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**Understanding Opportunities and Challenges in Using
Mobile Phones as a Means for Health Information Access
and Reporting: A Case Study from Malawi**

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**UNDERSTANDING OPPORTUNITIES AND CHALLENGES IN USING
MOBILE PHONES AS A MEANS FOR HEALTH INFORMATION ACCESS
AND REPORTING: A CASE STUDY FROM MALAWI**

THESIS SUBMITTED AS PARTIAL FULFILMENT OF THE REQUIREMENTS
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Abstract

This study focuses on the opportunities and challenges associated with the use of mobile phones to support health information reporting and access, using SMS and voice calls. The study was conducted at two rural hospitals in Malawi. The study shows that besides fulfilling user intentions for using them, mobile phones also expose users to various challenges. For example, empirical evidence shows that unlike fixed computing terminals, mobile phones allow users to stay in contact with colleagues and clients from various unpredictable places. On the other hand, they present users with the constant need to recharge their phones' batteries. Besides this, the study discusses means that can be adopted to minimize the challenges associated with mobile phone use, to the benefit of users.

The study also looks at how organizational, personal, cultural, and technological factors that make up the context of use, influence the implementation and use of mobile phone solutions. Besides this, the study examines the interplay between organizational and users' work practices and the use of mobile phone solutions.

Further findings from this study indicate that factors making up the context of use provide the building blocks (installed base) on which mobile phone solutions are built. The findings also indicate that limitations intrinsic to the installed base do negatively impact on mobile phone use. The study also shows that keeping the technical complexity of mobile solutions simple, allowing interoperability with existing systems, ensuring user information security and privacy, setting strategies for change management and risk mitigation, and demonstrating returns on investment, enhances the adoption of mobile phone solutions.

This study took a qualitative case study approach and was informed by the interpretive paradigm. Data for the study was mainly collected through semi-structured interviews, document analyses, observations, and SMS log analyses.

Key words: Mobile phone, SMS, voice calls, opportunities, challenges, work practices, installed base, reporting, access

Dedication

To my mum, Christina; my dad, Major Lee Donald; my siblings Salome, Bob, and Chimwemwe; my cousin Chrispine; and my lovely niece Lorreta.

Thanks for your endless love. You add so much meaning to my life

.

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List of Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ART	Anti-Retroviral Therapy
CAC	Community AIDS Committee
CBO	Community-based Organization
CHAM	Christian Health Association of Malawi
CHW	Community Health Worker
GPRS	General Packet Radio Service
GSM	Global System for Mobile communications
HBC	Home Based Care
HIV	Human Immune Virus
HMIS	Health Management Information System
ICT	Information and Communication Technology
II	Information Infrastructure
IMF	International Monetary Fund
IS	Information Systems
ITU	International Telecommunications Union
MACRA	Malawi Communications Regulatory Authority
M&E	Monitoring and Evaluation
MODEM	Modulator-demodulator
MOHP	Ministry of Health and Population
MPTC	Malawi Posts and Telecommunications Corporation
PHC	Primary Health Care
PMTCT	Prevention of Mother To Child Transmission of HIV/AIDS
SMS	Short Message Service
TA	Traditional Authority
TB	Tuberculosis
TNM	Telekom Networks Malawi Limited
UNICEF	United Nations Children's Fund
VAC	Village AIDS Committee
VCT	Voluntary Counselling and Testing
WAP	Wireless Application Protocol

Chapter 1 : Introduction

Currently, at least 14 out of 100 Malawians own mobile phones (Telecom-Networks-Malawi, 2009). In comparison, there is no more than 1 personal computer and less than 2 fixed phone lines for the same number of people. These figures indicate a jump from 0.43 mobile phone owners, 0.1 personal computers, and 0.4 fixed line phones, per 100 Malawians, in 2000 (ITU, 2007; UN-Statistics-Division, 2009). Furthermore, cellular telephony subscription makes up for at least 80 percent of the total number of phone subscribers in Malawi.

It is clear, from the above statistics that mobile phones are a more widely diffused information and communications technology, compared to personal computers and fixed line phones. Besides, considering the exponential growth in their diffusion, unlike personal computers and fixed line phones, mobile phones will continue to cement their place as a preferred information and communications technology for Malawians. The dominance of mobile phones is not only local to Malawi, but is evident from trends across the globe. For example, between 2005 and 2006 the number of mobile phone subscribers, worldwide, jumped by 500 million. In 2006, Africa registered 60 million new mobile subscribers. Furthermore, at the end of 2006 Africa had 22 percent of its population owning mobile phones, compared to 3 percent with fixed telephone lines and 5 percent who use Internet (United-Nations, 2008).

As is increasingly becoming the case, mobile phones are providing users with more than basic connectivity. Mobile phones now provide users with integrated cameras, mobile Internet connectivity, voice recording capabilities, and personal organizers, among other things. In this way mobile phones provide users with more options than fixed line phones and, in some cases, personal computers. Furthermore, unlike personal computers and fixed line phones, mobile phones are more portable and provide users with a high degree of independence, mobility and flexibility (Arnold, 2003). Because of such factors mobile phones and other mobile information technologies are changing how individuals and organizations

work (Scheepers et al., 2006). For example, mobile phones and their related services, such as SMS, mobile Internet connectivity, and voice calls, allow users communication access regardless of their location. This, in turn, enables users to negotiate with clients and fellow employees while away from the office.

The above mentioned qualities make mobile phones *particularly suitable for work situations that benefit mobility*, such as at the hospitals where this study was conducted. These hospitals cover extensive catchment areas and medical personnel or community health workers have to travel long distances to provide care to chronically ill patients enrolled on home-based palliative care programs. For such health personnel, the use of mobile phones presents new competencies and allows them to do things they couldn't do previously. At the same time the use of mobile phones also enables them do what they already could, more efficiently and effectively (Jarvenpaa and Lang, 2005; Kakihara and Sørensen, 2002).

On the other hand, despite providing users with various benefits, the use of mobile phones presents users with various challenges. Their mobility and multiple contexts of use mean multiple factors have to work in tune for users and organizations to benefit from their use (Scheepers et al., 2006). For example, not every corner of Malawi has GSM network coverage meaning *communication can only take place sometimes and in some places*. This deviates from the *anytime anywhere communication* promise associated with mobile phone use. Furthermore, the use of mobile phones also presents users with needs they never had (Jarvenpaa and Lang, 2005). For example, most community health workers, at one of the hospitals where this study was conducted, have to walk long distances to get their phones recharged. They have to do this because they do not have electricity in their homes. Additionally, as compared to static computing terminals, mobile phones are more susceptible to loss or damage, are resource-poor, have limited battery power, and their performance is highly variable due to gaps in network coverage (Satyanarayanan, 1996; Jarvenpaa and Lang, 2005).

1.1 Research domain

Effectively working health information systems are necessary to ensure good health management, which is, in turn, critical towards improving the efficiency and efficacy of health services. (Lungo, 2003; Galimoto, 2007). By providing health managers with timely and accurate data, resources can be allocated more effectively and epidemics monitored and appropriately addressed. For example, timely access to information can enable doctors, nurses and other health care professionals prescribe proper treatment (Kushchu and Kuscu, 2003). This makes the implementation of routine health information systems in developing countries critical, towards improving the quality of health services (Jacucci et al., 2006).

Although there is a multitude of factors that contribute towards building and sustaining effectively working health information systems (Kimaro and Nhampossa, 2005; Smith et al., 2008), sound ICT infrastructure is among the key factors. For example, having adequate ICT infrastructure plays an important role towards widening access to information and reducing the amount of time it takes people to access the information.

For Malawi, however, physical ICT infrastructure is currently under-developed and limited in coverage (DISTMS, 2006). In most cases health data reporting practices are tedious and most health programs run paper based system and have to manually aggregate data. This makes information sharing across geographical boundaries difficult (Galimoto, 2007). Galimoto (2007) also indicates that poor network infrastructure makes it hard to widen access to information being archived in Malawi's national health management information system. The wide usage of paper based systems, coupled with problems in network infrastructure, implies that data has to be physically moved from one place to another by individuals, as is currently the case. This is, in turn, bound to make data access and reporting more difficult for health facilities that are located in places with a poor road network. To shed more light on this, as much as 74 percent of Malawi's road network is unpaved and mostly in poor condition and

roads in rural areas are often impassable for up to four months in a year (Banda, 2008).

Infrastructure related problems like these make it difficult for health planners and decision makers to get data that can inform their decisions, on time, despite facing constant deadlines and time constraints (Lungu, 2003). Among other factors, Lungu (2003) attributes this lack of timely data access to poor transport and communication infrastructure, and lack of reporting tools, such as forms. He also notes that in some cases people have attributed their lack of data reporting to being located far from the point of data delivery. Lungu (2003) further states that health workers at lower levels rarely receive feedback, on reported data, from supervisors. This therefore makes them less interested in ensuring data quality and complying with reporting requirements and deadlines.

These findings are consistent with empirical evidence gathered in this study from St. Gabriel's hospital and St. Martin's hospital, in Malawi. The hospitals' records management is predominantly paper-based and ICT infrastructure in surrounding communities, with the exception of GSM cellular networks, is poorly developed. Because of this, before adopting mobile phones, face-to-face communication was a prerequisite to information sharing between the hospitals and community health workers. It also took time for people to exchange information in instances where they were staying far from each other.

However, after the adoption of mobile phones, to aid information reporting and access, face-to-face communication is not always necessary to enable information exchange. The study also found out that the use of mobile phones permits hospital medical personnel and community health workers to coordinate activities, such as patient referrals, and to plan meetings, remotely. Furthermore, the use of mobile phones means community health workers don't always have to walk or cycle for long distances to report urgent matters at the hospitals, as was previously the case.

1.2 Relevant previous findings in the research domain area

Introducing technology to improve health information systems will not automatically result in more efficient health services delivery (Lungu, 2003). When implementing new technologies it is vital to understand the context in which the technology will operate. More especially knowledge gaps in country to country context variations are known to negatively affect information technology initiatives (Dada, 2006). The issue of a technology's context of use is of particular interest when considering the implementation of mobile solutions. Their mobility and multiplicity of contexts of use means that multiple factors can positively or negatively influence their use (Scheepers et al., 2006). For example, users' overall satisfaction with mobile computing is influenced by the users' profession as well as organizational, societal, and private contexts of technology use (Scheepers et al., 2006).

This study is mainly guided by previous findings indicating that the use of mobile phones cannot be adequately understood through applying linear logic of cause and effect, situation and implication. Rather, the use of mobile phones results in both intended and unintended consequences with simultaneous movements in opposite directions (Archer, 2005). Furthermore, the study makes use of the concepts of *installed base* and *heterogeneity* from the Information Infrastructure theory (Hanseth, 2000; Hanseth and Lyytinen, 2005).

1.3 The research problem

As has been presented before, Malawi's ICT infrastructure is generally poor, but GSM cellular networks and services are quite extensively rolled out. This study was conducted to investigate the opportunities and challenges associated with the use of mobile phone solutions to improve access to health information, enhance task coordination and guide health services delivery. The study also sought to investigate the interplay between the use of mobile phones and users' work practices. Furthermore, the study sought to propose methods that can be applied to minimize the challenges associate with mobile phone use. In addition to this, the study aims to add on to currently existing literature on the use of

mobile technologies for e-health in developing countries, through understanding the use of mobile phone solutions in the context of a developing country.

Currently most published studies are on the use of mobile technologies in developed countries. Developed countries, however, have significant contextual differences with developing nations like Malawi. Such differences include, working cultures, skill sets, access to technology and other key infrastructure such as electricity and telecommunications (Dada, 2006).

To be precise, in going about my work, I address the following research questions:

- How does the context of use influence the use of mobile phones?
- How do mobile phones, and work practices interact?
- What opportunities and challenges are associated with the use of currently existing mobile phone solutions?
- How can the challenges associated with mobile phone use be minimised to maximise user benefits?

1.4 Research objectives

To answer the above posed research questions, the first objective of this study was to assess the current use of mobile phones in Malawi, in trying to improve access to health information and shape health services delivery. More specifically the study aimed at understanding the opportunities and challenges associated with the use of mobile phones in rural areas where infrastructure is underdeveloped. The second objective of the study was to draw conclusions from gathered empirical data and make recommendations on how best to implement and manage mobile solutions for e-health, in developing economies.

I also sought to address the following questions, previously addressed by Jarvenpaa and Lang (2005), in the context of a developing country and as part of the above stated research questions: Why do people use mobile services?; and What frustrates and frightens users?

1.5 Research approach

This study was conducted in Malawi, which is located in Sub-Saharan Africa and shares borders with Tanzania, Zambia, and Mozambique.

In conducting the study an interpretive qualitative research approach was adopted. An interpretive qualitative approach was chosen as it allows for the understanding and interpretation of social phenomena (Myers and Avison, 2002; Walsham, 2006). This approach was, therefore, appropriate to enable me understand and explain socio-technical phenomena vital to the success, or failure, of using mobile phones as a means for reporting and accessing health information, in Malawi.

More specifically, a case study approach was used and case studies were conducted at two hospitals namely St. Gabriel's hospital and St. Martin's hospital. St. Gabriel's hospital is located at Namitete in Lilongwe, whilst St. Martin's hospital is located at Malindi in Mangochi district.

Empirical data for the study was mostly collected between September 2008 and January 2009. However, during the writing of this document, I maintained contact with the two hospitals to enable me collect additional data that was necessary to fill various information gaps that emerged. Empirical data for the study was collected using semi-structured interviews, participant observations, document reviews and SMS log analyses.

1.6 Personal motivation

Personally, I am fascinated by how mobile phones have connected a lot more people in Malawi over the past five years, than fixed line phones have been able to in decades. If well utilised, I believe mobile phones and their associated services can help mitigate the negative effects of Malawi's poor ICT infrastructure and enable the development of innovative mobile solutions. In choosing my research area I was, therefore, particularly driven by the promise

mobile phones have towards contributing to developmental activities in Malawi and other developing countries.

My intentions are to understand how best to design, roll out and support mobile solutions to match with the intended context of use and user needs. I also intend to support ongoing projects in Malawi that are using mobile phones to improve access to information, particularly in the health sector. Besides this, I have noted that, currently, there isn't much research on how mobile phones are being used in Malawi. My research findings will go some way towards reducing the knowledge gap that currently exists. Furthermore, as previously said, I also intend to contribute to existing literature on how mobile phones are being used in developing countries.

1.7 Intended audience

The research is targeted at health managers, healthcare information systems workers, graduate students, mobile solutions designers, researchers on Information Systems in developing countries and anyone with an interest in Health Information Systems, in general.

This research contributes towards the understanding of the theoretical and practical concepts that apply to the use of mobile phone-based solutions to support health service delivery in developing countries. This work also seeks to contribute towards the effective design, implementation, and management of mobile solutions to enhance information exchange, task coordination, and healthcare delivery, especially at health facility levels, where ICT infrastructure is underdeveloped.

1.8 Organisation of the thesis document

This thesis is arranged in the following order. Chapter 1 introduces the research work covered in this thesis, research questions being addressed, and what motivated the research work presented here. Chapter 2 presents the theoretical concepts and literature that guide the discussions in this thesis. Chapter 3

presents the research methodology adopted in my research work. Chapter 4 presents a picture of the research settings under which this study was performed. The chapter also presents the case studies discussed in this thesis and the state of telecommunications in Malawi. Chapter 5 and chapter 6 present key findings of my research from St. Gabriel's hospital and St. Martin's hospital, respectively. Chapter 7 presents a combined analysis and discussion of the key findings from the research work. Chapter 8 presents concluding remarks, contributions, further research areas, and recommendations. At the end of the thesis, there are various appendices referred to in the discussions herein.

Chapter 2 : Literature Review

This chapter presents both the theoretical field and particular concepts relevant to this study. The chapter also presents a picture of the role of healthcare towards development, and on how ICTs can be employed to improve healthcare delivery.

This study mainly builds on the information infrastructure theory (Hanseth, 2000; Hanseth and Lyytinen, 2005) and concepts on the paradoxes of mobile technology use (Jarvenpaa and Lang, 2005).

2.1 Healthcare and development

For a country like Malawi human capital constitutes the most important asset in all development and organizational efforts. This makes the availability of adequate health services, a very important component to the development of this human capital (DISTMS, 2006). Although this role of healthcare is vital towards Malawi's, and indeed any country's development, the delivery and management of health services to deprived communities and regions is a very complex task (Braa et al., 2004). For example, among other things, Malawi has limited health facilities and resources. This, then compounds currently existing healthcare problems (DISTMS, 2006).

Limited access to health services in developing countries, like Malawi, and declining human resource levels have fuelled an accelerating collapse of public health services, thereby negatively impacting human capital development efforts (Picazo, 2002). This, in turn, is bound to negatively influence economic growth and other developmental efforts.

To address such challenges, it is necessary to identify and pursue innovative ways through which decision making and resource allocation can be enhanced. The timely availability of quality data, for example, is critical to public health decision making and towards effective allocation and utilization of scarce health

resources (AbouZahr and Boerma, 2005). It is therefore necessary to provide reliable, relevant, up-to-date, adequate, timely and reasonably complete information for health managers at community, facility, district and national levels. This can be made possible through the use of effectively working health management information systems (HMIS) (MOHP, 2003).

2.2 Health management information systems (HMIS)

The implementation of routine health information systems in developing countries is widely seen as critical for improving the quality of health services. By providing the management of the health sector with timely and accurate data, for instance, resources can be allocated more effectively and epidemics can be monitored and appropriately addressed (Lippeveld et al., 2000; AbouZahr and Boerma, 2005). Among other things, health information is required for strategic planning and the setting of priorities; clinical diagnosis and management of illness or injury; quality assurance and quality improvement for health services; and human resource management (Stansfield et al., 2006).

Health management information systems can enable proper management of health information and efficient allocation of scarce resource required to improve healthcare, in several ways. By using health management information systems with a geographical information component, for example, district health offices in Malawi know their catchment areas and the spatial distribution of the population to be served (Chaulagai et al., 2005). Such knowledge is vital in the visual monitoring of health services coverage, organizing outreach clinics and planning community health development activities. Health management information systems are also important for the evaluation of programs from both the perspectives of effectiveness and coverage (Azubuike and Ehiri, 1999). Furthermore, at district and national levels, the aggregation of data from various health facilities makes the comparison of key health indicators between different geographic areas, possible.

2.2.1 Problems with currently existing HMIS

Developing countries, generally, have a poor track record as concerns the planning and management of ICT projects (Gichoya, 2005). The implication of this is that even though health management information systems hold so much promise with respect to healthcare development, most of the health management information systems in Africa are not working effectively (Gething et al., 2006). A multitude of political, cultural, social and technological factors have negatively impacted on the effective use of health management information systems in Africa. There are a multitude of bottlenecks related to ICT implementation that include the top-down, centralized, and fragmented character of design and services (Kimaro and Nhampossa, 2005). Other additional factors include users' perception of information as a burden; inadequate access to information; poor preparation of data for use; weak analysis of data; some information bypassing decision makers; poor capacity for decision making; low initiative for using data; inability of central health management information system units to contribute effectively (Smith et al., 2008); and aiming the presentation of epidemiological data at specialists and other experts without regard to other stakeholders (Health-Metrics-Network, 2007).

Furthermore, heavy reliance on external donors to fund health initiatives, in general, and health information systems implementation, in particular, weakens health information systems in developing countries. Usually, external donors focus their efforts on specific program areas and impose their own information reporting needs. This, then, creates vertical program-specific information systems that exist parallel to government reporting structures, thereby giving rise to health information systems fragmentation (Galimoto, 2007; Aanestad et al., 2007). Historically, health information systems that hugely depend on donor funding have not been sustainable due to the short-term nature of funding, inability to mobilize national support, and the lack of focus on building local competencies to handle these systems. Without the availability of appropriate local capacity it is rather difficult to translate an organization's ever changing

needs into an effective health information system, which in turn contributing to unsustainable systems (Kimaro and Nhampossa, 2005).

Besides these problems, another huge stabling block to successful ICT projects implementation is usually the poor state of ICT infrastructure in developing countries (Dada, 2006). This coupled with unreliable physical (e.g., roads, power supply, and transportation) and communication infrastructure contributes to the underperformance of health management information systems in developing countries (Kimaro and Nhampossa, 2005).

2.2.2 Poor infrastructure and its implications

Poor infrastructure negatively influences coordination and information sharing (Kimaro and Nhampossa, 2005). In Malawi, most health programs run paper based systems and have to manually aggregate data when formulating reports. Poor network infrastructure at district level, also makes it hard to widen access to the country's central health management information system (Galimoto, 2007). These problems, therefore, usually make face-to-face meetings necessary for people to report and access centrally located data. However, during the rainy season travelling to various places to report or access data is bound to be problematic, as most of Malawi's roads are in poor condition and roads in rural areas are often impassable for up to four months in a year (Banda, 2008). This, then, makes data sharing difficult.

Considering that adequate and timely availability of health information is crucial towards managing and improving healthcare (Stansfield et al., 2006; Lippeveld et al., 2000), lack of adequate access to health information at the point of care, and poor communication are more likely bound to lead to errors and negatively impact patient care (Mendonça et al., 2004). These difficulties can, however, be mitigated through the use of mobile solutions to enable hospital or clinical workers, or community healthcare practitioners stay in constant communication and remotely report or access information. Furthermore, mobile solutions also

allow employment hours to be more flexible and extend beyond designated office hours (Archer, 2005).

2.3 Mobile technologies for health: A potential innovative solution

The exploration of novel information-based approaches can help improve communication and ensure access to information at the point of decision-making (Mendonça et al., 2004). Currently, in developing countries, mobile phones are being used by a broader segment of the population than computers and mobile telephony is the dominant means of communication (Rashid and Elder, 2009). Mobile phones and their corresponding infrastructure and services, like voice communication, SMS and mobile Internet, are increasingly being used to permit data transfer and coordination. In addition, mobile phones are a more accessible and affordable means to close the digital divide between developed and developing countries (Rashid and Elder, 2009).

Mobile phones, for example, can help in addressing the critical gap that exists in the reporting speed and quality of data between healthcare providers and centrally located managers, in developing countries (Ibrahim et al., 2007). In addition to this, although the cost of mobile phones is still an issue and income remains the major barrier for adoption, mobile phones are, over time, becoming increasingly less costly, thereby allowing a wider group of people to own the technology (Rashid and Elder, 2009).

To underscore the ubiquity and relevance of mobile phones, half the world's 6.5 billion people now use mobile phones and there are more than twice as many mobile phone owners in developing countries as in industrialized countries. To their users, the use of mobile phones enables people to do better what they already do and also grants them new ways to access services and support livelihoods (Heeks and Jagun, 2007). Heeks and Jagun put forward the following important benefits of using mobile phones:

- Mobility
 - By providing communications on the move, mobile phones enable people to engage in development activities that previously would not have been possible
- Multi-functionality
 - Mobile phones open up other windows of opportunity to users. Now many of the world's poor communities have access not just to a phone but to a camera, calculator, audio player, video player, and timepiece.
 - By using General Packet Radio Service (GPRS) technology, mobile networks are now a potentially viable way to deliver Internet services, and avoid costly and protracted fixed-line models
- Cross-functionality
 - Mobile phones bring together services that cross existing boundaries. For instance, by allowing airtime to be used as currency, they provide an overlap between telecommunications and finance.

The above listed benefits show that mobile phones can be used in a wide set of application areas.

2.4 Current use of mobile phones in the health sector

The growth of mobile phone GSM communication is resulting in the emergence of new telecommunication backbone networks in Sub-Saharan Africa (Engvall and Hesselmark, 2007). Through mobile phones, the first digital information and communication technologies (ICTs) have reached poor households and communities (Heeks and Jagun, 2007).

Some previous studies on the application of mobile phones in healthcare have focused on mobile phone-based wearable vital signs monitoring systems (Chen et al., 2005; Holopainen et al., 2007). Here, mobile phones have been used as a bridge between portable health status measuring tools and larger information

systems, to promote personalized healthcare (Holopainen et al., 2007). Halopainen et al. (2007), for example, present Health Gateway, a modularized system using a mobile phone client to capture patient health status data. The system captures data on blood pressure, blood coagulation and body weight, from measuring instruments and then relaying it to a remote information system for intervention by a care giver.

Further to this, other studies have included the use of mobile phones in a wide number of application areas, which include: reminding patients to take their TB medication at pre-determined times (Hüsler, 2005), tracking the daily exercise activities of people (Anderson et al., 2007), and improvement of maternal and child health in Egypt (Mechael, 2005).

In addition to all this, some studies have also covered the use of mobile phones in data gathering and reporting to aid decision making and resources allocation in health programs. In Rwanda, for example, mobile phones are being used by health workers to collect and report health data during field visits (GSMA-Development-Fund, 2007).

2.5 Understanding user- mobile technology interaction process

In as much as mobile phones provide users with new, and possibly better, ways of doing things, there are various challenges associated with their use. The use of mobile technologies is paradoxical (Jarvenpaa and Lang, 2005).

2.5.1 The paradoxes of mobile technology use

The use of mobile phones is not just a mechanism to achieving set user goals, where desires, means and ends can be understood in clear, linear and stable terms, as depicted in figure 2.1. Rather, the performance of mobile phones, for example, reconstitutes desires, ends, and mechanisms, giving rise to simultaneous movements in opposite directions (Arnold, 2003). This is the view adopted in this study and is captured in figure 2.2, below.

