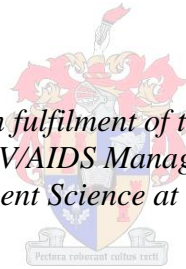


**Remote Area Health Workers Perceptions about mHealth Initiative  
“Talk for Life” in Ghanzi, Botswana**

by

Laura Martindale

*Assignment presented in fulfilment of the requirements for the degree of  
Master of Philosophy (HIV/AIDS Management) in the Faculty of Economic  
and Management Science at Stellenbosch University*



Supervisor: Mr Burt Davis

March 2013

## **DECLARATION**

By submitting this assignment electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Date: March 2013

## **ABSTRACT**

Mobile phones and recent technological advancements have impacted our lives and ability to communicate from almost anywhere in the world. A wide range of mobile devices has contributed to the evolution of health system transformation with the mHealth movement, enabling mobile health service delivery. This qualitative study explores health workers perceptions of mHealth pilot initiative “Talk for Life” in the remote areas of Ghanzi, Botswana. Health workers utilization, reaction, perceived improvements in service delivery and recommendations for future developments are discussed with the intention to inform interventions for increased equitable access to healthcare in the remote areas of Botswana.

Results of the study revealed remote area health workers have a need to utilize consistent mobile telecommunication to provide adequate patient care. Initial experiences with the “Talk for Life” pilot mHealth initiative confirm positive opinions with the use of the closed user group mobile phone network. The majority of health workers cite using the phones every day for diagnosis, patient management, emergency assistance, referral and follow up. Despite the numerous challenges with vast distance between health facilities, limited infrastructure and slow development in the remote areas of Botswana, mobile phones allow for immediate communication that surpasses such obstacles. Improvements in service delivery and recommendations to expand, replicate and further advance the mHealth pilot into a more comprehensive telemedicine based solution are presented.

## OPSOMMING

Die mobiele telefoon en onlangse tegnologiese vooruitgang het ons lewens en vermoëns op so 'n wyse geraak dat ons feitlik van oraloor ter wêreld kan kommunikeer. 'n Wye reeks mobiele toestelle het tot die evolusie van gezondheidstelseltransformasie, met die *mHealth*-beweging, bygedra en sodoende mobiele gesondheidsdiensverskaffing moontlik gemaak. Hierdie kwalitatiewe studie ondersoek gesondheidswerkers se persepsies rondom die *mHealth*-loodsinisiatief, *Talk for Life*, in die afgeleë gebiede van Ghanzi in Botswana. Die gebruik, reaksie, waargenome verbeteringe in diensverskaffing en aanbevelings vir toekomstige ontwikkelinge van gesondheidswerkers word bespreek met die oog daarop om intervensies aan die hand te doen vir verbeterde en billike toegang tot gesondheidsorg in die afgeleë gebiede van Botswana.

Bevindinge van die studie dui daarop dat gesondheidswerkers in bovermelde afgeleë gebiede die behoefte het om konsekwente mobiele telekommunikasie aan te wend om voldoende pasiëntsorg te verskaf. Aanvanklike ondervindings met die *mHealth Talk for Life*-loodsinisiatief bevestig positiewe sienswyses met dié geslote gebruiksgroep mobiele telefoonnetwerk. Die meerderheid gesondheidswerkers meld gereelde daaglikse gebruik van die telefone vir diagnoses, pasiëntbestuur, noodbystand, verwysing- en opvolg-aksie. Ondanks veelvuldige uitdagings weens enorme afstand tussen gesondheidsfasiliteite, beperkte infrastruktuur en stadige ontwikkeling in Botswana se afgeleë gebiede, bied mobiele telefone onmiddellike kommunikasie wat die vermelde hindernisse oorkom. Verbeterings in diensverskaffing en aanbevelings oor hoe om uit te brei, dupliseer en bevorder die *mHealth*-loodsinisiatief en maak daarvan 'n meer uitgebreide en omvattende diens gebaseer op telekommunikasie – telemedikasie, as't ware.

## ACRONYMS

AIDS	Acquired Immunodeficiency Syndrome
AMPATH	Academic Model Providing Access to Healthcare
ARV	Anti-Retroviral therapy
BUP	Botswana -University of Pennsylvania Partnership
CHAI	Clinton Health Access Initiative
CHP	Community Health Promoter
CHMI	Center for Health Market Innovations
CHO	Community Health Officer
CHP	Community Health Promoter
CTBC	Community TB Care
DHMT	District Health Management Team
DR-TB	Drug Resistant Tuberculosis
GPS	Global Positioning System
HEA	Health Education Assistant
HIV	Human Immunodeficiency Virus
Hp	Hewlett-Packard
ICT	Information, Communication and Technology
IHISM	Integrated Health Information System through Management
KFO	Kuru Family of Organizations
MDR-TB	Multiple Drug Resistant Tuberculosis
MoH	Ministry of Health
NGO	Non-Governmental Organization
PING	Positive Information for the Next Generation
SMC	Safe Male Circumcision
SMS	Short Messaging Service
TB	Tuberculosis
UB	University of Botswana
UBSOM	University of Botswana School of Medicine
USAID	United States Agency for International Development

VCT Voluntary HIV Counseling and Testing  
WHO World Health Organization

## EXPLANATION OF TERMS

The following terms are used as defined by the World Health Organization (WHO):

**eHealth:** ‘electronic health’, all transfer of health resources by electronic means including

- The delivery of health information for health professionals and consumers through internet and telecommunications
- Using information technology to improve public health services
- Use of e-commerce practices in health systems management.

**mHealth:** ‘mobile health’ is an area of eHealth, it is the provision of health services and information via mobile technologies such as mobile phones and Personal Digital Assistants (PDAs)

**tele-health:** includes surveillance, health promotion and public health functions including computer assisted telecommunications to support management, literature and access to medical knowledge

**tele-matics:** WHO composite term for both tele-medicine and tele-health, or any health related activity carried out over a distance by means of information communication technologies.

**tele-medicine:** the use of tele-communications to diagnose and treat disease and ill-health

## ACKNOWLEDGEMENTS

A very special thank you to all who have participated in this research. Your time and input is valuable to advance and improve the health system in the remote areas of Botswana. To all District Health Workers, Kuru Health Team, and community members in Ghanzi, I thank you for your active contribution and energy! Cooka boo! Thank you also to the Botswana Ministry of Health and District Health Management Team for allowing me permission to conduct the study.

Special recognition to all of the professors, colleagues and partners in Botswana and South Africa for your advice, guidance and feedback throughout my study endeavors! A sincere acknowledgement to the BUP and UB teams who have shared their work and inspired my interest in mHealth above and beyond this research.

And to all friends, family and neighbors who have actively supported discussions and inspired this work. One phone at a time, we contribute to increasing mobile access to health. Re mmogo!



**TABLE OF CONTENTS**

Declaration .....	i
Abstract.....	ii
Opsomming.....	iii
Acronyms.....	iv
Explanation of Terms.....	vi
Acknowledgements.....	vii
<b>1. INTRODUCTION.....</b>	<b>1</b>
1.1 Background .....	1
<i>The Global eHealth Movement</i> .....	1
<i>mHealth in Botswana</i> .....	3
<i>Health Workers Utilization of mHealth</i> .....	6
1.2 Research Problem.....	7
1.3 Research Question.....	7
1.4 Significance of Study .....	8
1.5 Aim.....	8
1.6 Objectives.....	9
<b>2. LITERATURE REVIEW.....</b>	<b>10</b>
2.1 mHealth Impacts on Health Service Delivery.....	10
2.2 mHealth in Botswana .....	13
2.3 “Talk for Life” mHealth Initiative in Ghanzi District.....	15
2.4 Strategic Directions for the Future of mHealth.....	17
2.5 Summary .....	19
<b>3. RESEARCH DESIGN AND METHODS.....</b>	<b>21</b>
3.1 Qualitative Data Collection.....	21
3.2 Semi-structured Interviews .....	22
3.3 Data Analysis .....	23
3.4 Ethical Considerations.....	23
<b>4. RESULTS AND DISCUSSION .....</b>	<b>25</b>

4.1	Health Worker Respondent by Category .....	25
4.2	Health Facility Description .....	27
1.	Grootlaagte Health Post .....	27
2.	Kuke Health Post .....	28
3.	D’Kar Health Post.....	29
4.	Ghanzi Clinic .....	29
5.	Letloa Trust, Kuru Community Health Program, D’Kar .....	30
6.	Ghanzi District Rural Administration Center .....	31
7.	Ghanzi Primary Hospital Lab .....	31
4.3	Reactions to “Talk for Life” mHealth Initiative.....	32
4.4	mHealth Impact on Health Service Delivery in Ghanzi.....	34
4.5	Recommendations to Improve mHealth in Ghanzi .....	36
4.6	10 E’s of eHealth from the lens of “Talk for Life” .....	38
5.	<b>CONCLUSION AND RECOMMENDATIONS</b> .....	42
	<b>REFERENCES</b> .....	44
	<b>ANNEX 1: Semi-Structured Interview Schedule</b> .....	52
	<b>ANNEX 2: Photo of community health mobile outreach in Ghanzi farms</b> .....	55

## 1. INTRODUCTION

### 1.1 Background

#### *The Global eHealth Movement*

Mobile phones and recent technological advancements have greatly impacted our lives and ability to communicate to almost anywhere in the world. “Mobile devices have had the fastest adoption in any technology in human history,” changing people into ‘mobi persons’ who use cell phones not only as a way to communicate through voice and text, but also to communicate to improve healthcare (Waegemann, 2010). Mobile phones are being used to strengthen healthcare delivery systems through a variety of technological advances which are in turn changing communication patterns and increasing access to health services and improving health outcomes. Recent expansion of cellular telephone networks in the remote settlements and farms in Botswana has enabled improved connectivity and increased access to mobile telecommunications.

The 58th session of the World Health Assembly in 2005 adopted a resolution that established an eHealth Strategy for the World Health Organization (WHO, 2008). Advances in mobile communication to address public health priorities have since evolved into the dynamic field of eHealth. The emerging field of eHealth encompasses all transfer of health resources by electronic means. eHealth has recently broadened in scope as an umbrella field for all information communication technologies and related activities for health carried out over a distance including tele-health, tele-medicine, and mHealth (WHO, 2013).

Tele-health includes disease surveillance, health promotion and public health activities using telecommunications as a means to facilitate the management of health systems, access to medical information, training of health workers, the use of e-commerce administration and collaboration among health providers and the public (WHO, 2013). Tele-medicine is a part of tele-health that uses telecommunications to deliver health services remotely through the facilitation of information exchange between primary care health workers and specialists from a distance to diagnose and treat patients (Bashshur, 1997). The field of mHealth, also known as ‘mobile

health', has transpired as the arena of eHealth that provides health services and information through mobile phones and other mobile devices (WHO, 2011). mHealth provides the opportunity to "surpasses other infrastructure such as paved roads and electricity...[and is] transforming the way health services and information are accessed, delivered, and managed. With increased accessibility comes the possibility of greater personalization and citizen-focused public health and medical care" (WHO, 2011:5). Such impacts of mobile telecommunication have especially significant impacts in remote parts of Africa where other infrastructural developments are not yet established.

The mobile phone density in Botswana has increased five-fold since 2005, with 99% of the population having access to mobile phone networks in 2012 (Monitor, 2012). The World Bank Information and Communications for Development Report 2012 indicates Botswana's mobile phone subscriptions to be one of the highest not only within the Southern African Region, but also among developed countries worldwide (World Bank, 2012). Mobile phones have inspired numerous developments and advancements in health service delivery. The use of mobile technology has not only become a means to reach desired health outcomes, but is transforming the entire health system communication patterns with tools that facilitate interaction from anywhere in the world. Botswana has received special recognition for the integration of mobile phone use in the health sector through collaborative efforts of government, non-governmental organizations (NGOs), and the University of Botswana's (UB) mobile initiatives for health (Monitor, 2012).

Efforts to scale-up mHealth initiatives are gaining momentum on a global scale; "mHealth is emerging as one of the most potent weapons in the fight against TB" said Dr. Lucica Ditiu, Executive Secretary of the Stop TB Partnership. "I know of no tool that holds as much promise as the mobile phone for closing the loop between diagnosis and successful treatment, effectively and affordably" says Aamir Khan, Executive Director of Interactive Research and Development organization (Stop TB, 2012). The main features of mHealth being portable, immediate and convenient with relative low cost have contributed to a growing momentum in wellness promotion and disease management (Norris, Stockdale & Sharma, 2008). Cell phones allow

communication in remote and isolated communities that has not been possible before (Curioso & Mechael, 2010).

