

mHealth for Strengthening Communication Along the EID Results Chain

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

OPHID OR Series 2014: Report 1



September 2014



mHealth for Strengthening Communication Along the EID Results Chain

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

OPHID OR Series 2014: Report 1



September 2014



Table of Contents

Figures and Tables	ii
Acronyms	iii
Acknowledgements	iv
Foreword	v
Executive Summary	vi
Background	vi
Study Objectives	vi
Methods	vi
Results	vii
Recommendations	xi
Report Structure	xii
1.0 Background	1
1.1 Early Infant Diagnosis of HIV.....	1
1.1.1 Early Infant Diagnosis of HIV is a Global Challenge	1
1.1.2 EID in Zimbabwe	2
1.1.3 Cell Phone Technology Improves HIV Results Turnaround in Low Income Settings	3
1.2 EID Cascade in Context of OPHID Trust Implementation Activities	3
1.2.1 Use of Cell Phones to Strengthen EID results chain in Mashonaland East, Zimbabwe	3
1.2.2 Village Health Workers and Cell Phones for EID	4
1.2.3 Relevance of Research	4
2.0 Methods	6
2.1 Research Approach	6
2.2 Study Objectives	6
2.3 Study Design and Rationale.....	6
2.4 Study Population and Sampling Procedure	7
2.4.1 Study Population and Site Selection	7
2.4.2 Sample Size Calculations and Sampling Procedures.....	7
2.5 Research Procedures and Instruments	7
2.5.1 Time Period	7
2.5.2 Geographical Areas and Sites.....	8
2.5.3 Research Procedures	8
2.6 Ethics	9
2.7 Data Analysis.....	9
3.0 Results	11
3.1 How health care workers use cell phones.....	11
3.1.1 Access to alternative forms of communication	11
3.1.2 General Operating Procedures for Cell Phone Use at Site Level.....	11
3.1.3 Health site cell phone utilisation monitoring data.....	12
3.2 HCW perceptions of challenges and benefits to cell phone use	15
3.2.1 Barriers to optimal use of cell phones.....	15
3.2.2 Health Care Worker perceptions on how the use of cell phones can be improved.....	17

Table of Contents

3.3	Village Health Worker access to and use of cell phones	17
3.3.1	Access to Cell Phones	17
3.3.2	How cell phones are used by VHWs	18
3.3.3	Facilitators and barriers to cell phone use among VHWs	18
3.3.4	VHW preferred support to optimise cell phone use	19
3.4	Barriers to Early Infant Diagnosis	19
3.4.1	HCW perceptions regarding barriers along the EID results chain	20
3.4.2	Village health worker perceptions regarding barriers to EID	21
3.5	How cell phones influence communication along the EID results chain	23
3.5.1	Cell phones and EID communication	23
4.0	Discussion	25
4.1	Key findings under each study objective	25
4.2	Early Infant Diagnosis – More than mHealth	29
4.3	In support of a more holistic conceptualisation of communication along the EID results chain.....	30
4.4	Study Limitations	31
5.0	Recommendations	32
5.1	Recommendations for action.....	32
5.2	Future Research.....	33
6.0	Conclusions	35
References	36
Figures and Tables		
Figure 1:	EID Cascade	1
Figure 2:	Median turnaround times for individual components of the EID process (Bhattacharya et al, 2012).	2
Figure 3:	Communication along the EID result chain.....	4
Figure 4:	District Map Mashonaland East Province, Zimbabwe	8
Figure 5:	Functioning communication systems participating health facilities (N=32).....	11
Figure 6:	Period of month during which allocated \$10USD airtime runs out	12
Figure 7:	Proportion of all cell phone contacts made by location of person called (N=3597)	13
Figure 8:	Location of person called and reason for contact	14
Figure 9:	Frequency distribution reason for contact by individual.....	15
Figure 10:	Proportion of individuals called under reason 'results notification' (N=242)	15
Figure 11:	Barriers to cell phone use at health facilities	15
Figure 12:	Type of access to cell phones	18
Figure 13:	Distribution of VHW access to power at different times by District	18
Figure 14:	Distribution of access to recharge cards for airtime top up	19
Figure 15:	Perceived barriers to communication along the EID result chain	20
Figure 16:	Availability of EID results when caregiver comes to collect.....	20
Figure 17:	Health system framework for decision making about mHealth for community based health services.....	28
Figure 18:	Communication along the EID results chain.....	31
Table 1	Frequency distribution of the suggested airtime requirements for each health care facility per month	12
Table 2:	Ranked reasons for cell phone use	13
Table 3:	Frequency distribution of person contacted.....	14
Table 4:	Ranked frequency challenges to successful EID	20

Acronyms

CCORE	Collaborating Centre for Operational Research and Evaluation
DBS	Dried Blood Spot
DHE	District Health Executive
ECD	Early Childhood Development
EID	Early Infant Diagnosis (of HIV)
FGD	Focus Group Discussion
GOP	General Operating Procedure
GPRS	General Packet Radio Service
HCW	Health Care Worker
LMIC	Low and middle income country
MOHCC	Ministry of Health and Child Care
OPHID	Organisation for Public Health Interventions and Development
PMTCT	Prevention of Mother to Child Transmission (of HIV)
PPP	Public Private Partnerships
RDNS	Rapid Disease Notification System
SOP	Standard Operating Procedure
TAT	Turnaround Time
UNICEF	United Nations Children's Fund
VHW	Village Health Worker

Acknowledgements

OPHID Trust would like to extend thanks to the following individuals and organisations that supported the design, implementation and write up of the mHealth for communication along the EID results chain study:

- Ministry of Health and Child Care (MOHCC), National PMTCT Program, AIDS & TB Unit
- UNICEF Zimbabwe for funding of the *Prevention and Treatment of HIV and Under-nutrition in Infants and Young Children in two districts of Zimbabwe: Innovation in Integrated Service Delivery* project in which this evaluation was embedded.
- Financial support from the Collaborating Centre for Operational Research and Evaluation (CCORE) UNICEF (Zimbabwe) and technical guidance and input of the CCORE Reference Group members.
- OPHID was fortunate to leverage funding support for the completion of the study from PEPFAR through USAID, under the Families and Communities for the Elimination of Pediatric HIV program, and greatly appreciates its contributions.
- Office of the Provincial Medical Director, Dr. S. Zizhou, Mashonaland East Province
- District Medical Officers Dr Tawanda Borerwe and Dr Lloyd Msau and District Nursing Officers M. Fadzi and M. Kanera, Marondera and Hwedza Districts, Mashonaland East Province

The evaluation design, analysis and report writing has been conducted by OPHID Trust Operational Research Director (Karen Webb) and Officer (Vivian Chitiyo) under the support and guidance of OPHID UNICEF Project Coordinator Sweden Chiruka, Deputy Country Director, Diana Patel and Country Director, Barbara Engelsmann.

This evaluation would not have been possible without the time and input of health care workers and village health care workers at participating health sites. Hwedza District: Chigondo, Chikurumadziva, Garaba, Goneso, Goto, Gotora Skimpton, Idube, Makarara, Mt St Marys, Mukamba, Sango, Sengezi, Wedza Rural Hospital, Zvidhuri. Marondera District: Border Church, Borradaile, Chihota, Chimbwanda, Chiparawe, Dimbiti, Dombotombo, Igava, Kushinga Phikelela, Lustleigh, Marondera Hosp, Masikana, MRDC, Mudzimurema, Nyameni, Nyembanzvere, St Thomas Prison, Wenimbe. The input provided by these groups regarding the facilitators and barriers to use of cell phone technology for improving communication along the EID results chain and exploring the outstanding barriers to achieving timely EID among HIV-exposed children has been invaluable.

Foreword

Despite a declining HIV prevalence among women attending ANC from 20.1% in 2005 to 16.1% in 2009, Zimbabwe remains one of the countries worst affected by the HIV epidemic in the world today. In the drive to virtual elimination of new pediatric HIV infections in children by 2015, Zimbabwe has made major gains in preventing mother to child transmission of HIV and providing care and support for mothers and infants infected with HIV in recent years. Rapid program expansion has seen 92% of health sites not only providing PMTCT, but HIV testing and counselling and ARVs for PMTCT. The vast majority (95%) of all pregnant women in ANC are HIV tested, and with the country's transition to a test and treat for life approach 'Option B+', a high proportion of pregnant women are being initiated on ART in 2004.

These successes however, have not been without challenges. Retention and adherence of HIV positive women and their HIV-exposed infants in care and treatment remains a practical and operational challenge. Not enough HIV-exposed infants are tested before two months of age, and as a nation we face challenges in ensuring rapid turnaround of Early Infant Diagnosis (EID) test results. We know that a major challenge in EID turnaround times is ensuring effective communication between HIV positive mothers, rural health care sites, tertiary District and Provincial hospitals, and national laboratories.

Overcoming such challenges in the long term will require support and action from stakeholders at multiple levels. We will require innovation and high-quality evidence to identify cost-effective solutions to overcoming barriers to ensuring every HIV-exposed child is tested for HIV and if positive, initiated on ART in a timely manner. Data presented in this report on the value and potential of mHealth initiatives for improving communication along the EID results chain is an important contribution to this on-going national dialogue.



Dr. Angela Mushavi
National PMTCT & Pediatric Care & Treatment Coordinator
Ministry of Health and Child Care

Executive Summary

Background

Early Infant Diagnosis of HIV is a Global Challenge: Nearly 400,000 infants per year are infected with HIV as a result of mother-to-child HIV transmission (MTCT)¹. In the absence of antiretroviral therapy (ART), as many as 50% of perinatally HIV-infected children will die before age two. ²Early initiation of ART is highly effective. ³In order to provide the benefits of early ART, early infant diagnosis (EID) of HIV infection must be accurate and prompt.(1)

EID in Zimbabwe: Recent evidence suggests that rates of EID less than two months among HIV exposed children in Zimbabwe are as low as 40%. There is documented need to improve Turnaround Times (TAT) from sending of DNA PCR results from the National Laboratory in Harare to the receipt of results by the caregiver at facility level.⁴ This data supports findings which indicate that opportunities to address the high HIV mortality in the first 24 months of life are being missed, with only 38.9% of children commenced on ART being under 2 years and late initiation being the norm.⁵ Greater need for integration of HIV programme activities for improving the EID cascade is highlighted by the lack of tracking of mother-infant pairs in PMTCT; and slow scale-up of EID and early treatment of HIV positive infants.⁶

Use of Cell Phones to Strengthen EID results chain in Mashonaland East, Zimbabwe: Through funding provided by the United Nations Children's Fund (UNICEF), the Organisation for Public Health Interventions and Development (OPHID) is currently implementing a *Prevention and Treatment of HIV and Under-nutrition in Infants and Young Children in two districts of Zimbabwe: Innovation in Integrated Service Delivery* project in 2 districts of Mashonaland East, Zimbabwe. Under this project, in October 2011, dedicated cell phones were provided to each health facility in Hwedza (14) and Marondera (18) districts with US\$20/month provided in airtime to each facility. The phones were provided in response to communication barriers noted by health care workers required for timely information communication along the EID results chain.

Accordingly, a process evaluation was required to determine how the cell phones were used, and the perceived impact of cell phone use upon communication along the EID results chain. In addition, a critical cadre not currently provided with technological support in this information technology loop for optimizing EID results chain efficiency, is that of Village Health Workers. In Zimbabwe, village health workers (VHWs) represent a critical link between clients and health care workers (HCWs) at rural health facilities and their use and access to cell phone technology is required to design targeted interventions.

Study Objectives

The overall goal of the descriptive implementation research was to make recommendations to UNICEF on current uses of cell phones by Health Care Workers (HCWs) and identify strengths and missed opportunities where current activities within the pilot programme can be leveraged to improve information flow along the EID results chain.

Specific objectives of the study were therefore:

1. To describe the uses of cell phones by HCWs.
2. To describe the facilitators and barriers to optimal use of cell phones to improve communication along the EID results chain.
3. To generate formative evidence regarding the feasibility of expanding access of mHealth to community level.

Methods

The study was a descriptive assessment of cell phone use by Health Care Workers to improve communication along the Early Infant Diagnosis (EID) results chain over a 12 month period in Hwedza and Marondera Districts of Mashonaland East province.

Data collection methods used in this study included:

- Routinely collected programmatic and health facility data
- Structured Questionnaires
- Focus Group Discussions

As piece of targeted implementation research, the *mHealth for strengthening communication along the EID results chain* study population comprised of the Health Care Workers (HCWs) and Village Healthcare Workers (VHWs) who serve health facilities in Hwedza and Marondera districts of Mashonaland East Province, Zimbabwe that received cell phones through the UNICEF-funded OPHID project.

Results

The Health Care Workers (HCWs) at health care centres in Marondera and Hwedza districts were targeted for completion of the site level operating procedures and utilisation questionnaire. A total of 29 out of the 32 health care facilities completed the questionnaire with 15 out of 18 sites in Marondera district and 14 out of 14 in Hwedza districts.