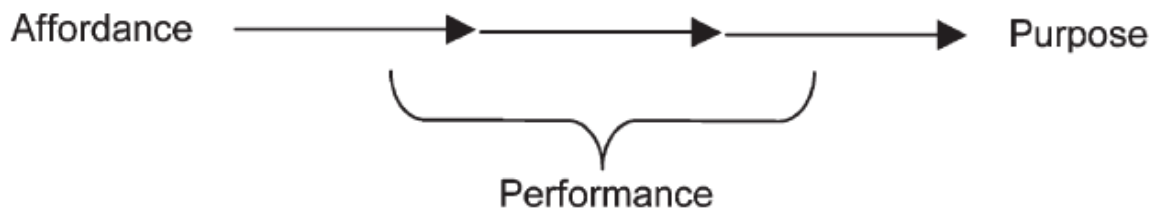


Figure 2.1: Linear Performance of Technology Use
(Source: Arnold (2003: p. 235))

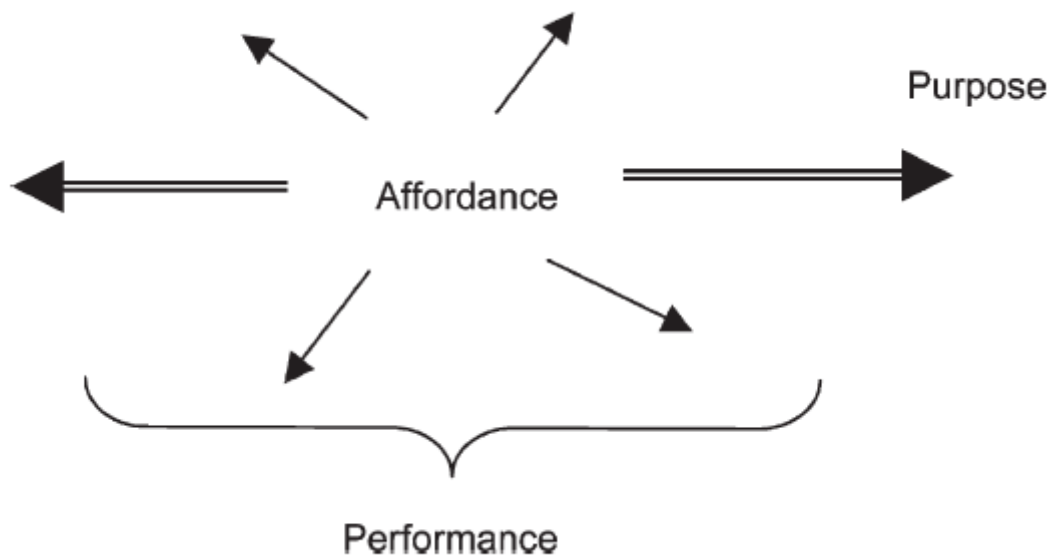


Figure 2.2: Contrary Performances of Technology Use
(Source: Arnold (2003: p. 235))

Figure 2.2 illustrates that use of mobile technologies both addresses user goals and gives rise to various unintended consequences. This underscores the paradoxical nature of mobile technology use. For example, mobile technologies *empower people and create new forms of enslavement* (empowerment/enslavement paradox). Their use also allows people to *acquire new competencies*, although, in certain situations, their use may also *create and expose incompetencies* (competence/incompetence paradox). Furthermore, the use of mobile technologies *fulfils users' needs, but also creates needs* (fulfils needs/creates needs paradox). In addition to this, the acquisition of mobile phones can *create illusions* of expectation which can lead to *user disillusionment* if the technology does not

meet their needs (Jarvenpaa and Lang, 2005). Below, I expound on these paradoxes as given by Jarvenpaa and Lang (2005). These paradoxes are relevant to the discussions in this thesis.

The Empowerment/ Enslavement paradox

This paradox demonstrates that the use of mobile technologies both provides people with opportunities that empower them, as well as situations that restrain them. For example, mobile technologies empower people by allowing them “constant” connectivity. This, in turn, enables users to take charge of business or social activities, *anytime and from wherever* they might be (Kakihara and Sørensen, 2002; Hurme, 2005; Jarvenpaa and Lang, 2005).

On the other hand, allowing users 24/7 connectivity fuses work and spare time, as users are unable to separate and keep distance from work. This, then, means that users have less personal time, which if not well managed can result in increased work pressure (Jarvenpaa and Lang, 2005; Hurme, 2005).

The Competence/Incompetence paradox

This paradox is related to the empowerment/enslavement paradox. The paradox illustrates that *anytime anywhere* communication accords users with new competencies, but also compromises other user competencies. For example, the use of mobile technologies during meetings can allow users gain access to important information, but can also distract them and compromise their participation. Furthermore, the paradox illustrates that limitations like small screen sizes, tiny input keys, network constrains, and limited battery power, can make mobile technologies unsuitable for some use situations.

Fulfills Needs/Creates Needs paradox

This paradox argues that the use of mobile phones provide solutions to various problems that benefit mobile connectivity. For example, mobility fulfils users’ information needs, by enabling them to communicate whilst on the move. Furthermore, mobile technologies help people feel more secure through allowing them to stay in touch.

However, besides fulfilling various user needs, the use of mobile technologies does introduce users to a whole range of problems, they neither had nor envisaged. For example, by using mobile phones people have to worry about regularly recharging phone batteries. Users also have to worry about privacy, when using phones in public places.

The Illusion/Disillusion paradox

As already put, this paradox illustrates that the acquisition of mobile phones can *create illusions* of expectation which can lead to *user disillusionment* if the technology does not meet their needs. For example the promise of *anytime, anywhere* communication might not be realised due to the existence of black holes in network coverage. Additionally, drained batteries and the unavailability of partners to communicate with prevent anytime, anywhere communication (Jarvenpaa and Lang, 2005).

2.5.2 User-technology interaction

In their use of mobile technologies for communication, coordination, improving work efficiency, supporting mobility, and sociability, users have to deal with the above presented paradoxes, amongst others. Jarvenpaa and Lang (2005), argue that users either adopt avoidance or confrontative strategies to deal with conflicting implications of mobile technology use. Users who adopt avoidance strategies seek to minimize interaction with technology. On the other hand, in adopting confrontative strategies users seek to negotiate with the technology and enhance use.

Beyond these arguments, it is also critical to realise that usage of mobile technologies and the derivation of strategies to deal with technological conflicts do not take place in a vacuum, free from the use context's gravitational pull. Mobility transcends multiple environments (Archer, 2005) and mobile technologies are not only extending the boundaries of the office in space and time, but shaping the social context of use. Therefore, the implication of their use is a function of multiple use contexts such as organizational and varying extra-

organization social contexts of individual use (Scheepers et al., 2006; Jarvenpaa and Lang, 2005). Understanding the local context of use is crucial in any technology's implementation process (Walsham and Sahay, 2006). Figure 2.3, below, models the above user-technology interaction process.

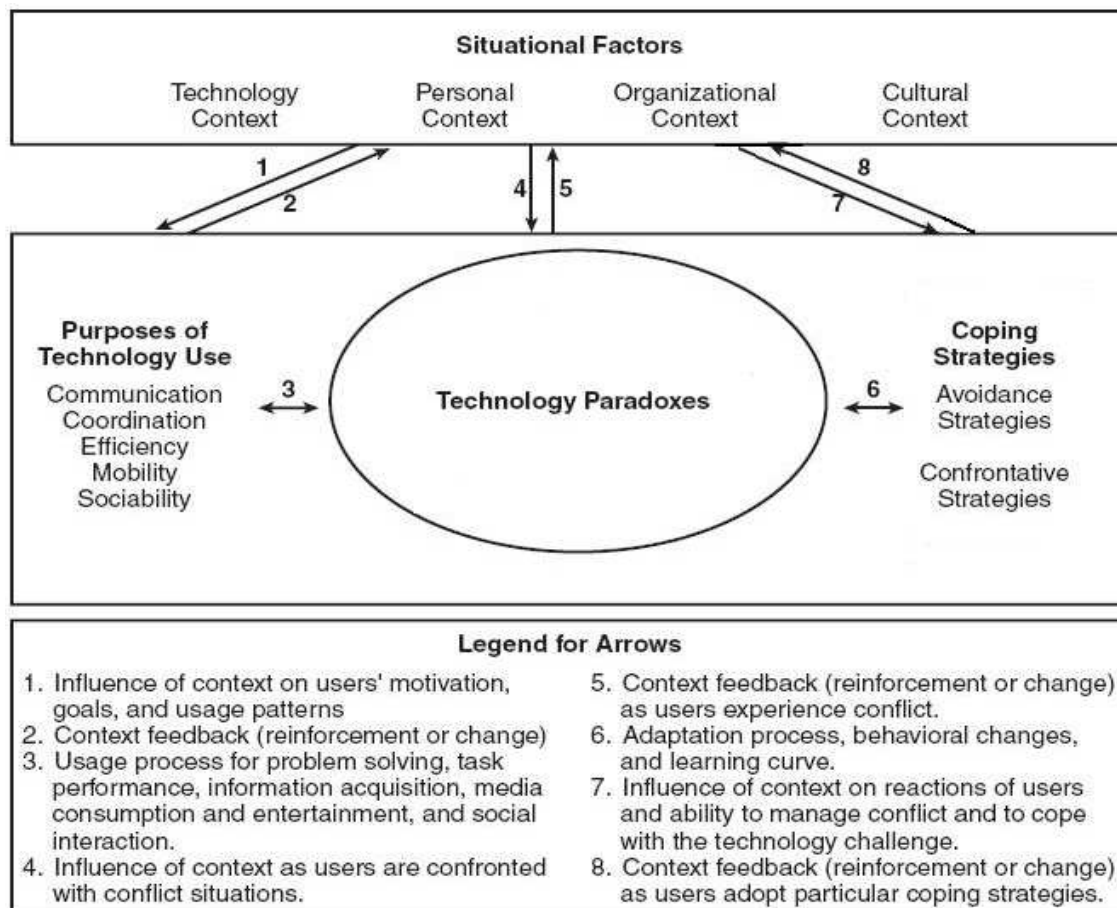


Figure 2.3: User-Technology Interaction Process

(Source: Jarvenpaa and Lang (2005: p.10))

Figure 2.3 demonstrates that users' purposes for using mobile technologies, context of use, paradoxes of technology use and related user strategies, interact and shape each other.

2.5.3 Minimizing user technology conflicts: Making the case for mobile phone use

From the above presentation, it can be seen that mobile technologies, such as mobile phones, are inseparable from the paradoxes that accompany their use (Jarvenpaa and Lang, 2005). Their successful implementation, therefore, to a significant extent, depends on how well challenges associated with their use can be mitigated to maximize user satisfaction. For example, change management and risk mitigation (Archer, 2005) can be employed as confrontative strategies in the above depicted user-technology interaction process.

Besides these two factors, usability, adoption, interoperability with other systems, security and privacy, and return on investment are other critical factors towards successful implementation and use of mobile technologies to support healthcare (Archer, 2005). Furthermore, user competence building also plays a very important role towards the successful implantation and use of any technology (Intaganok et al., 2008; Kimaro and Nhampossa, 2005). The availability of local capacity is a crucial component to the sustainability of implemented health information systems. Below, I present an overview of the importance of usability, adoption, interoperability with other systems, change management, risk mitigation, security and privacy, and return on investment, as presented by Archer (2005).

Usability: A system's usability can be defined as the ease with which a user can learn and meaningfully use the system to achieve a specified goal (Archer, 2005; Bauer and Tang, 2007). Usability plays a key role in the adoption of any information system, more so in the adoption of mobile systems where the devices have limited display and data entry capabilities. Interfaces that are easy to use and system designs that fit well with coping strategies of users are bound to persuade users into using a technology (Jarvenpaa and Lang, 2005). Furthermore, the level to which users are motivated to use mobile devices, influences their actual usage of the devices (Archer, 2005).

Adoption: With respect to the adoption of mobile technologies, it is important to consider the following question: *What factors influence users' adoption of mobile computing?; How does the design of the mobile devices and interface affect user adoption?; To what degree do specific factors such as trust, in the technology, and enjoyment, in using the devices, play a role towards adoption?* (Archer, 2005). To be attractive, an infrastructure's initial version must offer the first group of users immediate benefits through tailoring the information infrastructure to serve the users' specific needs (Hanseth and Lyytinen, 2005).

Interoperability with other systems: Interoperability with existing systems helps to improve the existing situation, or, in the worst case, avoid worsening the existing situation.

Change management: A number of issues, such as users' resistance to change, and the need to integrate with existing systems, crop up when an existing technology is changed or a new one is implemented. Therefore, the way change is made and resulting issues are handled, will greatly influence a technology's adoption process. Furthermore, when changing or implementing a new technology it is important to plan for unexpected changes and to make the technology flexible to ever changing user needs (Archer, 2005; Kimaro and Nhampossa, 2005). The heterogeneity of components making up an information infrastructure and their interconnectedness creates the potential for unanticipated effects (Sahay and Walsham, 2006). However, taking small incremental steps when making changes to an information infrastructure, whilst providing for further changes and flexibility, minimizes the risk of failure (Sahay and Walsham, 2006).

Risk mitigation: Risk mitigation involves addressing obstacles to end-user adoption through training, motivation, and improved quality of work and life. Risk mitigation also involves ascertaining the reliability of mobile systems, through adequate and rigorous testing, to ascertain system reliability.

Security and privacy: When using mobile technologies to support healthcare activities it is vital to ensure record privacy and confidentiality. The mobile solutions being used also need to be reliable, in terms of preventing data loss and frequent service interruptions.

Return on investment: For mobile solutions to be adopted by health services, where there are multiple competing demands on resources, there is need to make a convincing case on how the use of mobile solutions can help improve quality of health. For example, gains resulting from the adoption of mobile applications should outweigh their design, development, implementation and running costs.

2.6 Theory field

To examine how mobile phone applications interact with various socio-technical factors that make up their context of use, I use the concepts of *installed base* and *heterogeneity*, from the Information Infrastructure Theory (Hanseth, 2000; Hanseth and Lyytinen, 2005). Mobile phones applications for health information reporting and access cannot operate in isolation. Rather, they are part of a larger information infrastructure that is made up of healthcare work practices and routines, mobile telephony infrastructure, ICT policies, cultural practices, and other related social-technical factors.

Hanseth and Lyytinen (2005) define an information infrastructure (II) as a “*shared, evolving, heterogeneous installed base of IT capabilities developed on open and standardized interfaces.*”

Installed Base: This concept emphasises that information infrastructures are not built from scratch, but rather from what is already in existence (Hanseth, 2001). An infrastructure’s installed based can, for example, be made up of all currently integrated services and applications, their users and developers and the work practices that an infrastructure aims to support and embed (Hanseth and Lyytinen, 2005).

When considering the user-technology interaction process model by Jarvenpaa and Lang (2005), the Installed base can be seen as the constitution of situational factors and users' purposes for mobile solutions use. The installed base influences and is influenced by the use of mobile solutions. User interaction with mobile solutions, for example, builds on an installed base's strengths and is restricted by limitations intrinsic to the installed base. On the other hand, user interaction with mobile phones changes the installed base.

Heterogeneity: This concept emphasises that the components of an information infrastructure are interdependent. Furthermore, information infrastructures do not just consist of technological components, but are rather *heterogeneous* socio-technical networks. This means that, as already indicated, they comprise technological components, humans, organisations and institutions (Hanseth, 2001) and are linked to conventions of practice, which they influence and are influenced by (Bowker, 1999)

The view of information infrastructures as an interplay of socio-technical elements will be insightful in explaining the interaction between the use of mobile phone-based applications, the social context of operation, and existing technical infrastructure. This view is, for example, important in examining how these components interact to present users with both opportunities and challenges.

Chapter 3 : Research Methodology

In this section, I present the adopted research method for my research work.

Research into the relationship between information systems and the organizations and societies within which they are embedded is an important part of the development and diffusion of information technologies throughout organizations and society (Howcroft and Trauth, 2004). Various research strategies, influenced by different philosophical paradigms, exist in Information Systems (IS) research (Oates, 2006).

3.1 Research paradigms

A paradigm can be defined as set of logically held together assumptions, concepts, and propositions that form the underlying basis used to construct a scientific investigation (Krauss, 2005). Based on the underlying paradigm, IS research can be classified as positivist, interpretive, and critical (Klein and Myers, 1999; Myers and Avison, 2002).

In my research work I adopted the interpretive paradigm, to enable me understand how users socially construct mobile solutions and the organizations in which they operate (Howcroft and Trauth, 2004). I was interested in examining the socio-technical factors affecting the use of mobile phones in reporting and accessing health information, in Malawi. For example, I was interested in finding out the interplay between people's work practices and the use of mobile phones, opportunities and challenges associated with mobile phone use, and strategies employed to reduce user-technology conflict situations. To effectively carry out this type of investigation, a research paradigm supporting the understanding and interpretation of the user actions and various socio-technical factors that influence and are influenced by mobile phone use was necessary. I therefore chose the interpretive approach.

Interpretive research, unlike positivist research, takes the view that there is no universal truth and that our interpretations of the world are not always a product of objective reality (Walsham, 2006; Fitzgerald and Howcroft, 1998). Interpretive research is focused on investigating and understanding phenomena by considering meanings subjects under study attribute to such phenomena (Myers and Avison, 2002). In information systems, interpretive research methods help researchers understand the context in which information systems work. Furthermore, they aid in understanding the interplay between the information systems and the contexts in which they operate. For example, interpretive research is handy towards the understanding and interpretation of how people socially construct IS and the organizations in which they operate (Howcroft and Trauth, 2004).

Due to its potential to produce deep insights into information systems phenomena including the management of information systems and information systems development, interpretive research can therefore help IS researchers to understand human thought and action in social and organizational contexts (Klein and Myers, 1999). In my research, taking the interpretive approach allowed me to study how mobile phone solutions influence how people work, and how their use is influenced by peoples' work practices as well as organizational and social norms.

Positivist research, on the other hand, assumes that the world is not random, but ordered, regular and can be investigated objectively independent of the researcher and his or her instruments (Myers, 1997; Oates, 2006). With regard to systems development, the positivist approach regards systems development as a rational process in which actions are justified on rational grounds and appropriate organizational norms are observed (Howcroft and Trauth, 2004). This view, however, is not adequate as IS information systems are part of their social context of use, and vice versa (Braa and Hedberg, 2002). For example, IT development in developing countries involves multiple actors and an understanding of the interaction between these different actors is vital towards

effective IT implementation and use (Walsham and Sahay, 2006). The positivist approach is therefore not always well suited to studying social phenomena as compared to the other two paradigms (Oates, 2006).

Critical research, on the other hand, aims to enable and encourage social change by exposing, through critique, the illusions and contradictions of social existence (Richardson and Robinson, 2007). Critical researchers assume that social reality is historically constituted and that it is produced and reproduced by people (Myers, 1997; Myers and Avison, 2002). In this respect, the development of critical research in IS is a radical alternative to more traditional functionalist and managerial approaches towards understanding IS (Richardson and Robinson, 2007).

3.2 Research methods

Beyond the philosophical paradigms influencing the way we view the world, a researcher needs to choose an appropriate research method to aid research design and data collection. Research methods can be mainly categorized as either qualitative or quantitative (Myers, 1997; Myers and Avison, 2002). This study adopted the qualitative approach.

Qualitative research is focused on investigating and understanding phenomena by considering meanings subjects under study attribute to such phenomena (Myers, 1997; Hunter, 2005). Furthermore, qualitative research methods are focused on determining what things exist rather than the quantities in which they exist. They are descriptive, less structured and more adaptive to the research situation (Fitzgerald and Howcroft, 1998). In my research, taking the qualitative approach helped me to be flexible and investigate emerging themes that I had not previously envisaged.

Quantitative research methods, on the other hand, use mathematical and statistical techniques to identify facts and causal relationships between objects under study (ibid).

According to Myers and Avison (2002), there are multiple approaches to qualitative research, such as action research, case study research, grounded theory, and ethnography.

3.3 Adopted qualitative research approach

In my research I used the qualitative research method, because it was going to enable me understand and explain social phenomena that might be vital to the success, or failure, of using mobile phones as a means for reporting and accessing health information, in Malawi.

Furthermore, understanding current work processes and how mobile technologies are currently used in healthcare as well as user attitudes towards the introduction of mobile applications in healthcare was an important part of my research work. To effectively carry out this type of fact finding, a research methodology that allows for the understanding and interpreting social phenomena was, therefore, required. I therefore used the qualitative research methodology, because it was going to enable me understand and explain social phenomena that might be vital to the success, or failure, of using mobile phones as a means for reporting and accessing health information, in Malawi.

More specifically, my research work was a qualitative case study with the interpretive paradigm forming the philosophical basis. The case study approach is particularly suited to examining contemporary phenomena within real life context (Myers and Avison, 2002). Adopting an interpretive and qualitative case study approach helped me understand and interpret the context in which the mobile phone systems I was studying, work. For example, I was able to understand how the components forming the ecosystems in which the use of mobile phones occur, create both opportunities and challenges. Among the said components are: Available physical infrastructure; work practices; and cultural practices. Taking an interpretive and qualitative case study approach, has also allowed me to understand the process through which proposed solutions from this research work are bound to influence be influenced by their context of use.

3.4 Data collection

Empirical data for the research work was collected using semi-structured interviews, document analyses, participant observations, and text message log analyses. Empirical data was mainly collected between September 2008 and January 2009. However, additional data was collected to address gaps in the original data, noted during this thesis write-up. Table 3.1 shows the number of interviews conducted for this study and roles the interviewees play at the hospitals.

Table 3.1: Number of interviews conducted and roles played by interviewees

Hospital	Number of interviews	Interviewee portfolio
St. Gabriel's hospital	13	▪ HBC Coordinator/SMS system administrator ▪ SMS system implementer ▪ TB Officer ▪ PHC Coordinator ▪ ART coordinator ▪ Community health workers
St. Martin's hospital	8	▪ Hospital Administrator ▪ HBC coordinator ▪ Evangelical Association of Malawi's ICT projects officer ▪ Community health workers

3.4.1 Semi-Structured interviews

Data for this research work was mostly collected through the use of semi-structured interviews. In interpretive studies, interviews are an important data gathering tool and provide valuable access to the interpretations of informants in

the field (Walsham, 2006; Myers and Newman, 2007). In my research, I mainly used one-to-one semi-structured interviews. I also used semi-structured group-interviews, especially in situations where time constraints would not permit me to conduct one-to-one interviews.

The use of semi-structured interviews allowed me to probe unclear answers from respondents and pursue various interesting themes that emerged during the interviews, but were not necessarily on my original interview guide. The use of semi-structured interviews also gave respondents a chance to ask me questions when they were having problems understanding some issues under discussion. This was all possible because semi-structured interviews allow for improvisation during the course of an interview (Myers and Newman, 2007). Semi-structured interviews also allow a researcher to explore interesting lines of research, evaluate non-standard use of terms, and explore respondents' answers for credibility (Nandhakumar and Jones, 1997). Picture 3.1, below, captures one of the group interviews I conducted with community health workers at St. Gabriel's hospital, one of my research sites. Picture 3.2, captures an interview I had with community health workers from St. Martin's hospital, my other research site.



Picture 3.1: A group interview with community health workers from St. Gabriel's hospital



Picture 3.2: An interview with community health workers from St. Martin's hospital

During interviews I took notes, and in some cases, depending on respondents' willingness, made recordings. Recording interviews gave me a chance to concentrate more on leading the interviews, and later allowed me to pick up important points I had missed during the interviews. In cases where I only made notes as interviews progressed, it was relatively hard for me to simultaneously note all important points being raised by respondents and to direct the course of the interview. It was however much easier, after the interviews, to develop more in depth descriptions of the interviews from the notes I had gathered. On the other hand, transcribing interview recordings, for the same purpose, was a time consuming endeavor.

Finally, after conducting interviews, I wrote analytic memos of the interviews to help me make preliminary analyses of the data and discover common themes emerging from the gathered data.

3.4.2 Document analyses

Document analyses allowed me to understand the regulations, policies and procedures that influence mobile telephony in Malawi and at the hospitals where I performed my study. Various documentation on the organizations and projects under study provided useful background information on the same. In the case of St. Gabriel's hospital, a look at various forms used for data collection and reporting, like the monthly activity reporting forms for CHWs, helped me understand that SMS-based communication is not ideal for reporting such amounts of data. Project evaluation documents from St. Martin's hospital provided me with valuable information on how the successes and shortfalls of the hospital's mobile phone project. The evaluation documents also provided valuable call statistics from community based, organizations working with the hospital.

3.4.3 Observations

Observations helped me note things that I would have otherwise missed, had I only relied on interviews and document analyses to gather data for my research. For example by visiting some CBOs in Mangochi, I was able to know how far most villagers have to travel to get medical care and how the use of mobile phones does reduce access time to medical services for these people.

Besides this, attending a project review meeting at St. Gabriel's hospital, gave me an opportunity to witness how the hospital and community health workers collaborate. The review meeting focused on operations review and strategy formulation for the hospital's mobile phone project. The meeting was attended by around 40 community health workers and moderated by the hospital's Matron and HBC coordinator. Pictures 3.3 and 3.4, below, show pictures taken during the project review meeting.



Picture 3.3: Plenary session of a project review meeting at St. Gabriel's hospital



Picture 3.4: Time for group discussions at the project review meeting

Furthermore, during my field I was, at times, unable to reach some of my key responds when did not pick up my calls. Mostly, this happened because the respondents were not carrying their mobile phones when I was calling. This has helped me understand that although potentially able to remove time and physical

barriers to communication (Jarvenpaa and Lang, 2005), a technology like mobile phones can only fulfill its potential, in a given setting, if its use is successfully inscribed into users' communication practices.

3.4.4 Text message log analysis

During the research I got all text messages that had gone through the FrontlineSMS system at St. Gabriel's hospital between August 2008 and December 2008. FrontlineSMS is an SMS communication management system being used by St. Gabriel's hospital as an SMS communications hub.

Going through SMS logs, from FrontlineSMS, enabled me to better understand the type of information being shared by the hospital and community health workers. By analyzing the text message logs, and building on some initial analyses done by the hospital project's implementer, I was able to build a better picture of what the mobile phones at St. Gabriel's hospital are actually being used for. Using the logs, I categorized messages based on the purpose of information they contained (see chapter 5). For example, messages were grouped based on whether they just communicated information, served to coordinate tasks, plan meetings, support sociability, or mobility. Such type of categorization was informed by arguments from Jarvenpaa and Lang (2005) on why people use mobile technologies. Jarvenpaa and Lang (2005) state that people use mobile technologies for communication, coordination, enhancing efficiency, supporting mobility, and enhancing sociability.

Furthermore, by analyzing the message logs I was also able to better tell where community health workers were having problems, especially as regards requesting automated phone credit top-up. I was also able to note that some community health workers' messages were potential sources of error, because they are hardly readable. For example, some community health workers wrote entire messages just as one long word.

Although informative, it should be noted that doing a manual analysis of the messages was time consuming and cumbersome.

3.5 Data analysis

As indicated earlier, after conducting interviews, I wrote descriptive analyses (analytic memos) of the interviews, to help me formulate preliminary analyses of the data. My aim was to come up with core and subthemes through content analysis (Chan and Ngai, 2007), to address my research questions. Formulation of the themes was guided by both available literature and user experiences (Scheepers et al., 2006). Some guiding concepts from literature included technology use and work practices, as well as process reengineering.

After coming up with the preliminary themes, I then categorized my data along the generated core and subthemes. In my discussions, these themes were then analyzed using various concepts from literature. The preliminary themes helped me compare data from my two research sites along common themes. Furthermore, they allowed me to analyze my data in chunks that addressed specific research questions. In this way, the themes allowed my data analysis to be more precise.

3.6 Data validity

During my fieldwork I used multiple respondents and information sources to build up a story on how St. Gabriel's hospital and St. Martin's hospital are using mobile technologies. For example by asking the same question to multiple respondents, I was able to eliminate outliers because as issues that were consistent kept coming up in my discussions with various respondents. Furthermore, to come up with a more concise picture of how the organizations under study are using mobile phones, I interviewed both medical personnel, from the two hospitals, and community health workers they work with. I also interviewed some people that oversaw the implementation of the projects under study.

Even further, engaging with the various stakeholders also helped me to clear out misconceptions they had of each other. For example, most community health workers from St. Gabriel's hospital thought the hospital deliberately chose not to give them phone credit, when they sent in text-based credit requests. After chatting with the hospital's HBC coordinator, and the implementer of the SMS-based communication system, at the hospital, I came to know that the hospital had automated the credit top-up process. The problem was that most community health workers had just not mastered how to formulate required SMS-based credit top-up requests.

To further validate collected data, I also got SMS logs from St. Gabriel's hospital and phone usage statistics for the phones at St. Martin's hospital. The SMS logs enabled me to have a firsthand look at information going through St. Gabriel's SMS system and verify responses I got from respondents. The phone usage statistics from St. Martin's hospital enabled me to differentiate phone usage between community based organizations. With the statistics, it was also possible to determine what percentage of the calls made by community based organizations was health service delivery related or business related.

3.7 Ethical considerations

Before commencement of the research, written permission to conduct the research was sought from the Ministry of Health and Population in Malawi. The copy of letter of authorization for this research, from the Ministry of Health and Population is attached as appendix 1. During data collection, consent was also sought from respondents, before involving them in this research work. An informed consent letter is attached as appendix 2. Further to this, names of the people that provided information for this research have not been mentioned in the reporting of the results. Rules and regulations of the Ministry of Health in Malawi will also be respected.

3.8 Study limitations

At the beginning of my research work I had also intended to look at how mobile terminals are being used in Malawi for structured data collection. This was, however, not possible because I could not find an organization using mobile phones for structured data collection, in Malawi. In January 2009, UNICEF launched a pilot program that uses standard mobile phones to collect structured data on child nutrition. I was, however, unable to follow up on this pilot as it coincided with my departure for Tanzania, for my thesis write-up.

Chapter 4 : Research Setting (The Case)

This chapter provides a description of the research setting under which this study was performed. The research was conducted in Malawi at St. Gabriel's hospital in Namitete – Lilongwe and St. Martin's hospital in Malindi - Mangochi.

The chapter mainly provides geographic, demographic, and socio-economic information on Malawi. Besides this, the chapter presents a picture of the current status of telecommunications in Malawi, in general, and mobile telephony, in Particular. In addition to this, the chapter presents an overview of Malawi's health system and the sites where the research was conducted.

4.1 A Profile of Malawi

This section presents geographic, demographic, health-system and socio-economic information on Malawi.

4.1.1 Geographic profile

Malawi is a land locked country that lies along the African Great Rift Valley. The country is a former British colony and shares borders with Tanzania, to the North and North-East, Zambia, to the North and North-West, and Mozambique, to the East, South, and South-West. Malawi covers a total surface area of 118,480 square kilometres. Lake Malawi is the country's most prominent physical feature. The lake covers 580 km in length and about 20% of the land (Central-Intelligence-Agency, 2008).

Malawi has 28 districts, which fall under three larger administrative regions, the Southern Region, the Central Region and the Northern Region. The districts are further divided into Traditional Authorities, each covering groups of villages, which constitute the smallest administrative units in the country. Furthermore, the districts are also divided into constituencies, represented by members of Parliament (MOHP, 1999). Figure 4.1, below, shows a map of Malawi.



Figure 4.1: Map of Malawi

(Source: UN Department of Operations-Cartographic Section)

4.1.2 Demographic profile

Malawi has a population of 13,066,320 people, with a composition of 51 percent (6,700,549) females and 49 percent (6,365,771) males. Malawi's population is predominantly young and rural based, with about 82 percent of the population living in rural areas. The population's spatial distribution shows that 13 percent of the country's population lives in the Northern Region, 42 percent in the

Central Region and 45 percent in the Southern Region. Further to this, Malawi has 2,957,683 households with an average size of 4.4 persons per household (NSO-Malawi, 2008).

4.1.3 Socio-Economic profile

Malawi's economy is preponderantly agricultural based, with around 82 % of the population living in rural areas and 41% of the total population living below the poverty line (WHO, 2006). Due to its economic and social standing, Malawi is heavily dependent on economic assistance from the IMF, the World Bank, and individual donor nations.

Although ranking amongst the world's least developed countries and with 22 percent of its population unable to meet daily food requirements, Malawi has over the past few years registered high economic growth rates (DFID, 2008). The country registered economic growth rates of 8.6 and 7.5 percent in 2007 and 2008, respectively. However, despite registering such progress, poverty levels still remain high and food security remains a concern (MEPD, 2008).

4.1.4 Health system

Malawi's health system comprises government, private, and mission hospitals. The mission hospitals fall under the Christian Health Association of Malawi (CHAM). Throughout Malawi, healthcare services are provided free of charge in government hospitals. The government also has some service level agreements with CHAM for the provision of free maternal services in CHAM hospitals.

At the highest level of Malawi's public health system is the Ministry of Health and Population (MOHP). On the next lower level, MOHP is divided into 28 districts each of which is headed by a District Health Officer (African-Development-Bank-Group, 2005). Malawi has four tertiary hospitals and each district has a district hospital and satellite health centres. The only exceptions are Blantyre, Lilongwe, Mzuzu, and Zomba, which have no district hospitals but tertiary hospitals.

At district level, district health offices have established computerized systems and process data from health facilities including the district hospitals, within their jurisdiction. This data includes data on national indicators for district health services, diseases, and human resources. At the highest level, the ministry compiles data from all districts and central hospitals and produces quarterly monitoring aggregated and comparative reports for use by different national programs and other stakeholders (MOHP, 2003).

An overstretched healthcare system

On a different note, Malawi's health system is burdened with disease and lack of adequate medical personnel required to provide a minimum level of health care. For example, between 1999 and 2001, one tertiary hospital lost over 60% of the entire staff of registered nurses to foreign employment (Little and Buchan, 2007). Like many developing countries, Malawi faces ever increasing resource constraints. For example, population growth in Malawi has outstripped the capacity of the social infrastructure, including health services (MOHP, 1999). Besides this, about 46% of the population has to travel more than 5 km to get to the nearest health facility. Malawi's problems are further compounded as poverty, and diseases, such as Malaria and TB, and chronic malnutrition have combined with the AIDS pandemic to drastically reduce the quality of life. In some cases, basic health services are also unavailable at many health facilities in Malawi, to those in need.

4.2 The telecommunications industry in Malawi

The telecommunications industry in Malawi is regulated by the Malawi Communications Regulatory Authority (MACRA). MACRA was established in 1998 by an act of parliament, The Malawi Communications Act. Before the enactment of The Malawi Communications Act, a State-owned corporation Malawi Posts and Telecommunications Corporation (MPTC) was responsible both for operating and regulating postal and telecommunications services.

According to The Malawi Communications Act, MACRA, was among other things, established to ensure the provision of reliable and affordable communication services, throughout the country, sufficient to meet demand for them (MACRA, 1998). However, this is yet to be achieved to a satisfactory level. At the moment, for example, mobile telephony services are intermittent at times and tariffs are quite high.

4.2.1 Diffusion of telecommunications technology

At the moment, mobile phones are the most widely diffused and used information and communications technology, over fixed line phones, personal computers, and Internet. For example, the number of mobile telephony subscribers per 100 Malawians jumped from 0.43, in the year 2000, to 7.55, in the year 2007. Within the same period, the number of fixed line telephony subscribers only jumped from 0.4 to 1.26, per 100 Malawians. On the other hand, during the same period, the number of personal computers and Internet subscribers has not gone past 1¹, per 100 Malawians (ITU, 2007; UN-Statistics-Division, 2009). Figure 4.2, below, models the diffusion of mobile telephony, fixed line telephony, and Internet, in Malawi between the years 2000 and 2007. Figure 4.3, then shows the levels of mobile telephony subscription, as a percentage of total phone subscriptions, between the years 2000 and 2007.

¹ Figures on the diffusion of personal computers have been extrapolated, after 2004. I was unable to get more recent figures from either ITU or MACRA

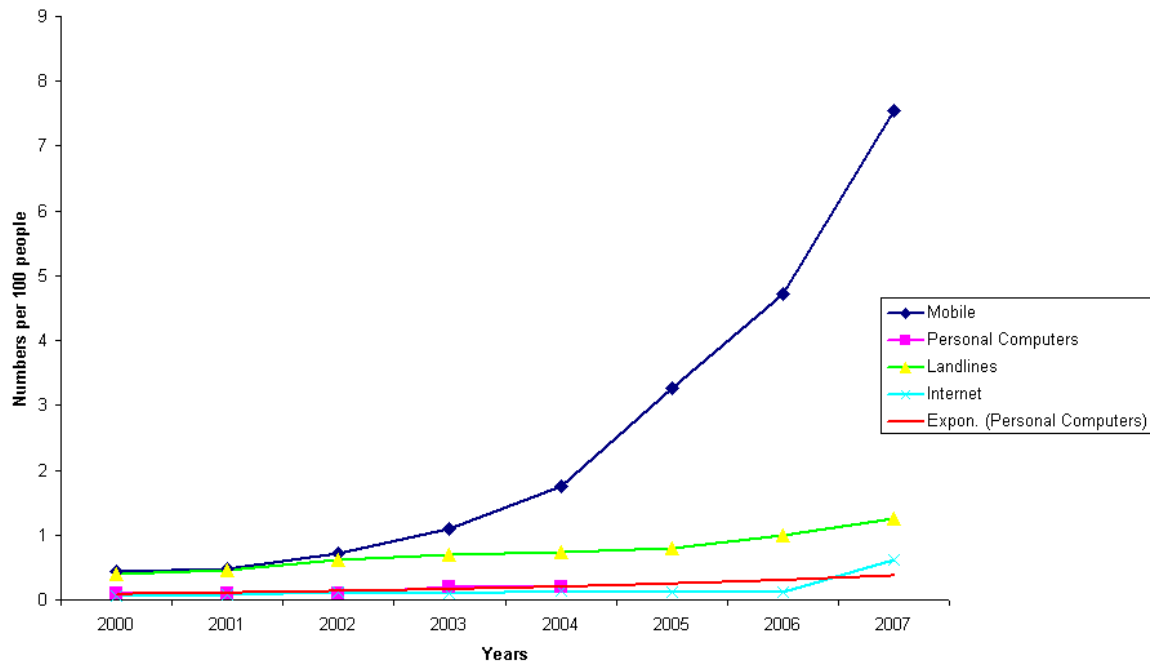


Figure 4.2: Diffusion ICT in Malawi
(Data source: ITU and UNdata)

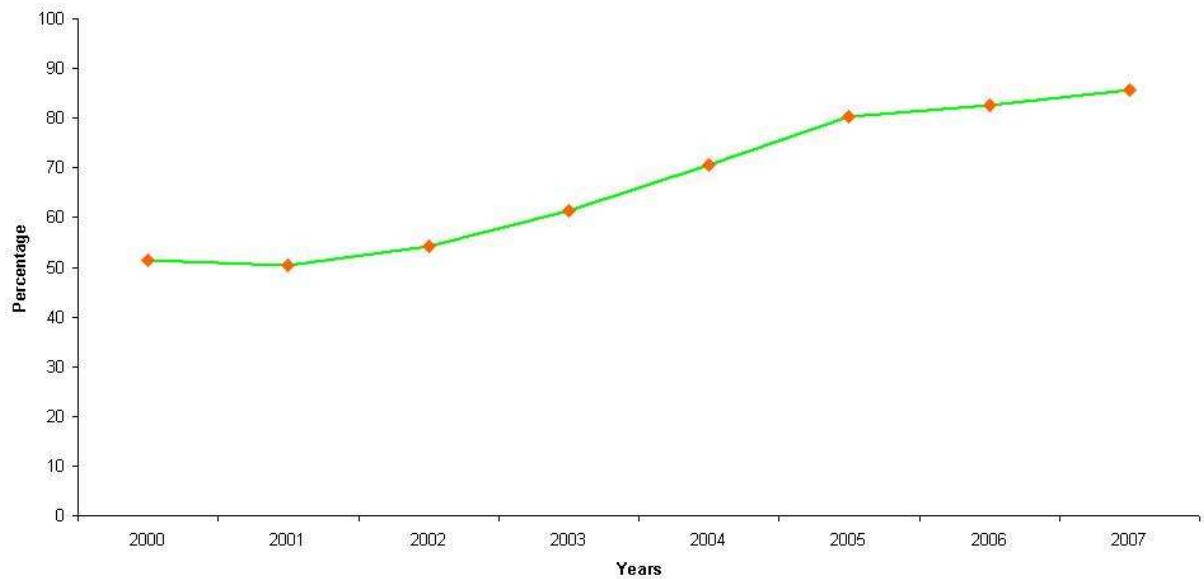


Figure 4.3: Mobile telephony subscription as percentage of total phone subscriptions, in Malawi
(Data source: ITU)

From figures 4.2, above, it can be clearly seen that mobile telephony diffusion, in Malawi, is way higher than that of fixed line telephony, personal computers, and Internet. The graph also depicts an exponential growth in the diffusion of mobile

phones. Further to this, figure 4.3 shows that mobile telephony subscription continues to grow and dominate fixed line telephony in Malawi.

4.3 Mobile telephony in malawi

This section builds on the previous section and particularly dwells on the state of mobile telephony in Malawi.

In 1995 a joint venture agreement between MPTC and TMB resulted in the establishment of Telekom Networks Limited, Malawi's first cellular telephony services provider. Later on the company was renamed Telekom Networks Malawi (TNM) Limited (Telecom-Networks-Malawi, 2009).

Celtel Malawi Limited, the country's second cellular telephony services provider, was incorporated in September 1998 and launched operations in 1999. The company later changed its brand to Zain, in August 2008 (ibid). After Zain, Malawi granted an operating license to a third operator towards the end of 2008. The new operator is yet to roll out its services.

4.3.1 Services subscription

Currently, TNM and Zain serve about 1,425,814 subscribers between them. From this number TNM is estimated to be servicing about 461,814 subscribers and Zain 964,000. The subscriber population is predominately on pre-paid subscription, with 452,031 of TNM's subscribers on pre-paid subscription and 958,216 of Zain's subscribers on pre-paid subscription (Telecom-Networks-Malawi, 2009).

To look at the diffusion rate of mobile services subscription, there were 14 subscribers per 100 Malawians, in June 2008. This, then, represents a jump of 13.3 mobile lines per 100 Malawians, from 0.7 in 2002 (ibid).

4.3.2 Voice call and SMS costs

In Malawi, cross-network cellular telephony services are usually higher than intra-network cellular telephony services. That is, it costs lesser to call someone

subscribed to the same provider as you than another person subscribed to a different mobile telephony service provider. There are also variations in service charges between peak and off-peak periods. Below, figures 4.4, 4.5, and 4.6 present a picture of SMS and voice call rates in Malawi. TNM's and Zain's services are charged in units (1 unit ~ \$0.01). The prices indicated below are exclusive of a Government tax of 16.5%.

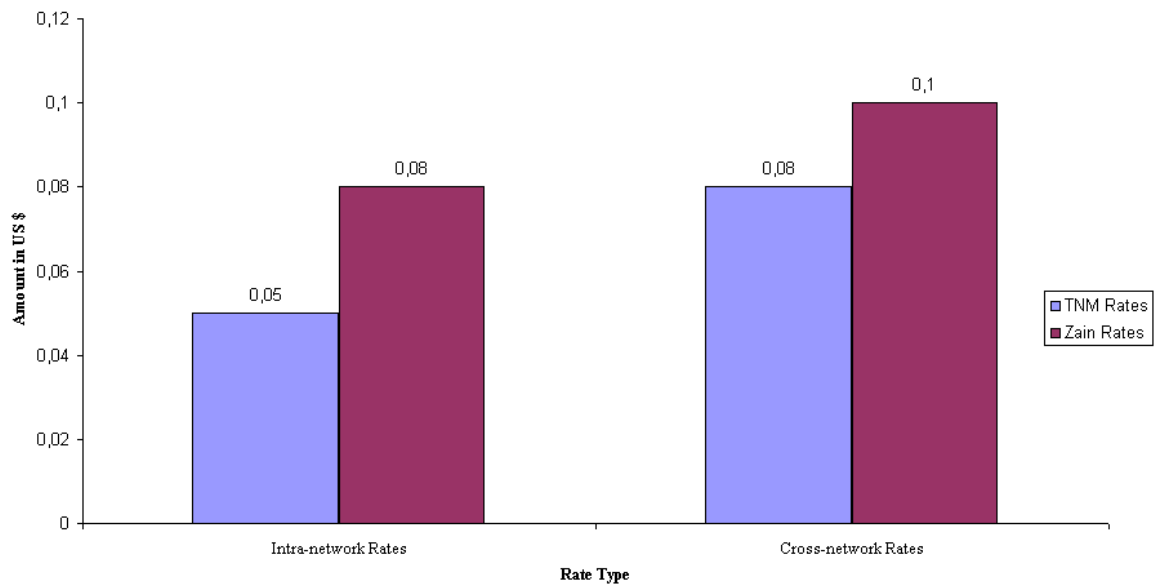


Figure 4.4: Local SMS Rates in Malawi

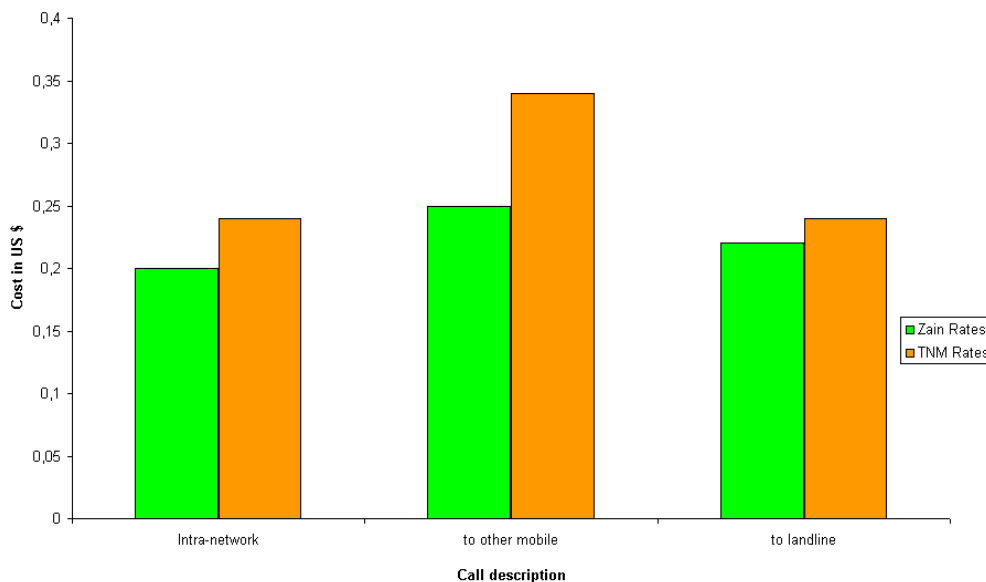


Figure 4.5: Pre-paid per minute voice call rates for peak hours

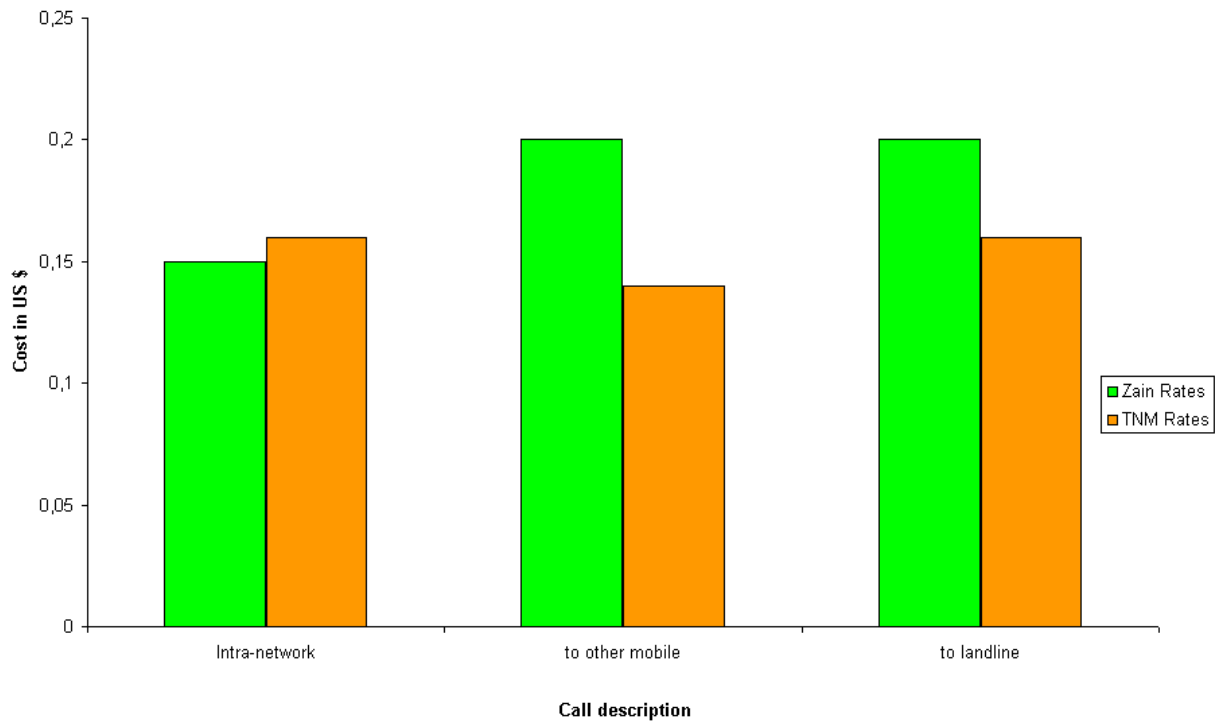


Figure 4.6: Pre-paid per minute voice call rates for off-peak hours

A notable thing from the graphs, above, is that SMS rates for the two providers are relatively lower than those of voice calls. Furthermore, as earlier explained, there are also variations on call charges depending on whether the calls are intra-network or extra-network, or are made during peak or off-peak hours. The peak hours for Zain are between 08:00 am and 10:00 pm. On the other hand, TNM's peak hours are between 07.00 am to 08.00 pm, from Monday to Friday.

4.3.3 Mobile Internet services

Currently, there are no 3G mobile data services rolled out in Malawi and the government of Malawi has not yet started issuing 3G licences. Despite this, both TNM and ZAIN provide mobile internet access via WAP on GPRS-enabled cell phones. Zain was the first to launch this service, during the second half of 2007, and now has a user base of just over 100, 000 for this service. TNM followed up with a similar service in early 2009.

The two cellular telephony providers charge for their mobile Internet services per megabyte of data transferred. At the moment, Zain is charging \$0.19 per megabyte of data transferred, whilst TNM charges \$0.15 for the same amount of

data, for customers not subscribed to its predefined monthly data bundles. Unlike Zain, TNM provides a varied range of data bundles and prices, to which customers can subscribe on a monthly basis.

4.3.4 GSM network coverage in Malawi

Both TNM and Zain have extensive coverage in Malawi. I was, however, unable to get specific figures on what percentage of the country they have thus far individually covered. However, the coverage maps below will help the reader understand the extent of network coverage in Malawi. Figures 4.7 and 4.8, below, show GSM coverage for Zain and TNM in Malawi.

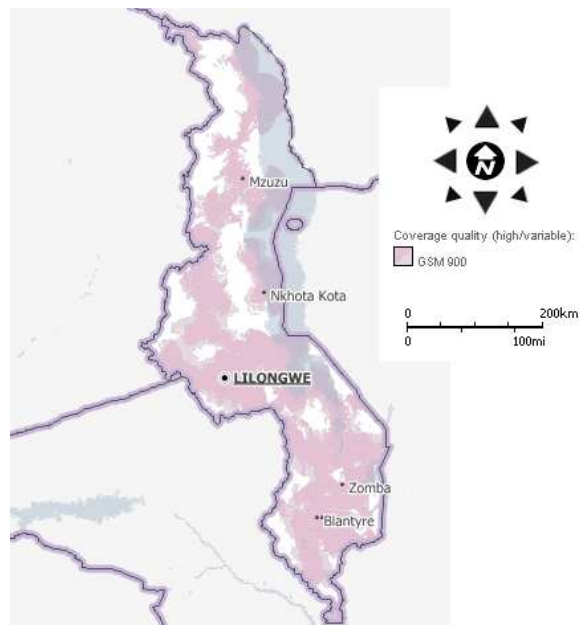


Figure 4.7: GSM network coverage map for Zain
(Source: GSM world)



Figure 4.8: GSM coverage map for TNM

(Source: Telekom Networks Malawi limited)

From the maps above it can be seen that although they have covered most of the land, Zain and TNM still need to extend their network coverage. At the moment, they are continuously extending their network coverage.

4.4 The research sites

As has already been presented, data for this research work was collected from St. Gabriel's hospital at Namitete, in Lilongwe and St. Martin's hospital at Malindi, in Mangochi. Figure 4.9, below, shows a map of Malawi and the research sites visited during this research work.

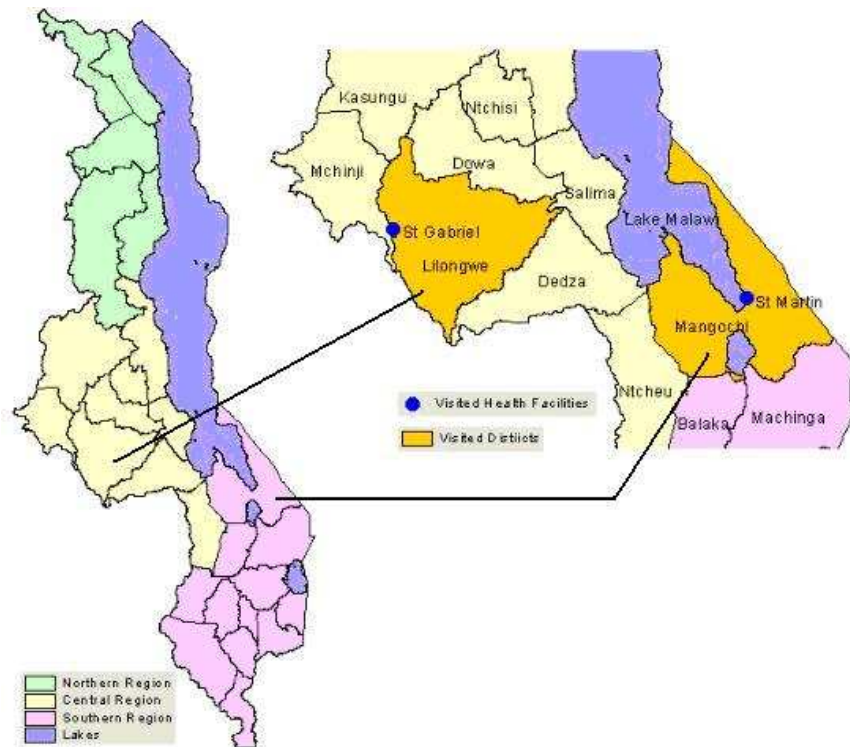


Figure 4.9: Map of Malawi showing the visited research sites

4.4.1 St. Gabriel's hospital

St. Gabriel's Hospital is located at Namitete, 64.5 kilometres west of Lilongwe, Malawi's capital city. Its catchment area includes parts of Traditional Authority Mavwere in Mchinji and Traditional Authority Kalolo in Lilongwe district. The hospital is accessible by a dusty road of about 4.5km from the main tarmac road that connects Lilongwe and Mchinji districts.

St Gabriel's Hospital is a Catholic mission hospital. The hospital started in 1959 as a small health centre and was established by the Congregation of the Carmelite Sisters from Luxembourg. It is owned by Lilongwe Diocese, advised by a Board of Governors and operated by the management team. The hospital is also a member of the Christian Health Association of Malawi (CHAM).

The hospital provides curative, preventive and promotive health care services to a population estimated at around 205, 000. This population is mostly made up of small holder farmers. St. Gabriel's hospital has a bed capacity of 240 composed of an out-patients department, a general male ward, a general female ward, a

labour ward, a maternity ward and children's ward. Maternal and child health services are provided through the hospital's static and outreach clinics. Besides all this, the hospital functions as a referral institution for six health centres.

4.4.1.1 The hospital's SMS communications project

In July 2008, the hospital, with the help of an American student, studying at Stanford University, launched an SMS-communication system, using FrontlineSMS. The project aims to improve information reporting and access between the hospital and community Health Workers (CHWs), working with the hospital. The project aims to cut the need for face-to-face communication when reporting or accessing information. Previously, for example, community health workers had to travel long distances to deliver urgent information at the hospital. Hospital personnel also had difficulties in planning and coordinating activities, such as patient visitations, patient tracking and urgent meetings, with community health workers. Currently, developments related to the project can be followed on <http://www.jopsa.org/>, under the projects section.

4.4.1.2 Communications technology in use at St. Gabriel's hospital

St. Gabriel's hospital uses SMS to report and provide access to health information. In doing this, the hospital uses FrontlineSMS, an SMS communications management system, as a communication hub between health personnel at the hospital and community health workers (CHWs), and also amongst community health workers.

FrontlineSMS is developed by kiwanja.net and provides functionality for sending and receiving messages, creating and managing contacts and contact groups, logging outgoing and incoming messages, and designing and running surveys using an inbuilt form-manager. FrontlineSMS can also be configured, using its reply-manager, to provide automated responses to incoming messages that contain certain code words. Further to this, FrontlineSMS can be configured to send copies of incoming messages to a remote email account. It also supports message exportation to applications that handle .csv files. Figure 4.10, below, shows a screenshot of FrontlineSMS' ContactManager.

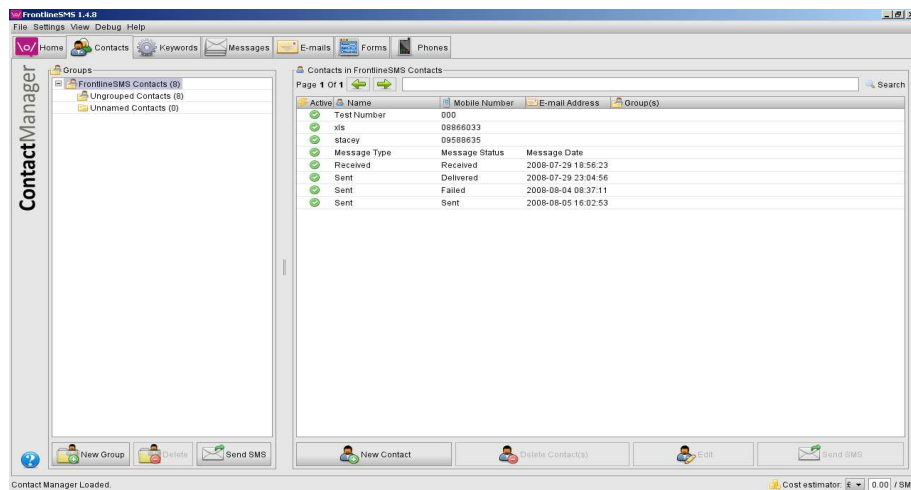


Figure 4.10: FrontlineSMS Contact Manager

At the moment, St. Gabriel's hospital uses all of the above stated functions, except for the form-manager.

4.4.1.3 SMS system setup

As has already been stated, the hospital uses FrontlineSMS as a hub for all its SMS-based communication with community health workers. The FrontlineSMS software is hosted on a Compaq Presario laptop computer, which has a SAMBA75 GSM MODEM attached to it. The MODEM has a simcard and connects the system to Zain Malawi, a cellular telephony services provider. The laptop computer also has an Internet connection, allowing FrontlineSMS to send, via email, copies of all SMS-based communication to the hospital system's initiator, currently studying in the USA.

Thus far, 70 community health workers and 6 medical personnel, from the hospital, have received mobile phones to use for sending and receiving text messages, via FronlineSMS. The phones are recycled and cost about \$ 8, each. Most are Motorola V195s, and a few are Nokia 6100s and 6210s. Picture 4.1 shows a community health worker using his phone, whilst out working in his field.



Picture 4.1: A community health worker using his phone

(Source: www.Jopsa.org)

4.4.2 St. Martin's hospital

St. Martin's hospital is at Malindi, twenty kilometres north of Mangochi town with Lake Malawi to its west and Gome hills to the east. The hospital started out as a small clinic, with one nurse, in 1898 to provide services to missionaries and their families. Currently the hospital has a 100 bed capacity and its catchment area constitutes 39 villages, with a combined population of 40,379. This population mostly comprises small holder farmers and fishing communities.

The hospital also acts as a referral hospital to Nkope, Mpondasi and Lulanga health centres. Nkope is located 68 kilometres North-west of the hospitals, Mpondasi 35 kilometres to the hospital's South-west, and Lulanga 108 kilometres to its North.

The hospital has two general wards for males and females, a maternity ward, paediatric ward, TB ward, VCT/ART clinic, dental department, operating theatre, laboratory, pharmacy, nutrition rehabilitation unit, PHC department, an

integrated department for antenatal and under five clinics, and an administrative department.

In April 2008, the hospital with the help of Evangelical Association of Malawi (EAM) installed a mobile phone network and gave out mobile phones to Community Based Organisations (CBOs) it is working with. Phones were given to CBOs so people could use them when they needed to request help from the hospital and also to enable CBOs raise money for patient care. The CBOs raise money for patient care and buying phone credit through running phone bureau services using their phones. Developments related to this project can be followed under the blog <http://mobilesmangochi.blogspot.com/>

4.4.2.1 Communications technology in use at St. Martin's hospital

St. Martin's hospital uses mobile pay phones to report and provide access to health information. The hospital is predominantly using voice calls to relay information between the hospital and community health workers, and also between community health workers.

The mobile pay phones are generally meant to operate as business phones. They are somewhat larger than handheld mobile phones and they have an inbuilt billing functionality. The billing functionality allows a user to program the duration of a call to be made, beforehand. Picture 4.2, below, shows a community health worker using a mobile pay phone.



Picture 4.2: A community health work using a mobile pay phone

4.4.2.2 System setup

The hospital has a switchboard and 12 extension lines, within the hospital. The hospital also has a direct line on which community health workers can reach the hospital's medical assistant. The medical assistant is in charge of the hospital's HBC program and directly works with community health workers. Community health workers can therefore route their calls via the switchboard or the medical assistant who in turn reroutes the calls to appropriate personnel at the hospital.

Unlike the case at St. Gabriel's hospital where phones were given to individual community health workers, at St. Martin's hospital phones were given to Community Based Organizations (CBOs). One phone was given per CBO and each CBO was responsible for choosing a person to manage the phone. St. Martin's hospital is working with 5 CBOs, with each CBO covering several villages. Some CBOs cover more than 5 villages.

Chapter 5 : Research Findings from St. Gabriel's Hospital

In this chapter, I present the key findings of my research work from St. Gabriel's hospital at Namitete, in Lilongwe. Findings from St. Martin's hospital at Malindi, in Mangochi, are presented in chapter 6. This chapter and the next show how the two hospitals are using mobile phones for reporting and accessing health information to improve healthcare delivery.

Information for the findings presented in this chapter was collected through, semi-structured interviews, a project review meeting, document reviews, SMS logs analyses, and observations. The interviews were either one-to-one or group interviews.

The key findings from St. Gabriel's hospital include the contextual setup for mobile phones use, the interplay between people's work practices and mobile phone use, and the opportunities and challenges associated with mobile phone solutions use. Besides these issues, the chapter also presents and examines strategies employed to address challenges associated with mobile phone use.

5.1 Operational context

This section gives information on the organizational, cultural and technical factors that shape and are shaped by mobile phones use, at St. Gabriel's hospital.

5.1.1 Organizational factors

As put in chapter 4 St. Gabriel's hospital is using mobile phones to enhance communication between the hospital and community health workers, it is working with. This section looks at the organisational factors that relate to mobile phone use, at the hospital.

Background organisational information

To better serve its community, St. Gabriel's hospital solicited the help of some volunteers, in 2002, to serve as community health workers. Among other things, the community health workers provide home-based palliative care (HBC) to chronically ill patients, within villages they serve. Further to this, they follow up on clients under the hospital's HBC program, within their communities. In addition, they also provide counseling services to clients within the hospital's catchment area. Some of the community health workers also work as drug adherence monitors.

Currently, the hospital works with around 600 community health workers, with 140 trained in HBC. However, it is the community health workers trained in HBC that are largely targeted in the use of the SMS communication system (FrontlineSMS) at the hospital. Of the 76 users directly interacting with the hospital's installation of FrontlineSMS, 70 are community health workers and the rest are medical personnel at the hospital. Of the 70 community health workers, currently using the system, 46 were trained in HBC, 21 in both HBC and ART monitoring, 1 in ART monitoring only, 1 in counseling, and 1 in youth related activities.

5.1.2 Organization of community health workers

To have them and their work well organized, community health workers operate under Village AIDS Committees (VACs). In turn, the VACs fall under Community AIDS Committees (CACs). Village AIDS committees fall under one or more village headmen. The community AIDS committees, on the other hand, include all village AIDS committees under a particular Traditional Authority (TA).

St. Gabriel's hospital serves the areas of Traditional Authorities Mavwere and Kalolo. At the moment, St. Gabriel's hospital has two community AIDS committees and 21 village AIDS committees, within its catchment area. Each

village AIDS committee has 30 members, with 5 to 6 members, under each village AIDS committee, trained in HBC.

5.1.3 How community health workers report on their work

Normally, at the end of each month, community health workers submit paper-based activity reports to the hospital, on what they have done within that month. Routinely, community health workers record their daily activities in books. The book entries are then used for the compilation of monthly activity reports. Besides this, community health workers can now send daily work updates, to the hospital, via SMS. Such messages are logged by the hospital's SMS system, FrontlineSMS, and acted upon by hospital personnel. When sending text messages to the hospital, community health workers normally use summaries of the above mentioned book entries. Following, is the sequence of steps to generating monthly reports on community health workers' activities at hospital level:

1. Individual community health workers meet at village AIDS committee (VAC) level to discuss and aggregate their activity reports. This is done by the 20th day of each month.
2. Community AIDS committee (CAC) representatives then consolidate all activity reports, under their CAC, no later than the 27th day of the same month.
3. On the 1st day of the following month CAC representatives meet at St. Gabriel's hospital to discuss and aggregate the CAC reports. This then results into an overall report on what all community health workers were involved in, within a particular month. Besides this, the hospital also retains individual reports compiled by Community health workers, VACs, and CACs. Figure 5.1, below, depicts the above mentioned steps for generating monthly activity reports.

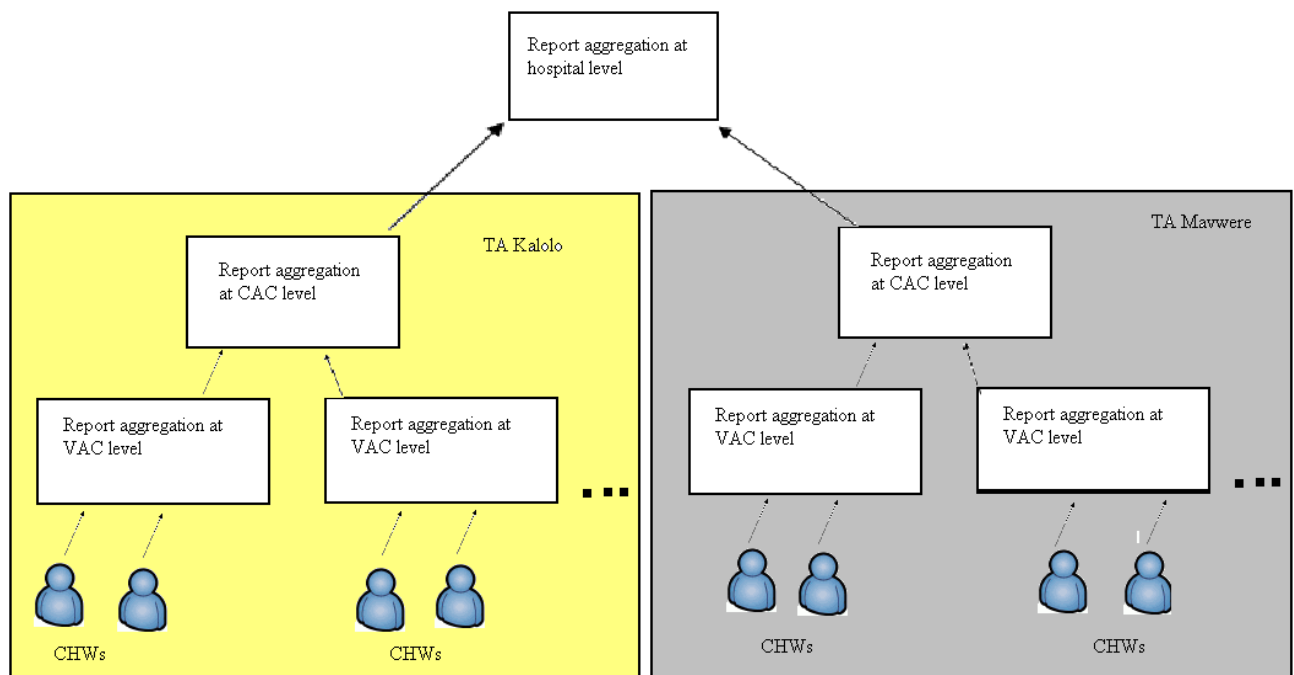


Figure 5.1: Generation of monthly community health workers' activity reports

In the above captured sequence of steps for formulating monthly activity reports on community health workers, each individual's report has to go through three levels of integration for the hospital to have an overall picture of all activities. To enable the hospital easily get updates on individual community health workers' work, before each month ends, the hospital and community health workers also exchange information via text messages using SMS and FrontlineSMS.

5.2 Management of text-based communication through FrontlineSMS

As indicated above, St. Gabriel's hospital and community health workers, it is working with, use text messages to report and access health information. In doing this, the hospital uses FrontlineSMS, an SMS communications management system, as a communication hub. The system is used to manage communication between medical personnel at the hospital, the hospital and community health workers, and also between community health workers.

At the hospital, FronlineSMS is mainly used to manage communication between community health workers and the hospital's TB, ART, HBC, PMTCT, PHC and support group program coordinators. FrontlineSMS keeps all incoming and outgoing text messages in a database.

The HBC coordinator, with the support of the ART coordinator, is responsible for the system's daily running. For example, the HBC coordinator is responsible for monitoring incoming messages and redirecting them to appropriate personnel. This is done by forwarding text messages to users' phones. For personnel at the hospital messages are sometimes delivered by word of mouth. The HBC coordinator is also responsible for communicating with community health workers, via FrontlineSMS, on behalf of the hospital. This usually involves forwarding responses to queries from community health workers or passing other work related communication, from the above mentioned program coordinators. Figure 5.2, below, models the communication system at S. Gabriel's hospital.

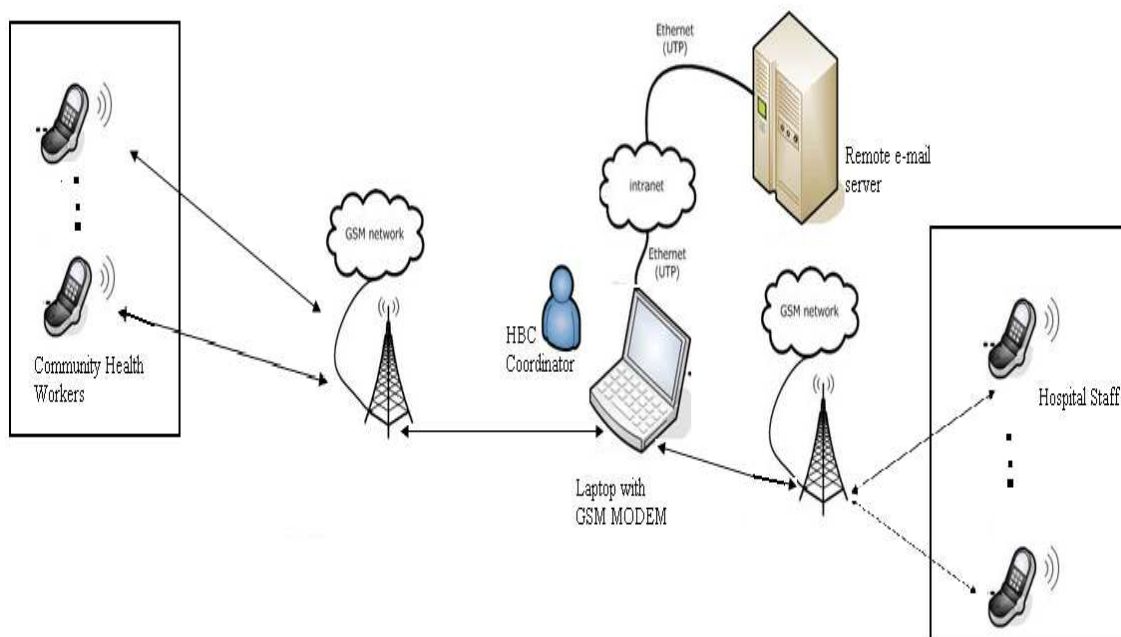


Figure 5.2: Model of the SMS-based communication at St. Gabriel's Hospital

In the communication model presented above, the HBC coordinator acts as a gateway to SMS-based communication being channeled through FrontlineSMS. This, therefore, makes the HBC coordinator a critical resource in the operation of

this communication model. By being the person responsible for monitoring FrontlineSMS and forwarding messages to relevant personnel, the HBC coordinator can accelerate, delay, or even block communication.

Besides using their mobile phones for communicating with St. Gabriel's hospital, community health workers are allowed to use their phones to communicate with each other. Although community health workers can communicate directly on private issues, they are required to channel all work related communication, amongst them, through the FrontlineSMS system at the hospital. For example, if community health worker A wants to send a message to community health worker B, he or she is required to send the message to the hospital instructing them to redirect the message to community health worker B. This, according to the HBC coordinator, helps the hospital track and log all work related communication between community health workers.

Requiring community health workers to communicate in this way implies a double cost to getting a message from community health worker A to community health worker B. This tradeoff, however, is inevitable if the hospital has to keep track of work-related communication between community health workers. Figure 5.3, below models this work related SMS-based communication between community health workers (CHWs).

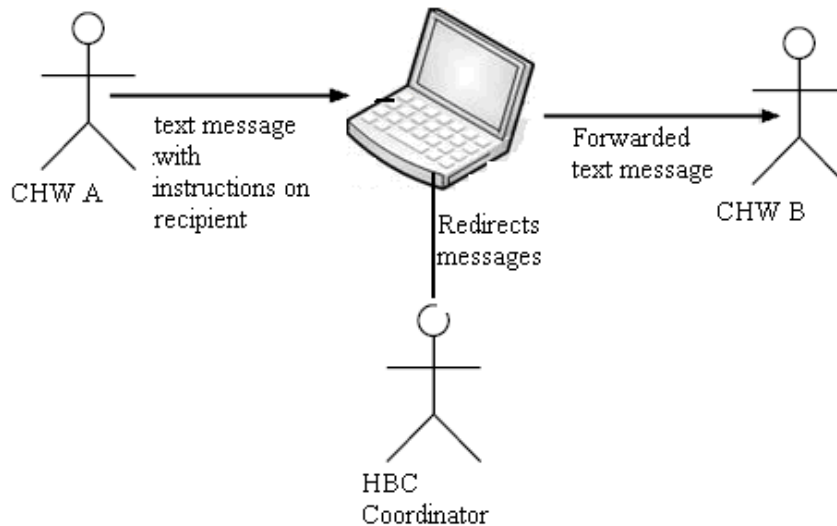


Figure 5.3: Work related communication between Community health workers

In addition to the above presented modes of technological use, the hospital also configured FrontlineSMS to auto respond to incoming text messages containing some predefined code-words, as shown in figure 5.4, below. For example, a community health worker, can text Panado to the system to get an automated response on the drug's use and recommended dosages. One community health worker had this to say, for example:

“When we forget how to administer medication to our clients, for example, Panado, multivitamins, Aspirin ...we just write a text message saying: ‘Panado.’ Immediately we get a reply [on how to administer the medication].”(Community health worker, 2009)

Besides this, the use of keywords also allows FrontlineSMS to manage credit top-ups to community health workers' phones. This is made possible through a credit transfer service, Me2U, provided by Zain Malawi, the hospital's mobile services provider of choice.

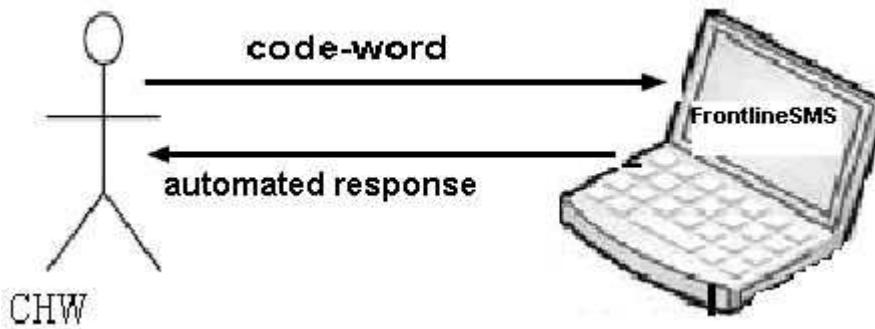


Figure 5.4: Use of FrontlineSMS to auto-respond to user requests

Another benefit realized by the use of code-words is that community health workers can get real-time help on how to administer medication, when out visiting patients. The automation of credit to-ups also simplifies phone credit management.

5.2.1 System interoperability

To maintain its relevance, the FrontlineSMS system at the hospital is linked to the hospital's manual record keeping systems through human gateways, like the HBC coordinator. Health information at the hospital is mostly kept in paper-based registers, making it necessary for hospital personnel to transfer information between FrontlineSMS and health information registers at the hospital. For example, community health workers do send death reports of ART patients through text messages. The hospital's ART coordinator, on the other hand, maintains a register for patients on ART treatment and sometimes has to use death reports received via FrontlineSMS to update her register.

5.3 SMS-based communication and work practices

Information transmitted through the system is largely free-form text explaining requests for medical care in distant villages, issuing patient follow-up updates, relaying ART and TB drug adherence information, health worker-to-health worker communication, support group mobilization, and general medical inquiries. On the one hand, the purpose for health related information reporting and access through the system is to guide healthcare activities and shape work

coordination. On the other hand, the hospital's and users' work practices also shape how mobile phones are used to support user activities. Next, I present my findings on how mobile phone use interacts with work practices.

5.3.1 Influence of mobile phone use on work practices

At the hospital, SMS communication is being used to coordinate tasks and people, provide support to personnel on the move, and re-engineer work processes.

Firstly, SMS-based requests for care, from remote villages, are helping hospital personnel know what drugs to carry when visiting patients. When visiting patients, it is necessary for medical personnel from St. Gabriel's hospital to carry the right drugs and medical supplies. It is also important to carry these items in right quantities.

Secondly, as has already been indicated, when community health workers forget how to administer certain drugs, when out visiting patients, they can send already fixed code-words to get reminders. Before starting to use mobile phones it was not possible for community health workers to get such help, remotely. Further to this, the use of SMS-based communication has made it possible for community health workers to access expert medical advice, whilst visiting clients. This is as evident from the quote below:

“When visiting a patient, if the patient asks a question we are unable to answer, we just send a text message to the hospital. The hospital responds and we immediately communicate the answer to the patient.” (Community health worker-St. Gabriel's hospital, 2009)

This quote demonstrates a shift from the period before mobile phones were being used and the hospital could not provide health workers with almost instantaneous advice, remotely.

Thirdly, through SMS communication with community health workers, the hospital is able to monitor patients' treatment and take appropriate action when need be. For example, the hospital gets updates on patients that are receiving ART and TB treatment, and are enrolled onto the hospital's HBC program. This information includes, but is not limited to, patients' drug adherence and response to medication, need for additional medicine or attention from the hospital, and death reports.

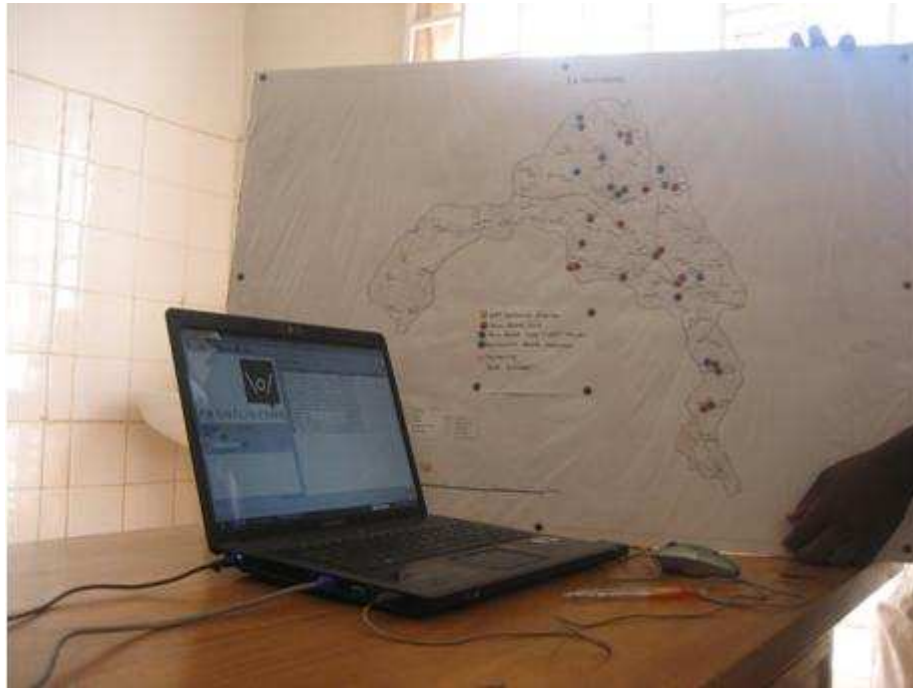
Fourthly, through SMS-based communication, the hospital and community health workers are able to plan or cancel meetings and appointments without the need for someone to travel around, informing people of such developments, as was previously the case. For example, when planning a meeting or patient visitation, the hospital can just send text messages to community health workers, informing them of such. The statement below, made by a community health worker, further illustrates this point.

“Currently, the hospital can communicate with us more easily. For example, I got the message for this meeting when I was out in the field gardening.” (Community health worker-St. Gabriel's hospital, 2009)

As already indicated, such use of mobile phones demonstrates a shift from the need for face-to-face communication to permit activity planning. Here, the use of mobile phones also accords users more flexibility when planning meetings.

Fifthly, in cases where hospital personnel cannot manage to visit all targeted patients, for a particular day, text messages are used share tasks with community health workers. To ease patient-community-health_worker pairing the hospital has a map that indicates where community health workers with phones are located, and services they are responsible for. This allows hospital staff to ably assign patients to community health workers closest to them. This, in turn, allows hospital staff to follow up on patients in areas where there are no community health workers with mobile phones. Pictures 5.1 and 5.2, below, show

maps used to locate community health workers and their tasks. The colored pins represent services various community health workers are responsible for.



Picture 5.1: Laptop hosting FrontlineSMS and map showing community health worker distribution



Picture 5.2: A map showing community health worker distribution

Besides guiding the pairing of patients with community health workers and the coordination of patient visitations, the maps above are also used to aid patient tracking. For example, if a patient is not coming for appointments the hospital uses the map to identify community health workers closest to the patient's village. This, then, makes it easier for community health workers to track patients. The HBC coordinator indicates such use of the maps in the statement below:

“If I have a patient ... I also inform the community volunteer... ‘At such and such you’ve got a patient who is suffering from, for example, Kaposi’s sarcoma. She is willing to be followed up right there in the community.’ This volunteer is [then] able to go and start visiting that patient.” (HBC Coordinator, 2008)

Lastly, SMS-based communication has made it easier for community health workers to bypass the normal monthly reporting structure, when sending in activity reports within the month. This is depicted in figure 5.5, below.

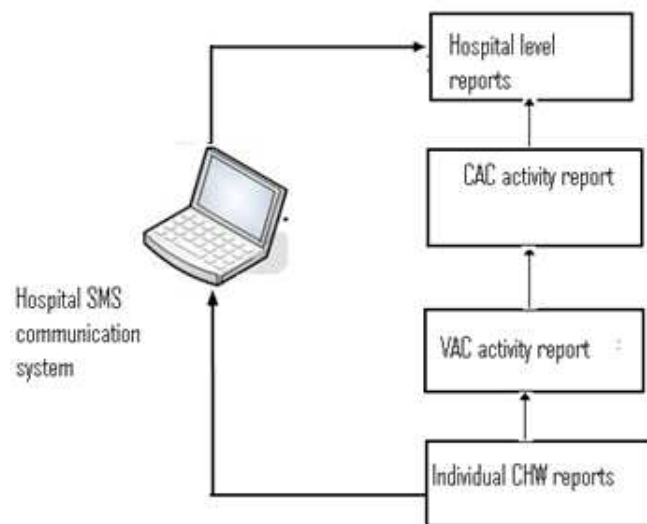


Figure 5.5: Information reporting flows for Community health workers

Previously community health workers had to travel to the hospital to deliver messages. However, since most of them reside very far from the hospital, they usually waited until the end of the month to send in their reports. The use of

SMS-based communication has, therefore, reduced the need for community health workers to travel to the hospital when they need to deliver urgent reports. The use of SMS-based communication has also cut on the need for people to walk to the hospital to call for medical help. The quotes below, further backup the points raised here:

“The cell phones have made our work easier. They have helped us to cut down on the number of trips we make to the hospital.”

(Community health worker-St. Gabriel's hospital, 2009)

“Previously we had problems submitting reports. Sometimes we had messages that needed to be communicated to the hospital on the same day. We, therefore, had to cycle to the hospital. Those who did not have bicycles would walk to the hospital.” (Community health worker - St. Gabriel's hospital, 2009).

The figure and quotes above show that the hospital has managed to strengthen the direct link with individual community health workers, whilst maintaining the existing structure for monthly activity reports generation.

5.3.2 Influence of work practices on mobile phone use

Just as they are influenced by the use of mobile phones, organizational and users' work practices do shape how users interact with the technology. For instance, although it is possible for community health workers to directly communicate using SMS, the hospital requires them to channel all work related messages via the hospital's communication system.

Furthermore, being attached to the hospital means that users largely use their phones for reporting or accessing health related information. Further to this, the sensitivity of patient information being transferred through text messages does place limits on how users can use their phones to share information.

To add on to this, users' workload and need for information exchange also determines the frequency with which different users use their phones to support their work. One community health worker had this to say:

“Other volunteers cover wider areas, whilst others cover smaller areas. Therefore, there has to be a difference in the number of messages they write.” (Community health worker-St. Gabriel's hospital, 2009)

Being aware of this is important for the hospital to objectively evaluate variations in the number of messages sent in by community health workers.

Above all else, the hospital's goals for introducing mobile phone use set the tone on how users have to use their phones to meet such goals. For example, the hospital has set what it deems acceptable use of phone-credit community health workers get from the hospital. Community health workers are, for example, supposed to send in eight to nine text messages for each dollar received.

5.4 Challenges associated with mobile phones use

In as much as SMS communication has had a huge impact on how St. Gabriel's hospital and community health workers work, challenges do exist.

5.4.1 Technological challenges

Due to the size of monthly activity reports, it is not practical, at the moment, for community health workers to submit their monthly reports via SMS. Appendix 3 shows a typical form for reporting monthly activities. Furthermore, due to the size of SMS messages, 160 characters, community health workers are sometimes unable to adequately communicate case details to the hospital. Besides this, paper-based monthly reports provide aggregated data on activities, a feature not currently provided by FrontlineSMS at the hospital.

In addition to the above given problems, SMS-based communication is greatly dependent on cellular network coverage and the availability of electricity. At the

moment, not all areas within the hospital's catchment area have cellular telephony network coverage, making it hard for the hospital and community health workers to communicate at times. This is expressed in the quote below:

“Another problem is the network ... especially for those who are coming from very far. You can text them an emergency message ‘Please, can come you come for a meeting tomorrow?’ If there is no network they receive that message, maybe, two days later.” (HBC coordinator- St. Gabriel's Hospital, 2008)

The hospital is also, at times, unable to reach community health workers on their mobile phones, when the phones have discharged or are out for recharging. At the moment most community health workers have to get their phones recharged away from their homes, as they do not have electricity at home. This costs the community health workers about \$0.35 for each recharge. Besides this some community health workers have to walk distances of about 5 kilometers to get their phones charged. In line with this, the HBC coordinator at St. Gabriel's hospital had this to say:

“You will find that some of the volunteers, if you text them a message, they will respond very late saying I had no power in my phone ... I didn't have time go and charge my phone.” (HBC Coordinator, 2008)

To partially address this problem, the hospital allows community health workers to recharge their phones for free, at the hospital. Community health workers residing very far from the hospital are, however, usually unable to take advantage of this provision.

Lastly, as has been presented above, the HBC coordinator, by virtue of his role, can slow down, speed up, or block information flow through the SMS communication system. The HBC coordinator also has other duties to perform. Furthermore, the HBC coordinator does not work 24/7, meaning the coordinator is unavailable sometimes and may cause information flow to halt. To add to this,

people can only handle so much pressure. For example, it is more likely that the number of community health workers using the system, as currently modeled, cannot be quintupled without putting further strain on the HBC coordinator and risking system collapse. The HBC coordinator is a potentially critical weak point for the system.

5.4.2 Organisational factors

From time to time, hospital personnel with no direct access to FronlineSMS do not get text messages forwarded to them on time. This in turn means that queries sent via text messages, by community health workers, are not responded to on time, by hospital personnel. For example, the PHC coordinator when asked whether he always gets messages on time, he had this to say:

“No! It depends on the availability of the HBC coordinator. If he is not there, that means I have to wait. For example, today he is going to the field and that means should there be a message I will not be able to see it.” (PHC coordinator, St. Gabriel's hospital, 2009)

The above scenario sometimes happens because officers responsible for monitoring the FrontlineSMS, at the hospital, are out attending to other duties. The hospital is understaffed and medical personnel are usually busy attending to patients.

Besides this, another challenge for the hospital is the availability of technical personnel to repair broken phones or further customize the available mobile phone solution, to meet changing needs. Currently the hospital does not have technical personnel capable of doing this.

Furthermore, at the moment the project has no M&E framework to provide a standardized way to measuring project impact and outcomes. Having an M&E framework would make it much easier to replicate the project's successes and isolate problem areas based on criteria that are uniform. Talking to personnel at St. Gabriel's hospital and community health workers one gets a sense that they

all very much appreciate how SMS-based communication has positively impacted their work. They are, however, not well equipped to consistently and quantifiably outline the project's impact on their work. For example, it is not easy for the HBC coordinator to quickly determine how often each supported program, at the hospital, sends or receives messages via FrontlineSMS.

Also, by not having a standardized base on which to base discussions, it will be rather difficult for hospital management to critically evaluate the project and adequately fund its activities. One medical doctor at the hospital, for example, indicated that management would want to see how the project can help horizontally integrate the vertical programs it is supporting at the hospital. This however, is unknown to the people that are responsible for running FrontlineSMS at the hospital.

5.4.3 Personal factors

As is currently the case, some community health workers still have problems writing and sending text messages. Furthermore, some community health workers are unable to effectively use SMS communication, because they still have problems requesting phone credit top-up from the FrontlineSMS system. To get phone credit top-up, for work related communication, community health workers are required to write *phone_ID_number <leave a space> units* and send the message to the FrontlineSMS communication system. If someone's phone ID number is 55, for example, a typical message to get credit top-up would look like: **55 units**. If the message is written correctly, FrontlineSMS transfers \$1 to the sender's account. This is done using the mobile service provider's credit sharing service called Me2U.

Although this simplifies credit transfer and makes credit transfer more transparent, a good number of community health workers seem not to have gotten around this credit request procedure. At a project review meeting between the hospital and community health workers that I attended in December 2008, most health workers said they were unable to get credit top-ups. Actually, a good

number of them thought that the hospital, purposefully, did not want to provide them with phone credit.

Besides this, some community health workers also have problems using free-form texting because they possess inadequate writing skills. In the quote below, a community health worker wrote an entire message as one word:

“Mudwelekunokulimatendaenaofunikamutadwelakukaonamunenetsik
ulodwelazikomo”

The meanings of text messages like the one shown above are hard to decipher and can give rise to errors.

5.4.4 Patient information security

If community health workers leave sensitive messages in their phones, patient information security can be compromised. The quote below, for example, shows that unauthorized people do play with the phones:

“At the places where we get the phone batteries recharged, these phones stand out and people usually play around with the phones. By doing this they sometimes mess up the messages on the phones. Some of our friends have also had their phone chargers stolen.” (Community health worker- St. Gabriel's hospital, 2008)

This, for example, can happen when the community health workers are having their phone batteries recharged away from their homes, at commercial phone recharge points, as is normally the case.

5.5 Minimizing the challenges associated with mobile phones use

A strong point for the project is its implementation strategy. Although the project's idea did not originate from inside the hospital, the project's initiator has worked hand in hand with the hospital's management and utilized local

personnel and resources. The hospital is also in charge of determining how the project should operate and what activities should be supported and how that should happen. This has increased the sense of ownership in the project, for the hospital and community health workers.

Apart from this, doing things in small incremental steps is another positive that can be observed from the way the project has been implemented. For example, training for the community health workers, on mobile phone use, was done in small groups of between 10 to 15 people. Also, when handing out solar panels to community health workers to ease phone charging problems, the project started out with 16 people. This has been helpful because the solar panels have not worked as desired. They are unable to fully charge the phones. The quote below, demonstrates problems community health workers are having with the solar panels.

“It only charges [the battery] for about 30 or 40 minutes, blinks, recharges for another two minutes, blinks, and then writes: *Unable to recharge! Unable to recharge! Unable to recharge!* When it does that I just disconnect the phone.” (Community health worker-St. Gabriel's hospital, 2009)

In this case, starting out with 16 people has averted large scale problems that might have occurred had all the 70 Community health workers received the solar panels at once.

Furthermore, when need be, the hospital does engage with community health workers to review project performance and plan the way forward. Such recognition of their importance motivates community health workers. Pictures 5.3 and 5.4 capture the project review meeting between St. Gabriel's hospital and community health workers that I attended in December 2008.



Picture 5.3: A plenary session of the review meeting



Picture 5.4: A time for group discussions

Engaging with community health workers in this way also helps the hospital discover operational flows that would otherwise have gone unnoticed. This also enhances ownership of the hospital's mobile phone project, amongst community health workers.

5.5.1 Competence building and utilization

Another factor that positively contributes to mobile phone use is having people with requisite skills to meaningfully interact with the technology. At the beginning of the project the hospital provided community health workers with training on how to use their phones and send text messages. The community health workers were trained in groups of between 10 to 15 people, starting with those that were most committed to their work. It appears the training groups were deliberately kept small to allow for better interaction between trainers and trainees. Apart from the health workers, the HBC coordinator and the ART coordinator also received some training on how to manage FronlineSMS and communication through it.

The hospital conducted the training sessions for community health workers in Chichewa, a local language. This was done to ensure that even community health workers with very basic education levels, benefited from the same. At the moment, most of the communication between the hospital and community health workers is also in Chichewa. Community health workers that are comfortable using English are, however, allowed to do so.

Chapter 6 : Research Findings from St. Martin's Hospital

In this chapter, I present the key findings from my research work at St. Martin's hospital in Malindi, Mangochi. These findings, like those from St. Gabriel's hospital (see chapter 5) focus on the use of mobile phones to shape healthcare. In presenting these findings, I compare them with those from St. Gabriel's hospital, to avoid empty repetitions of similar findings from the two sites. This presentation is then followed by an additional comparison of the communications technologies employed by the two hospitals.

Information for this part of my research was collected through, semi-structured interviews, document reviews, and observations. The interviews were mostly one-to-one interviews.

The key findings from St. Martin's hospital include the contextual setup for mobile phones use, the interplay between people's work practices and mobile phone use, and the opportunities and challenges associated with mobile phone use. Besides these issues, the chapter also presents and examines the implementation strategies employed in implementing the mobile phone solution under discussion here.

6.1 Operational context

This section gives information on the organizational and technical factors that shape and are shaped by mobile phones use, at St. Martin's hospital.

6.1.1 Organizational factors

Just like St. Gabriel's hospital, St. Martin's hospital is using mobile phones to enhance communication between the hospital and community health workers, it is working with. This section looks at the organisational factors that relate to mobile phones use, at the hospital.

Background organisational information

At St. Martin's hospital, community health workers belong to community based organisations (CBOs). At community level CBO activities are monitored by community leaders, and at hospital level they are monitored by the hospital's HBC coordinator. Each CBO has an executive committee and three other sub-committees responsible for orphan care, youth programs, and HBC. Each of the committees comprises around ten members and has a chairperson, a treasurer, and a secretary. Currently, the phones are mainly there for use by the HBC teams.

HBC teams provide home-based care services to chronically ill patients, within the villages they serve. For example, members of HBC teams administer medication to chronically ill patients. Further to this, HBC teams also coordinate with St. Martin's hospital on patient referrals and follow-ups. For example, the HBC teams do refer patients they deem eligible for HBC to the hospital and follow up on clients under the hospital's HBC program. Besides this, they also provide counseling services within their catchment area. The HBC teams usually cover several villages, up to ten in some cases, and look after clients with TB, Cancer, Diabetes, HIV/AIDS and those that have had a stroke.

6.1.2 How community health workers report on their work

At the end of each month CBO HBC teams are required to submit activity reports to the HBC programs coordinator, at St. Martin's hospital. When the hospital HBC program coordinator gets the reports, he also forwards them to Evangelical Association of Malawi. Reports are forwarded to Evangelical Association of Malawi to enable the organization monitor CBO activities and phone usage. It has to be noted however that reports submission by CBOs is not always timely.

Besides getting CBO activity reports, the Evangelical Association of Malawi gets monthly CBO phone usage statistics from Zain Malawi, to enable the organization determine actual phone usage at CBO level. At the moment, St. Martin's hospital is using mobile pay phones to enhance communication both at

the hospital and with community health workers. Unlike St. Gabriel's hospital, St. Martin's hospital is using voice calls and not SMS. Picture 6.1 shows a community health worker using one of these phones.



Picture 6.1: A community health worker using a mobile pay phone

6.2 Management of voice communication

St. Martin's hospital is using mobile pay phones to link the hospital's departments and also provide a communication link between community health workers and the hospital. Communication at hospital level is channeled via the hospital's switchboard, which links all end terminals within the facility. For communication with surrounding communities, the hospital's HBC coordinator mainly acts as a link between the hospital and community health workers.

The HBC coordinator's phone, apart from being part of the internal hospital network, can be directly reached from, outside the hospital. Besides being directly reachable from outside the hospital, the HBC coordinator can also be reached, through the switchboard, using the hospital's other external line. The HBC coordinator is, therefore, directly reachable via his phone or via the hospital's switchboard. The HBC coordinator at St. Martin's hospital plays a similar role to the HBC coordinator at St. Gabriel's hospital, as concerns linking the hospitals with community health workers.

When the HBC coordinator gets a phone call from a CBO, he directs it to the appropriate extension within the hospital. This makes the HBC coordinator act as a communication gateway between CBOs and the hospital. Figure 6.1, below, presents a diagrammatic view of this model.

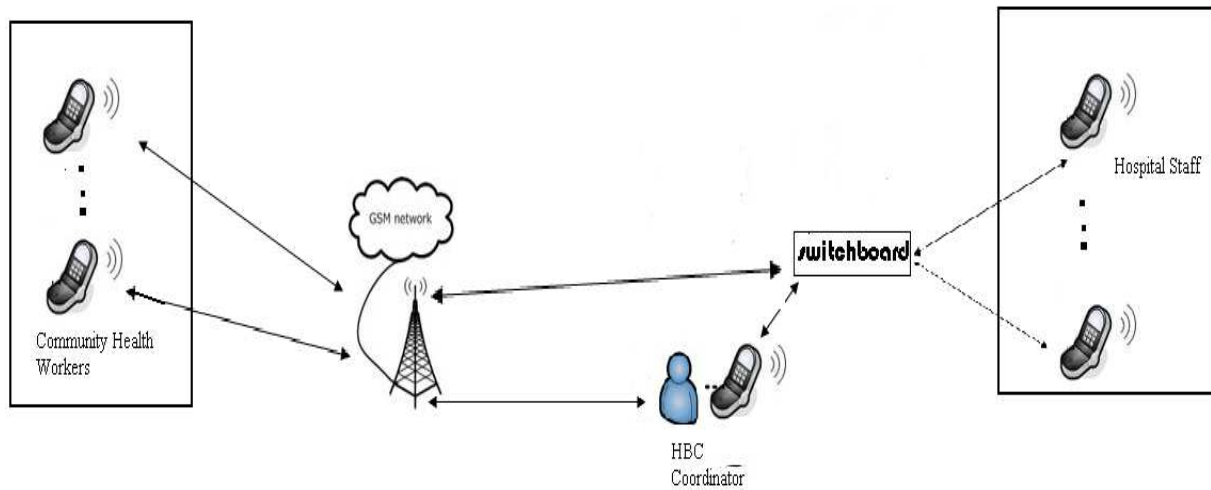


Figure 6.1: A model of the mobile phone communication between St. Martin's Hospital and CBOs

In the above described communication model the HBC coordinator and the hospital's switchboard act as gateways to communication. This makes the two resources critical points in the operation of this communication model. By virtue of the positions they occupy in the model the HBC coordinator and the switchboard can accelerate, delay, or even block communication. Here, unlike with the case at St. Gabriel's hospital, there is an increased risk to communication failure owing to the existence of the two gateways. To add on to this, voice messages, unlike text messages, are more prone to distortion when passed on between people.

At CBO level, the phones are managed by selected members and everyone intending to use the phones is required to know where a particular CBO's phone is. In cases where a message needs to be relayed to the hospital, the phone's

custodian makes a call to the hospital. When a connection is made, either the custodian of the phone or the person seeking help can talk to hospital personnel. Figure 6.2, below, extends the model presented above. In this model, the CBO member keeping the phone acts as an additional gateway to communication.

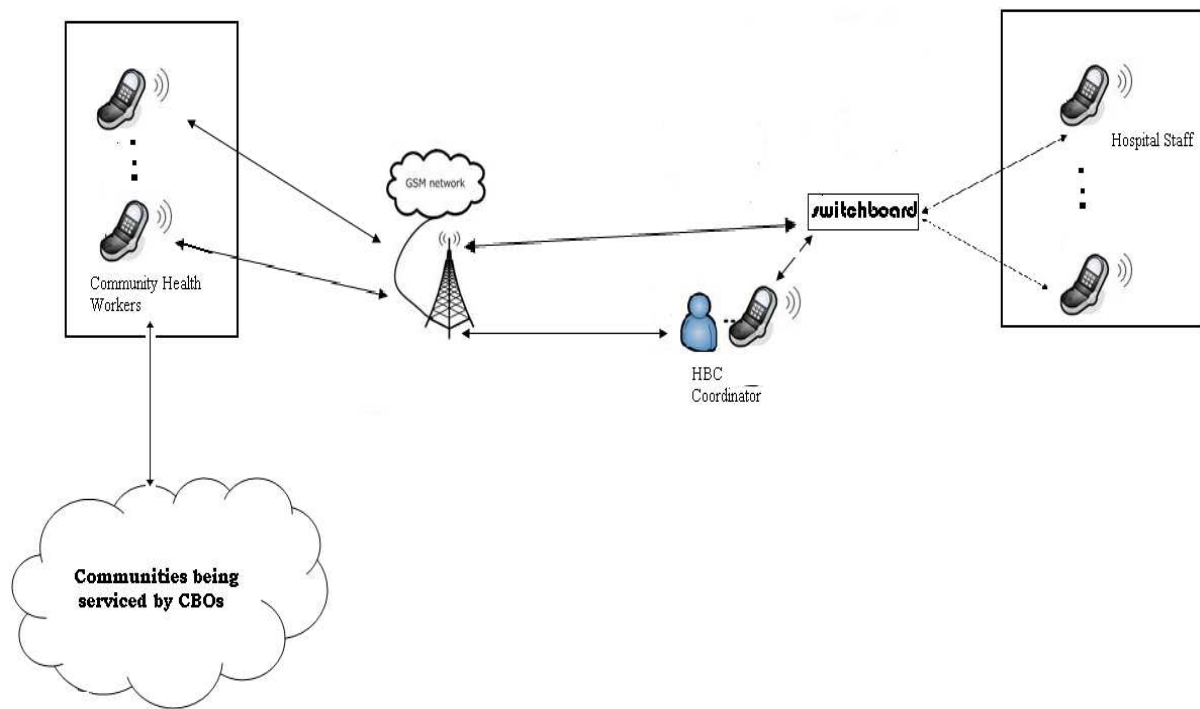


Figure 6.2: A model of the mobile phone communication between St. Martin's Hospital, CBOs, and surrounding communities

Besides linking up with the hospital, CBOs are allowed to use the phones to enable them communicate and exchange experiences. Unlike with St. Gabriel's hospital, here community health workers are not required to channel all work related communication, between them, through the hospital.

6.2.1 System interoperability

Just like at St. Gabriel's hospital, St Martin's hospital predominantly uses paper to maintain records. This, then, makes it necessary for the hospital to permit information transfer between its voice communication system and paper-based records management systems. Just like St. Martin's hospital, St. Martin's

hospital is using people as gateways, to permit information exchange between the two systems.

6.3 Voice based communication and work practices

As has already been explained, the communication system at St. Martin's hospital handles voice calls. Information transmitted through the use of mobile voice communication mainly includes requests for medical care from distant villages, details on patient referrals, general medical inquiries, updates on patients' well being, and instructions for community health workers on how to handle some cases. The mobile phones are also used by the hospital to relay various health information to CBOs, for them to disseminate in their communities. As indicate in chapter 5, the use of mobile phones does influence users' work practices and is influenced by the same.

6.3.1 Influence of mobile phone use on work practices

Just like St. Gabriel's hospital, St. Martin's hospital is using mobile phones to guide health services delivery. The hospital uses mobile phones to address pretty much the same information needs, as St. Gabriel's hospital, in as far as communication amongst CBOs, and between the hospital and CBOs is concerned. On the other hand, as concerns supporting intra-facility communication, St. Martin's hospital is heavily using its mobile phones as compared to St. Gabriel's hospital. Before, getting the phones St. Martin's hospital had no ground phones to aid message delivery within the hospital. People had to move between offices to deliver messages. This was a rather difficult task due to the landscape of where the hospital is. Picture 6.2 shows part of the setup at St. Martin's hospital.



Picture 6.2: Part of St. Martin's hospital

Beyond supporting intra-hospital communication, medical personnel from St. Martin's hospital also use mobile phone communication with community health workers to guide patient care. Information exchanged through mobile phone-based voice communication includes, but is not limited to, requests for the hospital's ambulance service, patients' drug adherence and response to medication, and need for additional medicine or medical attention from the hospital. Picture 6.3 shows community health workers visiting a patient.



Picture 6.3: Community health workers s visiting a patient

After visiting patients like this, community health workers can use their CBO phones to update the hospital on their work and patients' health status. Furthermore, through using the phones, community health workers can get expert advice on how to handle certain cases, right from their villages.

To add on to this, mobile phone based communication at St. Martin's hospital is also aiding task coordination as concerns patient referrals, patient tracking and meeting planning. For example, the hospital uses the phones to seek help from CBOs when it wants some patients tracked down. The quotes below demonstrate how the hospital uses the phones to aid patient tracking and referrals.

“Please track patient A. The patient is not coming [to the hospital] for appointments.” (HBC coordinator-St. Martin's hospital, 2008)

“If we send a patient to Malindi [meaning St. Martin's hospital] and the patient is unable to properly explain his or her medical condition, the hospital calls us for clarifications.” (Community health worker-St. Martin's hospital, 2008)

The use of mobile phones, as evidenced from the two quotes, above, displays the use of technology to alter and improve work practices. For example, it is evident from the quotes that mobile phones are being used to cut down on the need for face-to-face communication, in order to coordinate activities and healthcare services delivery. However, unlike with St. Gabriel's hospital, there was no evidence at St. Martin's hospital to suggest the use of mobile phone communication between the hospital and CBOs with respect to task division when conducting patient visitations.

6.3.2 Influence of work practices on mobile phone use

As seen in chapter 5, the designated use for the phones, in some ways, forces users to use their mobile phones in specified ways. For example, CBOs have to mainly use their phones for communication of health related information with the hospital. Further to this, CBOs are required to allow people use their phones

for free, when calling for an ambulance. The quote below illustrates how the hospital influences what CBOs use their phones for.

“We were instructed to use this phone to call for an ambulance, when someone is sick.” (Chairperson for Nkuli CBO, 2008)

Setting clear goals for the use of community phones, like is displayed here, is important to ensure that all CBOs use their phones to benefit their communities. It is also easier to evaluate whether users are using their phones to meet organizational goals.

Further to this, unlike St. Gabriel's hospital, CBOs under St. Martin's Hospital also use their phones for income generation. Generated income is, in turn, used to support patient care and credit purchase. At St. Martin's hospital all CBOs buy their own phone credit.

6.4 Challenges associated with mobile phones use

This section illustrates the challenges that exist as regards the use of mobile phones at St. Martin's hospital.

6.4.1 Technological challenges

Just as with SMS-based communication, voice calls are greatly dependent on cellular telephony network coverage and services availability. At the moment, not all areas within the hospital's catchment area have cellular network coverage. Even in areas with cellular network coverage the network is unstable at times, making it hard for the hospital and health workers to communicate at times.

Further to this, existing road networks in the area make it hard, at times, for the hospital to get to patients when they get emergency calls for medical attention. This is mostly true during the rainy season. Having seasonal roads also makes it harder for people to travel to places where the phones are. The following quotes better illustrate these points.

“Our villages are located in a remote area where roads are seasonal, so it becomes very, very difficult to travel from this village to the other, where the phones are... Transportation is one of the biggest problems.” (HBC coordinator-St. Martin's hospital, 2008)

“As a coordinator you need to go and see a patient when a call has reached you that there is this patient for you to see. At one point or the other you have to go and visit the CBO. Now, how do you travel?” (HBC coordinator-St. Martin's hospital, 2008)

This shows that various components of the use context need to play in orchestra for the use of mobile phones to bring about effective change. As is demonstrated in the last quote, above, the condition of other infrastructure, such as roads, can serve to limit or enhance the impact of mobile phones towards healthcare services delivery.

Lastly, at the moment, getting a message to the right people at the hospital is dependent on the availability of the custodians of CBO phones to call the hospital, and the availability of the HBC coordinator and the switchboard operator to relay a message to the right medical personnel at the hospital. The unavailability of any of these people, just like in the case of St. Gabriel's hospital, can slow down or block communication. Furthermore, scaling up the phone project, as currently modeled, is bound to put pressure on the people acting as gateways to communication. The current model can, therefore, only be scaled up to match the people's capabilities.

6.4.2 Organisational factors

Firstly, at St. Martin's hospital, CBO mobile phones are not accessible to most of the target population. The phones are usually located close to main roads or trading centres. This is so because CBOs seem to have prioritized using the phones for income generation, mostly to support patient care. Picture 6.4 shows a CBO phone being used close to a main road.



Picture 6.4: A typical location for the mobile phones

Having CBO phones located this way means that people residing far from the main roads have problems accessing the phones. People and vehicles using the road may also disrupt communication.

Secondly, although using CBO phones to request ambulance services is free, the cost for accessing an ambulance from St. Martin's hospital has contributed towards deterring people from using CBO phones for this purpose. The hospital's ambulance service, costs around MK 4000 (~\$28). This is expensive considering that a majority of the Malawian population lives on less than a dollar a day. So, although people can use CBO mobile phones for free when calling for an ambulance, they do not usually use the service. This is mostly true for communities closer to the hospital. The quote below emphasizes the point raised here:

“We told people in the villages that if they have a patient they can come to me so I call the hospital for help [an ambulance]. They don't come though. They are transported to the hospital by relatives who own cars, because the ambulance service is not free. People would not allow to be transported to the hospital using an ambulance when they can be transported there for free by their relatives. “(Chairperson for Nkuli CBO, 2008)

Furthermore, when asked how many times the phone had been used to call for an ambulance, during November 2008, a respondent from another CBO had this to say:

“Maybe three or four times only. This is so because people are afraid to call for an ambulance, as the ambulance service is not free.”

The two quotes, above, illustrate the influence of contextual factors towards the use of technology. This shows that making health related phone calls free is not an end in itself, but the collective actions of stakeholders can either encourage or discourage people from using the mobile phones. Stating it differently, a technology cannot exclusively determine its fate as regards adoption and use.

On top of the above stated reasons, the HBC coordinator also indicated that when the phones had just come some people regarded them as personal property, thereby making it hard for other people to access the phones. He also elaborated that some community members were reluctant to use the phones as they did not understand why selected people within their communities were entrusted with keeping the phones.

Lastly, although an M&E framework exists to help in evaluating the project at St. Martin's hospital, data to aid in this task is not being adequately collected by the stakeholders involved. This therefore makes it hard to truly measure how the use of mobile phones has impacted on health information reporting and access, as well as access to health care services, at St. Martin's hospital.

6.4.3 Cultural factors

As already indicated above, the decision to locate CBO phones at trading centres and close to main roads, has made community phones less accessible to a considerable section of the target population. This decision was mainly influenced by the role of traditional leaders, as shown in the quote below:

“When the thing [the phone] came, we took it to the group village headman who in consultation with village headmen, under him, decided that the phone should be placed at the trading centre. They also involved their subjects in the decision making process. The subjects were in agreement with the decision to have the phone at the trading centre.” (Chaiperson for Nkuli CBO, 2008)

In Malawi, traditional leaders are quite influential on activities taking place within their communities.

6.5 Minimizing the challenges associated with mobile phones use

When introducing a new technology it is vital to get the target population on board. One way to do this is to recognize and value the target population's values. In line with this, the hospital has sought to increase ownership of the mobile phone project by recognizing and taking advantage of existing administrative structures, during project implementation and operation. For example, as indicated above, CBOs, including chiefs and their subjects were solely responsible for deciding on where the phones are located and people responsible for managing the phones. The quote, below, further illustrates the importance of understanding the target population:

“We are working in a community where culture has got an influence, also. To reach these patients who are chronically sick, we realize as a facility...that these people have got their values, culture, roles, which are respected in their areas...So, where culture has got its own influence on the community, we are using people that understand their culture to interpret the need to use St. Martin's as a facility using our phones.” (HBC and CBC coordinator, 2008)

As has already been indicated, in Malawi, chiefs play important administrative and cultural roles. Getting the chiefs on board, through recognizing their role and

cultural values, increases the chance of getting their subjects to support the mobile phone project at St. Martin's hospital.

Besides this, in as much as the CBOs have some level of autonomy in deciding on how to use the phones, EAM monitors phone usage and phone usage statistics, via Zain Malawi. This is done, so CBOs don't deviate from set project objectives. It should be noted however that a few CBOs are not properly managing their phones.

Furthermore, to avoid a large scale disaster, should the project not work out as originally intended, St. Martin's hospital rolled-out the use of mobile phones on a pilot basis. This, then, helps the hospital to address inefficiencies before large scale implementations.

As the sustainability of mobile phone projects also depends on users' ability to purchase phone credit, CBOs under St. Martin's hospital are encouraged to raise own money for phone credit purchasing. To raise money, as has already been put, CBOs use their phones to provide phone bureau services.

6.5.1 Competence building and utilization

At the beginning of the project the Evangelical Association of Malawi trained CBO members, dealing with HBC, on how to use their phones and also provide HBC services. Training sessions on phone usage, lasted for about 3 hours, on average. Here, in contrast to training strategy employed by St. Gabriel's hospital, all participating CBOs were trained at once. The CBOs were trained on how to use the phones for health related issues as well as tools for income generation.

Judging from operational evidence, during my visits to the CBOs working with St. Martin's Hospital, CBO members are competent in making voice calls. This should, probably be an expected outcome as it is relatively easier to make voice calls than to write and send text messages, for people that did not own a mobile phone before and have basic literacy skills. Literacy skills between community

health workers working with St. Gabriel's hospital and those working with St. Martin's hospital are almost similar.

Just like the training sessions at St. Gabriel's hospital, training sessions at St. Martin's hospital were also conducted in Chichewa, a local language, to ensure that even the community health workers with basic education levels, benefited from the training. Currently, communication between the hospital and community health workers, and between CBOs, is predominately Chichewa based.

6.6 Text messaging Vs voice communication

Here, I present a simple comparison between SMS-based communication and voice communication. This serves to illustrate other benefits and choices associated with the adoption of either SMS-based communication or voice communication.

Table 6.1: SMS-based communication Vs voice communication

Text Messaging	Voice Communication
Takes time to type a message	Quicker to communicate a message
Better supports information persistence	Delivered information can be quickly forgotten
Difficult to simultaneously type a message and perform another task	Relatively easier to combine with other tasks
Cheaper	More expensive
If network is unavailable the message can be held up and delivered when network coverage is available	Information cannot be held up for later delivery
Easier to share received information without distorting its original meaning	Not as easy to share information, more especially without distorting its original meaning
Not possible to clarify the meaning of ambiguous messages upon delivery	Easier to clarify the meaning of ambiguous messages during delivery

The table above demonstrates that there are instances where voice calls server better than SMS communication, and vice versa.

Chapter 7 : Analysis and Discussion

In this chapter I analyse and discuss the key empirical findings from my research work, presented in Chapters 5 and 6. This chapter responds to the research questions presented in chapter 1, by reflecting on, and discussing, the empirical findings in relation to theories from extant literature. Guided by the concepts of installed base, and heterogeneity, from the Information Infrastructure theory, I aim to address the following research questions: *How does the context of use influence the use of mobile phones?; How do mobile phones, and work practices interact?; What opportunities and challenges are associated with the use of currently existing mobile phone solutions?; How can the challenges associated with mobile phone use be minimised to maximise user benefits?*

Besides making use of the information infrastructure theory, this discussion is guided, to a larger extent, by concepts from the papers “managing the paradoxes of mobile technology” by Jarvernpaa and Lang (2005) and “Mobile eHealth: Making the Case” by Archer (2005). Jarvernpaa and Lang (2005) argue that the use of mobile technologies, such as mobile phones, is paradoxical. That is, mobile phone use presents users with both new opportunities and challenges.

7.1 Influence of context (installed base) on mobile phone use

In this section I address the question: How does the context of use influence the use of mobile phones?

When being launched, the mobile phone projects under study here were introduced in an environment with already existing heterogeneous socio-technical systems. Among others, these included existing paper-based record management systems, mobile phone communication infrastructure, and organisational, personal, and cultural practices. These components provide the building blocks or installed base (Hanseth and Lyytinen, 2005) on which the mobile phone solutions, under study, are built. Furthermore, the mentioned

components make up the context in which users interact with their mobile phones. In so doing, they influence user interaction with mobile phones (Jarvenpaa and Lang, 2005; Scheepers et al., 2006). The remainder of this section looks at how organisational, cultural, technological and personal factors influence users' interaction with mobile phones.

7.1.1 Organisational factors

The projects at St. Gabriel's and St. Martin's hospitals have been built on existing components such as the hospitals and their human and financial resources. For instance, the projects have been built on the hospitals' work and communication practices, and the competencies of both medical personnel and community health workers. In addition, the hospitals and community organisations, to which community health workers belong, have an influence on what people use their phones for. For example, by being attached to the hospitals, users have to use their mobile phones to meet set organizational goals. The quote below helps illustrate how the hospitals influence how community health workers use their phones:

“We were instructed to use this phone to call for an ambulance, when someone is sick.” (Chaiperson for Nkuli CBO-St. Martin's hospital, 2008)

Here, in a way, the hospitals and their expectations align users' ambitions towards achieving common goals, when using the phones. Furthermore, being attached to the hospitals, means that users have to use their phones to send or receive health information or coordinate work-related tasks. Such tasks might include patient referrals, patient tracking, and organising meetings, among others. In addition to this, requiring community health workers at St. Gabriel's hospital to channel all work related correspondence, between them, through the hospital's SMS system (see section 5.2), restricts them from directly communicating even though the communication technology in use permits this.

Further looking at the organisational influence, organising community health workers in community groupings makes it easier to monitor their activities and use of their phones. As is currently the case, community health workers are not employed by the hospitals, but work as volunteers. This, then, greatly limits the amount of control the hospitals can exercise on them. However, organising the community health workers in community level groupings, answerable to influential traditional authorities, makes the community health workers directly responsible to some authority.

In addition to all this, other organisational policies and decisions do enhance or hinder the use of mobile phones. For instance, at St. Martin's hospital the cost of hiring an ambulance is deterring people from using community mobile phones to request ambulance services. The quote below better illustrates this:

“We told people in the villages that if they have a patient they can come to me so I call the hospital for help [an ambulance]. They don't come though. They are transported to the hospital by relatives who own cars, because the ambulance service is not free. People would not allow to be transported to the hospital using an ambulance when they can be transported there for free by their relatives. “(Chairperson for Nkuli CBO, 2008)

Here, although people can use community phones for free, when calling for an ambulance and mobiles phones permit faster message delivery, the cost of hiring an ambulance acts as a deterrent.

On a different note, by being hospitals that deal with sensitive patient information, these organisations need to maintain a high level of patient information security. This means the hospitals have to pay particular attention to the security aspects of their mobile solutions. The high level of information security required here might not, for example, be required in an application that simply allows people to socially connect. Such security requirements, then, limit

the type of information users can share with the public, for example, using their phones.

Lastly, the hospitals shape how users interact with mobile phones by training them on how to use the technology (sections 5.5.1 and 6.5.1). Through the provision of such training, the hospitals are trying to ensure that necessary competences that can enable users better interact with the available mobile solutions, are available.

7.1.2 Cultural factors

By building on already existing structures the mobile phone projects, under study, can leverage the installed base's strengths (Hanseth, 2000; Hanseth and Lyytinen, 2005). For example since chiefs are quite influential in Malawi, involving them in project activities makes it easier to get their subjects on board. This, in turn, simplifies the rolling out of technologies within their communities. In this respect, the mobile phone projects have embraced people's cultural values to stay relevant and avoid isolation. This is evidenced in the quote below from the HBC coordinator at St. Martin's hospital:

“We are working in a community where culture has got an influence, also. To reach these patients who are chronically sick, we realize as a facility...that these people have got their values, culture, roles, which are respected in their areas...So, where culture has got its own influence on the community, we are using people that understand their culture to interpret the need to use St. Martin's as a facility, using our phones.” (HBC coordinator-St. Martin's hospital, 2008)

Such understanding of a target population's culture potentially avoids a situation where the introduction of mobile phone solutions does not match users' needs and collective values. It is important to know that social and cultural characteristics play an important role in ICT adoption and use, through shaping peoples attitudes and subjective norms. Because of this, social and cultural

characteristics can either enhance or limit ICT use and adoption (Erumban and Jong, 2006).

Even further, traditional authorities within the catchment area of St. Martin's hospital were instrumental in deciding where to locate CBO phones. The traditional authorities decided that the phones should be located close to trading centres and main roads. In line with this, one community health worker had this to say:

“When the thing [the phone] came, we took it to the group village headman who in consultation with village headmen, under him, decided that the phone should be placed at the trading centre. They also involved their subjects in the decision making process. The subjects were in agreement with the decision to have the phone at the trading centre.” (Chaiperson for Nkuli CBO, 2008)

A direct implication of the choice of phone locations at St. Martin's hospital is that it helped increase revenues from using the phones to provide phone bureau services. Revenue generation contributes towards project sustainability and patient care.

Negative influence of cultural factors

On the other hand, relying on already existing components such as cultural norms also means that various limitations inherent in the installed base are transferred to the mobile telephony projects at the two hospitals. This restricts the projects' operations, in some ways. For example, the use of traditional authorities in determining where to locate CBO phones, has resulted in the phones being less accessible to people living far from the trading centres and main roads, where the phones are mostly located.

7.1.3 Technological factors

Unlike stationary computers or fixed line phones, mobile technologies accord users more flexibility as regards when and where use occurs. Use of stationary

computers and fixed line phones takes place when the user is at the place where such terminals are installed. On the other hand, since mobile technologies can be carried along by a user they can be used in various places, as and when the user sees fit (Weilenmann, 2001; Hurme, 2005; Jarvenpaa and Lang, 2005). Due to such use flexibility, it can be seen from the hospitals where this study was conducted that the use of mobile phones enables people to communicate and coordinate activities, remotely. Users are also able to communicate outside specified working hours. Using stationary computers, fixed line phones, and paper, would not permit these users such flexibility.

On the other hand, technological limitations, like small screen sizes and tiny input keys make mobile phones unsuitable for other tasks. Even further, due to their mobility, mobile phones are subject to variations in performance because they rely on limited battery power and varying technical infrastructure to operate (Satyanarayanan, 1996; Jarvenpaa and Lang, 2005). For example, as shown in chapter 5, recharging of phone batteries is quite problematic in rural settings like the hospitals where this study was conducted. Such is the case because most users have no electricity supply in their homes. In line with this, most community health workers at St. Gabriel's hospital, for example, have to walk distances of up to 5 km to recharge their phone batteries.

Furthermore, pockets with no GSM network coverage, combined with intermittent services, place limitations on when and where people can communicate. Due to such limitations, people can only communicate *sometimes and in some places*. The HBC coordinators from the two hospitals expressed this concern. The following quote from the HBC coordinator at St. Gabriel's hospital, illustrates this point.

“Another problem is the network ... especially for those who are coming from very far. You can text them an emergency message ‘Please, can you come for a meeting tomorrow?’ If there is no network they receive that message, maybe, two days later.” (HBC coordinator-St. Gabriel's Hospital, 2008)

This quote serves to illustrate that due to variations in the availability and quality of infrastructure that permits mobile communication, it is not always possible to achieve *anytime anywhere connectivity*. Table 7.1 shows a summary of variations that generally occur in the use of mobile phones, stationary computers and fixed line phones.

Table 7.1: A summary of variations in mobile phone, stationary computers, and fixed line phones use

Technology	Use Factors				
	<i>When</i>	<i>Where</i>	<i>For what</i>	<i>Battery life</i>	<i>Risk of variations in performance</i>
Mobile phones	Whenever user wishes	Wherever the user is	Voice and data communication, personal organisation	short	high
Fixed line phones	When the user is at the place of installation	Place where installed	Mostly used for voice communication	N/A	low
Stationary computers	When the user is at the place of installation	Place where installed	Voice and data communication, personal organisation	N/A	low

Now, looking at the influence of other technological factors, the availability of FrontlineSMS' ReplyManager, at St. Gabriel's hospital, and Zain's Me2U phone credit transfer service has allowed the hospital to automate phone credit top-up for community health workers (section 5.2). This has, on the one hand, simplified the management of phone credit transfers. However, on the other hand, the use of FrontlineSMS' ReplyManager and the Me2U service has also meant that community health workers who are unable to properly formulate credit top-up requests are unable to get phone credit, making it harder for them to communicate.

Furthermore, looking at the influence of other physical infrastructure, the poor condition of roads can prevent people from accessing communal CBO phones. This point particularly applies to St. Martin's hospital. Even further, the poor condition of roads can also slow down efforts to reach patients, in cases where the use of mobile phones reduces the amount of time it takes people to report incidents. The following two quotes better illustrate this point:

“Our villages are located in a remote area where roads are seasonal, so it becomes very, very difficult to travel from this village to the other, where the phones are... Transportation is one of the biggest problems.” (HBC coordinator-St. Martin's hospital, 2008)

“As a coordinator you need to go and see a patient when a call has reached you that there is this patient for you to see. At one point or the other you have to go and visit the CBO. Now, how do you travel?” (HBC coordinator-St. Martin's hospital, 2008)

This shows that for information infrastructures, such as the mobile projects under study, success also depends on the condition of other components they interact with. As, Hanseth and Lyytinen (2005) put it, though heterogeneous, all components of an infrastructure are interdependent.

7.1.4 Personal factors

Users' experience with technology ultimately determines whether they adopt a technology and continue using it, or shun the technology altogether (Archer, 2005). From my empirical work, I have seen that the mobile phone projects at the two hospitals appeal to users because they have provided them with immediate benefits. For example, the use of mobile phones has greatly reduced the amount of time it takes people to exchange information or report incidents. Mobile phones have also reduced the need for face-to-face meetings that were mostly necessary to permit information exchange and task coordination.

Furthermore, for most of the users who previously owned no phones, the use of mobile phones has helped them acquire skills in using the technology. Usage of the phones has also provided them with a means to enhance their professional and social networks. Providing users with such immediate benefits has made users more interested in the technology. This is in line with the argument by Hanseth and Lyytinen (2005) that to be attractive, an infrastructure's initial version must offer the first group of users immediate benefits.

On the other hand, even with the most effective technology, data quality is not independent of the competencies of the people collecting and reporting that data. In the case of St. Gabriel's hospital it can be seen that the lack of writing skills in some community health workers is a potential source of errors, as messages they write are hard to decipher (section 5.4.3). In the sample message, below, for example, a community health worker wrote an entire message as one word:

“Mudwelekunokulimatendaenaofunikamutadwelakukaonamunenetsik
ulodwelazikomo”

In this example inadequate writing skills and choice of technology meet to create a weak point in the use of mobile phones and SMS for health information reporting. It is difficult to maintain quality in free-form data entry, as inconsistent spelling and other mistakes are common (Parikh et al., 2006).

Another factor determining technology use is the amount of workload users have. For example, users that deal with more clients will have more issues to report on than those with fewer clients, as is shown below:

“Other volunteers cover wider areas, whilst others cover smaller areas. Therefore, there has to be a difference in the number of messages they write.” (Community health worker-St. Gabriel's hospital, 2009)

This illustrates that variations in how users interact with mobile phones should be expected, depending on what they do.

7.2 Technology use and work practices

In this section I address the question: How do mobile phones, and work practices interact?

The use of mobile phones shapes, and is shaped by, its users and their work practices. For example, the use of mobile phones has reduced the need for face-to-face communication, which was previously necessary to permit information exchange, events planning, and task coordination. The statement below, made by a community health worker, further illustrates this point.

“Currently, the hospital can communicate with us more easily. For example, I got the message for this meeting when I was out in the field gardening.” (Community health worker-St. Gabriel’s hospital, 2009)

Here the use of mobile phones allows users to improvise as and when unexpected events come up. The use of mobile phones, here, not only allows people to improvise, but also permits them to remotely and quickly communicate changes in events.

Furthermore, the use of mobile phones now permits medical personnel and community health workers to plan and share their workload when organising patient follow-ups. For instance, the hospitals use voice calls or text messages to coordinate patient tracking and referrals with community health workers, as indicated in the quote below:

“Please track patient A. The patient is not coming [to the hospital] for appointments.” (HBC coordinator-St. Martin’s hospital, 2008)

This illustrates how the use of mobile phones has provided users with more flexibility in coordinating tasks, in turn, allowing them to work more efficiently.

Related to this, the combination of maps and mobile phones has opened up new ways of working for St. Gabriel's hospital. The combination of mobile phones and maps enhances remote coordination of patient referrals, tracking and visitations. The use of maps allows medical personnel to remotely assign patients to community health workers closest to them (section 5.3.1). Furthermore, by using maps medical personnel can better instruct community health workers on where to find patients who are not reporting for appointments. Furthermore, when under staffed, medical personnel make use of mobile phones and maps to share tasks with community health workers when planning to visit patients.

To add on to this, as is discussed in section 7.3.2, below, the use of mobile phones has also reinforced the role of community health workers as an information source, by making it easier for them to directly and more easily update the hospitals on their work.

Furthermore, the use of mobile phones at the two hospitals has reconstituted communication practices by enforcing the roles of HBC coordinators as communication gateways between the hospitals and community health workers. The role of community health workers as information gateways, between the hospitals and communities they serve, has also been strengthened.

On the other hand, the use of mobile phones is also being influenced by people's work practices. For example, although mobile telephony permits people to communicate directly, work requirements demand that community health workers at St. Gabriel's hospital channel all work related communication through FrontlineSMS. Besides this, being involved in health work, to some extent, determines what sort of information users can send or receive using their mobile phones. Furthermore, patient information privacy laws demand the safeguarding of patient information when using the phones to either receive or send information. This, then, places limitations on how people can use phones to share information, as has already been discussed. To add on to this, as has already

been discussed, the workload of community health workers and medical personnel has a bearing on the frequency with which they use mobile phones to support their work.

7.3 Application-related opportunities and challenges: The paradox of mobile phone use

In this section I address the question: What opportunities and challenges are associated with the use of currently existing mobile phone solutions? In doing this, I present, side by side, opportunities and challenges presented by the use of mobile phone solutions, at the two hospitals where this study was done.

The use of mobile phones is not simply a mechanism to achieving set user goals, where desires, means and ends can be understood in clear, linear and stable terms. Rather, the performance of mobile phones reconstitutes desires, ends, and mechanisms (Arnold, 2003) and is continuously influenced by ever changing user intentions, situational factors, and is paradoxical (Jarvenpaa and Lang, 2005). For example, the use of mobile phones at the two hospitals, under consideration in this study, has empowered users in several ways and also exposed them to various challenges.

7.3.1 The Empowerment/ Enslavement paradox

This section seeks to help the reader understand how the use of mobile phones creates opportunities that empower people. The section also looks at how the same use of mobile phones can create challenges that enslave users.

Opportunities: Empowerment

The use of mobile phones can provide people with “constant” connectivity, allowing them to take part in business or social activities *anytime and from wherever* they are, as has already been indicated. For example, the use of mobile phones allows health workers remotely update the hospitals on their work and patients’ medical status. The hospitals can also reach community health workers right from their villages. Now, community health workers do not always have to

travel long distances to report and access information at the hospitals, or request urgent help. The use of mobile phones provides users with 24/7 connectivity and allows them to *take charge anytime, from wherever* they are (Jarvenpaa and Lang, 2005), as has already been presented. In line with this, one community health worker had this to say:

“The cell phones have made our work easier. They have helped us to cut down on the number of trips we make to the hospital.”

(Community health worker-St. Gabriel’s hospital, 2009)

This statement illustrates how the use of mobile phones has initiated a positive change in how community health workers do their work and communicate with the hospital. Cutting down on the number of trips they make to the hospital, also gives community health workers more time to attend to other important things.

Challenges: Enslavement

In as much as use of the phones empowers users in several ways, allowing users constant connectivity fuses work and spare time, as users are unable to separate and keep distance from work. This, then, means that users have less personal time, which if not well managed can result in increased work pressure (Hurme, 2005; Jarvenpaa and Lang, 2005). For example, for less experienced community health workers, giving patients anytime access to them, might lead to increased work pressure.

7.3.2 The Competence/Incompetence paradox

This section seeks to help the reader understand how the use of mobile phones creates opportunities that equip users with new competences, but also exposes existing limitations.

Opportunities: Competencies

By being able to do *anything, anytime, and from anywhere* mobile phone users gain a whole new set of competencies. They gain the ability to do things they could not do before. They are also able to do what they were already doing, more

efficiently and effectively than before (Jarvenpaa and Lang, 2005). The use of mobile phone based solutions at the two hospitals has enabled new ways of working, and allowed the re-engineering of work processes (Boddy et al., 2005), for example, through allowing the reduction in the number of steps to getting some activities done.

Firstly, at St. Gabriel's hospital, the use of mobile phones has resulted in increased reports submissions. This change has occurred because the use of mobile phones has enabled community health workers to directly, more easily, and quickly report on their daily work. This is evidenced in the following quote, for example:

“Previously we had problems submitting reports. Sometimes we had messages that needed to be communicated to the hospital on the same day. We, therefore, had to cycle to the hospital. Those who did not have bicycles would walk to the hospital.” (Community health worker - St. Gabriel's hospital, 2009).

Enabling community health workers to better communicate with the hospital has, in turn, strengthened the direct communication link between the hospital and individual community health workers, as shown in figures 7.1 and 7.2, below. Because of this, the hospital is now better placed to formulate a picture of what is going on in its catchment area before monthly activity reports are submitted. This also means that there are a reduced number of steps for the hospital to get reports on what individual community health workers are doing, enabling them to play a more key role as information sources.

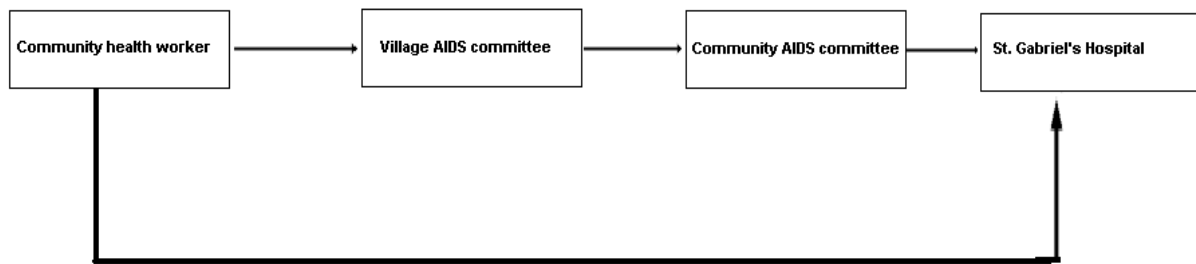


Figure 7.1: Strengthening of direct communication link between hospitals and CHWs



Figure 7.2: direct communication link between hospitals and CHWs as primary channel for information transfer

Secondly, the use of mobile phones also provides medical personnel and community health workers with more flexible and efficient ways to coordinate tasks and people. For example, the use of mobile phones has allowed medical personnel and community health workers to more readily exchange information on patient referrals and consult when attending to patients (sections 5.3.1 & 6.3.1). This is, in part, illustrated in the quote below:

“If we send a patient to Malindi [meaning St. Martin’s hospital] and the patient is unable to properly explain his or her medical condition, the hospital calls us for clarifications.” (Community health worker-St. Martin’s hospital, 2008)

In addition to this, the use of mobile phones also allows users, at the two hospitals, to coordinate meetings, patient visitations, and share tasks. Furthermore, giving community health workers’ phone numbers to patients also

gives patients anytime access to the community health workers. This means that patients can then be quickly linked with the two hospitals.

Thirdly, the use of mobile phones has allowed users to exchange information and coordinate activities without the constant need for face-to-face communication, as can be noted from the preceding paragraphs. This is, in part, also emphasised in the case of St. Martin's hospital where there was no internal phone network between departments and people had to walk between offices to deliver information. Currently, after the installation of an internal network of mobile phones, with the phones working as extensions, users can make calls and pass information right from their offices. To add on to this, community health workers are now able to remotely query the two hospitals for expert advice on how to handle certain medical cases, as evident from the quote below:

“When visiting a patient, if the patient asks a question we are unable to answer, we just send a text message to the hospital. The hospital responds and we immediately communicate the answer to the patient.” (Community health worker-St. Gabriel's hospital, 2009)

This quote demonstrates that the use of mobile phones can enhance remote collaboration and permit real-time information exchange. To add on to this, community health workers, at St. Gabriel's hospital, are also able to remotely query FrontlineSMS for information on how to administer various drugs, when out visiting patients. Granting community health workers such real-time access to expert medical advice, is bound to enhance the quality of care they give to chronically ill patients.

Fourthly, the projects have also allowed users to acquire skills on how to use mobile phones. Previously, most of the community health workers did not own phones. Giving community health workers mobile phones, then, gives them the opportunity to enhance both their social and professional communication links.

Challenges: Incompetencies

Despite empowering users in multiple ways, the use of mobile phones has also exposed some user, technological, organizational and cultural incompetencies. Figure 7.3, below, presents an overview of the factors discussed here. The arrows in the figure are unidirectional to emphasise the effect of the limitation on user-phone interaction.

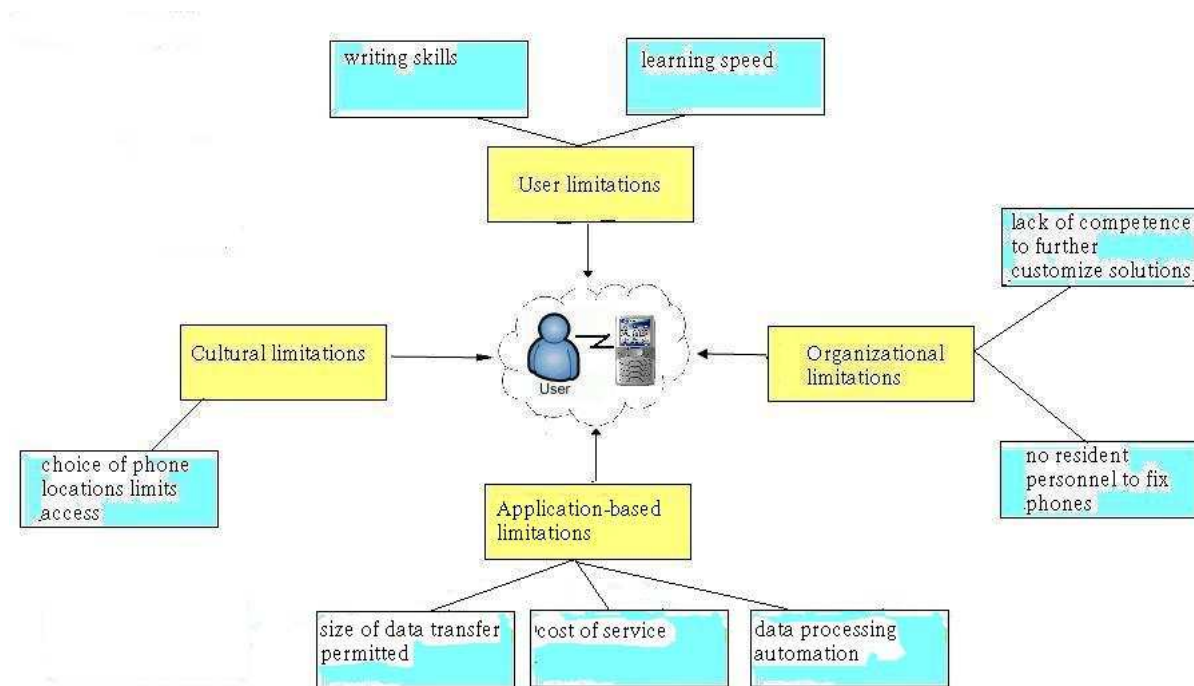


Figure 7.3: Use context incompetencies and mobile phone use

Firstly, considering the lack of adequate writing skills, for some community health workers, the use of free form text messages is a possible source for errors. The meaning of some messages might be very hard to decipher, as has been shown in section 7.1.4, above.

Secondly, the two projects do not have the requisite internal technical capacity to further customize the functionality of the mobile solutions in use. In addition, the two hospitals do not have resident personnel to attend to faulty phones. The two hospitals are largely users of technology, as they have only managed to build capabilities to a level where they can adequately use the available mobile phone solutions. At best they can only find innovative ways to maximise benefits

realised from using the mobile solutions, and minimise challenges to using the technology.

Thirdly, in cases where most community health workers are still having problems to master the mobile solutions in use, it is rather hard to make more complex and significant changes to the same. For example, with some community health workers at St. Gabriel's hospital still struggling with texting and sending text-based credit top-up requests, as shown in section 5.4.3, it would be rather hard to introduce the users to additional and more advanced communications modes, such as mobile Internet.

Fourthly, the choice of technology can produce inefficiencies (Jarvenpaa and Lang, 2005). For example, it takes longer to write an SMS that says, "*I visited John today. He is much better now, and the fever has disappeared,*" than to just call and tell it. It has to be noted, however, that although calling might lead to quicker message deliveries, it costs more. Furthermore, due to the size of SMS, the amount of effort it takes to write a text message and the cost of voice calls, community health workers cannot submit monthly reports using mobile phones. Voice and SMS communication, at the two hospitals, also do not support automatic data aggregation to formulate hospital level reports on health activities.

Fifthly, reliance on humans to act as communication gateways (sections 5.4.1 and 6.4.1) can greatly restrict the mobile phone projects from growing. Human gateways can slow down or block information flow (see section 7.3.3, below). Furthermore, the mobile phone solutions cannot be scaled up to handle more traffic than the people acting as gateways can handle. The mobile phone solutions also remain susceptible to physical or social problems these people may encounter. To add on to this, should these people leave the organizations their valuable experience in acting as gateways would be lost, rendering the projects weak for some time until the competence they possess can be replaced. People cannot be quickly replaced without notable negative consequences, like

technological plug and play devices. These factors, therefore, render human gateways as potential critical weak points to ensuring efficient communication through using the mobile phones to support relaying of health information.

Lastly, as has been shown in section 7.1.2, the decision to locate community phones close to trading centres and main roads has made the phones less accessible to some section of the target population. This decision, as previously indicated, was largely influenced by traditional leaders who have also played a vital role in mobilising their subjects to use the community mobile phones.

7.3.3 Fulfills Needs/Creates Needs paradox

This section seeks to help the reader understand how the use of mobile phones creates opportunities that meet various user needs, but also creates new needs that users did not have before.

Opportunities: Fulfilling Needs

As is evident from the sections above, the use of mobile phones, at the two hospitals, is providing solutions to various problems that benefit mobile connectivity. For example, community health workers can seek expert medical advice on how to handle certain medical conditions, right from their villages. This, as has been previously discussed, has reduced the need for face-to-face communication to allow information exchange and task coordination. In turn, this has helped cut the number of trips people have to make between the hospitals and the communities they serve. At St. Gabriel's hospital, community health workers can also query FronlineSMS for information on drug use, as they go around visiting patients.

In addition to all this, it has been demonstrated in section 7.3.2 that the use of mobile phones does facilitate process re-engineering. This is achieved through reducing the amount of time and number of steps taken to transfer information from individual community health workers to the hospital.

Challenges: Creating Needs

On top of fulfilling various user needs, the use of mobile phones has introduced users to a whole range of problems, they neither had nor envisaged. Such is the Janus-faced nature (Arnold, 2003) or underlining paradoxical nature (Jarvenpaa and Lang, 2005) of mobile phone use. Firstly, for example, users now have to worry about mastering the mobile phone solutions in use and any extensions that might be made to these solutions. Furthermore, to be able to communicate, users have to worry about raising money for phone credit.

Secondly, due to the role they play in routing information between the hospitals and community health workers, the hospitals' HBC coordinators need to be constantly accessible. However, this cannot always be achieved, as the HBC coordinators also need to attend to other medical duties. As a result, it is not always possible to timely route information between the hospitals and community health workers, using the hospitals' HBC coordinators as gateways. For example, the PHC coordinator at St. Gabriel's hospital, when asked whether he always gets messages on time, had this to say:

“No! It depends on the availability of the HBC coordinator. If he is not there, that means I have to wait. For example, today he is going to the field and that means should there be a message I will not be able to see it.” (PHC coordinator, St. Gabriel's hospital, 2009)

This scenario can leave users frustrated if the HBC coordinators are unavailable for long periods.

7.3.4 The Illusion/Disillusion paradox

This section seeks to help the reader understand how the use of mobile phones can create new and exciting opportunities for users. The section also looks at how unrealised promises associated with mobile phone use can lead to user dissatisfaction.

Opportunities or illusion?

As discussed in the previous sections, the use of mobile phones brings with it so much promise. For example, as has already been presented, owning a mobile phone ideally means one can communicate with other people *anytime and from anywhere* (Jarvenpaa and Lang, 2005; Hurme, 2005). This gives the impression that users can take charge of situations and collaborate with colleagues and clients, anytime and from anywhere. The use of mobile phones also suggests improved information delivery, and expedited access to healthcare services since one can quickly request medical help by using mobile phones.

Additionally, the use of software such as FrontlineSMS that supports the redirection of text messages gives the impression that users can share information as and when they please. FrontlineSMS can be used to redirect incoming text messages via SMS or email.

Challenges: Illusions and disillusionment

As is evident from the two hospitals under study *communication is only possible sometimes and in some places*, as has already been discussed. Furthermore, anytime communication requires that communication partners are available at the other end and willing to communicate (Jarvenpaa and Lang, 2005). To add on to this, at St. Gabriel's hospital, the FrontlineSMS system is switched off at night. This effectively means that text messages sent by community health workers at night are remain undelivered until the next morning.

Apart from the factors above, FronlineSMS does not effectively support the notion of anytime anywhere communication. FrontlineSMS is a desktop system

and this means it is harder for the system administrator to access and forward messages to other user, when he is out of office. Although FrontlineSMS supports text message forwarding to remote email accounts, the user needs Internet access to read the messages. Even if the user manages to read the messages it is rather hard to redirect them to other people via SMS. Redirecting messages to other people using email would mean that such an operation would not be logged by the FrontlineSMS system at the hospital. This would in turn make it had to log and monitor work related correspondence.

7.4 Minimizing user-technology conflicts to maximize benefits from technology use

In this section I address the question: How can the challenges associated with mobile phone use be minimised to maximise user benefits?

When confronted with conflicting situations in using a technology, users either minimize technology use (avoidance strategies) or confront the conflicting situations (confrontative strategies) to maximise benefits realised from using the technology (Jarvenpaa and Lang, 2005). For the projects under study, avoidance strategies will most likely end in project failure but confrontative strategies, if well managed, are bound to maximise user-technology interaction. Confrontative strategies such as change management and risk mitigation (Archer, 2005) can help minimize the negative aspects of mobile phone use, presented in the preceding sections. A good example of change management is the giving of solar panels to community health workers at St. Gabriel's hospital, to address their new found need of having to charge phone batteries quite often. Keeping with the same example, trying out the solar panels with only 16 out of 70 CHWs, currently taking part in the project has proved to be good risk mitigation. The panels that were solicited are unable to adequately charge the phones. Trying out the panels with fewer community health workers has therefore averted a larger scale problem. When making changes to an information infrastructure it is important to plan for unexpected changes, just as in this case. This enables organizations cope with unexpected changes, when they occur (Archer, 2005).

Besides this point, the two hospitals under study have showed good change management and risk mitigation principles by firstly piloting their projects with smaller groups of users, before grand rollouts. Considering the heterogeneity of components making up information infrastructures and their interconnectedness, there is always potential for unanticipated effects (Sahay and Walsham, 2006). Therefore, taking small incremental steps when making changes to an information infrastructure, as the two hospitals have displayed, whilst providing for further changes and flexibility, minimizes the risk of failure (Sahay and Walsham, 2006).

7.4.1 Usability

System usability plays a key role towards the adoption of a technology. Considering the use of mobile phones, at the two hospitals under study, text messaging and voice calling are relatively easy to master, making it more likely for users to be motivated to use the technology. The simplicity of these technologies makes it possible for users to quickly get into meaningful interaction with the technology, and achieve their goals. Interfaces that are easy to use and system designs that fit well with coping strategies of users are bound to persuade users into using a technology (Jarvenpaa and Lang, 2005). User motivation is important towards project sustainability, as the level to which users are motivated to use mobile devices, influences their actual usage of the devices (Archer, 2005).

7.4.2 Interoperability with other systems

A new system is bound to be successful if incrementally built by linking it to, and allowing interoperability with, existing infrastructures (Hanseth and Lyytinen, 2005). Moreover, interoperability with existing information systems, for example, allows users to gradually adjust to change. It also minimizes the risk of failure inherent in sudden large scale changes. In the case of the two hospitals under study, where records management is predominantly paper based, interoperability between the mobile solutions in use and existing manual systems is mandatory. The use of some users, like the HBC coordinators, as gateways to facilitate

information exchange between mobile solutions and existing paper-based record management systems, helps to make the mobile solutions relevant to the context of use. This also prevents large scale failure, as it is easier and less risky to use gateways and allow communication between systems than to change the two hospitals' entire paper-based systems.

7.4.3 Security and privacy

To improve on the trustworthiness of the mobile solutions under study, it is important to carefully consider and improve on patient information privacy and security. At the moment, the use of mobile phones at the two hospitals, to transfer information, exhibits some gaps as concerns privacy and the security of patient information. For example, at St. Martin's hospital where certain community based organisation members are in charge of the phones, patients might be uncomfortable to make calls with the phone's custodian present. At St. Gabriel's hospital, where community health workers usually recharge their phones at public business places, unauthorised personnel can gain access to sensitive information, if community health workers leave copies of sensitive messages on in their phones. As is the case, some of the messages contain patient names.

A possible solution to ensure patient privacy, when using SMS, is using pseudonyms for patients, when transferring information. Alternatively the project at St. Gabriel's hospital can shift to GPRS and online patient databases to which users can connect and upload or access information. This way, users would not keep sensitive information on their phones.

7.4.4 Return on investment

Mobile phones need to provide significant tangible benefits, in order to be adopted by health service providers, as there are multiple competing demands and resources are not adequate (Archer, 2005). It is important that the two projects under study here continuously document their achievements to prove their relevance. For example, the mobile phone projects should continuously demonstrate how they have helped medical personnel and community health

workers to save on time, through reducing the need for face-to-face communication. It is also important that the projects demonstrate how they have enhanced healthcare delivery through permitting users more flexibility and efficiency in coordinating task and people, remotely.

Quantify savings on time in monetary terms, for example, can make it possible for the hospitals to use money they are saving to support their mobile phone projects. This would be particularly important for St. Gabriel's hospital, as its mobile phone project currently relies on donor funding. Raising local capital would also better equip the two hospitals to scale up the projects in ways that better support their needs. For example, St. Martin's hospital needs more phones to increase accessibility to the phones, throughout its catchment area.

7.4.5 Adoption

To be attractive, an infrastructure's initial version must offer the first group of users immediate benefits through tailoring the information infrastructure to serve the users' specific needs (Hanseth and Lyytinen, 2005). For the mobile phone projects under study, it is crucial to address challenges pertaining to usability, interoperability with existing systems, return on investment, security and privacy, change management, and risk mitigation. Addressing these challenges will most likely lead to greater adoption and sustained use of the mobile phones. This is possible as addressing these issues answers important questions (section 2.5.3) pertaining to technology adoption (Archer, 2005), which include: *What factors influence users' adoption of mobile computing?; how does the design of the mobile devices and interface affect user adoption; to what degree do specific factors such as trust, in the technology, and enjoyment, in using the devices, play a role towards adoption?*

Chapter 8 : Conclusion

This chapter summarizes the discussions presented in this thesis.

Firstly, this thesis has looked at how the context of use influences user interaction with mobile phones. Further to this, the thesis has also discussed how the use of mobile phones accords users new opportunities that enable them to take charge of both professional and social responsibilities, whilst on the move. The thesis has also presented and discussed various challenges associated with mobile phone solutions use. More specifically, the thesis has adopted the view that mobile phone use is paradoxical. Besides looking at the opportunities and challenges associated with mobile phone use, the thesis has also looked at how the use of mobile phones influences, and is influenced by, organizational and users' work practices. Furthermore, this thesis has looked at various measures that can be employed to address conflict situations that users experience when using mobile phones.

The discussions in this thesis were aimed at answering the questions:

- How does the context of use influence the use of mobile phones?
- How do mobile phones, and work practices interact?
- What opportunities and challenges are associated with the use of currently existing mobile phone solutions?
- How can the challenges associated with mobile phone use be minimised to maximise user benefits?

8.1 Influence of context of use on the mobile phone use

In considering how the context of use influences mobile phone use, this study adopted the position that the context of use for mobile phones is made up of a heterogeneous set of socio-technical factors. These factors are organisational, personal, cultural, and technological. These factors form the ecosystems in which user interaction with mobile phones takes place. Further to this, this study

concludes that the above mentioned factors provide the building blocks (installed base) on which the mobile phone solutions at St. Gabriel's hospital and St. Martin's hospital are built. Furthermore, it is the position of this study that in as much as the installed base provides a platform on which mobile phone solutions are built, limitations intrinsic to the installed base do negatively impact the use of mobile phones.

Looking at the influence of organisations, this study has shown that organisations to which users belong set the tone for mobile phone use. For example, the organisations set goals to be achieved through mobile phone use. To add on to this, organisations also set correct practices for mobile phone use. Furthermore, the type of work an organisation is involved in determines the type of information people can send or receive using their mobile phones.

As regards technical factors, this study has shown that mobile phone communication in Malawi builds on GSM networks, services, and communication protocols. This study has also shown that the extent of GSM networks coverage and quality of available services determines whether people can communicate *anytime and anywhere, or sometimes and in some places*. In addition to this, the constant need for recharging phone batteries, more especially in a setting where most of the users do not have electricity at home, is another infrastructural limitation that negatively impacts on mobile phone use. Empirical evidence from this study has shown that, in some cases, community health workers have to travel long distances to get their phone batteries recharged. Even further, it has been shown in this study that the condition of other infrastructure, such as roads, can enhance or slow down the impact of mobile phone use to in healthcare.

Moving to the influence of personal factors on mobile phone use, this study has shown that the extent to which users are motivated to use a technology does indeed influence actual usage. To add to this, this study has shown that the workload of community health workers and medical personnel has a bearing on the frequency with which they use mobile phones to support their work. This

study has also shown that users' level of literacy has an impact on how fast, and how well, they learn and use available mobile phone solutions. In line with this, the study has shown that free-form text exposes users' lack of writing skills and can be a source of errors.

On the influence of cultural factors, this study has shown that culture can either enhance or hinder mobile phones use. Furthermore, the study takes the position that understanding the target population's cultural values enhances the rollout of mobile phones projects. For example, in Malawi, where traditional chiefs are quite influential, gaining their approval simplifies the rolling out of technologies within their communities.

8.2 How mobile phones, and work practices interact

This study has shown that the use of mobile phones both influences, and is influenced by, its users and their work practices. Among other things, the use of mobile phones cuts down the need for constant face-to-face communication to enable information exchange. Resulting from this, it has been shown that the use of mobile phones has helped community health workers cut down on trips they make to the hospitals, they collaborate with. To extend on this, this study has shown that the use of mobile phones and geographic information allows medical personnel and community health workers to collaborate on patient follow-ups and tracking. In this light, mobile phones permit users to remotely coordinate tasks and activities. Furthermore, the use of mobile phones, in some cases, reduces the number of steps it takes community health workers to send information to the hospitals. This study has also shown that the use of mobile phones has made it possible for community health workers to access expert medical advice remotely.

On the other hand, this study has shown that the nature of people's work has a huge bearing on how they use mobile phones and what type of information they send and receive using their phones. For example, this study has shown that by working with hospitals users are expected to use their phones to send and receive

health related information. Furthermore, this study has shown that privacy laws for safeguarding patient information place limitations on how people can use their phones to share information.

8.3 Opportunities and challenges associated with mobile phone applications use

As earlier indicated, this study has adopted the position that mobile phone use accords user both opportunities and challenges, and is therefore paradoxical. This study has shown that although the primary goal for mobile phone use is to achieve various set goals, significant secondary factors do exist, which can hinder effective user-technology interaction. These factors can be organisational, personal, cultural, or technological, as previously discussed. Below are some findings from this study, on the opportunities and challenges associated with mobile phone use.

8.3.1 Opportunities created by use of mobile phones

The empirical findings of this research work put forth various opportunities associated with the use of mobile phones. These, for example, include:

- Enabling mobile phone users to maintain work and social relations in new ways that were not possible before they acquired phones. Mobile phone users stay connected whilst on the move, allowing them to collaborate with colleagues and send or access data remotely. Unlike personal computers and fixed lines phones, which have to be used at the pace of installation, mobile phones provide users with more flexibility on when and where they can interact with their terminals.
- Reducing the need for face-to-face communication to permit people and activity coordination
- Cutting down the amount of time it takes to relay information between community health workers and the hospitals where this study was performed

- Acquisition of new skills, like the use of mobile phones, for community health workers who previously had no phones
- Enabling community health workers seek expert medical advice whilst out visiting patients
- Reducing the amount of time it takes to request urgent medical help from the hospitals
- Granting patients anytime access to community health workers

These opportunities, as already stated, allow users to remotely communicate and coordinate tasks and people.

8.3.2 Challenges associated with the use of mobile phones solutions

Despite the above outlined benefits realised from the use of mobile phone applications, this study has also discussed several challenges associated with their application. Amongst others, the challenges include:

- Inadequate measures to ensure patient information security when using the available technology
- The use of human information gateways, which can heavily limit project scaling up. Humans can only take so much pressure and are not as easily replaceable when compared to technical components.
- Providing users with constant connectivity fuses work and personal time, which, if not well managed, can lead to increased work pressure.
- The inability of users to master a technology quickly slows down the rate at which enhancements to the current solution can be made.

Upon discovering the above challenges, this study has suggested ways to minimise them, so users can better interact with their mobile phones.

8.4 Minimising challenges associated with mobile phone use to maximise user benefits

This study has shown that to minimize the challenges associated with mobile phone use, users should be encouraged to confront challenges they encounter. This will, in turn, enhance their use of the available mobile phone solutions. This study has shown that deployment of technologies that are easy to master makes it possible for users to quickly get into meaningful interaction with implemented mobile phone-based solutions. Further to this, the study has shown that it is important to equip users with requisite skills that can enable them meaningfully interact with mobile phone solutions being introduced. Empirical findings from this research indicate that users are motivated towards using mobile phone solutions that are easy to master. This agrees with the argument by Jarvenpaa and Lang (2005) that interfaces that are easy to use and system designs that fit well with the coping strategies of users are bound to persuade users into using a technology (Jarvenpaa and Lang, 2005).

The study has also shown that when introducing new mobile phone solutions or making changes to existing ones, it is necessary to do things in small incremental steps. For example, piloting new solutions before large scale roll-outs avoids catastrophes should things not work as originally envisaged. This corresponds with the argument by Hanseth and Lyytinen (2005) that making changes to information infrastructures in small incremental changes averts large scale failures should things not work. Furthermore, the study has also shown that provisions for unexpected eventualities should be made beforehand. This way, organisations can better cope when the unexpected happens. These measures are referred to as change management and risk mitigation strategies by Archer (2005).

Further to this, the study has shown that allowing interoperability with existing systems promotes the relevance of new mobile phone solutions in situations where they would have otherwise not thrived. For example, in the case of the

hospitals where this study was performed, records management is predominantly paper-based. In such cases, this study shows that allowing interoperability between mobile phone solutions and existing paper-based systems promotes information integrity and the relevance of these mobile phone solutions.

Even further, this study has shown that safeguarding sensitive personal information improves on a solution's trustworthiness. In addition to this, empirical findings from this study indicate that users are attracted towards solutions that provide them immediate benefits. For example community health workers and hospital medical personnel are happy to use mobile phones in cases where phone use allows them to remotely coordinate tasks and people. This is in line with the argument by Archer (2005) that in order to be adopted by health service providers, mobile phone solutions need to provide significant tangible benefits, as there are multiple competing demands (Archer, 2005). This also matches with the argument by Hanseth and Lyytinenen (2005) that, to be attractive, information infrastructures need to provide the first set of users with immediate benefits

To cap it all, the study adopts the position that usability, change management, risk mitigation, interoperability with existing solutions, information security and privacy, and return on investment, are key to addressing various problems associated with mobile phone use. These concepts were adopted from Archer (2005).

8.5 Contributions

This study provides various theoretical and practical contributions.

8.5.1 Theoretical contributions

Through the analysis of the research findings and available literature, this study provides an understanding of how mobile phone use is shaped by organisational, personal, cultural, and technological factors, making up the context of use. This research shows that the context of use plays an important role in the use of

mobile phones and needs to be understood, to ensure effective use of available mobile phone solutions. This study also provides insights on how mobile phone use shapes, and is shaped by, organisational and users' work practices.

Further to this, the study builds on the work by Arnold (2003) and Jarvenpaa and Lang (2005) to demonstrate how the use of mobile phones provides users with both opportunities and challenges, in the context of a developing country. The works by Arnold (2003) and Jarvenpaa and Lang (2005) were based on the setting of developed nations. This study, then, shows common opportunities and challenges of mobile phone use, between developed and developing nations. The study also presents an understanding of opportunities and challenges unique to developing countries, like Malawi.

More specifically, this research contributes towards the study of mobile phone solutions diffusion in developing countries. Currently, there is not much literature on the use of mobile phones to support information reporting and access in developing countries. Developing countries like Malawi have significant infrastructural, cultural, organisational setups from developed nations.

8.5.2 Practical contribution

During this research I was able to share my expertise with people from the hospitals where I conducted my research work. For example, in sharing experiences with the initiator of the mobile phone project at St. Gabriel's hospital, I was able to communicate the need for categorising and quantifying incoming and outgoing text messages. This makes it possible to monitor impact across categories and health programs.

Furthermore, during my field work I shared my findings with the initiator of the project at St. Gabriel's hospital. These findings further informed his work and helped him take notice of things he would have otherwise missed. To add on to this, I plan to further collaborate with the hospitals where I did my research work.

Besides this, my empirical data serves to indicate the performance of the mobile phone projects at St. Gabriel's hospital and St. Martin's hospital. In a way my empirical data and analyses contribute towards the evaluation of the mobile phones projects at these hospitals.

8.6 Further research

Further research is required to look at how mobile phones and other mobile devices are used for collecting, reporting, processing, and accessing structured data. This study considered the use of mobile phones to collect free-form text. In going about the proposed study, particular attention should be paid to the differences and similarities in the handling of structured and unstructured data, as concerns collection, reporting, processing, and access.

Besides the above proposed research, there is also need for research on the development of methods and tools to automatically redirect and tag unstructured information sent using SMS. This study found that at one hospital, currently using SMS for information exchange, there is always need for someone to read and redirect incoming messages to the right people. This delays communication, more especially when the person acting as a gateway is unavailable. Relying on people to read and redirect all incoming text messages also introduce inefficiencies if there is a lot of messages coming in or going out. The use of human gateways can hinder project scaling up, as scaling up would increase traffic and pressure on the human gateways

Besides these research areas, the study of mobile phone use and geographical information systems (GIS) to support healthcare delivery and monitoring is needed. Currently, more and more mobile phones, for example, are coming with GPS support. Findings from this research have also shown that the use of mobile phones and maps can improve work planning, task distribution, and patient follow-ups and tracking.

8.7 Recommendations

Lastly, this study sheds light on the possible strategies that may be employed when introducing mobile phone solutions. More specifically, I make the following specific recommendations:

1. When introducing mobile phone solutions it is important to set clear and measurable goals, as well as acceptable practices, for phone use. This way, stakeholders will have a clear picture of what is expected of them and will work towards achieving common goals. Furthermore, setting measurable goals will make project evaluation much easier.
2. It is important to understand the target user group and operating environment. For example, knowing what infrastructure is or is not available can help project implementers know what solutions can, or cannot, work in a particular setting. As regards the target users, it is important to know their capabilities and inabilities. This will go a long way towards determining whether the users can use the technology that is being introduced. This knowledge can also be helpful towards the categorisation of a mobile solution's functionality, to fit with user skills.
3. It is also necessary to understand user and organisational practices, and cultural values of the target population. This way the functionality and use of a proposed solution can better fit with the users' need and expectations.
4. When introducing a new information and communication technology, it is important to keep the technology simple. It is also important to ensure that the implemented solution offers the first group of users immediate benefits. Keeping a technology simple and offering the first set of users immediate benefits will increase a solution's chances of adoption and use (Hanseth and Lyytinen, 2005). The technology should grow based on changing user needs. The technology should also grow as users' expertise grows.

5. When introducing a new mobile phone solution or making changes to an existing one, it is important to do things in small incremental steps (Hanseth and Lyytinen, 2005). This avoids large scale failures should things not go according to set plans. *Pilot first*.
6. Building on the point above, it is important to make provisions for unintended complications (Archer, 2005). Things cannot always go right, considering the range of heterogeneous socio-technical factors that need to work in orchestra to ensure perfect use of mobile phones.
7. It is important for users to assume ownership of introduced solutions. Having users actively participate in project activities will keep them motivated. A project cannot survive if the target users are not motivated to take part. For example, considering the hospitals that participated in this study, if community health workers were not properly motivated it would have been hard to control their actions. This is so because they are not employed by the hospitals, but work as volunteers.
8. Lastly, for mobile phone projects being implemented in rural areas it is critical to be aware of prevailing technical limitations, like the unavailability of electricity in most people's homes. It is, therefore necessary to make provisions for such limitations. For example, solar panels can be made available to users to prevent the charging of phone batteries becoming a bigger issue than actual phone use itself.

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Appendices

Appendix 1: Study Authorization Letter

Telephone: + 265 789 400
 Facsimile: + 265 789 431
 e-mail: doccentre@malawi.net
 All Communications should be addressed to:
 The Secretary for Health and Population



In reply please quote No. MED/4/36c
 MINISTRY OF HEALTH
 P.O. BOX 30377
 LILONGWE 3
 MALAWI
 8 October 2008

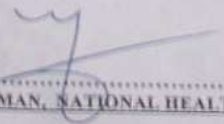
Twonge Davis Manda
 Chancellor College
 Box 280
 Zomba
 Dear Sir,

RE: Protocol # 565: Understanding Opportunities and Challenges in Using Mobile Technology As a Means for Health Data Access And Reporting

Thank you for the above titled proposal that you submitted to the National Health Sciences Research Committee (NHSRC) for review. Please be advised that the NHSRC has **reviewed** and **approved** your application to conduct the above titled study.

- **APPROVAL NUMBER** : NHSRC 565
 The above details should be used on all correspondence, consent forms and documents as appropriate.
- **APPROVAL DATE** : 08/10/2008
- **EXPIRATION DATE** : This approval expires on 07/10/2009
 After this date, this project may only continue upon renewal. For purposes of renewal, a progress report on a standard form obtainable from the NHSRC secretariat should be submitted one month before the expiration date for continuing review.
- **SERIOUS ADVERSE EVENT REPORTING** : All serious problems having to do with subject safety must be reported to the National Health Sciences Research Committee within 10 working days using standard forms obtainable from the NHSRC Secretariat.
- **MODIFICATIONS** : Prior NHSRC approval using standard forms obtainable from the NHSRC Secretariat is required before implementing any changes in the Protocol (including changes in the consent documents). You may not use any other consent documents besides those approved by the NHSRC.
- **TERMINATION OF STUDY** : On termination of a study, a report has to be submitted to the NHSRC using standard forms obtainable from the NHSRC Secretariat.
- **QUESTIONS** : Please contact the NHSRC on Telephone No. (01) 789314, 08588957 or by e-mail on doccentre@malawi.net
- **Other:**
 Please be reminded to send in copies of your final research results for our records as well as for the Health Research Database.

Kind regards from the NHSRC Secretariat.



FOR CHAIRMAN, NATIONAL HEALTH SCIENCES RESEARCH COMMITTEE

PROMOTING THE ETHICAL CONDUCT OF RESEARCH
 Executive Committee: Dr. C. Mwanuzambo (Chairman), Prof. B. Molyneux (Vice Chairperson)
 Registered with the USA Office for Human Research Protections (OHRP) as an International IRB
 (IRB Number IRB00003905 - FWA00003976)

Appendix 2: Informed Consent

Dear Participant:

I am a University of Oslo graduate student. I invite you to participate in a thesis research study, entitled “**Understanding Opportunities and Challenges in Using Mobile Technologies as a Means for Health Data Access and Reporting: A Case Study from Malawi**”

To participate in this project you will be required to at least take part in an initial interview of about one hour. Any follow-up interviews will be agreed upon by you, the respondent, and me, the researcher. Your involvement in the study is voluntary, and you may choose not to participate or to stop at any time. These surveys are anonymous. Your name will not be linked to responses in any presentations or publications that are released from as a result of this work. In fact, the results will be presented in summary form only. **All information you provide will remain strictly confidential.**

The findings from this study will provide information that will help us understand the socio-technical factors that surround the use of mobile technologies as a means for improving health data collection, reporting and access.

If you have any questions about this research project, please feel free to contact me, Tiwonge Davis Manda, at 08 88 869 935 or e-mail at tiomanda@gmail.com.

By completing the surveys, you are agreeing to participate in the above described project.

Thank you for your consideration.

Sincerely,

Tiwonge D. Manda (Graduate Student, University of Oslo)

This study has been explained to me. I volunteer to take part in this research. I have had a chance to ask questions. If I have questions later about the research, I can ask the researcher above.

Name _____ Signature _____

Date_____

Appendix 3: Monthly Activities Reporting Form

ST GABRIEL'S HOSPITAL HBPC PROGRAM

LIPOTI LAPA MWEZI LA OSAMALIRA ODWALA KUMUDZI

1. Mwezi Chaka
2. Dzina la bungwe
Mfumu yayikulu/TA
3. Chiwerengero cha osamalira odwala kumudzi
(HBPC volunteers) Amuna..... Akazi.....
4. Chiwerengero cha osamalira odwala kumudzi amene akugwiradi
ntchitoyi.....
5. Chiwerengero cha odwala olowa kumene mkaundula (new clients)
Amuna..... Akazi.....
6. Chiwerengero cha odwala akale
Amuna..... Akazi.....
7. Chiwerengero cha odwala omwe atumizidwa
 - Kuchipatala.....
 - Kuzipembedzo.....
 - Kumagulu ena.....
8. Chiwerengero cha odwala amene ayenderedwa mwezi umenewu

Atsopano	Amuna.....	Akazi.....
Akale	Amuna.....	Akazi.....
- ✱ 9. Chiwerengero cha odwala omwe ali ndi:

➤ HIV/EDZI	Amuna.....	Akazi.....
➤ Matenda a Khansa	Amuna.....	Akazi.....
➤ Matenda a TB	Amuna.....	Akazi.....
➤ Matenda ena okhalitsa	Amuna.....	Akazi.....
10. Chiwerengero cha ma ulendo amene odwala ayenderedwa mwezi wathawu
ndi: Voluntiya.....
Achipatala.....

Appendix 3: Monthly Activities Reporting Form (continued)

11. Chithandizo chomwe chapelekedwa

➤ Othandizidwa kusamba	Akazi.....	Amuna.....
➤ Kumanga mabala	Akazi.....	Amuna.....
➤ Kusamala malo opsinjidwa	Akazi.....	Amuna.....
➤ Kuthandiza kudyetsa	Amuna.....	Akazi.....
➤ Chisamaliro cha pakhomu	Akazi.....	Amuna.....
➤ Mituka ya chakudya	Akazi.....	Amuna.....

12. a. Chiwerengero cha odwala amene alandira uphungu

➤ Woyezetsa magari (HIV)	Akazi.....	Amuna.....
➤ Wothetsa nkawa	Amuna.....	Akazi.....
➤ Wauzimu	Amuna.....	Akazi.....

b. Chiwerengero cha achibale/Gadiani omwe alandira uphungu wosamalira

Amuna.....	Akazi.....
------------	------------

13. Nambala ya odwala atsopano omwe atumizidwa/alowa support group

Amuna.....	Akazi.....
------------	------------

Nambala ya omwe ali mu support group akale

Amuna.....	Akazi.....
------------	------------

14. Zinthu/zipangizo ndi mankhwala omwe agwiritsidwa ntchito kawirikawiri

.....

15. Chiwerengero cha odwala amene akupezako bwino ndipo atulutsidwa mkaundula

Amuna.....	Akazi.....
------------	------------

16. Odwala omwe amwalira

Amuna.....	Akazi.....
------------	------------

17. a. Chiwerengero cha odwala amene akumwa:

➤ Ma ARVs	Amuna.....	Akazi.....
➤ Mankhwala a TB	Amuna.....	Akazi.....
➤ Morphine	Amuna.....	Akazi.....

Appendix 3: Monthly Activities Reporting Form (continued)

18. Zomwe mukuchititsa zobweretsa ndalama

.....

.....

.....

19. Dzina la chipatala chapafupi.....

20. Mavuto omwe mwakumana nawo mwezi umenewu

.....

.....

.....

21. Ndemanga.....

.....

.....

.....

Saini ya opereka lipoti.....

Saini ya a HBPC nurse.....