Hosted by the United Nations, the *mHealth Alliance* was established in 2009 to support mobile technologies and networks to enable improved access to health care especially in developing countries. Patty Mechael, the mHealth Alliance's Executive Director states that "mHealth innovations are among the most important contributions to delivering on the world's most important health goals," from child and maternal health to HIV and AIDS (SNS, 2011). With limited access to internet in sub-Saharan Africa, and extensive access and use of mobile phones (Armstrong et al., 2012), mHealth initiatives have great potential to reach a large percentage of the population. Such technological driven health care improves efficiency and quality of life (Jones, 2011).

Even in remote areas that lack basic necessities of water and electricity and that have poor infrastructure and access to health and education, "cell phone towers are often ubiquitous" (Canton, 2012). Tele-medicine can reach out to the poorest and furthest populations by focusing on linking underserved remote, difficult environments with resources that are located in the central health services (Mupela et al., 2011). Many countries have successfully engaged community health workers to provide such service delivery in the remote areas. Telemedicine solutions provide a gateway to decentralize health services with guidance from remote specialists to primary care workers, further shifting service provision to community and home based care (*as cited in* Rygh & Hjortdahl, 2007).

### ***mHealth in Botswana***

With mobile telemedicine "becoming a more pervasive and realistic means of ensuring the delivery of health services to resource-poor populations" (Quinley et al., 2010) locally adapted initiatives are developing rapidly. Botswana's healthcare delivery faces challenges of inadequate infrastructure and lack of human resources that limit access to health in remote areas. The current system relies on physical transport of hard copy records, diagnostic test results, official correspondence and has a lack of specialists available to provide adequate point of care service. Mobile communication presents an opportunity to reduce the challenges by connecting health

workers from towns to rural areas to improve quality of care at the level of patient care. With the ability to engage in direct verbal communication using mobile phones, health workers can make follow ups more quickly, initiate treatment early and essentially improve treatment outcomes and primary health of community members at the point of care.

Botswana-University of Pennsylvania Partnership (BUP) and the University of Botswana School of Medicine (UBSOM) have developed several mHealth initiatives to strengthen the quality of health service delivery within the last five years. Many of the mHealth projects are based on a model of telemedicine where health workers use mobile devices; cell phones, smartphones and portable devices to collect clinical information to send to a remote specialist for consultation. Along with telementoring of physicians at UBSOM, BUP has specific mHealth projects with mobile cervical cancer screening, mobile teleradiology, mobile oral telemedicine, and mobile teledermatology.

“Appropriate technology must be paired with motivated users and integrated with diverse practice settings if it is to be saleable and sustainable” (Littman-Quinn et al., 2010). As the ICT (information and communication technologies) and mHealth movement gains momentum in Botswana, the remote areas have the potential to benefit from more effective personalized care through establishing e-health markets (Dzenowagis, 2011). Evaluating users perceptions of acceptance of telemedicine is valuable to guide future strategies to increase access to health care. A review of one teledermatology mHealth project with HIV+ patients in Botswana concluded a high acceptance rate of the mobile health service. Reported barriers to accessing health services are time, cost and distance. Patients who utilized the mobile phone consultations in Botswana accepted the initiative, citing reduced cost and time for traveling to health as a positive method to reduce the access barriers (Weinburg et al., 2010).

Ghanzi District in Western Botswana is a remote area with numerous structural and environmental challenges of access to health services that could largely benefit from mHealth solutions. Ghanzi is challenged with severe poverty, high rates of illiteracy, one of the weakest economy bases in the country as well as lack of access to health care and education (UNDP, 2010). Ghanzi District has the highest TB notification rates in the country (MOH, 2008) and

higher than the national rate of HIV infection among infants born to HIV positive mothers (MLG, 2010). Basic public health service delivery in the remote areas is low and expensive for the government to provide. The understanding of providing health care in remote areas of Botswana requires reflection on the degree of “isolated and dispersed communities, low density populations, limited public transport and road infrastructure, long distances to hospitals and health care services, and the difficulties in attracting and recruiting qualified personnel” (Rygh & Hjortdahl, 2007).

Local NGO, Letloa Trust (member of Kuru Family of Organisations) Community Health Program is actively working to increase access to health services with indigenous San groups in the remote areas of Ghanzi and Okavango Districts, Botswana. The Program commonly known as Kuru Health works in partnership with governmental health authorities to design and implement culturally and contextually relevant initiatives for TB, HIV and AIDS management with remote populations (Kuru Health, 2011). Community Health Promoters (CHP) are engaged in remote areas to implement Community TB Care (CTBC) by providing daily DOT, assisting in TB contact tracing and household level infection control talks, voluntary HIV counseling and testing (VCT) and targeted TB and HIV/AIDS health educational campaigns.

Kuru Health’s recent pilot mHealth initiative “Talk for Life” has established a local network of mobile phones placed at each of the remote area health facilities. The pilot mHealth initiative has provided more than 20 phones in a closed user group free of charge to health workers to enable two-way direct communication despite vast distances. The “Talk for Life” mHealth pilot was established in response to local challenges including: long turn around time for diagnostic test results from the lab to remote area health posts, ad-hoc patient referral networks and late initiation of medical treatments (Kuru Health, 2012). Customizing mHealth systems specifically for the structural environment and context of Ghanzi District users requires anticipating the potential challenges and working through them accordingly with partners (Littman-Quinn et al., 2010).

### ***Health Workers Utilization of mHealth***

Various positions within the healthcare sector have documented the advantages of mHealth technology to be: patients' reduced time in clinic visits, improved communication in diagnosis, and the ability to liaise with other health workers (Vodaphone Group, 2011). Although the advantages take precedence, the Vodaphone mHealth Insights Guide (2011) states a number of obstacles to the adoption and utilization of mHealth initiatives, with human behavior as one of the main barriers (2011). The reluctance of health workers to change current practices of hand written recording to new mobile practices has also been identified as an obstacle (Hwabamungu & Williams, 2010) associated with human behavior that inhibits effectiveness and potential sustainability of mHealth initiatives. As primary users of the mobile devices, people are responsible for ensuring the mHealth solutions are integrated into daily health care service delivery as an effective practice.

The primary users of the "Talk for Life" mHealth pilot initiative are health workers from government health posts, clinics, mobile stops, community based health workers and lab technicians. Numerous studies discuss the importance of user perceptions and satisfaction in the mHealth environment with specific reference to the effect of user satisfaction on the quality of life (*as cited in* Akter, D'Ambra & Pradeep, 2010). User satisfaction among other technical, economic and social aspects of mHealth are critical to explore in order to assess effectiveness of the "Talk for Life" mHealth initiative.

Mobile electronic applications and mHealth systems are designed to improve quality of patient care and individual quality of life. Reshaping some of the mechanisms of the existing health care delivery with mHealth could powerfully impact patient information management and access (Istepanian, Jovanov, & Zhang, 2004). The World Health Organization (*as cited in* Curioso & Mechael, 2010) states some of the challenges linked with mHealth to be lack of knowledge about current applications, public health outcomes, cost effectiveness, infrastructural components and supportive policies. Health workers as the primary users of the mobile phones determine the frequency and purpose of use of mHealth facilities. "It is critical to understand the calling preferences and patterns in order to understand the natural role of mobile phones within the health sector...[and] maximize health benefits" (Mechael, 2009:109).



The behavioral attitudes about the adoption and utilization of mHealth technologies may “be more important to progress than technology” itself (*as cited in* Bedford, 2011:24). “Talk for Life” mHealth functionality depends on the nature of communication between the remote health workers and their perceived satisfaction. “Extant literature on services quality found both a direct relationship between perceived service quality and satisfaction and an indirect relationship between service quality and intention to continue using through satisfaction” (*as cited in* Akter et al., 2010). The perceptions of the health workers as users of mHealth facilities and the importance of whether the mobile phones as technological resource impact improve service delivery is a critical aspect affecting adoption of mHealth (Hwabamungu & Williams, 2010). Remote health workers’ reactions to Kuru Health’s initiative in Ghanzi contribute to evaluation of mHealth pilot initiatives in the area.

## **1.2 Research Problem**

Since the inception of Kuru Health’s “Talk for Life” mHealth pilot initiative, there has not been any formal assessment of how the phones are working for the users. Most mobile health innovations have not documented lessons learned or been evaluated beyond pilot phases which limits the potential for equitable advances (Curioso & Mechael, 2010).

“mHealth allows multi-disciplinary teams to collaborate closely and quickly with each other to develop patient care plans, share updated information, and commission treatment delivery. It supports patient-centric healthcare with the cost effective delivery of Remote Care Services that improve the patient’s quality of life” (Vodafone, 2011). Remote area health workers in Ghanzi District engage with numerous stakeholders. With the ability to engage in direct verbal communication, health workers can initiate follow ups quickly, initiate treatment early and essentially improve treatment outcomes and primary health of community members. Taking into account that “mobile technologies are only as good as the information and communication to which they provide access” (Shields, Chetley & Davis, 2005) it is important to explore experiences of health workers with mHealth in the remote areas of Botswana.

## **1.3 Research Question**

The research question of this study is:

## **What are the health workers' perceptions of the "Talk for Life" mHealth initiative's effects on service delivery in the remote areas of Ghanzi District?**

### **1.4 Significance of Study**

mHealth interventions require review and evaluation to provide evidence and experience that will encourage expanding partnerships and investments within the field of eHealth (Curioso & Mechael, 2010). With much of the existing eHealth literature focusing on the macro or broader potential benefits with mHealth, there is a need for case specific information to evaluate impacts (Schweitzer & Synowiec, 2012).

This study provides insight that can potentially strengthen health service delivery in Ghanzi as well as on a national level. Improved communication between health workers can assist in daily service delivery. With cell phones on hand to immediately connect health workers in the remote areas to the referral hospitals, lab, and other facilities, patients also benefit from mHealth. Lab test results can be communicated directly over the phone rather than rely on physical transport which in turn allows for early diagnosis and treatment initiation. Mobile tele-communication can further allow immediate referrals and follow ups which can facilitate successful treatment outcomes.

Determining the health workers perceptions of the usefulness of "Talk for Life" is important to ensure the cell phones are providing the intended service of improving communication within the health system. Integration of mHealth into daily working styles is also important to investigate to guide practical implementation. Understanding of how health workers perceive the effect of "Talk for Life" mHealth pilot is critical to study the influence of communication on health care system delivery in Ghanzi. The results have the potential to benefit national health service delivery with recommendations that could be replicated in other areas around Botswana.

### **1.5 Aim**

The aim of this study is to explore health workers perceptions of "Talk for Life" mHealth initiative's effects on service delivery in order to inform current and future interventions for increased access to health care service in the remote areas of Ghanzi District, Botswana.

## **1.6 Objectives**

The objectives of the study are:

1. To determine how health workers are using “Talk for Life” phones.
2. To identify health workers reactions to “Talk for Life” mHealth initiative.
3. To explore perceived changes in health care service delivery as a result of mHealth initiative “Talk for Life”.
4. To provide recommendations to improve remote area health mHealth service delivery.

## 2. LITERATURE REVIEW

Mobile devices are rapidly transforming healthcare service delivery. Diagnosis, clinical assessment, disease management, and remote access to healthcare are improving with mHealth initiatives that connect health workers through mobile technology. Various impacts of mHealth experiences are illustrated through the users perceptions of the mobile devices in this chapter. Health workers responsiveness to incorporate mobile technologies are changing communication patterns and enabling improved patient care at the point of service is highlighted with the specific context of Botswana. Particular assessment of the pilot mHealth initiative “Talk for Life” in Ghanzi, Botswana demonstrates the practicalities of surpassing obstacles of access to healthcare with mobile telecommunication. Reflection on how health workers are using the mHealth initiatives can inform future developments in remote area integrated patient care. Strategic directions and mHealth advancements in Botswana are deliberated with reference to collaboration, sustainability and cost-effectiveness.

### 2.1 mHealth Impacts on Health Service Delivery

The disease burden of HIV/AIDS and TB in Southern Africa places heavy demands on health care providers (Mars, 2009). “mHealth initiatives have shown to reduce the burden of diseases including HIV/AIDS, malaria and TB ... [and are] being used for improving access to everyday and general health services, managing patient care, reducing drug shortages, enhancing clinical diagnosis and treatment adherence” (WHO, 2011:5). There is a potential for physicians to access patient records, laboratory results and provide diagnosis and referral from any location. Smart sensors placed in drug containers improve drug supply and delivery with alerts sent to a central server. Developments in progress further include individual patient monitoring applications on cell phones to observe physiological changes in blood pressure and track treatment adherence. With the advancement of the ICT sector and improved wireless infrastructure, there are a number of mHealth initiatives that have the possibility to impact positively on health systems.

The current reality of health care delivery in the era of HIV/AIDS requires high quality transfer of information across system boundaries (Norris, Stockdale & Sharma, 2008:328). Patient data including diagnosis, treatment progress, referrals, treatment outcomes, and follow ups are all part

of clinical procedure. With data being passed from the initial point of care to laboratories that are located far from the health facility, information sharing across vast distances is required within the health delivery system. With the health management focus on individual integrated patient care and increasing equitable access for remote area populations, mobile technologies have a unique role in facilitating convenient and timely delivery irrespective of obstacles.

“The benefits of mHealth can only be maximized if all of the elements in the network, including health facilities and professionals, are seen as accessible” (Mechael, 2009:108). Both positive and negative experiences and impressions have been documented by various community health workers utilizing mHealth systems throughout Africa (Stone et al., 2011 and Vodafone, 2011). The most common attributes of successful mHealth services can be categorized in three spheres being adoption, engagement and impact (Johnston, 2011:10). Adoption of mHealth initiatives require an adequate design tailored to the needs of the users that is simple enough to be perceived as an improvement in comprehensive healthcare. For mHealth solutions to be effective, they require interactive engagement by the users through mobile telecommunications. Finally, the impact of the mHealth initiative must have an added value that can demonstrate joint improvements in clinical health outcomes.

The New Horizons for Health through Mobile Technologies study done by WHO’s Global Observatory for eHealth documents numerous mHealth activities. The report (2011) highlighted the most frequently used mHealth initiatives to be call centers (59%), emergency toll-free services (49%), managing emergencies and disasters (54%) and mobile telemedicine (49%) (SNS, 2011). The study included data from 112 countries, the majority having reported pilot mHealth projects. “Two-thirds of countries surveyed reported between one and three mHealth activities, yet only 12% of reported efforts to evaluate their mHealth activities” (2011). With a diverse range of mHealth activities being implemented globally, it is important to study and document lessons learned to share with the public health community. Evaluation allows for guidance in strategic direction, engagement and collaborative impact.

Initial data produced by mHealth project in Kenya using mobile phones and community health workers found the data collection system ‘was faster, easier to use, and produced higher quality

data than using paper-based” methods (Rajput et al, 2012). The community health workers were trained using Android smartphones to facilitate population surveillance. Offering patient focused health services by visiting people at their households allowed for collection of health information, voluntary HIV testing, and TB screening. Using the Android Open Data Kit and OpenMRS software, data were collected electronically in resource limited settings (Rajput et al, 2012). Satisfaction was demonstrated both with the utilization of the mHealth facility as well as with the mobile devices. The Ministry of Health of Kenya was supportive of the USAID-AMPATH partnership since inception. The project has not yet reached completion.

Transforming the center of care from the health facility towards the community and the patient requires collaborative actions between many stakeholders and systems. Telemedicine allows for remote patient monitoring, group consultation networking, and emergency assistance. Such mHealth initiatives and technologies need to be aligned with structural and behavioral changes within the healthcare practice. The current trends of decentralizing health systems using mobile technologies incorporates diverse care providers (Waegemann, 2010). Both technological and health systems are run and managed by people. Human behavior and systems change largely depend on perceptions toward a certain benefit. Adoption and engagement of changing communication patterns requires contextual reflection and attention to specific cultural norms of certain geographic localities. Reflecting on how people use mobile technology and perceive the benefits of instant communication leads to better understand how to best target future mHealth systems.

Health care workers mind-sets, attitudes and perceptions greatly impact the way they provide services. Numerous theoretical models have been discussed as to their relation to the adoption and utilization of mHealth services. Acknowledging that a number of behavior models illustrate associative actions, there is a need to also be aware that a variety of influences may also contribute to behavior. A combination of approaches should be used to assess viability of mHealth. Contextual analysis is critical to triangulate the historical methods of health service delivery, user responsiveness, health outcomes and cost-benefit results. “To understand behavior associated with the adoption of technologies of health, we need to overlay theories derived from social and behavioral science, with theories of user engagement drawn from the fields of

Information Communication and Technology” (Bedford, 2011:18). The WHO global e-health case studies that have been documented after a decade of experience focus on categories for analysis including: connectivity, content, capacity and context (Dzenogwagis, 2011).

## **2.2 mHealth in Botswana**

Similar mHealth projects have been established throughout the sub-Saharan African Region. Ghana, Sierre Leone, South Africa, Malawi, Kenya and Tanzania have documented experiences with mHealth initiatives (WHO, 2011; Wootton, 2009). To date, there are some documented telemedicine and mHealth applications in public health interventions in Botswana. Chobe District with NGO partners PING (Positive Information for the Next Generation), Clinton Health Access Initiative (CHAI), Hewlett-Packard (Hp) and Ministry of Health (MoH) are engaged in a year long clinical trial in malaria outbreak with Mascom mobile service provider (Dolan, 2011). The PING project has since extended services to HIV patients and Safe Male Circumcision (SMC) clients providing SMS support with appointment reminders, treatment refills, feedback to questions and emergency assistance (Mogorosi, 2012). Meanwhile the UBSOM with BUP partners have been exploring the role of smartphones by resident physicians in resource-limited settings (Chang et al., 2012).

Additionally, the Microsoft Research Digital Inclusion Program provided funding to the UB Project ‘Integrated Health Information System through Mobile Telephony’ (IHISM) in 2005 to create a text based messaging medical information system that can improve timeliness and overall quality of patient care for HIV/AIDS patients (Microsoft, 2007). With partners Botswana National Call Center on HIV/AIDS and Botswana Baylor Children’s Clinical Center of Excellence, UB is developing an internet based health care information system to facilitate relevant messages to patients as well as allow health workers to monitor and manage patient records, and assist in referrals to offer improved treatment and lower health care costs. The system will essentially provide a two-way communication between doctors and patients. Mr. Henry Nyongesa, professor of computer science at UB believes “Using the text-message capabilities of mobile phones to delivery medical information can greatly increase HIV/AIDS awareness and prevention, especially in underprivileged communities” (Microsoft, 2007).

Provision of the IHISM allows text based questions of how to prevent and manage HIV/AIDS with cell phones linked to a central database server containing answers to frequently asked questions. When reviewing the system, more than 90% of the selected participants agreed that the system was easy to use and was able to provide relevant answers to input questions (Masizana-Katongo, Leburu-Dingalo & Mpoeleng, 2009). The IHISM has the potential to provide accurate information to the general public and further expand into the rural areas with continued development.

The BUP in collaboration with ClickDiagnostics and Orange Botswana have embarked on a mobile telemedicine project to enable ‘see and treat’ cervical cancer screening. Due to shortages of specialized health workers, particularly gynecologists, the partnership provided camera phones to allow images of the cervix to be sent from the mobile phone to off-site specialists. The images along with patient medical history are sent and diagnosed by specialists through the use of mobile phones. “Mobile telemedicine connects patients to expert clinicians through nurses equipped with mobile phones, utilized to provide remote medical support, in order to develop countrywide low-cost, sustainable health care service” (Gormley et al., 2009). The outcomes suggest a reduced burden on patients and providers with one specialist being able to provide consultation and diagnosis to numerous facilities without being physically on site at any of them. The patient is not required to travel to where the specialist is and there is no need to require a specialist in all facilities.

Another mobile phone pilot initiative developed by BUP in collaboration with the Botswana National Library of Medicine involves SMS for clinicians to send and receive questions from PubMed/Medline and Botswana clinical guidelines (Armstrong et al., 2011). The txt2MEDLINE allows clinicians to search Botswana specific treatment guidelines for HIV, AIDS, TB and skin disease. Upon evaluation, positive feedback was documented with the majority using the telemedicine network SMS-optimized clinical guidelines daily. The text2MEDLINE program aims to improve the service to enable easy access to current medical findings and guidelines in resource limited areas (2011).

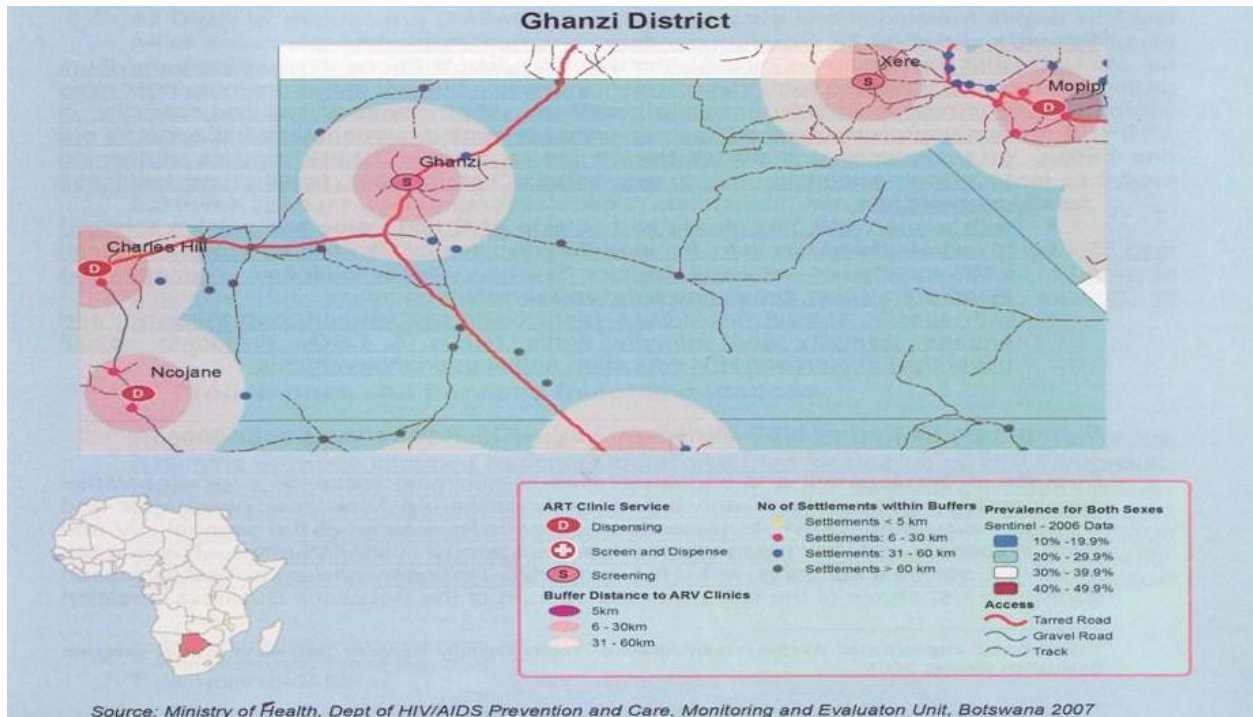


### **2.3 “Talk for Life” mHealth Initiative in Ghanzi District**

Kuru Health conducted a Baseline Rapid Assessment (2012) as part of the development process initiating the ‘Talk for Life’ mHealth project. The assessment documented data from interviews with health workers, focus group discussions with TB patients and community health workers. Three themes emerged from the rapid assessment: turn-around time, transport and communication. The remote area transport challenges do not allow for effective management of patients’ treatment outcomes; urgent correspondence detailing diagnosis, blood and sputum test results, and treatment initiation instructions can take days to arrive from the hospital to the settlements (Kuru Health, 2012).

A document review of clinic facility TB registers was also done to calculate the length of time it takes to get TB test results back from the lab to the remote area facility. The challenges surrounding communication in the remote area health facilities in Ghanzi and Okavango were documented and presented to District Health Management Teams for discussion. Turn around times for TB test results was calculated to be on average around 8 days from the time the specimen goes from the remote facility to the lab in the township, tested and then results sent back to the facility. Despite the results being processed within 24 hours once reaching the lab, there is a substantial delay in communicating the test results due to the physical transportation of the test results from the remote areas to the town center and back. Lack of transportation was also recorded as one of the most pressing challenges of communication.

Most of the remote health facilities in the remote areas in Ghanzi are under staffed, and some run by Health Education Assistants many of whom have not received any formal health training. To date there is only one district hospital, 4 clinics, and 17 health posts that serve 356 remote mobile clinic stops in the district. Despite the fact that by 1995, 88% of the population in Botswana lived within 15 km of a health facility (UNDP, 2010:11), only 60% of the population in Ghanzi is within a 15 km radius of a health services to date (MLG, 2009:8). The disparities in access to health services in the remote areas of Ghanzi are mainly a result of vast distance, lack of ICT infrastructure, inadequate transport within the health system, and slow pace of remote area development.



*Ghanzi District Map of Health Facilities (MoH, 2007): The map above indicates the distance between health facilities throughout the District.*

The majority of settlements and private farms in Ghanzi District do not have electricity. To date there is only one mobile communication service provider that reaches most of the settlements and private farms in Ghanzi District. It is common practice for community members to pay a small fee to charge personal mobile phones at a local tuck shop that uses a car battery to charge (Kuru Health, 2012). BeMobile established a mobile network in the remote areas of Ghanzi in 2011 whereby previously there was only selected reach by Mascom and Orange networks, often with unreliable coverage.

The Ghanzi District health system is overly reliant on physical transportation of health test results from the lab to the remote health posts and hand written records. Alternative direct communication remains through face-to-face meetings or via roger-roger two-way radio. Reluctance of health workers to use personal cell phones due to lack of air-time has been a recurrent theme throughout NGO progress reports (Kuru Health, 2012). Considering the distance from Ghanzi township to some of the settlements and farms being up to or more than 100 km by sandy road, communication poses challenges and often delays diagnostics, treatment

initiation and referrals with the health system. For mHealth to be effectively adopted, solutions to various challenges need to be addressed.

In Ghanzi and Okavango Districts, “Talk for Life” mHealth initiative by Kuru Health has taken the approach to allow mobile phones for health workers to consult with each other unlimited with no cost to the user. The “Talk for Life” mHealth project was introduced at the beginning of 2012 to health facilities throughout the remote areas of Ghanzi and Okavango Districts in Western and Northwestern Botswana. “The need to bring about this facility was necessitated by recurrent challenges with communication between the various stakeholders which are exacerbated by limited communication infrastructure and the difficult terrain between the locations” (Kuru Health, 2012).

All the mobile phones are part of a private closed user group network. The health facilities can communicate with each other, with the laboratories at the district hospitals, the District Health Management Team and Kuru Health officers. By the end of 2012, the “Talk for Life” mHealth pilot initiative grew into more than 20 phones. This expansion allowed clinics responsible for mobile stops in the network to enable communication in the areas that only have access to health care when the mobile clinic travels through their area. Some of the locations have been reportedly missed by mobile clinic stops for more than 3-6 months due to transport shortages in the central government transport operations.

#### **2.4 Strategic Directions for the Future of mHealth**

The users’ experiences are valuable to explore as a key component of mHealth initiatives. Perceptions and responses can provide insight into how best to engage in future development with mHealth. Various models have been presented in a range of contexts as to critical criteria for review and evaluation. Standard metrics for designing and delivering mHealth applications as presented by Ouma, Herselman, and Van Grauen (2010) provides a practical base to apply to including usefulness, integration, and sustainability.

Connecting health workers to improve remote care patient centered care, monitoring, and treatment are some of the core activities of a health system (Waegemann, 2010). Connecting

health workers through mobile telecommunications requires customized strategies tailored to unique environmental and contextual characteristics of a particular health system and the users (Littman-Quinn et al, 2010). Development of an effective strategy for mHealth implementation that allows for dynamic growth and resilience involves establishing operational frameworks, adoption, monitoring and evaluation.

Sustainable mHealth strategies have been proposed in three phases being: identification of appropriate applications, selected development, and confirmation of activity (Norris, Stockdale & Sharma, 2008:331). Selected development must consider issues of interoperability between two or more systems (Waegemann, 2010). Confirming the activity and monitoring utilization of mHealth solutions allows for assessment of the effectiveness. Empowering health workers in remote facilities to make decisions with the support of mHealth has potential to increase accessibility of services and treatment of chronic diseases with an integrated approach.

There are few evaluations of mHealth that exist due to the relatively early stages of adoption and development (WHO, 2011). Insufficient data on how mobile technologies influence health access and outcomes hinders best practice identification (WHO, 2008:15). Numerous evaluation elements require additional research if mHealth is to be economically viable or sustainable. Cost effectiveness of mHealth is one element that needs to be explored along with operational frameworks, infrastructure requirements, utilization by health workers, and knowledge of technical expertise.

One of the mobile telemedicine projects implemented by BUP for improving cervical cancer screening highlight the cost-effectiveness of using phones for consultation and diagnosis in rural Africa and areas with limited access to health care. The affordability has been deemed through consideration that phones are less expensive than the diagnostic infrastructure required in cervical screening (including electricity, equipment and specialists). Further, the ability of nurses to be able to take photos and send via cell phone enables patient care to be provided with a significantly lower level of training to utilize mobile applications (Gormley et al, 2009).

Development of national mHealth systems beyond pilot projects requires participation and review from multi-disciplinary stakeholders. Scalability and replication of successful pilot mHealth initiatives requires adequate research into the usability of mobile phones, the process of adopting new operational technologies as well as the interoperability and cost effectiveness. Partner collaboration from both public and private sector is necessary to essentially integrate mHealth as a model for improved health service delivery in remote areas of Botswana. There is a perception that governments and donors should be primarily responsible for financing and developing mHealth, yet how mHealth can be maintained and managed requires further investigation (Hwabamungu & Williams, 2010).

Policy coordination of comprehensive mHealth reach and practical utilization requires understanding of the benefits from local and national stakeholders. The specific needs of remote area communities require support from policy makers to collaboratively transform healthcare with mHealth. Health workers who provide direct service to patients should be in the forefront of strategy development as the primary users of mHealth facilities (Norris, Stockdale & Sharma, 2008:332).

Potential public private partnerships and social corporate investment are additional areas to explore along with viability of establishing and sustaining mHealth in remote areas of Botswana. Comprehensive mHealth policies and systematic practices require evidence to guide development according to the realities and needs of specific health systems (WHO, 2011:77). The remote area health service delivery in Ghanzi District has unique needs to be considered to advocate for collaboration with strategic partners. Facilitating the expanded development and replication of mHealth solutions and telemedicine projects from the urban areas to remote areas of Botswana is possible through collaboration and continued commitment of resource allocation.

## **2.5 Summary**

The transformation of health service delivery with mobile technology has demonstrated improved access to care. Various impacts of mHealth initiatives have been illustrated through users perceptions of the mobile devices. Improving mobile telecommunication connecting health workers in remote areas of Botswana with pilot mHealth initiative “Talk for Life” reveals

practical solutions to mitigate challenges to access in a resource limited setting. Reflecting on the experiences of health workers in Ghanzi is critical to determine the influence of telecommunication on service delivery in remote areas and to guide future interventions for increased access to healthcare. Collaborative stakeholder involvement has the potential to further advance and sustain cost-effective contextual mHealth solutions.

### **3. RESEARCH DESIGN AND METHODS**

#### **3.1 Qualitative Data Collection**

A qualitative study was conducted with health workers between October and November 2012. Data was collected from a total of 15 semi-structured interviews with a variety of health workers throughout Ghanzi District. Inclusion criteria for the target group are health workers that have been based with the health facility for more than one year in “Talk for Life” operational areas. The sampling was purposive in locations where the phones are in use. Specific locations of data collection include sampling of seven health facilities in Ghanzi District:

1. Grootlaagte Health Post
2. Ghanzi District Rural Administration Center
3. Kuke Health Post
4. Letloa Trust, Kuru Community Health Program Office, D’Kar
5. Ghanzi Primary Hospital Lab
6. D’Kar Health Post
7. Ghanzi Clinic

Sampling of the semi-structured interviews was done with fifteen various health workers:

1. Nurse based in Health Post (2)
2. Nurse based in Township Clinic (1)
3. Ghanzi District Health Team Management, TB Coordinators (1)
4. Ghanzi District Health Team Management, Public Health Specialist (1)
5. Kuru Health NGO program staff (5)
6. Nurse orderly based in Health Post (1)
7. Cleaner based in Health Post (1)
8. Night watchman based in Health Post (1)
9. Lay VCT counselor (1)
10. Health Education Assistant (1)

The following documents were also reviewed and further contribute to the results and discussion:

- Kuru Health “Talk for Life” phone log books: located at each health facility and/or location using the “Talk for Life” mobile phones (2012). The log books contain information including: date, name of person calling, location calling to, person calling to and the reason for the call.
- Kuru Health Program monthly progress reports (2010-2012).
- “Talk for Life” mHealth Baseline Rapid Assessment, Kuru Health (April, 2012)
- “Talk for Life” mHealth Pilot Initiative Mid-Term Assessment, Kuru Health (July 2012).

### **3.2 Semi-structured Interviews**

The semi-structured interviews gathered data on participants’ reactions to the “Talk for Life” pilot, how they use the mobile phones and their overall perceptions to the mHealth initiative. The interviews allowed for qualitative data collection of the health workers’ professional background and experiences with healthcare service delivery in the remote areas of Ghanzi. General data including development status of the remote area health facilities was collected. Information including whether or not the facility has electricity, water, communication and transport methods was collected for contextualization of available services in Ghanzi. Respondents were further asked about how often they require communication with other health facilities within the system and what are the most common methods of reaching the hospital, lab, and ambulance. General communication patterns and the reasons for using telecommunications in particular were also documented.

The majority of the interview focused around how the health workers are using the “Talk for Life” phone and what are their opinions about the Kuru Health mHealth initiative. How the phone is used, reasons and frequency of use along with practicalities of how the phone is being shared amongst the other health workers in the facility and community health promoters. As the primary users of the phones, respondents explained what they believe is the most beneficial about the “Talk for Life” initiative. Challenges were also probed along with individual recommendations on how to improve the pilot mHealth initiative.



Interviews with Botswana Ministry of Health, District Health Management Team employees allowed for further discussion of potential mHealth collaborations between NGOs and government. The Public Health Specialist and TB Coordinators were interviewed to assess perceived changes in the healthcare service delivery in Ghanzi as a result of “Talk for Life”. Experiences with HIV/AIDS and TB management in the remote areas were discussed in relation to use of telecommunications in the District. Recommendations on how to improve the pilot mHealth initiative were also documented.

Kuru Health Program Manager was interviewed to gather the NGO’s experiences as the initiators and implementers of the project. Views on how the pilot project is working and future plans for “Talk for Life” mHealth initiative were gathered from Kuru Health Program staff. Respondents were asked to describe what they believe are the most positive results of the pilot project during the first year of inception. Their perceived changes of the healthcare service delivery as a result of the “Talk for Life” mobile phones were collected.

### **3.3 Data Analysis**

The qualitative data from the interviews were transcribed. Common responses were grouped and then coded. The codes were then categorized and grouped into themes. Discussion around the resulted theme provides the basis for the recommendations and conclusions surrounding perceptions of health workers about the “Talk for Life” mHealth project.

### **3.4 Ethical Considerations**

Ethical clearance to conduct the study was granted by the following institutions:

- Stellenbosch University, Research Ethics Committee
- Botswana Ministry of Health, Health Research and Development Division
- Botswana Ministry of Health, Ghanzi District Health Management Team

Professional opinions were documented in confidence taking full responsibility so as not to inconvenience participants. Voluntary consent was obtained from all participants in writing through the use of the participant consent form. Names of health workers interviewed were not

recorded during data collection. There were no incentives given to participants. All of the data collected was stored safely in a locked cabinet. Electronic transcription, analysis and write-ups were stored in a password protected computer. There was no sharing of data with external parties.

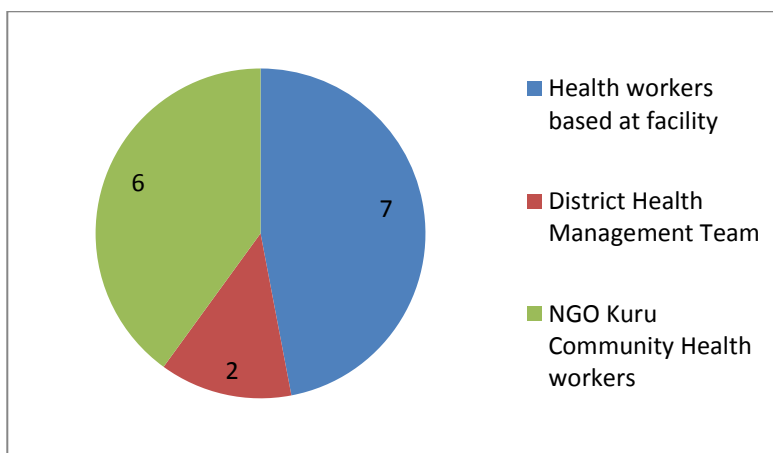
## 4. RESULTS AND DISCUSSION

This chapter details qualitative findings from 15 semi-structured interviews with health workers in Ghanzi District. The general professional background of the respondents is reported by category, position, type of facility and gender as captured from section A of the interview schedule. Descriptions of the individual facilities sampled include infrastructure, communication methods and reasons and frequency of use are encapsulated from section B of the interview questions. The results are then further combined and discussed according to: the reactions to the mHealth initiative (as taken from section B of the interview), the mobile phones impact on service delivery in Ghanzi (section C), recommendations to improve the “Talk for Life” network in Ghanzi (section D) and assessment of “Talk for Life” initiative according to the 10 e’s of eHealth (combination of interview section B, C and D).

### 4.1 Health Worker Respondent by Category

General professional background of the respondents was captured in section A of the interview. The results highlight experiences from health workers based at primary care facilities in the remote areas, District Health Management Team staff and NGO Kuru Community Health workers. The graph below illustrates the various categories of respondents. All of the respondents are users of the “Talk for Life” mobile phones and have been working in the area for more than one year.

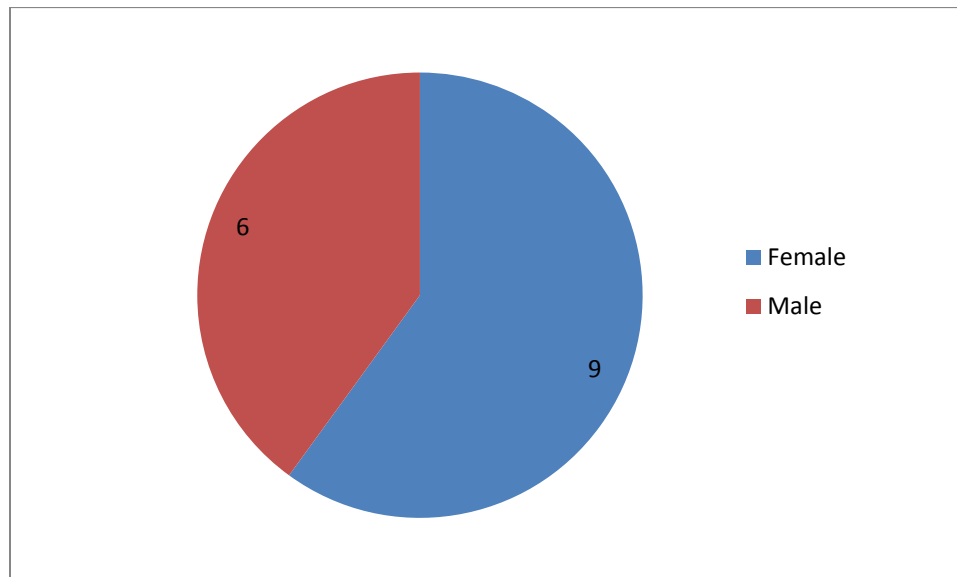
*Health worker respondents by category*



The general background of the 15 health worker respondents by category are detailed below according to position, type of facility and gender:

1. Nurse based in Health Post (2 Females)
2. Nurse based in Township Clinic (1 Female)
3. Ghanzi District Health Team Management, TB Coordinators (1 Male)
4. Ghanzi District Health Team Management, Public Health Specialist (1 Male)
5. Kuru Health NGO program staff (3 Female, 2 Male)
6. Nurse orderly based in Health Post (1 Female)
7. Cleaner based in Health Post (1 Female)
8. Night watchman based in Health Post (1 Male)
9. Lay VCT counselor (1 Female)
10. Health Education Assistant (1 Female)

*Health worker respondents by gender*



For ethical purposes of confidentiality and consideration, distinction between respondent category and professional affiliations are not indicated in the findings. Individual respondents

are indicated numerically and presented in a common category as '*Health worker, Ghanzi District*'.

## **4.2 Health Facility Description**

The health facility descriptions encapsulate section B of the interview schedule detailing health workers' experience with health service delivery in Ghanzi. The health worker respondents were sampled from health facilities in seven different localities within Ghanzi District. Respondents' experiences with health service delivery were captured with specific reference to infrastructure, communication methods and reasons and frequency of use.

### **1. Grootlaagte Health Post**

Grootlaagte Health Post was connected to electricity in 2010. There is no land-line telephone in the health facility. The two-way roger-roger radio was reported to be working. The two-way radio was reported to be used a couple of times a week, mostly to communicate with Qabo (another settlement relatively nearby) where the water supply is pumped from. The two-way radio was also reported to be used to contact the hospital and clinic in Ghanzi township with emergency medical cases before the 'Talk for Life' phones were introduced. The two-way radio was reported to be difficult to use because often there is no answer from who one is trying to reach. In emergency situations when the health worker needs to report and emergency or seek assistance from a mid-wife, there is often no answer on the other end with the radios.

The most common mode of transport from Grootlaagte to Ghanzi township is government vehicles, the ambulance, and lifts from various private farm owners. It was reported that the ambulance is physically used to deliver messages to facilities in town on a daily basis. The facility requires contact with colleagues for lab test results, certain medical supplies and general patient management on a daily basis, which is done with physical transport by the ambulance.

There is only one mobile phone network available in Grootlaagte. Bemobile provides cellular connectivity, which was reported to be 'sometimes reliable' by respondents. Health workers reported using their own personal cell phones to contact the hospital with emergency cases, but only when they have enough air-time to do so. The 'Talk for Life' phone "has allowed us to help

people and connect more easily whereas before we were relying solely on physical transport. The phone is kept at the facility to ensure anyone who is there can use it” –*Health worker 11, Ghanzi District.*

## **2. Kuke Health Post**

Kuke Health Post is not connected to electricity. A small solar panel provides an alternative source of power that only has enough capacity for small appliances such as charging cell phones. There is a land-line telephone at the facility. The land-line provides for communication only with other land-lines, it is not open to call mobile numbers. The health workers reported using the land-line for contacting colleagues at the lab to get test results, order clinical supplies and follow up on those patients who have been referred to the hospital in Ghanzi township. The respondents reported a need to communicate with colleagues in other facilities on a daily basis. “We use cell phones more than the land-line because not all facilities have land-lines and we often need to contact others when tracing patients. Also the toll-free number for the hospital can take a long time or not work at all, there are times when there is no answer at all” –*Health worker 12, Ghanzi District.*

Kuke Health Post provides care for a number of private farms surrounding the area. Challenges communicating to the majority of farms were reported by respondents since the ‘Talk for Life’ phones are only available in two of many farms in the area. Use of physical transport with the ambulance is the only means of reaching the farm communities. An ambulance was stated to make at least two trips to the hospital in Ghanzi township each week to deliver specimen and collect lab test results. Respondents described challenges of notifying patients that are staying in the farms once results have been collected. The health workers are often forced to wait until there is transport available to conduct the mobile outreach to deliver test results to patients in the farms.

Kuke has three mobile networks available including Mascom, Orange and Bemobile. Respondents stated the connectivity of the networks to be ‘very reliable’. Health workers reported using personal cell phones for contacting doctors outside of the ‘Talk for Life’ phone network. They reported a need to communicate directly with doctors for specific advice in

diagnosing patients and certain treatments. The ‘Talk for Life’ phone remains located at the facility and is shared by all staff and volunteers while the clinic is open.

### **3. D’Kar Health Post**

D’Kar Health Post is connected with electricity. The facility has a land-line telephone. The need to communicate daily to other health workers was reported by respondents. Patient referrals, tracking patients and emergency situations were mentioned as reasons for contacting other colleagues in the District.

“The land-line is placed in a central location within the health post. We are often busy with clients so are not able to move to answer the phone. When someone answers it, nurses are busy consulting in other parts of the facility. It is easier to reach someone with a mobile phone because you are able to move around with it” –*Health worker 14, Ghanzi District.*

The cellular network providers available in D’Kar are Mascom, Orange and Bemobile. Respondents reported the connectivity to be ‘very reliable’. The most common mode of transport is an ambulance which makes daily trips to the hospital in the township. An ambulance will be sent to collect any supplies required by the facility, and was previously used to collect lab results before the “Talk for Life” phones. Now that there is a mobile phone connected with the lab, it is used to follow up results more than the land-line or physical transport. The ‘Talk for Life’ phone was reported to be shared by all of the facility staff and volunteers.

### **4. Ghanzi Clinic**

The Ghanzi Clinic facility is connected to electricity. The facility has two land-line telephones, one located in the office and one located in the consultation room. There is a two-way radio in the facility that is not working properly. When the radio is working, it was reported to be used only when the land-lines were not working. Health worker respondents at Ghanzi Clinic have a need to communicate with colleagues in other facilities district wide on a daily basis, all day. The biggest challenge reported was contacting remote facilities where there are no land-lines and no electricity. There is a need to be in contact with such facilities to track patients, follow up patient progress and give feedback to health workers about patient referrals and diagnosis.

Physical transport with the ambulance is used to get ahold of a nurse in a remote facility in the absence of an alternative method of communication.

The cellular providers available in Ghanzi township are Mascom, Orange and Bemobile. The networks were reported to be ‘very reliable’. The “Talk for Life” phone was reported to be shared by everyone in the facility. The “Talk for Life” phone was said to make contact with remote facilities easier and has assisted in tracking patients and reaching health workers immediately. The health worker reported use of a personal cell phone to reach colleagues in facilities that are not connected in the “Talk for Life” areas of operation.

#### **5. Letloa Trust, Kuru Community Health Program, D’Kar**

The Kuru Community Health Center located in D’Kar is connected to electricity. The office has a land-line telephone. The program staff respondents reported the need to communicate with colleagues on a daily basis primarily for purposes of reporting patient progress and following up lab test results. Additional reasons were stated to be planning for mobile health outreach visits to remote localities and progress reporting with district wide community health promoters.

The program staff reported inadequate availability of transport to be able to physically visit remote area locations to provide adequate program support. Official correspondence required to notify health workers of program activities requires physical transport of letters and lab test results from intensive TB case finding exercises. Respondents stated the “Talk for Life” phones have provided a viable means of communication until transport becomes available either from the government ambulances or monthly community health promoter monitoring.

Challenges with the “Talk for Life” phones were expressed with the management of the phones in some of the remote facilities. A number of phones have been stolen and broken which caused certain locations to be disconnected from users in the network. The respondents described the interruptions in communication to delay progress while sorting out replacement phones and further agreeing on alternative security measures to prevent future damage.



## **6. Ghanzi District Rural Administration Center**

The Ghanzi District Rural Administration Center is connected to electricity. There are a number of land-line telephones in the offices for use by District Health Management Team staff. The respondents reported a need to communicate with health workers throughout the district facilities on a daily basis. The majority of reasons for contacting colleagues were cited as following up patients and reporting on health outcomes. The “Talk for Life” phone was said to be used more than the land-lines due to a number of facilities in the district without access to land-lines.

The “Talk for Life” phone was reported to be shared amongst all TB and HIV/AIDS program staff as well as facility supervisors. Respondents described using the phone more frequently at the end of the month when compiling reports of health outcomes. Personal cell phones were required to be used to contact the remote facilities that are without a land-line not included in the “Talk for Life” network. Physical transport was previously required to reach certain locations in the absence of a tele-communication option. The availability of transport for use by the District Health Management Team staff was proclaimed to be very difficult and often not available. Without being able to physically visit remote facilities for monitoring, the ‘Talk for Life’ phone provided means to verify health outcomes.

## **7. Ghanzi Primary Hospital Lab**

The Ghanzi Primary Hospital Lab is connected to electricity. There is a land-line in the lab. The respondent reported the need to communicate with health workers in all facilities district wide on a daily basis throughout the day. Sometimes specimens are delivered to the lab without complete records which requires clarifications to be sought. Additionally, being able to communicate results of the lab tests immediately requires the lab to contact facilities directly. The respondent explained at times there is a need to locate a certain patient from anywhere in the district immediately depending on the outcome of the lab result. Positive TB diagnosis requires patients to start treatment instantly, which requires communicating results to the health worker at the facility. In the absence of land-line telephones in some facilities, the ‘Talk for Life’ phone is able to reach the nurse to locate the specified patient for treatment initiation. When there is no way to reach the remote facilities and health workers by phone, physical transport is required to deliver results and sometimes track patients.

### 4.3 Reactions to “Talk for Life” mHealth Initiative

This section encapsulates combined responses from section B of the interview stating experiences with health service delivery. The results of this study confirm health workers reactions and utilization of the “Talk for Life” mHealth initiative. Remote area health workers have an overwhelming need to utilize consistent mobile telecommunication to provide adequate patient care. Initial experiences with the mobile phones as documented in this discussion contribute to lessons learned and perceived impacts of the mobile phones on service delivery by health workers throughout Ghanzi District. Common themes from health workers’ utilization of mobile telecommunication for health, specific content, and capacity are considered with a contextual health system management perspective analysis.

“Talk for Life phones allow us to follow up immediately, reach who you are looking for quickly and you can talk for as long as you need...we are now able to reach the Community Health Promoters on the farms, it has made a lot of change” –*Health worker respondent 1, Ghanzi District.*

Health workers throughout Ghanzi District are using the “Talk for Life” mobile phones for multi-purposes. The most common response cited primary use of mobile phones to track patients. Diagnosis, treatment initiation, follow-up and referral were daily activities mentioned by health workers’ responsibilities of tracking patients. Numerous experiences with the phones indicate how mobile telecommunication is improving the provision of health care in the remote areas. The reasons respondents cited for utilizing mobile telecommunications in health care delivery on daily basis in Ghanzi District include:

- Feedback on individual patient clinical diagnosis and progress
- Referral from remote health post facility to District Primary Hospital
- Results of lab tests
- Confirm patient details for lab specimen
- Tracking TB patients that have moved from one location to another
- Give information about TB patient progress for reporting
- Verify patient lists for managing Community TB Care
- Inform the lab of specimen that are on the way

- Emergency car accidents require assistance from ambulance to transport patients to the health facility
- Ordering clinical supplies and drug stock from other facilities
- Request transport to collect pregnant woman and assist them to present at health facilities when giving child birth.

The majority of respondents cited the portability and mobility of the phones as being one of the most important features contributing to reach health workers wherever they are. Most of the time one will not be able to reach the nurse because he/she is in the consulting room or traveling with the mobile clinic and is not within physical reach of the land-line at the health facility. Even in areas where there are reported land-line telephones, mobile phones are perceived to be much more effective and user friendly.

“Patient care requires consultation with doctors and colleagues in a variety of locations...the mobile phones are the best way to communicate because you can take them anywhere” –*Health worker respondent 2, Ghanzi District.*

Using mobile phones has also assisted health workers in contacting the hospital with emergency cases. A number of respondents reported situations of accidents resulting in injuries requiring a patient to be transported from a remote settlement to the District Primary Hospital. When the ambulance is not at the health facility to be able to assist a patient with transport, and there is no way to communicate with the hospital in town, health workers expressed inability to provide adequate care. Acknowledging that numerous emergencies occur far away from central hospitals and are often treated by non-specialist health workers, telemedicine provides the easiest way to enable mobile communication anywhere, anytime (Kyriacou et al., 2011).

“When there is an emergency we can now call for help from others immediately” –*Health worker respondent 3, Ghanzi District.*

The “Talk for Life” phones have enabled serious health conditions to be communicated to the primary care center from instances of 100 km away. The ability and user satisfaction of respondents to reach emergency assistance with a mobile phone indicates the change in communication pattern contribution to improved service delivery.

The “Talk for Life” Mid-Term Assessment conducted by Kuru Health in July 2012 also documented positive perceptions of the mHealth initiative. Health workers as primary users of the mobile phones rated the overall performance of the Talk for Life project five months after inception to be excellent (55%) and very good (45%). Practical examples of how the mobile phones are contributing to improved health service delivery have been documented by a variety of health workers, from nurses in the township to community health promoters in private farms.

There was a certain woman, who was staying here on the farm, and she was diagnosed with TB and ... she kept on running from farm to farm. I used the Talk for Life phone to call and notify the Kuru Health people about the woman and they made follow up on her until she was found...The woman was then enrolled on our community TB treatment program –*Community Health Promoter (2012)*.

The phones have allowed community health promoters in remote farms to be connected to the health workers at the facility. Before the phones, the only connection with health workers would be when they pass through providing brief mobile clinic visits which vary in frequency depending on the availability of transport. Communicating either once a month or once every few months with the mobile stops has since changed to provide the means to connect whenever the need arises.

#### **4.4 mHealth Impact on Health Service Delivery in Ghanzi**

The impact mHealth has made on health service delivery in Ghanzi is encapsulated with responses from health workers observations in (section B of interview) and opinions (section D). The highest ranking theme response by respondents illustrate that the mobile phones are working well at contributing to the need for daily communication between healthcare workers in remote areas for adequate service delivery. Practicing medicine at a distance involves communicating with other health workers to confirm patient diagnosis, determining appropriate treatment plans and health education. “Before it was hard to find a TB patient that has defaulted on treatment, but since Talk for Life phones we are able to trace them so easily” (Kuru Health, 2012). mHealth facilitates a communication channel for health workers to provide care regardless of physical location at a given time.

“I use the Talk for Life phone all day, every day. It is the busiest phone...for both incoming and outgoing calls” –*Health worker respondent 4, Ghanzi District.*

The majority of respondents illustrated changes in health service delivery as a result of “Talk for Life” phones. Respondents recognized that there is a significant amount of time wasted by health workers as human resources required to physically travel to find a particular patient who needs urgent care. In the remote areas cell phones allow the communication to locate and advise patients remotely and from a distance. Previously the healthcare system in Ghanzi primarily relied on physical transport as a means of communicating between healthcare workers. Improving the turn-around-time for diagnostic lab test results from the district hospital to remote area facilities also ranked a high priority theme among respondents.

“Patient care has improved a lot, since these phones we can identify MDR-TB patients well on time...Before it was difficult to know about the results from the labs, but now we can communicate TB results to the health facilities through the phone” –*Health worker respondent 9, Ghanzi District.*

External factors potentially contributing to improved ability to diagnose DR-TB are recent developments that have improved Ghanzi Primary Hospital Laboratory. The upgraded diagnostic tool of GeneExpert allowing for rapid testing of TB resistance also promotes expedited results. The combination of rapid diagnostic infrastructure and mobile phones to communicate the results immediately has significantly sped up diagnosis and treatment initiation of DR-TB for patients district wide.

In the absence of communication through a land-line or two-way radio, health workers reported using their own personal cell phones for communication with other colleagues, but without compensation for air-time, the calls get cut short and inhibit service delivery. At times, health workers stated they would only make calls from personal cell phones when requiring emergency assistance. Other purposes of following up patient progress, tracking patients, or getting test results back from the lab were described by respondents as not as high of a priority to use personal resources in the absence of a communication device provided by the health system itself. Cases of respondents waiting to receive physical paper based notification of lab test

results were reported to previously take up to many weeks. Using the “Talk for Life” mobile phone, it takes only one day.

Healthcare delivery systems that are modeled around patients presenting to providers at a facility ‘have proved inadequate in many developing country settings’ (Rajput et al, 2012). The Center for Health Market Innovations (CHMI) explains “the use of technology by a large percentage of programs to extend geographic access to health care is particularly promising... [in] the form of telemedicine, which connects physicians and patients via technologies such as video chat, or health hotlines, which provide patients with around the clock access to qualified doctors” (Lewis et al., 2012). A study done by CHMI found that a high majority of more than 90% of programs that facilitate patient communication use phones. The programs that were able to connect underserved patients with lesser trained health workers to specialized physicians through mobile devices reported improved access to care, treatment and diagnosis (Lewis et al., 2012).

Similar sentiments were acknowledged by the respondents in Ghanzi District. Despite vast distances between facilities, the “Talk for Life” phones are used for improving patient diagnosis with the ability to communicate to the laboratory from the remote area facility. The mobile phones have enabled health workers to initiate TB treatment earlier with a mobile communication channel informing the facility as soon as the test results are out. The lengthy turn-around-time of waiting for transport to be availed to deliver lab test results to the remote facilities has been improved with the mobile phone. Health worker respondents’ positive opinions of how the phones are working has enabled the adoption and engagement with immediate communication to improve service delivery.

#### **4.5 Recommendations to Improve mHealth in Ghanzi**

The recommendations to improve mHealth in Ghanzi in this section are encapsulated from the opinions section D of the interview schedule. When asked to recommend how to improve the “Talk for Life” mHealth initiative for more effective health service delivery, all of the respondents suggested an expansion of the pilot project to varying degrees. Some believed that expanding the number of mobile phone units to other facilities that do not yet have a “Talk for Life” phone would be sufficient. Others suggested specific positions within the health system

that should be included in the mobile phone network (drivers, nurses, health education assistants). Locations suggested for expansion include Bere, Qabo, East Hanahai, and Ghanzi Primary Hospital (reception, out-patient ward, male ward, female ward). Doctors and specialists linked to referral hospitals in Gaborone were also mentioned by a number of respondents.

Various other recommendations include the evolution of “Talk for Life” into a more sophisticated mHealth initiative using smartphones to allow for more than two-way voice communication.

“We could really use assistance making diagnostic decisions to best help our clients. It could especially help with patients on the spot. There are many of our patients in Ghanzi that are reluctant to access referral care at the district hospitals. We have a short time with them and we would be able to do more if it were possible to send pictures to specialist and be able to get feedback during initial consultations. We would not lose as many patients to follow up that we are now. Smartphones would allow us to connect with doctors remotely” –*Health worker respondent 5, Ghanzi District.*

Such a structural system change to develop the mHealth pilot into a larger telemedicine interactive practice in the remote areas requires more in-depth feasibility studies for interoperability and operationalization. One respondent explained that implementing dynamic changes would require strong partnerships and memorandums of understanding between the government MoH, NGOs, and private sector partners. There is a potential for a larger more comprehensive mobile network to link the health workers in Ghanzi with regional mHealth networks.

“More electrification will enable a more sophisticated infrastructure and mHealth initiatives in the remote areas. Telehealth allows health to expand to areas where there is no doctor within reach of travel. Talk for Life infrastructure could improve to beyond just voice. Smartphones would essentially allow for a more diverse data transfer with photo mHealth applications. Such developments are highly dependent on the mind-set of government actors” –*Health worker respondent 6, Ghanzi District.*

All of the respondents believed that “Talk for Life” mobile phones have positively improved healthcare service delivery in Ghanzi. Insights from various implementers of mHealth projects find it “obvious to every person in public health care” that in remote area service delivery, health

workers require means to provide care in their own communities (Ingawale, 2012). Such systems could also be cost effective (Rajput et al, 2012) with more in depth assessments of communication and health system integration.

Despite unanimous responses to expand the “Talk for Life” mHealth initiative, various challenges limit the feasibility of the recommendations. Ghanzi District’s lack of ICT infrastructure, inadequate connectivity and low pace of development remain as barriers to effective mHealth expansion. Even in areas that do have electricity and mobile network connectivity, frequent power cuts are very common. Some of the respondents mentioned either cuts in cellular reception or inadequate access to electricity as constraints in their observations and experiences with the mobile phones.

#### **4.6 10 E’s of eHealth from the lens of “Talk for Life”**

This section encapsulates a combined discussion of responses from health workers experiences with health service delivery (section B of interview schedule), observations of mHealth initiative ‘Talk for Life’ (section C), and their opinions (section D). Assessing the experiences and perceptions of the health workers as users of the “Talk for Life” mHealth initiative according to the 10 e’s that “best characterize what e-health is all about” (Eysenbach, 2001) allows recognition of impact. The following discussion highlights the local capacity leading to potential future directions for health systems strengthening through mobile telecommunication in remote Botswana.

1. **Efficiency:** The “Talk for Life” mHealth solution is perceived to improve efficient health service delivery by all of the respondents as the users of the facility. Notification of lab test results is now done immediately without delay of waiting for transport to become available to deliver to the designated facility. Patients are able to be followed with a quick phone call rather than physical travel that could possibly take more than one day.

2. **Enhancing quality:** The “Talk for Life” mHealth solution enables enhanced quality of health management through mobile communication. One respondent indicated the mobile phone being the desired communication channel for verifying patient treatment outcomes and reporting



monthly data to the District health officials. More timely and adequate reporting of treatment outcomes essentially enhances quality of disease surveillance.

3. **Evidence based:** documentation by Kuru Health of the perceptions of “Talk for Life” users was done before the inception of the project as a Baseline Rapid Assessment in March 2012. A Mid-Term Review was undertaken in July 2012. This study provides further evidence that the “Talk for Life” mHealth project is well received by the users and is improving service delivery in the remote areas.

“The cost is small in monetary terms comparing the numerous benefits that Talk for Life has improved communication and accessibility in the overall health care system” –*Health worker respondent 7, Ghanzi District.*

4. **Empowerment:** The “Talk for Life” phones have enabled a network of health workers to communicate with each other. With the phones based at healthcare facilities, numerous service providers have been empowered to utilize the phones. Some health workers explained sharing the phone with everyone connected to the healthcare facility including the night watchman, cleaner, nurse orderly, etc. In some instances these are the only individuals that can be found at the facility and they have recently been empowered to use the phone to communicate emergencies, request drug stock and/or clinic supplies. One respondent reported using the “Talk for Life” phone to communicate with other community service providers in the settlements including the government alcohol volunteers and community police volunteers. Others reported referrals and tracking patients in the area that are highly mobile has been made easy with the mobile phones.

5. **Encouragement:** The “Talk for Life” mHealth project initiated by Kuru Health has received a plethora of encouragement from partners. The Ministry of Health National TB Program and District Health Management Teams highly encouraged the project and further guided the rapid assessment and pilot evaluation design to fully document the outcomes.

Encouragement has also been expressed to Kuru Health by other health sector partners including BUP and UB.

6. **Education:** “Talk for Life” mobile phone facility does not directly provide education for the users. This is an opportunity that could be further explored with an upgraded mobile device such as a smartphone.

Almost half of the respondents were aware of other mHealth initiatives in the country. There are still a large number of people in the District that are not yet aware of the potential of ICT to provide health education through mobile phones. Some reported having heard of the SMS based project in Gaborone that facilitates ARV treatment adherence, clinic appointment and medication refill reminders. One of the respondents mentioned being aware of the interactive mHealth initiative that allows one to send an SMS to ask questions and get answers about HIV/AIDS and TB. Others mentioned being aware of the smartphones being used with GPS in Chobe District for malaria eradication.

7. **Enabling:** “Talk for Life” enables 24-hour immediate and mobile two-way telecommunication between health workers in the remote areas with no cost to the user.

“There was a certain woman who was tested for TB, and her results were being delayed so I used the Talk for Life phone to call the lab and within a short period of time I enquired about the results. I was given notice that the woman tested sputum positive for TB and was able assist her to enroll in TB treatment immediately. If it wasn’t for the Talk for Life phone, the results were going to take a long time to be communicated to us...waiting for transport to be made available and physically transport the results by road” –*Health worker respondent 13, Ghanzi District*

8. **Extending:** Respondents unanimously believe mobile telecommunication has been extended to community service providers through the health facilities with “Talk for Life” phones. Health worker respondents from the NGO sector further portrayed the mHealth project extending the partnership and working relations between civil society and government health service providers to be positive.

9. **Ethics:** Challenges with management of the phones as well as patient monitoring are ethical issues that apply to mHealth initiatives. Security of the mobile phones is important to

ensure they are maintained to be able to serve the desired purpose of enabling health workers to communicate with each other. There were few responses that highlighted frustrations of the mobile phones being lost, stolen or damaged. Additional challenges mentioned that some forget to turn the phone on or re-charge the battery. “The person using the phone has the responsibility to take care of the cellphone. We always encourage each other to be extra careful when handling the phone. To us it has to do with responsibility to those people on-call to make sure the phones are kept safe” –Health worker (Kuru Health, 2012).

“Joint ownership of the mHealth initiative between NGO and government partners will improve the security and management of the cell phones. Increased accountability by managers and users of the phones will ensure they are looked after and taken care of. In that way the phones will last longer and continue to be available for their intended purpose of connecting health workers” – *Health worker respondent 10, Ghanzi District.*

10. **Equity:** “Talk for Life” mHealth pilot has demonstrated that equitable communication for improved health service delivery in the remote areas may be as simple as providing a closed mobile phone network. Integrated outreach programs and telemedicine have been cited as relevant initiatives “associated with greater equity in access to care, and more coherent services with greater continuity” (Rygh & Hjortdahl, 2007).

Despite numerous respondents desire to have the closed user group network opened to allow the mobile phones to be able to call any number, contradictory arguments reveal the cost of providing such a solution is not effective, nor necessary for the intended purposes. Increasing access to the closed network by drivers of ambulances, nurses on mobile clinics and additional locations deemed the most viable and cost-effective means of expanding the mHealth solution.

## 5. CONCLUSION AND RECOMMENDATIONS

As the eHealth movement continues to develop and expand throughout Southern Africa, many of the current structural obstacles can be more effectively managed through the use of ICT and interactive mHealth for customized patient care. The challenge of vast distance between health facilities in Ghanzi District, Botswana has been improved with a closed mobile phone network for health workers. Health workers in Ghanzi reported being able to access lab test results faster, provide TB treatment initiation earlier, and respond more effectively to emergency cases with the use of the “Talk for Life” mobile phones. All respondents as users of the pilot mHealth initiative expressed satisfaction with the facility.

With data being passed from the initial point of care at remote health posts to laboratories that are located far from the health facility, information sharing across vast distances is required within the health delivery system. Experiences described by users of “Talk for Life” phones indicate the mHealth initiative has improved communication between health workers in the remote areas of Botswana that were previously solely reliant on physical travel for patient diagnosis and follow up. Recommendations made by health worker respondents to expand the mHealth facility into a district wide network are critical for the full potential of the initiative to be realized. “Talk for Life” phones should be extended to facilities that are not currently part of the “Talk for Life” pilot. Specific locations proposed by respondents include health post facilities in Bere, East Hanahai, Qabo, and the Ghanzi Primary Hospital TB Ward. Health workers believe expanding the locations in the network will assist in tracking patients, improve referrals and reduce the instances of patients being lost to follow up.

Additional suggestions by health worker respondents include expanding the network to doctors in urban referral hospitals to enable “Talk for Life” to advance from a simple mHealth initiative into a more comprehensive solution. Further improvements to the system by upgrading the basic mobile phones with smartphones and linking into existing telemedicine projects located in the urban centers would allow for yet another dimension of improved ability to provide and manage decentralized health services in the remote areas of Botswana. Numerous health workers advocated for smartphones replacing the simple “Talk for Life” phones that only allow for two-

way voice communication. Responses motivating health workers to request smartphones include the ability to access updated medical advances from the internet and further expand mobile communication through applications beyond voice.

The opinions of respondents as the users of “Talk for Life” mHealth initiative provide a strong basis for larger scale telemedicine advancement in the remote areas of Botswana. Fundamental changes in health service delivery through the use of mobile technologies will continue to enable improved patient centered access and clinical care. Telemedicine solutions provide a gateway to decentralize health services with guidance from remote specialists to primary care workers, further shifting service provision to community and home based care (*as cited in Rygh & Hjortdahl, 2007*). Obstacles including delayed notification of lab test results, lack of transport, difficulties in tracking patients, and poor reporting of treatment outcomes have improved as a result of “Talk for Life” mHealth initiative.

“There is no question about it, Talk for Life has added value to communication, it has improved management of the health system in the area... Lets continue with the Talk for Life and find ways to sustain it” –*Health worker respondent 8, Ghanzi District.*

Policy makers and National health management teams have the responsibility to realize the benefits of mHealth and telemedicine for cost-effective improved access to healthcare in the remote areas of Botswana. National health outcomes have a strong potential to improve with a more pro-active integration of mHealth into public health strategic plans and operational frameworks.

## REFERENCES

Akter, S., D'Ambra, J., & Pradeep, R. (2010). User Perceived Service Quality of mHealth Services in Developing Countries. 18th European conference on Information Systems. Research paper manuscript number ECIS2010-0087.R1. [Electronic version] Retrieved 5 April 2012 from [is2.1se.ac.uk/asplaspewis/20100030.pdf](http://is2.1se.ac.uk/asplaspewis/20100030.pdf)

Armstrong, Kathleen, Fang Liu, Anne Seymour, Loeto Mazhani, Ryan Littman-Quinn, Paul Fontelo, and Carrie Kovarik.(2012). Evaluation of text2MEDLINE and Development of Short Messaging Service-Optimized, Clinical Practice Guidelines in Botswana. *Telemedicine and e-Health Journal*. January/February 2012, vol 18(1).

Bashshur R., Sanders J, Shannon G. (1997). *Telemedicine Theory and Practice*. Springfield, IL: Charles C Thomas Publisher Ltd, p.9.

Bedford, Juliet. (2011). Understanding health psychology and the science of human behavior. Vodafone mHealth Solutions, Evaluating mHealth Adoption Barriers; Human Behavior. Insights Guide. Vodafone Group. [Electronic version] Retrieved 10 April 2012 from [mhealth.vodafone.com](http://mhealth.vodafone.com)

Canton, N. (2012, September 12). Ex-Apple boss tackles poverty in India with mobile technology. *Our Mobile Society*. [Electronic version] Retrieved on 23 September 2012 from [CNN.com](http://CNN.com).

Chang, AY, Ghose, S., Littman-Quinn, R., Anolik, RB., Kyer, A., Mazhani, L., Seymour, AK., & Kovarik, C. (2011). Use of mobile learning by resident physicians in Botswana. *Telemedicine journal of eHealth*. Jan-Feb; 18(1): 11-3.

Curioso, H., & Mechael, P. (2010). Enhancing 'M-Health' With South-To-South Collaborations. *Health Affairs*. 29(2): 264-267.

Dolan, B. (2011, June 6). HP supports malaria tracking in Botswana. Chester street publishing. [Electronic version] Retrieved 5 April 2012 from <http://mobileHealthnews.com/11122/hp-supports-malaria-tracking-in-botswana/>

Dzenowagis, J. (2011). Bridging the Digital Divide in Health. [Electronic version] Retrieved 10 October 2012 from [www.un.org/80/issues2011](http://www.un.org/80/issues2011).

Eysenbach, G. (2001). What is e-health? *Journal of Medical Internet Research*. April-Jun 3(2): e20.

Gormley, Rachel H., Kelly Quinley, Ting Shih, Zsofia Szep, Ann Steiner, Doreen Ramogola-Masire, and Carrie Kovarik. (2009). Use of Mobile Telemedicine for Cervical Cancer Screening. Poster session presented at mHealth Summit in 2009 Washington, DC.

Hwabamungu, B. & Williams, Q. (2010). M-Health adoption and sustainability prognosis from a Care givers' and patients' perspective. Meraka Institute, Council for Scientific and Industrial Research. Pretoria, South Africa. [Electronic version] Retrieved 17 May 2012 from [researchspace.csir.co.za/dspace/bitstream/10204/5366/1/Hwabamungu\\_2010.pdf](http://researchspace.csir.co.za/dspace/bitstream/10204/5366/1/Hwabamungu_2010.pdf)

Ingawale, M. (2012, September 16). Handheld device that saves lives. CNN.com Our Mobile Society. [Electronic version] Retrieved 23 September 12.

Istepanian, R., Jovanov, E., & Zhang, Y. (2004). Guest Editorial Introduction to the Special Section on M-Health: Beyond Seamless Mobility and Global Wireless Health-Care Connectivity. *IEEE Transactions on Information Technology in Biomedicine*. 8(4).

Johnston, Stephen. (2011). Evaluating behavior to marketed mHealth services. Vodafone mHealth Solutions, Evaluating mHealth Adoption Barriers; Human Behavior. *Insights Guide*. [Electronic version] Retrieved 10 April 2012 from [mhealth.vodafone.com](http://mhealth.vodafone.com)

Jones, Tim. (2011). An overview of mHealth opportunity. Vodafone mHealth Solutions, Evaluating mHealth Adoption Barriers; Human Behavior. *Insights Guide*. [Electronic version] Retrieved 10 April 2012 from. [mhealth.vodafone.com](http://mhealth.vodafone.com)

Kuru Health. (2010-2012). Letloa Trust (Kuru Family of Organisations) Community Health Program Progress Reports. D'Kar, Botswana.

Kuru Health. (2012, April). "Talk for Life" mHealth Baseline Rapid Assessment. Letloa Trust Community Health Program unpublished documents. D'Kar, Botswana.

Kuru Health. (2012, July). "Talk for Life" mHealth Pilot Initiative Mid-Term Assessment. Letloa Trust Community Health Program unpublished documents. D'Kar, Botswana.

Kyriacou, E.C., C.S. Pattichis, M.S. Pattichis. (2009). An Overview of Recent Health Care Support Systems for eEmergency and mHealth Applications. *Proceedings of the 31<sup>st</sup> Annual International Conference of the IEEE Engineering in Medicine and Biology Society*. 2-6 September 2009. Minnesota, USA.

Lewis, Trevor, Christina Synowiec, Gina Lagomarsino, Julian Schweitzer. (2012). E-helth in low and middle income countries: findings from the Center for Health Market Innovations. *Bulletin of World Health Organisation*. 90(332-340).

Littman-Quinn, R., Amit Chandra, Aileen Chang, Sankalpo Ghose, Carrie Kovarik. (2010). mHealth in Botswana: Driven by partnerships, customization, and local empowerment. Lessons learned on implementation, stakeholders, and sustainability in resource-limited settings. *Poster presented at mHealth Summit*.

Mars, Maurice. (2009). Telemedicine in Sub-Saharan Africa. In. R. Wootton, N. Patil, RE Scott, & K. Ho (Eds). *TeleHealth in the Developing World*. International Development Research Center (IDRC), Canada. Published by Hodder Education.



Masizana-Katongo, A., Leburu-Dingalo, T., & Mpoeleng, D. (2009). An Expert System for HIV and AIDS Information. *Proceedings of the World Congress on Engineering Vol.1*. London, UK.

Meachael, P.N. (2009). The Case for mHealth in Developing Countries. *Innovations*, 103-118. [Electronic version] Retrieved 5 April 2012 from [www.k4health.org](http://www.k4health.org)

Microsoft. (2007). HIV/AIDS Information System Taps Cell Phone Texting Capabilities. External Research, Digital Inclusion Program. [Electronic version] Retrieved 17 May 2012 from <http://research.microsoft.com/erp/digincl>

Mogorosi, G. (2012, July 26). ICTs crucial in health care delivery. Botswana Daily News, No. 139, p. 9. *Botswana Press Agency (BOPA)*. Gaborone, Botswana.

Monitor. (2012, July 23). Botswana Leads In Global Mobile Phone Density. [Electronic version] Retrieved 20 December 2012 from [www.mmegi.bw](http://www.mmegi.bw)

Mupela, Evans, Paul Mustarde, Huw LC Jones. (2011). Telemedicine in Primary Health: The Virtual Doctor Project Zambia. *Philosophy, Ethics and Humanities in Medicine*. 6 (9).

Norris, T., Stockdale, R., & Sharma, S. (2008). Mobile Health: Strategy and Sustainability. *The Journal on Information Technology in Healthcare*. 6(5): 326-333.

### ***Republic of Botswana***

Ministry of Health (MOH). (2008). Botswana National TB Program (BNTP). National Tuberculosis Control Program Strategic Plan 2008-2012. Gaborone, Botswana

Ministry of Health (MOH). (2007). Map of Ghanzi District Health Facilities. Department of HIV/AIDS Prevention and Care, Monitoring and Evaluation Unit. Gaborone, Botswana.

Ministry of Local Government (MLG). (2009). Ghanzi Profile. District Multi-Sectoral AIDS Committee (DMSAC). Ghanzi, Botswana.

Ministry of Local Government (MLG). (2010). Ghanzi Profile. District Multi-Sectoral AIDS Committee (DMSAC). Ghanzi, Botswana.

Ouma, S., Herselman, M., & VanGrauen, D. (2010). Essential UX Metrics to be Considered When Designing M-Health Applications in Order to Provide Positive User Experiences. *IADIS. International Conference eHealth*. 271-274.

Ouma, S, Herselman, M., & VanGrauen, D. (2011). Factors that influence m-health implementation in resource constrained areas in the developing world. *CIRN Prato Community Informatics Conference 2011, Referred Stream*. [Electronic version] Retrieved 5 April 2012 from [www.kit.nl](http://www.kit.nl)

PING (Positive Innovation for the Next Generation). (2011). Chobe MEEDS Pilot Project. [Electronic version] Retrieved 5 April 2012 from [www.pingsite.org/tech-projects/disease-surveillance-project](http://www.pingsite.org/tech-projects/disease-surveillance-project)

Quinley, Kelly, Rachel Gormley, Ann Steiner, Doreen Ramogola-Masire, Carrie Kovarik. (2010). The Use of Mobile Telemedicine for Remote Diagnosis of Cervical Lesions. *Telemedicine and e-Health*. vol 16 suppl 1.

Rajput, Zeshan, Samuel Mbugua, David Amadi, Viola Chepng'eno, Jason Saleem, Yaw Anokwa, Carl Hartung, Gaetano Borriello, Burke Mamlin, Samson Ndege, Martin Were. (2012). Evaluation of an Android –based mHealth system for population surveillance in developing countries. *Journal of American Medical Information Association*.

Rygh EM, & Hjortdahl P. (2007). Continuous and integrated health care services in rural areas. *Rural and Remote Health* 7: 766. [Electronic version] Retrieved 20 December 2012 from <http://www.rrh.org.au>

Schenck, Fonny. (2011). Adopting technology: understanding the challenges for healthcare professionals. Vodafone mHealth Solutions, Evaluating mHealth Adoption Barriers; Human

Behavior. *Insights Guide*. [Electronic version] Retrieved on 10 April 2012 from [mhealth.vodafone.com](http://mhealth.vodafone.com)

Schweitzer, J. & Synowiec, C. (2012). *The Economics of eHealth*. Results for Development Institute.

Shields, T., Chetley, A., & Davis, J. (2005). *Improving Health, Connecting People: the role of ICT in the health sector in developing countries*. *infoDev Working Paper Series, ICT and Health* [Electronic version] Retrieved 10 April 2012 from [www.infodev.org](http://www.infodev.org)

SNS (States News Service). (2011, October 26). *7 Billion Reasons for mHealth*. *Academic OneFile*. Washington, DC. [Electronic version] Retrieved 10 October 2012 from <http://go.galegroup.com>

SNS (States News Service). (2011, June 7). *Mobile Health Activity Spreads to over 4 in 5 countries, but remains limited to small scale and single issue projects*. *Academic OneFile*. [Electronic version] Retrieved 10 October 12 from <http://go.galegroup.com>

Stone, A., Schmitt, M., Awoonor-Williams, J., Phillips, J., & Yeji, F. (2011). "Community health worker reactions to data capture, patient alerts and care reminders via mobile phone". *Mobile Technology for Community Health in Ghana (MoTech)*. *mHealth Summit*, Washington DC December 5-7, 2011.

Stop TB Partnership. (2012). *Dramatic results from TB REACH project make case for mHealth scale up*. [Electronic version] Retrieved on 14 June 2012 from [www.stoptb.org](http://www.stoptb.org)

United Nations Development Program (UNDP). (2010). *Botswana Country Profile. The Program of Action for Sustainable Development in Botswana with specific reference to the Cross-Cutting Issues*. [Electronic Version] Retrieved on 20 February 2011 from [www.un.org/jsummit/html/prep\\_process/national\\_reports/botswana\\_natl\\_assess.doc](http://www.un.org/jsummit/html/prep_process/national_reports/botswana_natl_assess.doc)

United Nations Development Program (UNDP). (2010). Human Development Report 2010. [Electronic version] Retrieved on 20 February 2011 from <http://www.hdrstats.undp.org/en/countries/profiles/BWA.html>

United Nations (UN) Statistics Division. (2011). Country Profile: Botswana. [Electronic version] Retrieved on 5 March 2011 from <http://www.data.un.org/CountryProfile.aspx?cname=Botswana>

Van Limburg, Maarten et al. (2011). Why Business Modeling is critical in the development of eHealth technologies. Ins. Bernard Fernando, Denise Silber & Jan van Ootegham. *Journal Med Internet Res.* Oct-Dec :13(4).

Vodafone. (2011). Nompilo Mobilizing Community Care Workers. Collaboration and Care. [Electronic version] Retrieved 8 April 2012 from [http://mHealth.vodafone.com/discover\\_mHealth/](http://mHealth.vodafone.com/discover_mHealth/)

Vodafone Group. (2011). Cutting through the Barriers to Adoption of mHealth Services. Vodafone mHealth Solutions, Evaluating mHealth Adoption Barriers; Human Behavior; *Insights Guide*. [Electronic version] Retrieved 10 April 2012 from [mhealth.vodafone.com](http://mhealth.vodafone.com)

Waegemann, Peter. (2010). mHealth: the next generation of telemedicine? Telemedicine and e-Health 16(1). *Academic OneFile*. [Electronic version] Retrieved 10 Oct 2012 from <http://go.galegroup.com>

Weinburg, J., G Cavric, I Lee-Keltner, W Bilker, J Gelfand and C Kovarik. (2010). HIV+ patients in Botswana find mobile teledermatology an acceptable method for receiving dermatologic care. *Society of Investigational Dermatology*. Num 390.

Wootton, R., Patil, N., Scott, RE., & Ho, K. (Eds.). (2009). TeleHealth in the Developing World. International Development Research Center (IDRC), Canada. Published by Hodder Education.

World Bank. (2012). Information and Communication for Development Report. [Electronic version] Retrieved 20 December 2012 from [data.worldbank.org/country/Botswana](http://data.worldbank.org/country/Botswana)

World Health Organisation. (2008). Towards the Development of an mHealth Strategy: A Literature Review. Original draft by P. Mechael (2007) Updated by D. Sloninsky (2008).

World Health Organisation. (2010). World Health Report. Health Systems Financing the Path to Universal Coverage. Geneva, Switzerland.

World Health Organisation. (2011). A new health sector agenda for HIV/AIDS. Global health sector strategy on HIV/AIDS, 2011-2015. Geneva, Switzerland.

World Health Organisation. (2011). mHealth New Horizons for health through mobile technologies. Based on the findings of the second global survey on eHealth. Global Observatory for eHealth series, vol. 3. Geneva, Switzerland.

World Health Organisation. (2013). E-Health. Trade, foreign policy, diplomacy and health. [Electronic version] Retrieved 20 December 2012 from [www.who.int/trade/glossary/story021/en/index.html#](http://www.who.int/trade/glossary/story021/en/index.html#)

## **ANNEX 1: Semi-Structured Interview Schedule**

### **A. General professional background**

Location:

Position/job title:

Male/Female

Length of time working in location:

### **B. Experience with health care service delivery in Ghanzi**

1. Does the health facility have electricity?
2. Does the health facility have a landline phone?
3. Does the health facility have a two way radio (roger-roger)?
  - If Yes, Is it working?
  - If no, how long has it been not working?
  - If yes, how often do you use the radio?
  - If yes, what are the most common reasons for using the radio?
4. What is the most common mode of transport in your location?
5. What are the challenges with communications do you encounter between your work base and colleagues in other areas?

6. How often do you contact colleagues in other health facilities when managing patients?
  - Via Telephone/landline
  - Cell phone
  - Roger roger (two way radio)
  - Ambulance to deliver message
7. Do you ever use your personal phone for official duties Yes/ No
  - o If yes, for which reasons
8. How long does it take to get your lab results back from the health facility? (sputum, blood, TB, HIV)
9. What cell phone networks are available in \_\_\_\_\_(location)?
10. What is your opinion on the reliability of the cell phone network(s)?

**C. Observations of mHealth initiative “Talk for Life”**

11. Describe your experience with “Talk for Life phones”
12. How are “Talk for life” phones working for you?
13. How are “Talk for life” phones not working for you?
14. Who do you share the “Talk for life” phone with?
15. How is the phone shared?

16. How often do you use the “Talk for life” phone?
17. What are the main purposes you use the “Talk for life” phone for?

#### **D. Opinions**

18. What is most beneficial about “Talk for life” phone?
19. Are you aware of other mHealth initiatives in Botswana? If yes, which ones?
20. What recommendations do you have to improve “Talk for life” mHealth initiative?

#### **E. Closing**

21. Any other comments:



**ANNEX 2:** Photo of community health mobile outreach in Ghanzi farms  
(courtesy of Kuru Health)