I. How Health Care Workers use cell phones

General operating procedures:

- Inventory of functional communication methods demonstrated cell phones as the only method of communication available at all health facility sites.
- The majority of the health care facilities reported that they do not have Standard Operating Procedures (SOPs) for the use of cell phones at their health facilities (72%).

Executive Summary

- The majority (52%) of the health facilities reported that the cell phone is kept on the person of the most senior person on duty while 48% of the health facilities have a specific place in the facility where the cell phone stays.
- 93% of the health facilities reported using up the allocated \$10 each month, the majority reporting that the airtime runs out after mid-month (71%).

II. Utilisation monitoring of cell phone use

Call volume:

- A total of 3,597 calls were recorded (1841 Hwedza and 1756 in Marondera) in the 27 sites over a 9 month period (mean of 15 calls per month per site, range from 2-64).
- The nurse was recorded as the caller in 99% of telephone calls that were recorded over the period.
- The voice call is the main mode of communication, with 98% of the health facilities in the two districts having reported using the mobile phone to make voice calls with only 2% of the communication being text messages.

Place and reason for call:

- The majority of calls made using cell phones were made from rural health facilities to contact higher level facilities, with 64% (n=2259) of the calls made to District and Provincial health facilities.
- Almost one third (32%; n=1136) cell phone contacts were made to village level.
- Overall, contacting the village level for follow up of missed appointments was the most frequently recorded single reason at all health care levels, comprising of 15% of all calls made (n=556).
- Patient referrals and emergency services were major reasons for contacting the provincial and district health facilities, combined, matching follow-up for missed appointments as the most frequently cited reason for cell phone use by location (15%; n=555).

Individual called:

- Cell phones were primarily used to contact other health care workers, with over half of all calls made registered as being to other health care workers (56%; n=2002). The next most common group contacted were village health workers at 26%.
- Health care workers were contacted primarily for patient referrals, emergency services and other reasons, such as rapid disease surveillance data and making procedural enquiries to the district health facility.
- The health facilities reported they contacted the VHW mainly for following up patients in the community for missed appointments.
- Although, the site utilisation monitoring tool is important for cell phone use monitoring it was difficult to obtain timely and complete data from the health facilities, and also does not enable verification of calls made.

III. Challenges and benefits to cell phone use by Healthcare Workers

Healthcare worker perceptions of barriers to optimal use of cell phones:

- The majority of sites (69%; n=20) reported facing challenges to the effective use of cell phones at their health facility in the GOP questionnaire.
- The most frequently cited barrier to cell phone use was power for recharging cell phones (85%), followed by adequate airtime (65%) and consistently available network coverage.
- The failure to adopt standardised procedures for use of the cell phones were noted to result in inconsistent use of cell phones and failure to complete utilisation forms correctly and consistently.
- HCWs expressed frustration that cell communication to community level is largely a one-way process, as Village Health Workers are not formally supported to use cell phones as part of their duties.

Suggestions for improving cell phone use:

- Ensure cell phones are kept on site and accessible to all nurses
- Clear rules regarding the use of cell phones (no personal use, no removing cell phones from health site property) – put in place mechanisms to track the use of cell phones
- Purchase cell phones for VHWs and other groups involved in the EID results chain who currently do not have dedicated phones (such as labs).
- Provide solar chargers to ensure cell phone is reachable at all times of day

IV. Village health care workers and cell phones

286 VHWs from Marondera and Hwedza responded to a structured questionnaire (96% response rate). To provide qualitative depth to the questionnaire data, 5 Focus Group Discussions (FGDs) were held in October 2013 at district health care sites.

VHW access to cell phones:

- There is near universal access to cell phone among the village health workers with 94% (n=270) reporting that they have access to cell phones, with 87% reporting that they owned their own phone.

How VHWs use their cell phones as part of community-based duties:

- Communicating with next level health sites
- Reporting and responding in cases of emergency
- Receiving messages regarding meetings/trainings
- Following-up with patients
- Immediate referrals and requests for ambulances

Executive Summary

Barriers to the use of cell phones:

- 94% of VHWs (n=220) described having access to mobile network at all times where they stay, with 5% (n=12) reported that they walk some 5-10 minutes from their place of residence to access mobile network.
- 61% of the VHWs in the two districts reported that they have access to power every day for charging cell phones and 24% percent have access to power once every few (2-3) days.
- VHWs do not have easy or readily available access to airtime cards to top up their cell phones. Over one third (35%) reported that they access airtime cards only once a month and airtime is paid out of pocket.
- VHWs indicated the main challenge to the use of cell phones as part of their duties was lack of airtime/support to purchase airtime.

Preferred support to optimise cell phone use

In line with noted barriers to cell phone use, VHWs cited support with airtime, solar chargers, support to VHWs without cell phones, and development of standard processes and regulations for cell phone use as ways that barriers to more efficient use of cell phones as part of their duties could be achieved.

V. Barriers to Early Infant Diagnosis (EID)

Healthcare Worker perceptions of barriers to EID

- Most frequently cited challenge to EID from the perspective of health care workers was caregivers agreeing to have the child tested (53%).
- The transportation of DBS samples to the laboratory was reported as a challenge to EID by 40% of the health facilities.
- With specific regards to communication challenges along the EID results chain, communication from the facility to the client is considered the main challenge along the EID results chain as it was reported by 46% of sites.
- Cumulatively however, 76% determined the greatest challenges to communication exist at community or patient level.
- 53.6% of healthcare workers reported DNA PCR results for EID were available half the time or less when caregivers returned to the facility to collect them. being available when a caregiver returns to the clinic to collect them.

Village Healthcare Worker perceptions of barriers to EID

During FGDs, VHWs provided a unique perspective of community-level barriers to EID, which primarily centered around women to bring their child in for testing in the first place. Specific barriers described included women defaulting by choice, providing incorrect information making VHW tracking difficult, low levels of knowledge and awareness of importance of EID and high levels of stigma and discrimination around testing of children among women who have not disclosed their HIV status, and lack of targeted male involvement in EID leading to resistance from male partners to have children tested.

VI. Benefits to cell phone use for communicating along the EID results chain

97% of sites reported improved information flow across the EID results chain through the use of cell phones. Specific ways cell phones were cited as improving EID communications included improved efficiency, improved relationships between health care workers at different levels, including VHWs, improved flexibility in follow up with clients.

Recommendations

Based on the findings of the *mHealth for strengthening communication along the EID results chain* assessment, the following key recommendations are made:

I. Policy Level

1. *Government investment in cell phones for health communications.*
2. *Strategic capacitation of health system frameworks for the use of mHealth in community based health services.* Pursue an eHealth strategy for PMTCT/MNCH in partnership with MOHCC and in line with existing and planned eHealth strategies.
3. *Formalise Public Private Partnerships for mHealth in Zimbabwe* – on issues including development of strategies to expand mHealth in Zimbabwe; efficient systems for monitoring and evaluating cell phone use by health care workers; cost-effective technological solutions to overcoming barriers to cell phone use in rural settings (i.e., solar power for charging, access to airtime).

II. Health systems and program level action

1. *Develop Standard Operating Procedures for Cell Phone use by healthcare workers:* In cooperation with Ministry of Health and Child Care, SOPs should be developed which provide clear guidance to health care workers regarding the conditions and procedures of use of cell phones as part of patient management and follow-up.
2. *There is need to capitalise on the value of text messages:* Only 2% of recorded cell phone communications in this assessment were in text form. Systems for using texting for results ready notification, reminders for key services and messaging following missed appointments should be explored.
3. *Stronger integration of EID into standard MNCH services:* Integrated service provision through programmes such as within the current UNICEF-funded Prevention and Treatment of HIV and Under-nutrition in Infants and Young Children project should be enhanced and specific health service opportunities for the provision of timely EID explored.
4. *Higher levels of the EID cascade still require attention:* Further support to strengthen the laboratory sample transportation and processing, particularly from rural health care sites is required.

Executive Summary

III. Community level action

1. *Extend mHealth support to community level:* The gaps identified in communication along the EID results chain at community and patient level indicate the need to extend the mHealth net to include VHWs and patients.
2. Community-based efforts to increase uptake of timely EID should focus on providing *information and support to women at household level* in a culturally acceptable and feasible manner.
3. *Strategic engagement with 'gatekeepers' for EID* such as male partners within traditional community forums.

IV. Future Research

1. Establish impact of mHealth on turnaround time across the EID results chain.
2. Establish cost-effectiveness of mHealth over existing communication methods such as radio and landlines.
3. Pilot the impact on the support to cell phone use as part of VHW duties.
4. Patient level mHealth applications should be piloted and rigorously evaluated:
5. Develop effective networks of mHealth implementers to share lessons for developing a common evidence base and maximising the impact of mHealth.
6. Greater research is required to understand the barriers to EID from the perspective of HIV positive mothers.
7. Knowledge, attitudes and beliefs of male partners and traditional leaders to HIV testing and treatment of infants need to be documented.

Report Structure

- 1.0 Background** – presents the context of EID both globally and nationally. Information on the UNICEF-funded OPHID project is described and justification for this embedded research is provided.
- 2.0 Methods** – outlines the research approach, objectives and study sampling and research procedures, ethical clearances and data analysis techniques employed
- 3.0 Results** – presents the findings of the study under clear topic headings
- 4.0 Discussion** – interpretation and discussion of key findings
- 5.0 Recommendations** – recommendations for policy, health system, programs and community action and future research priorities based upon interpretation of findings
- 6.0 Conclusion** – final summary of key findings and future implications

1 Background

1.1 Early Infant Diagnosis of HIV

1.1.1 Early Infant Diagnosis of HIV is a Global Challenge

Nearly 400,000 infants per year are infected with HIV as a result of mother-to-child HIV transmission (MTCT).¹ In the absence of antiretroviral therapy (ART), as many as 50% of perinatally HIV-infected children will die before age two.² Early initiation of ART is highly effective; a randomized trial in South Africa demonstrated that ART initiation before 3 months of age can reduce mortality by 76%, compared to waiting until signs and symptoms of AIDS develop.³

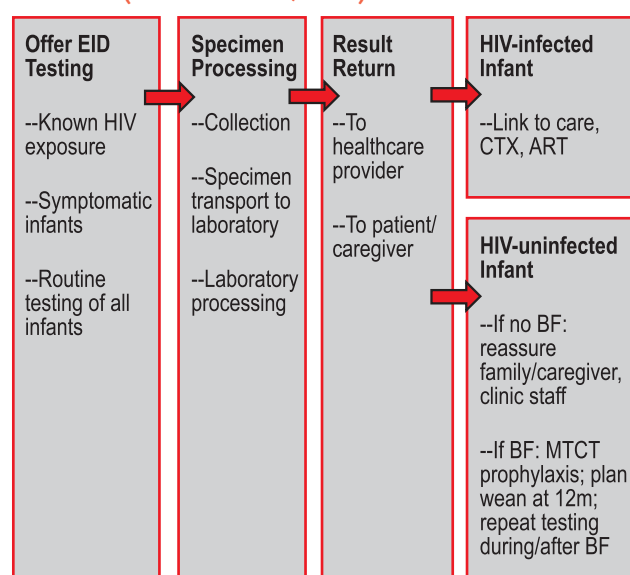
The current 2013 guidelines advocate for early infant diagnosis at 4–6 weeks for all infants whose mothers are living with HIV or if maternal HIV status is unknown; determine the final infant HIV infection status after 18 months and/or when breastfeeding ends. In addition, the World Health Organization now calls for initiation of ART in all HIV-infected children below 5 years of age regardless of their WHO clinical staging or CD4 cell count.⁷ These recommendations stem from research demonstrating that in order to provide the benefits of early ART, early infant diagnosis (EID) of HIV infection must be accurate and prompt.⁸ The health benefits of breastfeeding can also be preserved for both HIV-infected and HIV-uninfected infants if infection status is known early in infancy.⁹

Although rapid, inexpensive, antibody-based diagnostic tests are available for older children,¹⁰ maternal anti-HIV antibodies are detectable in the sera of all HIV-exposed infants, and do not indicate true infant infection. (1) Current EID assays require PCR amplification of HIV RNA or DNA, performed in central laboratories where resources are sufficient for personnel training, machine maintenance, and quality assurance. Access to EID in Zimbabwe remains very limited, with only 28% of all HIV-exposed infants estimated to undergo testing in 2010.

Successful EID depends on uptake at several steps in a "cascade" of care as depicted by Ciaranello et al. (Figure 1).⁷ Specimen collection and transport to laboratories (the early "cascade") have improved markedly with recent dried-blood spot (DBS) specimens, transportable via courier or mail services,⁶ yet major barriers to the second half of the cascade remain. After laboratory processing, median times to result receipt at clinics are 10-70 days,⁷ leading to delays in ART initiation. Wide variability in these "turnaround times" (range, 1-21 weeks) also prevents clients from scheduling return appointments that coincide with result availability. As a result, the longest delay in the EID cascade is often between result arrival in clinic and result provision to clients, and 30-80% of EID-tested infants fail to receive test results and link to care.⁷

Accordingly, the need to develop and use innovative mechanisms to improve transport times and logistics that pose barriers to reaching families in a timely manner has been identified as a priority for scaling up EID¹², and in the 'Countdown to 2015' towards the virtual elimination of new paediatric HIV infections, UNAIDS has called for academic and research institutions to "accelerate innovations for improved service delivery especially early infant diagnosis and paediatric-related elements of HIV care and treatment".¹³

Figure 1: Early Infant Diagnosis (EID) Cascade (Ciaranello et al., 2011)



CTX: cotrimoxazole prophylaxis; BF: breastfed; m: months

1 Background

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

1.1.2 EID in Zimbabwe

In Zimbabwe, a heavily HIV-affected country with antenatal HIV prevalence of 16%, EID access among HIV-exposed infants is estimated at 14%.¹⁴ Early ART initiation for HIV infected children has been supported in Zimbabwe since 2008 through Early Infant Diagnosis (EID) within Prevention of mother to Child Transmission (PMTCT) programme and since 2010 through adoption of WHO early initiation guidelines for under 2's.

The National Microbiology Reference Laboratory (NMRL) is currently the only public sector laboratory currently capacitated to conduct manual DNA PCR testing for HIV diagnosis in infants. Steady gains have been made in the number of health sites sending specimen and the number of specimens processed for EID. The number of specimens being processed also increased from 712 in 2007 to 47,771 in 2012.¹⁵

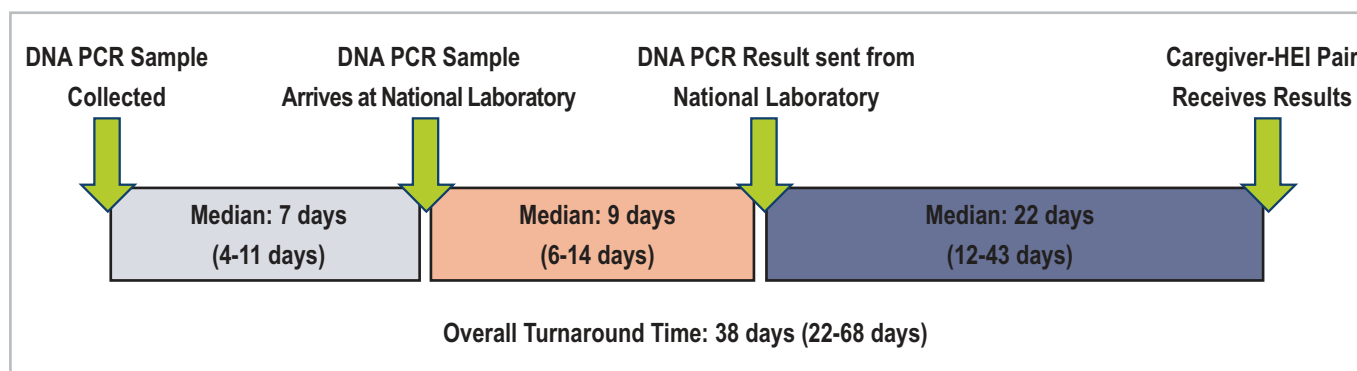
However, the average age at Dried Blood Spot (DBS) collection for EID in 2012 was 4.2 months, more than double the recommended age of less than 2 months and the national average turnaround time (TAT) from collection to dispatch from the lab was 54 days.¹⁸ Critically, these TAT figures do not include the time it takes from dispatch of results to receipt of results by caregiver. Available evidence indicates that it is this final stage is where the longest delay for completing the EID process (Figure 2).⁴ This data supports findings which indicate that opportunities to address the high

HIV mortality in the first 24 months of life are being missed, with only 38.9% of children commenced on ART being under 2 years and late initiation being the norm.⁵ Greater need for integration of HIV programme activities for improving the EID cascade is highlighted by the lack of tracking of mother-infant pairs in PMTCT; and slow scale-up of EID and early treatment of HIV positive infants⁶ resulting in a mere 14% of infants born to HIV positive mothers having received a virological HIV test within 2 months of birth in 2011.¹

1.1.3 Cell Phone Technology Improves HIV Results Turnaround in Low Income Settings

In recent years, the use of mobile health (mHealth¹) technology has demonstrated a reliable and sustainable solution to the slow transmission of HIV test results. As noted by Seidenberg et al¹⁶, the mobile phone platform is increasingly being used across sub-Saharan Africa for functions other than conversations, including the dissemination of information about weather trends and commodity market prices to farmers, the provision of electronic food vouchers from the World Food Programme, and monetary transactions.¹⁷⁻²¹ The use of cell phones by community based health care workers (HCWs) has been shown to reduce missed clinic appointments; improve clinic-patient communication; and reduce time to EID result return.²²⁻²⁸

Figure 2: Median turnaround times for individual components of the EID process (Bhattacharya et al, 2012).



¹ While no standard definition exists at present, mHealth or mobile health as medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices. (WHO, 2011)

The use of cell phones in effort to specifically improve PMTCT programme outcomes and results notification for EID is an expanding area of intervention in low-income settings. Providing mothers of HIV positive infants with cell phones was reported to reduce loss-to-follow up and increase adherence to antiretrovirals in Haiti.²⁹ In a Rapid Results Initiative (RRI) in Kenya, mobile phones were used to communicate positive results within the EID programme and were linked to improved TATs.³⁰ With UNICEF support, Project Mwana in Zambia used short message service (SMS) texts to significantly reduce EID result notification from sample collection to results notification to both health facilities and caregivers.¹⁶ In Cameroon, authors attributed the failure of environmental factors to present as significant risk factors to “incomplete EID process” partly to the use of active phone reminders.³¹

While mHealth initiatives are increasingly reported to improve turnaround times for test results and reduce loss-to follow-up in EID programmes, research seeking to establish the impact of cell phones upon results turnaround should be undertaken with full awareness of the limitations of such investigations. A recent review assessing mobile phone messaging for communicating results of medical tests found few studies where effects of mobile phone messaging could be established independent of other technologies or interventions.³² Authors concluded that more research is needed on the effectiveness and user evaluation of these interventions with investigations into the potential risks and limitations of the use of cell phones for communicating test results being of particular importance.

With a rapid growth in mHealth initiatives over the past decade, the need to understand user perspectives on how cell phone technology can be optimised and the barriers and facilitators to using cell phones is important in sub Saharan Africa, and Zimbabwe in particular, where mHealth initiatives have lagged behind neighbouring countries. Operating costs, knowledge, infrastructure and supportive policies to stimulate growth in telecommunications have ranked as the top four barriers to mHealth implementation

in Africa.³³ Accordingly, capturing the operational realities of cell phone technology for improving health system processes will be a critical first step to the design of effective and sustainable mHealth programmes in Zimbabwe and optimising the impact of existing programmes using mobile technology.

1.2 EID Cascade in Context of OPHID Trust Implementation Activities

1.2.1 Use of Cell Phones to Strengthen EID results chain in Mashonaland East, Zimbabwe

Through funding provided by the United Nations Children’s Fund (UNICEF), the Organisation for Public Health Interventions and Development (OPHID) implemented the *Prevention and Treatment of HIV and Under-nutrition in Infants and Young Children in two districts of Zimbabwe: Innovation in Integrated Service Delivery* project in 2 districts of Mashonaland East, Zimbabwe (2011-2014). The project intended to build onto OPHID’s existing activities supporting the implementation of the national PMTCT programme in the province by addressing infant and young child feeding, community management of malnutrition and OI/ART management, whilst integrating HIV and nutrition services bi-directionally at health care centre, mobile outreach team and community levels. Expected result from this intervention include an increase in the percentage of pregnant women delivering at rural health centres; an increase in HIV infected pregnant women assessed for ART eligibility immunologically through their CD4 count and accessing treatment; and an increase in the percentage of Early Infant Diagnosis (EID) uptake and access to treatment in the Hwedza and Marondera populations.

Under this project, in October 2011, dedicated cell phones were provided to each health facility in Hwedza (14) and Marondera (18) districts with US\$20/month provided in airtime to each facility. The phones were provided in response to communication

1 Background

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

barriers noted by health care workers required for timely information communication along the EID results chain. HCWs noted the potential for cell phones at site level to be used for information transfer between:

- Lower and higher level health facilities where specimens are collected/results received
- Health care workers and village health workers regarding follow-up with clients at community level and notification of test results ready for collection
- Health care workers and clients regarding Dried Blood Spot (DBS) sample results ready, follow up testing required, or missed appointments.
- Additional communications not directly related to EID, but to improve efficiency and functioning of health service provision including: contacting higher levels regarding stock-outs and procurement issues, calling for ambulances when district-level equipment/expertise is required (labour/post-partum complications), arranging and follow up with District Health Executive (DHE) regarding meetings, project reporting etc.

Accordingly, a process evaluation was required to determine how the cell phones were used, and the perceived impact of cell phone use upon communication along the EID results chain (Figure 3).

1.2.2 Village Health Workers and Cell Phones for EID

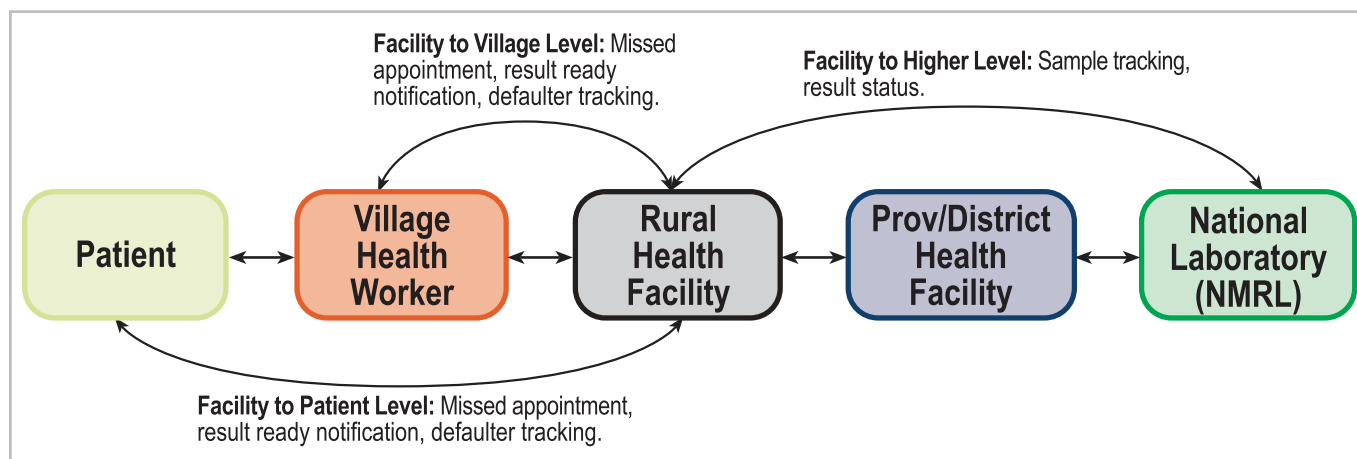
A critical cadre not currently provided with support in this information technology loop for optimizing EID results chain efficiency, is that of Village Health Workers. In Zimbabwe, village health workers (VHWs) represent a critical link between clients and health care workers (HCWs) at rural health facilities. VHWs can notify clients of critical lab results and assess medical and non-medical barriers to care. Previous interventions have demonstrated how community health workers with little experience of data collection could be trained and successfully supervised to collect data using mobile phones.^{27,34}

However, under the current project funding, VHWs were not provided with cell phones or airtime. Accordingly, in addition to evaluating HCWs use of cell phones at facility-level, there is also the need to conduct a formative evaluation to determine the feasibility of leveraging upon the current UNICEF program to provide support for use of cell phone technology by VHWs to improve the EID results chain and other essential community health services.

1.2.3 Relevance of Research

On the basis of the pilot programme described and in order to assist UNICEF to further its efforts to increase

Figure 3: Communication along the EID result chain



Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

the coverage and quality of integrated HIV prevention, care and treatment and nutrition services targeting mothers, infants and young children, the proposed research will seek to describe how cell phones are currently being used by HCWs, including the identification of barriers and facilitators to their optimal use. This implementation research will provide evidence required for leveraging pilot programme activities and improving turnover along the EID results chain. Related to investigating the optimal use of cell phone technology by participating HCWs, will be an embedded formative evaluation regarding the feasibility of extending the use of mHealth technology

to community-level by providing cell phones to VHWs. The potential role of implementation research to fill the program-implementation gap and address barriers to effective replication of evidenced-based interventions in local settings has been acknowledged.³⁵ Research outcomes will feed back into UNICEF programme activities, in addition to adding to the knowledge base regarding mHealth initiatives in Zimbabwe. As yet, no known investigation has reported on perceptions of the facilitator and barriers to the use of mobile phone technology or captured the technology needs of community-level cadres such as Village Health Workers.

2 Methods

2.1 Research Approach

With an epistemological approach aligned with a Paradigm of Praxis (that knowledge is derived from practice, and practice informed by knowledge, in an on-going process), the research strategy employed was that of Action Research. As an evaluation of on-going program implementation, this approach is most suited as action research seeks to study a system and concurrently collaborate with members of the system in changing it in what is together regarded as a desirable direction.³⁶

The “*mHealth for strengthening communication along the EID results chain: Usage patterns, facilitators and barriers of the use of mobile technology*” study therefore aimed to contribute both to the practical concerns of OPHID and UNICEF in evaluating the use of cell phones, as well as providing a mechanism for on-going feedback and self-reflection at participating Health Sites as implementers and service providers of the UNICEF-funded programme. These action research-oriented goals sought to engage project actors in immediate problem solving, informing project evaluation and learning as well as furthering the knowledge-base by documenting the facilitators and barriers to the use of mHealth in Zimbabwe.

2.2 Study Objectives

The overall goal of the descriptive implementation research was to make recommendations to UNICEF on current uses of cell phones by Health Care Workers (HCWs) and identify strengths and missed

opportunities where current activities within the pilot programme can be leveraged to improve information flow along the EID results chain.

Specific objectives of the study were therefore:

1. To describe the uses of cell phones by HCWs.
2. To describe the facilitators and barriers to optimal use² of cell phones to improve communication along the EID results chain.
3. To generate formative evidence regarding the feasibility of expanding access of mHealth to community level.

2.3 Study Design and Rationale

The study was a descriptive assessment of cell phone use by Health Care Workers to improve communication along the Early Infant Diagnosis (EID) results chain over a 12 month period in Hwedza and Marondera Districts of Mashonaland East province.

The evaluation made use of a mixed method design that includes complimentary research strategies adapted from previous use in health service evaluation³⁷⁻³⁹ and correspond to each of the study objectives. Mixed methods were used, as qualitative data are a key supplement to quantitative evaluations because they can provide complementary perspectives on a program’s performance.

Data collection methods used in this study included:

- Routinely collected programmatic and health facility data
- Structured Questionnaires
- Focus Group Discussions

² 'Optimal' by definition refers to 'best or most favourable conditions' – accordingly, in the context of our assessment 'optimal cell phone' use involves the best possible functionality and most efficient use of cell phones by health care workers for communicating across the EID results chain.

2.4 Study Population and Sampling Procedure

2.4.1 Study Population and Site Selection

In qualitative methodology, sample size and power depend on purposeful selection of participants to achieve an information-rich and heterogeneous sample that represents the target populations of interest.⁴⁰

As piece of targeted implementation research, the mHealth for strengthening communication along the EID results chain study population comprised of the Health Care Workers (HCWs) and Village Healthcare Workers (VHWs) who serve health facilities in Hwedza and Marondera districts of Mashonaland East Province, Zimbabwe that received cell phones through the UNICEF-funded Prevention and Treatment of HIV and Under-nutrition in Infants and Young Children in two districts of Zimbabwe: Innovation in Integrated Service Delivery programme.

The sampling procedures employed were therefore purposive, though inclusive of the entire population of study, as all participating health sites were targeted. Eligibility criteria for site selection was therefore those health sites who had received a cell phone to improve communication along the EID results chain under the UNICEF-funded pilot programme.

2.4.2 Sample Size Calculations and Sampling Procedures

Within the study, two separate samples were derived for health care workers and village health workers as described below:

2.4.2.1 Health Care Worker Sampling

The number of Health Care Facilities in each district that received cell phones is as follows:

Marondera District:	18 sites
Hwedza District:	14 sites

Health facility personnel (such as Matron/Head Nurse) involved in the management and monitoring of cell phone use (airtime) were purposively selected to participate in all data collection activities (standardised questionnaire, utilisation monitoring form completion, focus group discussion participation) due to their knowledge regarding facility-level use of phones.

2.4.2.2 Village Health Worker Sampling

The number of Village Health Workers in each district working in the catchment areas of targeted health facilities is as follows:

Marondera:	178
Hwedza:	123

The total population of VHWs in these districts were targeted for questionnaire completion. Focus group discussions with Village Health Workers will purposively sample those VHWs operating in the catchment area of one high volume (rural or district hospital) and one low volume (rural clinic) health site in each district. Indications of the sample size for each FGD are provided below:

Marondera: Chiwota Rural Hospital: 18 VHWs
Rural Clinic: approx. 10 VHWs

Hwedza: Mount St. Mary's Rural Hospital: 23 VHWs
Rural Clinic: approx. 10 VHWs.

2.5 Research Procedures and Instruments

2.5.1 Time Period

Routine project data presented in this report took place from January to September 2013. Data collection outside of routine activities, and requiring Medical Research Council of Zimbabwe (MRCZ) approvals, was conducted from August to December 2013 following formal approvals.

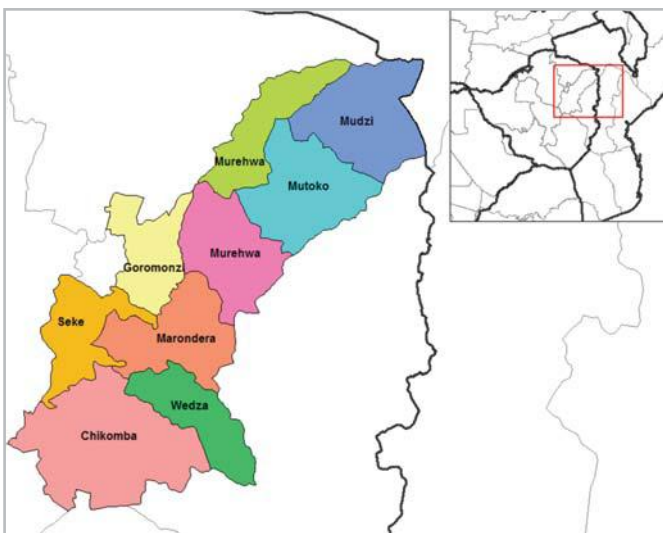
2 Methods

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

2.5.2 Geographical Areas and Sites

The Districts of Marondera and Hwedza in the province of Mashonaland East were the geographic targets, with eighteen individual health sites in Marondera and fourteen in Hwedza purposively selected for inclusion in the study. A map of the Province can be found in Figure 4.

Figure 4: District Map Mashonaland East Province, Zimbabwe



Source: http://upload.wikimedia.org/wikipedia/commons/6/6f/Mashonaland_East_districts.png

2.5.3 Research Procedures

The research procedures for the study will be described according to the methods employed under each of the four objectives.

Objective 1: To describe the current uses of cell phones by HCWs.

Objective 1 was achieved using two separate data collection tools completed by relevant health facility staff:

1. General Operating Procedures (GOPs) structured questionnaire: this structured questionnaire sought to capture the operating procedures for cell phone use,

perceived barriers and facilitators for optimal cell phone use, including specific questions with regard to barriers along the EID results chain was completed by all participating health facilities.

2. Cell phone utilisation monitoring register: this tool sought to establish a log of calls made over a 12 month reporting period. This was intended to identify both intended and novel uses of cell phones as well as an indication of areas which may require further training or support to maximise the use of cell phone technology. Utilisation monitoring forms were self-completed by the individual responsible for cell phones at each health facility (i.e., Sister in Charge at clinic sites/Matron at hospital sites), and data reviewed for completeness by the OPHID/UNICEF project officer upon collection of the questionnaire.

Objective 2: To describe the facilitators and barriers to optimal use of cell phones to improve communication along the EID results chain.

In addition to data captured on the structured tools under Objective 1, a Focus Group Discussion (FGD) was held in each district, including representatives from each participating health facility. The purpose of the focus group discussion was to collect qualitative data about health care worker perceptions of the facilitators and barriers to optimal use of cell phones at their site level, and to identify any trends in barriers/facilitators noted that may be appropriate for improving programme implementation across the existing programme, or inform further intervention design. The question of facilitators and barriers to optimal use of cell phones to improve communication along the EID results chain was placed on the agenda of the monthly District Health Executive (DHE) Meeting in November 2013, and a facilitated discussion conducted by the UNICEF project coordinator and OPHID Trust Operational Research Officer. The Project Coordinator sensitised health sites in Hwedza and

Marondera districts in advance to send appropriate representatives from each site (i.e., Sister in Charge) knowledgeable about the cell phone programme to attend the meeting.

In addition to providing additional depth for interpretation of quantitative data from structured tools, conducting FGDs within a District-level health meeting provided an opportunity for shared experience to identify any trends in facilitators and barriers, innovative solutions to overcoming barriers as well as sharing information with district and Ministry of Health and Child Care (MOHCC) health structures on the successes and challenges of the programme.

Objective 3: To generate evidence regarding the feasibility of expanding access of mHealth to community level.

To provide an indication of how the current pilot programme can be leveraged to provide complete ‘communication coverage’ across the health cadres involved in the EID results chain, formative work was conducted on the feasibility of providing Village Health Workers (VHWs) with cell phones.

Data were collected at monthly meetings held from a total sample of 301 VHWs in the catchment area of each health facility in the districts. The nurse in charge will distribute a brief questionnaire during this meeting for completion.

VHWs were asked to fill in a simply structured data collection tool translated into Shona which captured:

- # of VHWs who currently have a personal cell phone
- An estimate of cell phone coverage/VHW – how often coverage reached
- Access to basic infrastructure/VHW required including:

- ❑ Electricity for charging (regularity)
- ❑ Access to airtime charge cards

Focus group discussions were held under Objective 3 at one rural hospital and one rural clinic in each district. Focus group discussions were conducted to collect qualitative data regarding:

- How VHWs currently use cell phones in the scope of their duties at community level.
- Barriers to the use of cell phones by VHWs. How barriers can be overcome.
- Perceived barriers to effective EID at community level.
- Ways VHWs feel the introduction of a cell phone programme might assist them to support the EID results chain.
- Other ways the use of cell phones could improve the services they provide to families in their community.

2.6 Ethics

The study protocol was submitted to the Medical Research Council of Zimbabwe (MRCZ) as a new application (Approval no. MRCZ/A/1718), together with letters of support from the offices of the Provincial Medical Director’s Office of Mashonaland East, Ministry of Health and Child Care. District health official permission was sought to collect all data from health facility level as part of OPHID’s UNICEF-funded project. Written informed consent was obtained from Village Health Workers for completion of written questionnaires and FGD participation.

2.7 Data Analysis

Data collected during routinely collected programmatic and health facility data and coded/structured questionnaires were analysed

2 Methods

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

descriptively. Structured questionnaires and utilisation monitoring forms will be serialized and entered in EPI Info and analyzed using STATA statistical package. Because the study was intended as a process evaluation of an existing program, lacking a comparison group or randomised sampling procedures, analysis of study data is descriptive in nature, and presented primarily in the form of frequency distributions.

Focus group discussion feedback from HCW and VHW FGDs were documented through transcribed and translated notes. Coding was conducted from a Framework Analysis perspective, starting with the development of a thematic framework to guide the process beginning with open coding of key concepts according to objective (for example: uses of cell phones, barriers, facilitators), selective coding (for example: types of barriers) and theme development.

3 Results

The process evaluation employed a mixed-method approach to data collection, including:

- A survey of 'General Operating Procedures (GOPs) with reference to cell phone use at Health Care sites
- Utilisation Monitoring of OPHID/UNICEF supported cell phones at site level
- A survey of Village Health Worker access and use of cell phones
- Perceptions of VHWs and HCWs regarding the barriers and facilitators to cell phone use

Accordingly, the results section reports findings using multiple methods, grouped according to topic.

3.1 How health care workers use cell phones

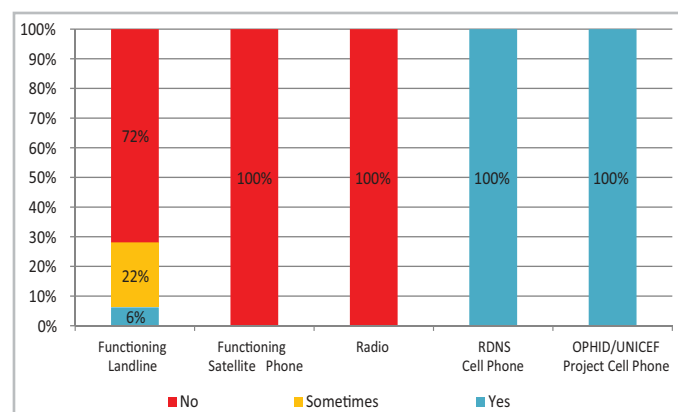
The target population for inclusion in the study was all health care facilities that have received cell phones from OPHID Trust under the UNICEF-funded project. The Health Care Workers (HCWs) at health care centres in Marondera and Hwedza districts were targeted for completion of the site level operating procedures and utilisation questionnaire. A total of 29 out of the 32 health care facilities completed the questionnaire with 15 out of 18 sites in Marondera district and 14 out of 14 in Hwedza districts. To gain an in-depth understanding of the use of mobile phone technology for EID services and the site level barriers and facilitators, focus group discussions were held with the health care workers in the two districts. The following are findings from analysis of data from the two districts Marondera and Hwedza.

3.1.1 Access to alternative forms of communication

To inform the interpretation of cell phone operation and utilisation study data, an inventory of all functioning communication methods at participating health facilities. The results of this inventory are

summarised in Figure 5, which demonstrates project and Rapid Disease Notification System (RDNS) cell phones as the only method of communication available at all health facility sites.

Figure 5: Functioning communication systems participating health facilities (N=32)



3.1.2 General Operating Procedures for Cell Phone Use at Site Level

3.1.2.1 Standard operating procedures for cell phone use

The majority of the health care facilities reported that they do not have Standard Operating Procedures (SOPs) for the use of cell phones at their health facilities (72%). However, all the health facilities reported that they record the use of the cell phones and the records were generally up-to-date as all reported that their cell phone use records were up-to-date.

The majority (52%) of the health facilities reported that the cell phone is kept on the person of the most senior person on duty while 48% of the health facilities have a specific place in the facility where the cell phone stays. 97% of the health facilities reported that all staff involved in EID services had access to the project cell phone.

3.1.2.2 Airtime allocations

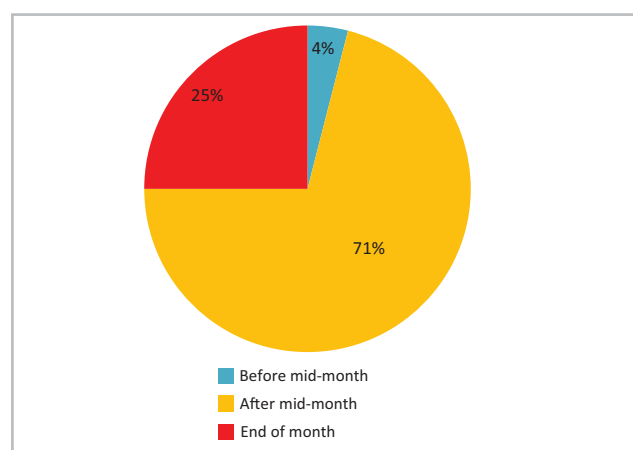
From October 2011 to December 2012 the amount of airtime provided to health care facilities was \$20USD

3 Results

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

per month. Reductions in project budgets resulted in the reduction of the airtime allotted per month to \$10USD from January 2013 to present.

Figure 6: Period of month during which allocated \$10USD airtime runs out



The vast majority (93%) of the health facilities reported using up the allocated \$10 each month. Figure 6 shows the distribution of the times when the airtime was reported to normally run out with the majority of the health facilities reporting that the airtime runs out after mid-month. 78% of the health facilities reported using the health facility fund to purchase more airtime when the monthly allocation runs out. Worth noting, 19% of sites reported using personal funds to top up airtime once the allocated airtime ran out. Table 1

Table 1: Frequency distribution of the suggested airtime requirements for each health care facility per month

Suggested Amount	Frequency	Per cent
\$20	6	20%
\$30	8	27%
\$40	12	40%
\$50	4	13%

presents the airtime allocations suggested by the health care workers for optimal use of the phones. While the majority of sites only ran out of airtime after mid-month, the suggested airtime requirements were higher than the original \$20 provided.

3.1.3 Health site cell phone utilisation monitoring data

A total of 32 health care facilities were expected to complete the utilisation monitoring tool every month from September 2012 to date with 18 sites in Marondera district and 14 in Hwedza districts.

The current report presents analysis of the utilisation monitoring tool from January to September 2013. The decision was made to restrict the analysis of utilisation monitoring data to a 9 month rather than one year period due to problems of incomplete data in the initial months. One site reported a malfunctioning cell phone, and 4 others (most high volume sites such as Marondera Provincial Hospital) faced challenges in consistently completing utilisation forms. Consequently, the decision was made to exclude 5 sites from the formal analysis, though this data will be considered as part of program evaluation.

Data from 15 of the 18 sites in Marondera district and 12 of the 14 sites in Hwedza district (27 total) were analysed as these submitted their utilisation monitoring data for all the months of the analysis period.

3.1.3.1 Call volume and method of communication

A total of 3,597 calls were recorded (1841 Hwedza and 1756 in Marondera) in the 27 sites over a 9 month period (mean of 15 calls per month per site, range from 2-64). The nurse was recorded as the caller in 99% of telephone calls that were recorded over the period.

The voice call is the main mode of communication, with 98% of the health facilities in the two districts having reported using the mobile phone to make voice calls with only 2% of the communication being text messages. With no formal templates or systems for text messaging, during FGDs health care workers reported voice calls allowed for clear explanation of the reason for call and assurance (and accountability) that the message had been received and action was being taken.

3.1.3.2 Place and reason for calls

Figure 7 demonstrates the breakdown of calls made by location of person called. As the majority of calls originated from the rural health facility to other levels, the 'village level' category represents community level contacts (i.e., VHWs and patients). The majority of calls made using cell phones were made from rural health facilities to contact higher level facilities, with 64% (n=2259) of the calls made to District and Provincial health facilities. The other important communication link is between the health facility and the community with almost one third (n=1136) contacts made to village level.

Figure 7: Proportion of all cell phone contacts made by location of person called (N=3597)

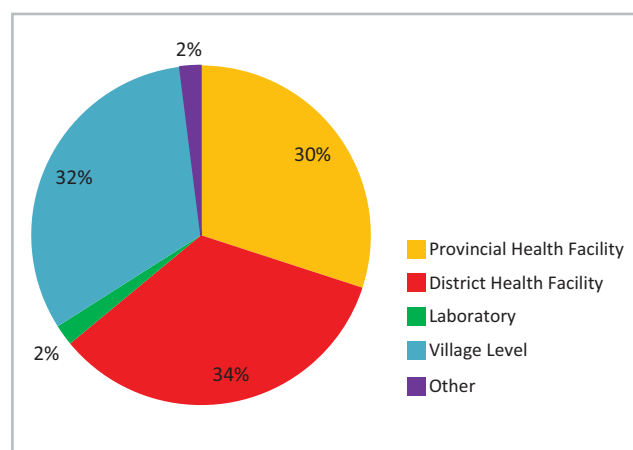


Table 2 demonstrates the grouped frequency breakdown of the overall reasons cited for contact

based upon the codes provided on the utilisation monitoring form.

The number one most frequently cited category for use of cell phones by health facilities was 'other', which in specified reasons included rapid disease surveillance data and making procedural enquiries with the district and provincial health facilities. The frequency of calls made for 'other reasons' by location approximated that of general location as depicted in Figure 7, approximately one third each by provincial, district and village levels. Community, village health worker and Health Center Committee meetings were reported as the primary 'other' reasons for contacting the village level.

Table 2: Ranked reasons for cell phone use

Rank	Reason	Frequency (N=3552)	Percent %
1	Other	918	25.9%
2	Follow up missed appointment	767	21.6%
3	Patient referral	599	16.9%
4	Emergency services	598	16.8%
5	DBS results/samples follow up	427	12%
6	Notification of results ready	243	6.8%

Further analysis of the reasons for contact at various health system levels are presented in Figure 8. Overall, contacting the village level for follow up of missed appointments was the most frequently recorded reason at all health care levels, comprising of 15% of all calls made (n=556). The data shows that contact with the community was also frequently done regarding the collection of DBS samples for EID and for notification of results ready for collection, being the

3 Results

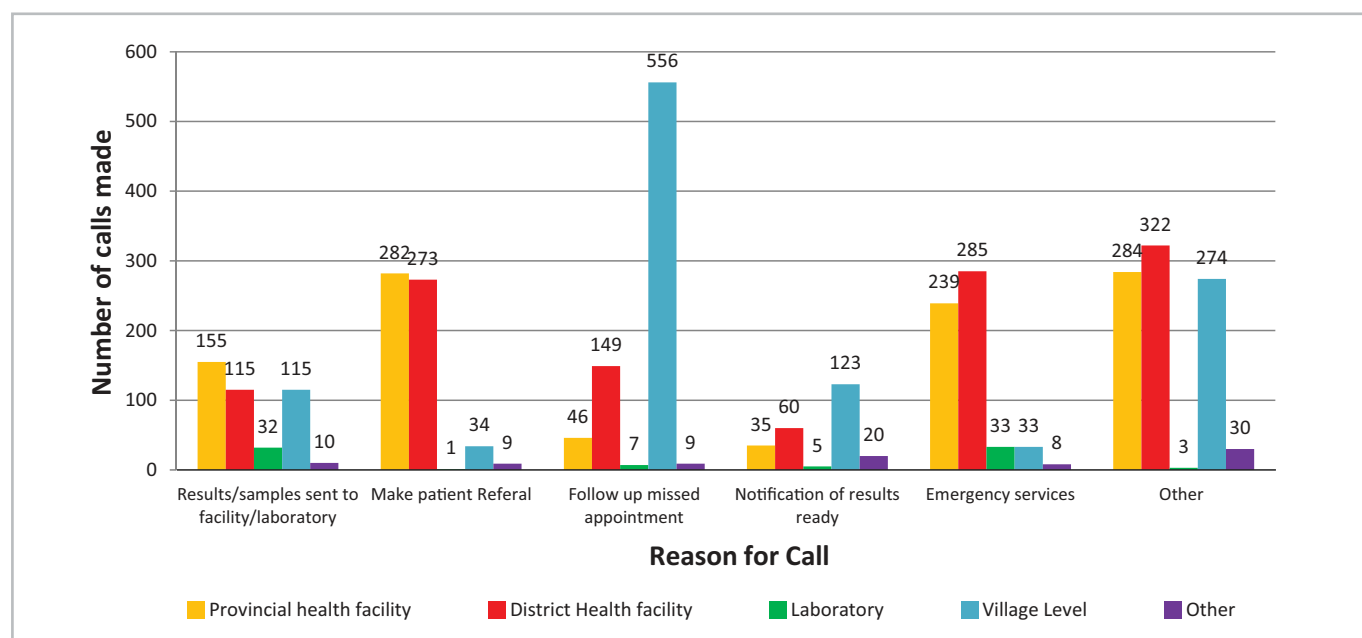
Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

location of 36% (n=238) of calls made under these two reasons. Making patient referrals and emergency services were major reasons for contacting the provincial and district health facilities, combined, matching follow-up for missed appointments as the most frequently cited reason for cell phone use by location (15%; n=555).

Table 3: Frequency distribution of person contacted

Rank	Person contacted	Frequency (N=3552)	Percent %
1	Health care worker	2002	56%
2	Village health worker	914	26%
3	Patient	205	6%
4	Ambulance	186	5%
5	Lab technician	136	4%
6	Other	123	3%

Figure 8: Location of person called and reason for contact



3.1.3.3 Individual contacted and reason for calls

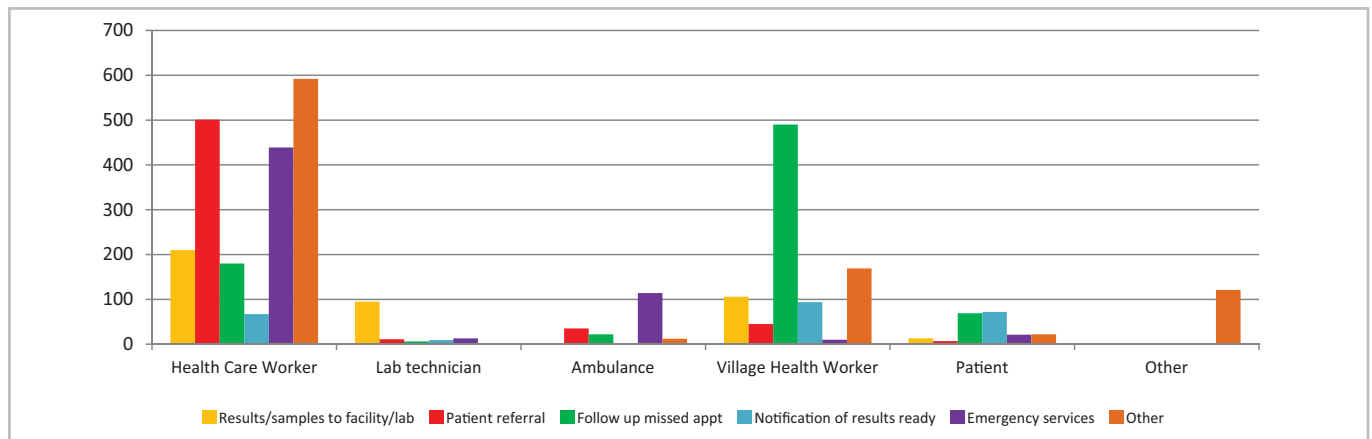
Corresponding to the distribution of call location (Table 3), cell phones at the health care facilities have primarily been used to contact other health care workers, with over half of all calls made registered as being to other health care workers (56%; n=2002). The next most common group contacted were village health workers at 26%.

Analysis of the main reasons for contacting the health care workers show that the health care workers were contacted primarily for patient referrals, emergency services and other reasons, Figure 9. Other reasons for contacting the health care workers include, sending

rapid disease surveillance data and making enquiries to the district health facility. The health facilities reported they contacted the VHW mainly for following up patients in the community for missed appointments. Following up VHW meetings are the main other reasons for contacting the village health workers.

Ranking of the primary reasons for the phone calls by individuals contacted mirror those in Table 2 by location, with 'other' being the most frequently cited reason. Although, the site utilisation monitoring tool is important for cell phone use monitoring it was difficult to obtain timely and complete data from the

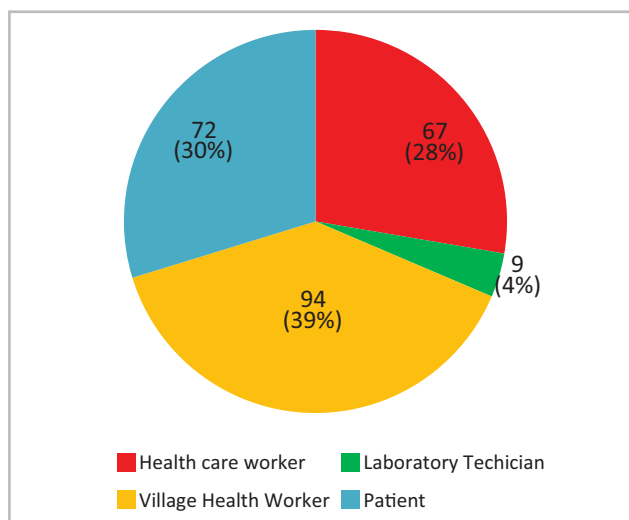
Figure 9: Frequency distribution reason for contact by individual



health facilities. Staff shortages at the health facilities were cited as the chief reason as the health care workers were already burdened by other registers and attending to the patients.

Examination of individual called by reason for call demonstrated that for reasons such as result notification (Figure 10) and follow up of missed appointments, the majority of calls are made to the community level. For calls made regarding the notification of a ready result village health care workers being the primary person contacted (39%), followed by patients (30%).

Figure 10: Proportion of individuals called under reason 'results notification' (N=242)



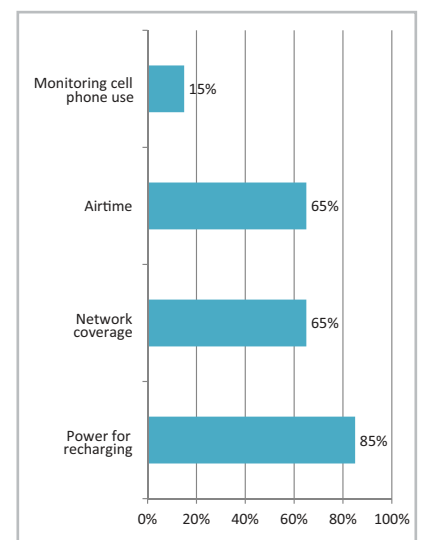
3.2 HCW perceptions of challenges and benefits to cell phone use

3.2.1 Barriers to optimal use of cell phones

The majority of sites (69%; n=20) reported facing challenges to the effective use of cell phones at their health facility in the GOP questionnaire. 76% of the health facilities reported that the use of the cell phones could be improved to maximize efficiency and patient outcomes suggesting the increased airtime allocations and purchase of solar charges for the cell phones for uninterrupted readiness of the cell phone when the need arises.

The most frequently cited barrier to cell phone use cited in the GOP questionnaire (85%) was power for recharging cell phones (Figure 11).

Figure 11: Barriers to cell phone use at health facilities



3 Results

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

The barriers noted by facilities in the GOP questionnaire were largely echoed during FGDs with nurses, however FGDs revealed additional barriers not captured in the structured questionnaire.

Power: HCWs noted that many sites do not have electricity, or have intermittent access to power, which can make charging cell phones a problem. The provision of solar lamps with cell charging plugs was recommended as a means of overcoming this limitation.

“We do not use the phones for PMTCT only, but for other follow up and emergencies. If we had more airtime, we could do more direct contact with clients.” – HCW Hwedza

Airtime: The change in allocated airtime from \$20USD to \$10USD was described to be insufficient by many sites, particularly high volume urban clinics. The suggestion was made to allocate airtime based on an analysis of client volume at each site, rather than a fixed amount for all sites.

Network: While in general, network availability at health sites was reported to be generally adequate to make use of cell phones, the majority (65%) reported experiencing network problems at some point. HCWs noted that inconsistent network at very rural clinics posed a problem.

“We have the problem of a poor network, so that sometimes our messages are delayed and we have to walk long distances for signal.” – HCW Chigondo Clinic, Hwedza

Standard Operating Procedures: The failure of many sites to adopt standardised procedures for use of the cell phones (intended as dedicated for use for EID/PMTCT) were noted by health care workers to

result in inconsistent use and application of cell phones and failure to complete utilisation forms correctly and consistently. HCWs noted that training and making explicit on the conditions of use of the cell phones and the procedures for making calls, including recording in a log specific individuals using phones would help prevent the misuse of the phones.

Inconsistent Access Across Health Care Levels: HCWs noted that while sites had been supported with cell phones and airtime, that both upper and lower health care levels required for communication along the EID results chain were not, creating a ‘black box’ in terms of communication flow, where by calls and messages were often only being made in one direction.

At higher levels, HCWs in Hwedza noted that the lab for follow up of DBS samples for EID did not have a dedicated cell phone, or provided with airtime.

“The lab does not have a cell phone so it is difficult to follow-up to track the flow of DBS samples. Even if they were given airtime, they could use their personal phones.” – HCW Hwedza

Communicating with community level: Central to the ‘black box’ issues, HCWs expressed frustration that cell communication to community level is largely a one-way process. Messages sent by health sites to VHWs and clients are rarely responded to. HCWs noted the failure to support VHWs with airtime as a limitation to effective communication about missed appointments and result ready notification. Often messages sent via text were only ‘responded to’ physically, once VHWs come for regularly scheduled meetings at the health facility.

Accountability of use: While cited by only 16% of sites in the GOP questionnaire as a barrier to optimal use of cell phones, during FGDs the challenge of monitoring appropriate use of cell phones by health care staff was discussed. A paradox of challenges was revealed in terms of accountability. In large sites,

where many have access to the cell phone, monitoring use among many different health care workers is difficult. Conversely, at sites where only one person, such as the sister in charge had access to cell phones, HCWs expressed frustration that the phone could not be used efficiently or when needed during the scope of daily duties as issues arise.

“It is not easy, especially at large centres with many staff – accountability is difficult. We have so much to do we cannot spend all of our time monitoring cell phone use.” – HCW Marondera

“If the call registers are not filled in, and even if they are, there is the opportunity for airtime to be abused. The registers do not work. People just have to be honest with their use of the phoning cell phone use.” – HCW Marondera

3.2.2 Health Care Worker perceptions on how the use of cell phones can be improved

The following are some common responses provided during FGDs on how to improve the current use of cell phones to maximize efficiency and patient outcomes along the EID results chain:

- Ensure cell phones are kept on site and accessible to all nurses
- Clear rules regarding the use of cell phones (no personal use, no removing cell phones from health site property) – put in place mechanisms to track the use of cell phones
- Purchase cell phones for VHWs and other groups involved in the EID results chain who currently do not have dedicated phones (such as labs).
- Provide solar chargers to ensure cell phone is reachable at all times of day

3.3 Village Health Worker access to and use of cell phones

The total number of VHWs in the two districts is 301 (Marondera: 178; Hwedza: 123). The total population of VHWs in these districts were targeted for completion of a short cell phone access and use questionnaire completion. 286 VHWs completed the questionnaires resulting in a response rate of 95%. Accordingly, unless stated otherwise, N=286.

To provide qualitative depth to the questionnaire data, 5 Focus Group Discussions (FGDs) were held in October 2013 at 2 Health Care sites in Hwedza Rural Hospital and Mount Saint Mary’s Hospital in Hwedza and Masikana Clinic, Border Church Clinic and Chiota Rural Hospital in Marondera. Village Health Workers attached to each health site were invited to attend FGDs. A total of 94 VHWs participated in FGDs, with the majority of participating VHWs being females (n=84; 89%). The average size of FGDs was 18 participants (range 6 – 31). It should be noted the average was skewed by the fact that large numbers attended 2 sites, and the decision was made to allow participation of all those in attendance to provide a diversity of perspectives. VHW FGDs took on average of 1 hour and 30 minutes to complete. Written informed consent was provided by VHWs for both Questionnaire and FGD participation.

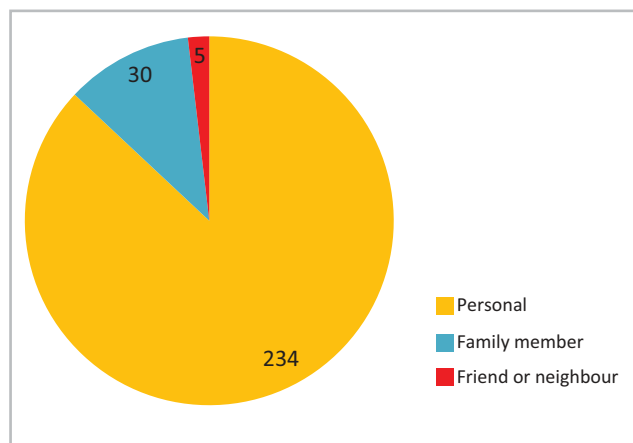
3.3.1 Access to Cell Phones

There is near universal access to cell phone among the village health workers with 94% (n=270) reporting that they have access to cell phones. Figure 12 demonstrates that of the VHWs reported that they have access to cell phones, the vast majority (87%) reported owning their own phone. Marondera district, a larger, more urban District, had a higher proportion of VHWs with personal cell phones compared to Hwedza district, 90% (n=168) and 76% (n=66) respectively.

3 Results

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

Figure 12: Type of access to cell phones



3.3.2 How cell phones are used by VHWs

During FGDs, VHWs described the variety of uses of cell phones in the scope of their community-based duties including:

- **Communicating with next level health sites** – receiving messages from health care sites and in turn reporting to health sites regarding patient follow up and suspected cases of notifiable diseases such as cholera and TB.
- **Critical for reporting and responding in cases of emergency** – all groups emphasised the key role that cell phones have in reporting and receiving assistance for community-members in emergency and other time-bound situations.
- **Receiving messages regarding meetings/trainings** – from health care sites, and organising activities with other VHWs who do not have cell phones.
- **Following-up with patients** – regarding missed appointments, treatment adherence on ART or DOTS, or to check whether patient has made use of services/outcome following referrals (such as for EID).
- **Immediate referrals and requests for ambulances** – informing RHCs of referred patients without delays in urgent situations

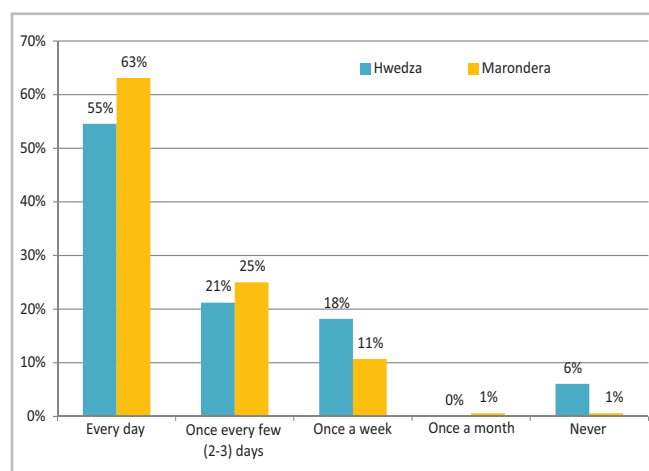
including following home deliveries, burn cases, in cases where patients are too weak to walk to the clinic, etc.

3.3.3 Facilitators and barriers to cell phone use among VHWs

The VHWs reporting access to personal cell phones in the questionnaire (N=234) were asked additional questions on the availability of resources that are important for the usage of cell phones including network coverage, access to power for charging the cell phones and access to recharge cards to top up the cell phones.

Network: The data reveal that 94% of VHWs (n=220) have access to mobile network at all times where they stay, with 5% (n=12) reported that they walk some 5-10 minutes from their place of residence to access mobile network. One VHW reported needing to walk between 10-20 minutes and one more than 30 minutes to receive network coverage. The proportion with access to mobile network at all times at their place of residence did not vary significantly between the two districts with Marondera being slightly higher at 95% than Hwedza which reported 92%.

Figure 13: Distribution of VHW access to power at different times by District



Power: On access to power i.e. electricity or solar for charging the cell phones, 61% of the VHWs in the two districts reported that they have access to power every

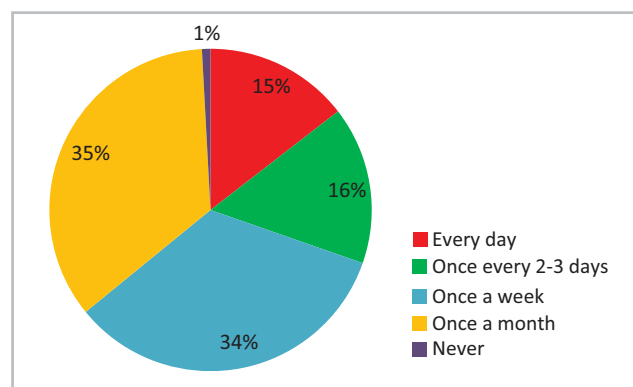
Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

day and 24% percent have access to power once every few (2-3) days. Figure 13 shows that Marondera district has more village health workers with access to power for charging the cell phones every day or once every few days compared to the VHWs in Hwedza district.

While the majority of VHWs indicated that they were able to access power to charge their phones, FGD findings revealed that in many instances this is not straightforward. VHWs in all areas described having to 'make a plan' to charge cell phones including using power at a neighbours or the shops to charge their cell phone, often being required to pay up to 5 Rand to have their phone charged.

Airtime: VHWs do not have easy or readily available access to airtime cards to top up their cell phones. Over one third reported that they access airtime cards only once a month (Figure 14).

Figure 14: Distribution of access to recharge cards for airtime top up



This questionnaire finding was supported in FGDs with VHWs, in which the main challenge to the use of cell phones as part of their duties described was lack of airtime.

3.3.4 VHW preferred support to optimise cell phone use

Airtime: The resounding majority of VHWs in all FGDs indicated support through the provision of airtime on a monthly basis through the health care sites as the preferred means through which the use of cell phones

as part of their duties could be supported. Increases in and timely payment of monthly allowances to VHWs was noted as an alternative means that VHWs could be supported to purchase airtime. VHWs noted that \$5USD per month in airtime would be adequate, however the amount indicated ranged from \$5USD-\$20USD.

Solar Chargers: VHWs indicated the provision of solar lights with cell phone chargers would increase use of cell phones as part of their duties.

Cell phones for those without: The provision of cell phones for those VHWs who do not have personal access was also noted as an important way that the use of cell phones by VHWs could be improved. It was noted that if all VHWs had cell phones, then standardised procedures for their use as part of their duties could be created to improve efficiency (such as processes for making referrals, follow-ups and receiving/sending messages from health sites) and save time for other tasks

Improved Communication/Permission to Make Phone Follow-Up: Given the long distances many VHWs are required to travel to make a household visit, VHWs indicated receiving permission to make phone follow ups with patient permission regarding things like missed appointments would save time and increase their attention on other duties that would not be appropriately conducted using cell phones (i.e., home based care visits, attending community meetings, providing information and referrals to community members).

3.4 Barriers to Early Infant Diagnosis

As the primary purpose of the provision of cell phones was to improve the TAT on the EID results chain, the perceived barriers existing to EID from the perspective of both HCWs and VHWs was captured through both GOP and FGD data collection.

3 Results

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

3.4.1 HCW perceptions regarding barriers along the EID results chain

3.4.1.1 Key Barriers to Effective EID

Data were collected on the factors that the health care workers perceived as challenges to the successful implementation of EID in their setting (Table 4). The data show that greatest challenge to EID from the perspective of health care workers was caregivers agreeing to have the child tested, with more than half (53%) of the health facilities citing this as a challenge. It was suggested that continued community education and mobilisation could help address the challenge of caregivers for successful implementation of EID.

The transportation of DBS samples to the laboratory poses challenges to EID as 40% of the health facilities reported this as a challenge to EID with 6 of the 12 sites rating it as a major challenge. In open-ended questions, training of health care workers on the use of the frontline system was suggested as a pathway to improve the receipt of results from the laboratory in a timely manner. It was also suggested that the health care workers should emphasise to the patients the need to provide correct contact details to facilitate timely notification of results so that appropriate action can be commenced on time.

3.4.1.2 Communication barriers along the EID results chain

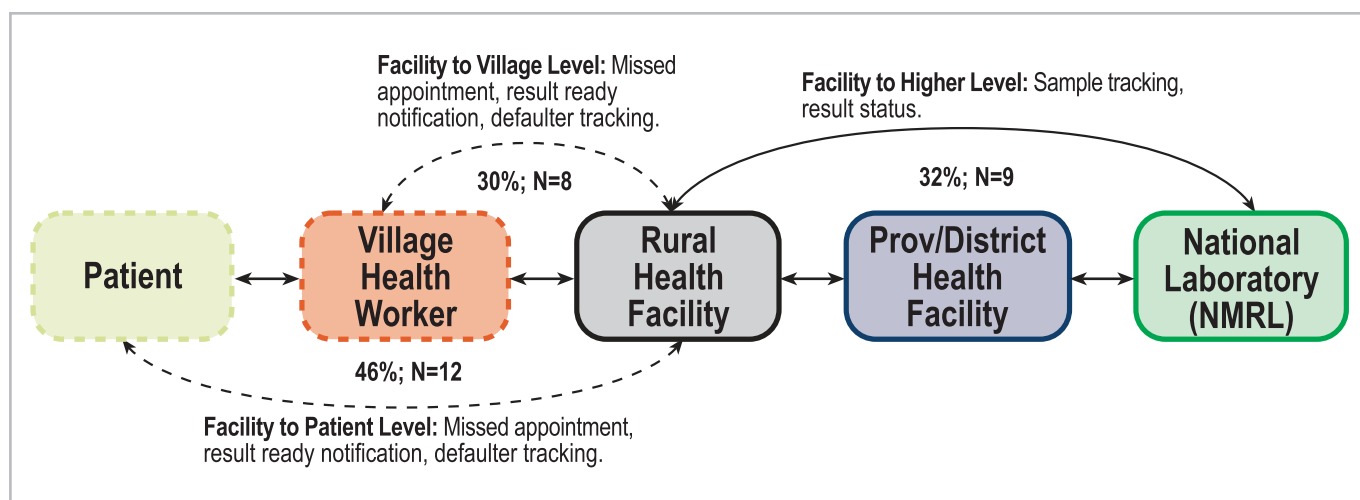
Table 4: Ranked frequency challenges to successful EID

Rank	Barrier to successful EID	Frequency (N=30)	Percent %
1	Caregivers agreeing to have child tested	16	53%
2	Transportation of DBS samples to laboratory	12	40%
3	Receiving results back from lab to facility in a timely manner	8	27%
3	Notifying caregivers of results in a timely manner	8	27%
4	Identifying HIV exposed infants for testing	7	23%

Communication from the facility to the client is considered the main challenge along the EID results chain as it was reported by 46% of the health facilities, but that cumulatively 76% determined the greatest challenges to communication exist at community or patient level.

Returning to the communication along the EID results chain from Figure 3, Figure 15 demonstrates the main barriers to this process from a health care worker perspective.

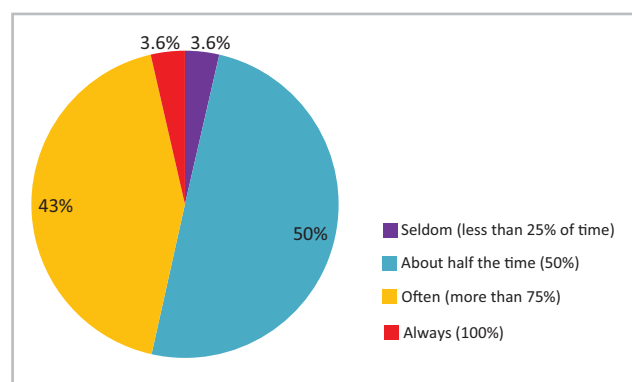
Figure 15: Perceived barriers to communication along the EID result chain



3.4.1.3 EID Result collection by caregivers

To ascertain the perceived success of completion of the EID result chain, to caregivers receiving results following collection of a DBS sample for EID, HCWs were asked ‘how frequently do you think mothers return to the health facility to receive results at scheduled follow-up appointments and they are available?’ (Figure 16).

Figure 16: Availability of EID results when caregiver comes to collect



While this question involved an estimation of how often results are ready, as opposed to a direct observation of clinic data, the majority of health care workers perceived that results were ready half the time or less when caregivers came to collect them (53.6%).

3.4.2 Village health worker perceptions regarding barriers to EID

The specific purpose of the assessment was to determine the facilitators and barriers to the use of cell phone technology by HCWs on communication across the EID results chain. Accordingly, FGDs with VHWs also focussed on the perceived barriers towards EID in their communities as well as the perceived role of cell phones for overcoming some of these barriers.

3.4.2.1 Challenges to supporting EID at the community level

The challenges described by VHWs to support mothers to make use of EID services during FGDs

- **Information completeness** – wrong addresses, different surnames used (maiden vs. married) resulting in difficulty tracking mothers for EID follow-up at community level.
- **Defaulting by choice** – VHWs described that many mothers knowingly miss their appointment dates and default on their own ART treatment, which translate to failure to uptake HIV-related services for their infants. The perceived reasons for purposeful disengagement in care were varied, including simply not wanting to ‘be bothered’ to go to the clinic, the challenge of distance and transport, and issues of stigma and discrimination related to failure to disclose their HIV status.
- **Knowledge and Awareness** – VHWs described a perception that awareness and education on PMTCT and HIV is very intense during ANC, but that awareness raising largely ends following delivery, resulting in many women not fully understanding the importance of EID. VHWs noted their own role and highlighted the importance of continuous education in the postnatal period as critical for ensuring high uptake of postnatal services for PMTCT including maternal ART adherence and EID.

“Mothers seem to value vaccinations following delivery more than other aspects of the child’s health, like HIV testing. This makes it difficult to deal with mothers on HIV issues after the 9 month immunization.” – VHW Mount St. Mary’s

- **Stigma/Discrimination & Disclosure** – many women may have not disclosed their HIV status to their husbands making household visitation and openly discussing need for EID without breaching confidentiality of mothers difficult in community settings. As fellow community members, in area where stigma and discrimination against HIV positive

3 Results

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

individuals exists, VHWs indicated that women may not be willing to discuss/disclose their HIV status.

“If a VHW is referred by the clinic to a mother’s homestead, they may not be accepted in to discuss the baby’s issues and refused by the parents.” – VHW, Masikana clinic.

- **Rejection of VHW involvement** – VHWs reported that they often face problems in being accepted by mothers/parents to discuss issues regarding EID when referred by the clinic to a household following a missed appointment.

“Some mothers are not interested in going to the clinics because their churches do not allow them.” – VHW Mount St. Mary’s

- **Religious beliefs** – VHWs cited problems in encouraging women belonging to the Apostolic faith to uptake health care services for themselves, and for their children.
- **Home Deliveries** – VHWs noted that home deliveries were a contributing factor to failure to uptake EID services after birth. VHWs reported that women who deliver at home were less likely to bring their children in for EID, even those women who are aware of their HIV positive status.
- **Lack of Male Involvement** – if couples are not HIV tested together and male partners do not support the uptake of services of women and children, VHWs described difficulties for women to explain, receive resources to make use of postnatal HIV services, including EID. Male involvement was perceived to be particularly important in decisions to make use of services for the child.

VHW Mount St. Mary’s Examples of the role of men in uptake of EID services:

- *“Sometimes the husband does not allow the mother to go with the child to the clinic for DBS (dried blood spot) collection, even when the mother knows she is HIV+ and on ART”.*
- *One VHW provided an example of the influence of male involvement by describing a case where by a husband refused his wife to take their child in for EID. In order to gain permission, the wife subsequently sought for the support from the village Headmen.*
- *VHWs in Hwedza rural described ‘Operation Perekedza mimba yako’ ‘Operation Accompany Your Pregnancy’ as a good process to encourage men to accompany their pregnant wives to health services and indicated the same should happen for EID.”*

- **Internal Migration** – Following delivery, VHWs described movements by women (and their infants) in search of employment as limiting their ability to make community-level follow ups. VHWs highlighted that many patient transfers go undocumented, as many HIV positive patients leave the area without notifying the clinic, making follow-up of mother-baby pairs very difficult.

“Some patients are moving out of the community to nearby farms and it then becomes very difficult to follow up and monitor them.” – VHW Masikana Clinic

- **Cultural Practices** – in Shona culture it is customary for the women to deliver her baby at her own parent’s home (*kusungirwa*). In

such situations the mother may not disclose her HIV status to her parents/spouse, and will therefore be afraid to be found out to have had her child tested for HIV.

- **Orphans and Vulnerable Children** – VHWs noted that in households where the mother has died or has moved away, infants are not tested for EID at the right time as caregivers fail to value the importance of testing the child for HIV.

3.5 How cell phones influence communication along the EID results chain

3.5.1 Cell phones and EID communication

3.5.1.2 Health Care Workers and cell phones for EID

While challenges to optimal use were noted, the overwhelming majority of facilities reporting that the introduction of cell phones has improved turnaround times along the EID results chain. 97% of sites reported improved information flow through the use of cell phones.

The perceived impact of cell phones upon communication along the EID results chain was further elaborated by HCWs during FGDs. Specific improvements noted as trends in discussions included:

Improved Efficiency: HCWs described the role cell phones have played in saving time and increasing efficiencies in providing EID services. Examples of these improved efficiencies included:

- Only having sample collection transport come to clinic when there are samples to be collected.
- Receiving notification of results earlier over cell phone rather than waiting for physical results slip
- Reduced TAT between sample collection and

result notification due to improved communication and less 'leg work' by both health care providers and patients (only coming to clinic when results are ready).

- Earlier ART initiation in HIV positive infants by reduced time for result notification.
- Reduction in work load, messages previously required physical movement, now can be sent via cell phone.
- Better planning between District level and community level for arranging meetings and planning for outreach and other community sensitisation activities.

Improved communication: Nurses reported that in general cell phones have greatly improved communication along the EID results chain.

Facility and Higher Level: Many facilities discussed the use of dedicated phones for communicating with labs for results receipt using the 'frontline system', an instant electronic messaging system that provides EID results prior to the despatching of a physical results slip to the health care centre. The use of the frontline system between sites however was reported to be inconsistent, with some sites using it well, but others indicating the need for additional training. In those facilities where it was being used however, the system was reported to greatly improve result TAT.

***"The system enables us to get the results right away. Before we had to wait until the results slips were sent all the way to the rural health facility."** – HCW Hwedza*

Facility and Community Level: Supported by the utilisation monitoring data, the most beneficial aspect of cell phones and airtime upon the EID results chain has been communication with community-level. Numerous HCWs noted the benefits of having airtime available to notify patients and village health workers that results are ready, or to follow up. In cases where patients are not reachable, HCWs reported calling the VHW to pass a message to a mother in her area.

3 Results

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

3.5.1.2 VHW perceptions on challenges to Early Infant Diagnosis and the role of cell phone technology

VHWs perceived the role of cell phones in assisting them to overcome some barrier to supporting mothers/caregivers in their community to uptake EID as:

- **Improved Communication:** Improving communication across all levels of the EID results chain using cell phones. VHWs noted that currently cell phones are formally supported to transmit information and conduct follow-up at all other health care levels involved in the EID results chain of communication, with the exception of VHWs. This gap in the communication chain was also noted by health care workers and demonstrated in Figure 14. VHWs noted that through the introduction of cell phones, the communication chain could be further extended to patients, traditional leaders, and others.
- **Improved Turnaround Time:** Cell phone notification of result notification would improve turnaround time between when results are available and when the VHW notifies the client to go to the clinic to collect. This system of notification would also prevent unnecessary trips by clients to the clinic to see if results are ready.
- **Earlier uptake:** VHWs noted that text reminders to clients when they are approaching an important milestone appointment for HIV care (such as EID before 2 months) could help clients to keep to scheduled appointment dates and reduce late uptake of services.
- **Improved interpersonal / professional relationships:** VHWs noted that an additional benefit of strengthening the communication chain would be improved interpersonal relationships between VHWs, rural health site nurses and District Health Executive (DHE)

members. Tensions between the different health cadres would be reduced by creating more efficient systems of sending messages, fewer miscommunications and greater transparency in communication between different health care levels.

“Wherever I am, at all times of day, the cell phone will be available.” – VHW Border Church

“Cell phones will save us time and money. It is cheaper to use phones to relay messages than to travel to the clinic, and communication is faster.” – VHW Hwedza Rural

- **Greater flexibility in notification times:** Allows communication with/regarding patients at all times of day, not just during daylight hours when travel is possible.

“Those who are shy to talk to me face-to-face about HIV could then communicate with me freely.” – VHW Border Church

- **Greater confidentiality and disclosure:** VHWs noted that given the often complex interplay between stigma, disclosure and testing of children at community level, use of cell phones might be able to increase confidentiality.
- **Increase status and confidence of and community confidence in VHWs:** Being formally supported by MOHCC to use cell phones as part of their duties would increase the status of VHWs. VHWs reported the perception that community members would have more confidence to approach them knowing that the VHW could consult the clinic for guidance if required.

4 Discussion

4.1 Key findings under each study objective

The findings of the mHealth for communication along the EID results chain yielded a number of important revelations regarding the strengths, barriers and missed opportunities resulting from the use of cell phones by health care workers.

The discussion is structured to report the key findings under each of the study objectives:

1. To describe the uses of cell phones by HCWs.
2. To describe the facilitators and barriers to optimal use of cell phones to improve communication along the EID results chain.
3. To generate formative evidence regarding the feasibility of expanding access of mHealth to community level.

Additional important findings regarding the key challenges to EID, as well as policy level considerations regarding the use of cell phone technology for mHealth will be discussed.

4.1.1 Objective 1: Uses of cell phones by health care workers

WHAT WORKS

Cell phones are the only functioning means of communication at most health sites: The importance of cell phone technology in the delivery of health care services in Zimbabwe, including HIV and EID services is highlighted by the finding that cell phones were the *only* functioning method of external communication at almost all rural health sites. Central to this important point is that many health care facilities with functioning landlines noted the inefficiency of making calls from landline to cell phone, rendering landlines only useful for calling other landlines. As the majority of individuals at both health facility and community level communicate using cell phones, the potential of cell phone technology for improving communication between health care workers cannot be understated.

The findings of the mHealth for EID study should not be viewed in the context of ‘Is there capacity for cell phone use to improve communication along the EID results chain?’ but rather ‘How can we harness the existing use of cell phones to reduce workload and maximise efficiency in communications?’.

The increasing availability and use of smart phones, allowing internet access and the use of mobile applications (apps), present even greater possible uses of cell phones for health care workers. Smart phones have been used in sub Saharan Africa for data collection and management, and the provision of real-time technical support and training to health care workers in very rural settings and patient monitoring and support, including adherence monitoring tools for people living with HIV (PLHIV). The rapid development of mobile applications enhance the ability to provide health care workers and patients to diagnostic tools and information that could greatly contribute to increased knowledge and standard of care for rural patients. The Royal Tropical Institute offers an up-to-date source of information for sharing knowledge on the current use, potential and limitations of mHealth in low-resource settings at <http://www.mhealthinfo.org/>

Cell phones are critical for communication between rural health facilities, and other health systems

levels: Utilisation monitoring records indicate that location of calls made from health facilities were roughly divided in thirds between: provincial, district and community level. Of interest, the reasons cited for use of cell phones primarily centred around ensuring patients received EID in the first place (i.e., follow up of missed appointments and referral for services) as opposed to ensuring receipt of results. This trend indicates some progress in strengthening certain parts of the EID results chain through targeted efforts of MOHCC and PMTCT program partners in recent years, such as result communication between labs and facility through the use of cell phones and General Packet Radio Service (GPRS) printers. Such findings coincide with health care worker perceptions regarding key barriers to EID being at entry into the EID cascade, related to caregivers accepting/bringing in their infants for testing.

4 Discussion

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

The top ranking of the 'other' category of reasons for calls made can be said to partly reflect a limitation of the utilisation tool, with many health care workers citing 'arranging meetings' as a frequent 'other reason' for cell phone use to other health care workers. While the importance of organising health centre meetings should not be undermined, the predominance of the 'other' category re-emphasises the importance of SOPs for guiding use of phones.

WHAT NEEDS WORK

Procedural variability and uses of cell phones underscore the need for SOPs: The majority of sites did not have any Standard Operating Procedures to guide the use and storage of cell phones. The implications of supporting cell phone use without a set of SOPs was evidenced by the between-site variability on things such as: where the cell phone is stored while not in use, who has authorisation to use the cell phone, conditions under which cell phones would be used and the recording of calls made.

FROM: HWEDZA RUAL HF

TO: MOTHER1

MESSAGE:

YOUR RESULTS ARE READY FOR COLLECTION

The development of SOPs should not only include general operating procedures, but also seek to introduce procedures to save time and promote cost-effective use of cell phones. For example, the indication that almost 100% of recorded use of cell phones were to make voice calls, with virtually no text messages recorded, indicates a missed opportunity of standardizing follow up and results notification procedures using cell phones.

Accurate, consistent cell phone utilisation monitoring is an operational challenge: Linked to the development of SOPs, OPHID's experience in collecting cell phone utilisation data using facility-based registers is that obtaining timely and complete data from the

health facilities is a challenge. Accurately monitoring cell phone use by health centres require innovative approaches that are both cost-effective and prevent additional cumbersome administrative processes by health care workers that should be devoting their time to patient care.

Registers were not filled in completely by all sites. Staff shortages at the health facilities were cited as the chief reason for incomplete registers, with health care workers already over-burdened by other registers and attending to the patients. It is important to note that even when registers were completed consistently, there was no efficient method of establishing whether they were filled in accurately. For example, the resources required for manual review of phone records and 'policing' of cell phone usage by senior staff at health sites, are not efficient uses of limited resources.

4.1.2 Objective 2: Facilitators and barriers to optimal use of cell phones

WHAT WORKS

Providing airtime supports health care workers to use cell phones

The benefits of predominance of cell phones as the only functioning communication system at almost all sites and impact of cell phones upon the information flow, task efficiency and working relationships between all levels of health care system actors underscore the importance of continued support for cell phone use by rural health care sites. The provision of airtime was the primary facilitator enabling health care workers to make effective use of cell phones.

Overcoming barriers to optimal use of cell phones are within reach and call for application of complementary innovations: While over half of all facilities reporting facing barriers to the effective use of cell phones, the main barriers noted access to power for charging and adequate airtime can both be addressed through strategic use of existing resources and introduction of cost-effective solutions such as solar power chargers and automatic recharge of airtime. Problems such as network fluctuations will

require higher-level solutions between service providers and MOHCC through PPPs.

Based on the responses of participating health facilities, it can be proposed that the cost of overcoming the barriers to use of cell phones will be considerably less than those required to optimise the use of alternative forms of technology (introduction/fixing of land lines; purchasing/repair/maintenance/powering of radios).

WHAT NEEDS WORK

Missed opportunities at community-level should be explored: The need to support community level structures and formally include patients within the cell phone communication chain were emphasised as a critical missed opportunity to optimal use of cell phones by both health care workers and village health care workers. This will be discussed in detail in the next Section 4.1.3.

The future of mHealth relies on effective Public Private Partnerships with technology and service providers: Problems such as poor network coverage in remote areas, appropriate solar technology for charging phones, provision of used cell phones to VHWs and HIV positive women without access to personal phones, and other areas generally outside the scope of donor intervention and public health agencies should be investigated through public private partnerships (PPPs). Innovative methods for the management of mHealth initiatives including monitoring and utilisation of cell phone usage (mechanised review of call records) should also be explored through PPPs.

4.1.3 Objective 3: feasibility of expanding access of mHealth to community level.

WHAT WORKS

Cell phone access is not a major barrier faced by village health workers: Access of individual VHWs to

cell phones approximated that of health facilities. The vast majority of VHWs indicated they had access to a cell phone, and 81.8% reported owning a personal cell phone. The high rate of personal ownership of phones provides strong evidence for the feasibility of expanding support for cell phones to community level (both VHW and patient levels) without requiring major investment in actual cell phone hardware, but rather investing in effective and efficient use of cell phones as part of routine duties through airtime and procedural support.

mHealth has vast potential to decrease travel time and increase efficiency at community level: In a country where one of the primary barriers to uptake of health services of all kind, including EID is distance to the health facility, the potential power of cell phone technology to improve efficiencies and reduce time required to physically travel to send/receive health care related messages is massive. Current reported uses of cell phones by VHWs in the absence of formal procedures and support for cell phone use including communicating with next level health sites, reporting and responding in cases of emergency, receiving messages regarding meetings/trainings, and following-up with and referring patients for care demonstrate the salience of the technology for overcoming distance, saving time, improving efficiencies and reducing unnecessary work hours of this voluntary cadre.

Findings provide a strong case for supporting cell phone use by village health workers: The limitations on communication to communities through lack of formalised support for cell phone contacts between health care workers and village healthcare workers represents a critical missed opportunity to improve health communication in general, and specifically along the EID result chain.

The weak systems for cell phone communication with VHWs are particularly inefficient for EID given that the time between result received at site and client pick up is the largest lag in the EID result chain. