost savings and improvements in data quality and availability. Health workers are referring to the literature available in their handhelds, including national treatment guidelines, for their daily practice.

However, while enthusiasm is high among the users of PDAs, there are challenges that have a potential to affect the gains. For instance some access points are over 5 kilometres away from their work stations and in some cases over 10 kilometres. This affects regular utilisation of the handhelds and needs to be looked into. Occasional delays in updating content and fixing technical breakdowns also can affect usage of the technology as they might lead users to lose interest.

None-the-less there is no reason why Government cannot scale up the project beyond Mbale, Manafwa, Bududa, Rakai and Lyantonde districts where it has been piloted. While the pilot has taken over six years, for many of the health workers using the PDAs, it took them only a month or two to appreciate the time element of the Innovation- Decision Process. It did not take them a long time to adopt the innovation as specific objective one of this study sought to establish. The

UHIN project also provides an opportunity of translating research into policy. These findings underscore the importance of making the ICT policies more functional now than ever before, yet the ICT section within the health sector remains unfunded. While ICT is emerging as an important medium for communication and exchange as well as a tool for development, health care delivery inclusive, this potential is yet to be effectively leveraged.

Even after continuously updating the Health Ministry on the project, and a 2007 commitment that the Government would roll out the network to an additional 20 districts, this is yet to happen. Now that the there is proof of concept, experience from Mozambique where Government was the lead implementing partner, the UHIN Project implementers should use this chance in addition to the new National Health Policy (due for launch by the end of 2010) to catalyze the Government into scaling up the initiative to cover an additional 3000 health centers as intended. In the upcoming national health policy, Government commits to provide the necessary resources to ensure provision and maintenance of adequate infrastructure over the next decade. Among this is the provision of "communication and IT equipment necessary for staff to carry out Ministry of Health functions professionally."

The exemption of taxes on Information and Communication Technologies hardware is another advocacy tool that can be employed by the implementers of the Uganda Health Information Network. This can be used to harness public-private partnerships and boost the scale up, given that the private sector controls almost half of the healthcare delivery system in a country, with

one of the highest disease burdens in the World.

Uganda, which has some of the best and fastest growing cellular telephone network coverage in Africa, the innovation of handheld technology and cellular telephony represents a watershed moment in the battle against health information gaps. This should be used as an advocacy tool for urging the Government to scale up this new technology.

Further development and implementation activities should be qualitatively improved and quantitatively multiplied, so that the potential of the personal digital assistants can go beyond continuing medical education and collecting HMIS data. The uses can be extended to taking patient records, and making e prescriptions among others.

Involvement of more government institutions, private industries (as part of their Corporate Social Responsibility) and the whole community are required, to achieve sustainability and scale up. Private industries have previously come in to help particular health causes. This could be one of them.

Significant contribution by UHIN towards achieving the MDGs is highly expected in the long run. This can be used as an advocacy tool to gain support from several stakeholders since everyone seems to be focused on achieving the millennium development goals.

There is need for the UHIN Project managers to establish dialogue with policy makers at parliamentary level using the evidence generated so far. The parliamentary committees on social services and Information Communication Technologies in particular should be approached. Evidence from the Uganda Health Information Network so far shows that doctors are not the only ones who can use the personal digital assistants. Even nurses and community health workers are using the handheld computers. In an era where there is a lot of talk about task shifting, the PDA can be advocated as a tool that can facilitate this new thinking aimed at boosting delivery of health services.

The country's leading Medical School where UHIN is headquartered should take advantage of this to incorporate the use of personal digital assistants in teaching. This can inculcate in students as is done elsewhere, the culture of using the handhelds, even after they graduate.

The Uganda Health Information Network Project managers took significant efforts towards user education. However in all the documents accessed the issue of security received little and needs more attention now and when the scale up of the initiative starts. The prudent use of the personal digital assistants, which some health workers use to play music during their leisure time need to become a part of the culture of this cadre if the initiative is to be successful. In other words, there is need to include in the training kit for users about the risks of carrying a PDA that contains sensitive data.

According to Blanton (2001),

"Users need to be advised that:

- The loss or corruption of data could impact their patients and exposure of the data to inappropriate entities and could carry civil and criminal penalties under the law.
- The Personal Digital Assistant should not be shared with others.
- They should use care with regard to the infrared beaming. It would be advisable to turn off the beam-receive option and enable it only when one is intentionally receiving data from another user. Even then, they should be wary of what data is being sent to them and guard against the possibility of receiving malicious code.

- Users should safeguard the PDA against theft or loss as they would their own credit cards or car keys.
- They should use care in downloading and installing non-approved applications from the web to avoid the possibility of accidentally installing malicious software."

While UHIN looks viable for now, some studies have found that the failure rate for ICT projects such as these with an industry average of around 50 percent (Elder L, Clarke M, (2007). The two argue in their journal article that the fundamental issue that seems to pervade the case histories of failed health ICT projects - a lack of focus on the patient - must be addressed. They argue that by putting the patient at the centre and continually verifying that the link between the targeted intervention and the well-being of patients is clear, the likelihood of success will be significantly improved.

Uganda continues to receive large amounts of donor aid from agencies like the US President's

Emergency Plan for Aids Relief (PEPFAR) and accountability is increasingly being sought. Yet countries like Uganda are still building their health management information systems, and the related information and communications technology infrastructure needed to access and report high-quality data. For disadvantaged communities, UHIN's PDA technology can be marketed basing on the available evidence on data collection in the five districts where it has been operating.

References

1. AED, AED Communications. Spring 2008 Edition

2. Ashley, C. & Carney, D. (1999) 'Sustainable livelihoods: Lessons from early experience'. London: Department for International Development DFID. [Retrieved in July 2010 from http://www.livelihoods.org/info/docs/nrcadc.pdf]

3. Aziz O et al (2005) Handheld computers and the 21st century surgical team: a pilot study. Adapted from < http://www.biomedcentral.com/1472-6947/5/28>

4. Batchelor and Norrish (2002) „Sustainable Information and Communication Technology (ICT)". [Retrieved in July 2010 from http://www.sustainableicts.org/Sustainable.htm]

5. BBC, (2010) „Uganda Country Profile" [Retrieved in July 2010 from http://news.bbc.co.uk/2/hi/africa/country_profiles/1069166.stm].

6. Blanton, S H.(2001) Securing PDAs in the Health Care Environment, SANS Institute

7. Dentzer S. "The E-Health Connection: Information and Communications Technology and the Developing World" in Health Affairs, 27, no. 6 (2008)

8. Doran, D (2009), „The Emerging Role of PDAs in Information Use and Clinical Decision Making, Evidence Based Nursing". 12: 35-38. doi: 10.1136/ebn.12.2.35

9. Elder L, Clarke M, (2007) „Past, Present and Future: Experiences and Lessons from Telehealth Projects". Open Medicine, Vol 1, No 3

10. Evans RG, Barer ML, Marmor TR, eds. *Why are some people healthy and others not? The determinants of the health of populations.* Berlin, de Gruyter, 1994.

11. Freudenrich, C and Carmack, C (2009). How PDAs Work. [Retrieved in July 2009 from http://www.healthnet.or.ug/index.php/categoryblog/57-pdas.html?showall=1]

12. Gantthead, (u/d) „Project Viability Checklist". [Retrieved in July 2010 from http://www.gantthead.com/checklists/Project-Viability-Checklist.html]

13. IDRC (2007). The Future of Africa is Mobile. Media Release [Retrieved in January 2009 from http://www.idrc.ca/uploads/user-S/11629238071mobile_africa_eng.pdf]

14. Jamison et al, (2006). „Priorities in Health". The World Bank

15. Kahn, T (2004). Mobile Phones Keep Track of HIV Treatments. News Article. [Retrieved in July 2009 from **http://www.scidev.net/en/news/mobile-phones-keeptrack-of-hiv-treatments.html**]

16. Kakaire.A, (2008). Is Funding The Answer To Health Woes? News Feature. [Retrieved in March 2009 from http://www.monitor.co.ug/artman/publish/news/Is_funding_the_answer_to_health_woes_67438.shtml]

17. Kakaire, F. (2003).Outcome Mapping: A monitoring and Evaluation tool for the Uganda Health Information Network Project. Uganda Chartered HealthNet, Makerere University Faculty of Medicine, Kampala, Uganda

18. Kinkade, S. & Verclas, K. (2008) Wireless Technology for Social Change. Washington, DC and Berkshire, UK: UN Foundation–Vodafone Group Foundation Partnership

19. Lee, S et al. „The Role of Low-Bandwidth Telemedicine in Surgical Prescreening**.** Journal of Pediatric Surgery", 38(9) Sep 2003, p 1281-3.

20. Lindquist A.M, et al (2009), „The Use of the Personal Digital Assistant (PDA) among Personnel and Students in Health Care: a Review". [Retrieved in July 2010 from http://www.jmir.org/2008/4/e31/]

21. MoH, (2010) „Draft Uganda National Health Policy II"

22. Mugumya L. (2008), Promoting Continuing Medical Education (CME) among Rural Health workers by use of ICT, Uganda Martyrs University

23. Nabukalu D et el (2006). The Use of PDAs in Longitudinal Data Collection. Research Paper. [Retrieved in January 2009 from http://www.indepthnetwork. org/AGM2008/2.Tuesday/Morning/Para%201/Use%20of%20PDA%20-%202008%20AGM2%20%5BCompatibility%20Mode%5D.pdf]

24. OECD (undated). Information and Communication Technologies (ICTs) in Health Systems. [Retrieved in July 2009 from http://www.oecd.org/document/42/0,3343,en_2649_33929_38311850_1_1_1_37407,00.html]

25. PDA Cortex Store (2003). Ugandan Doctors Pilot Electronic Communications. Media Release. [Retrieved on April 20, 2009 from http://www.pdacortex.com/Wireless_Uganda.htm]

26. Rao, M. The information society: visions and realities in developing countries. In Hemer, O. and Tufte, T. (Eds.) (2005) *Media and Glocal Change. Rethinking Communication for Development*. Buenos Aires, Göteborg: CLACSO/Nordicom

27. Rogers, E.M. (1983) *Diffusion of innovations*, 3rd edition. New York: Free Press.

28. Rogers, E.M and L. Scott L.M (1997) The Diffusion of Innovations Model and Outreach from the National Network of Libraries of Medicine to Native American Communities, Paper prepared for the National Network of Libraries of Medicine, Pacific Northwest Region, Seattle.

29. Rwashana and Ddembe (2008) „Enhancing healthcare delivery through ICTs: A case study of the Ugandan immunisation system". International Journal of Education and Development, Vol. 4, No. 2 (2008)

30. Satellife- UHIN (2006). Summary of Achievements, Challenges and Way Forward. [Retrieved in January 2009 from http://www.givewell.net/files/Cause1-2/AEDSATELLIFE/AED-SATELLIFE%20-%20EIN%2022-3051191-%20CAUSE%201%20ATTACHMENT%20-%20UHIN%20-%20Project%20Overview%20-%202003%20to%20Present.pdf]

31. SearchCIO-Midmarket.com Definitions. ICT. [Retrieved in July 2009 from http://searchciomidmarket.techtarget.com/sDefinition/0,,sid183_gci928405,00.html]

32. Servaes, J and Malikhao, P. Participatory Communication: the new paradigm. In Hemer, O. and Tufte, T. (Eds.) (2005) *Media and Glocal Change. Rethinking Communication for Development*. Buenos Aires, Göteborg: CLACSO/Nordicom

33. Uganda Ministry of Health, 2005. Health Sector Strategic Plan.

34. Virtuelles, F (2005), „Viability of an ICT Project". [Retrieved in July 2010 from http://franco.ca/internet/index.cfm?Voir=sections&Id=1512&M=615&Repertoire_No=2137985072]

35. Waisbord, S, (2000) "Family tree of theories, methodologies, and strategies in

development communication". New York: Rockefeller Foundation

36. Berg, L. B. (2007). *Qualitative Research Methods for Social Sciences*. New York: Library of Congress.

37. Burns, T., & Sinfield, S. (2003). *Essential Study Skills: The complete Guide to success at Universtity.* London: Sage Publications.

38. Kombo, K.D., & Tromp, L.D. (2006). *Proposal and Thesis Writing: An Introduction.* Nairobi: Paulines Publications Africa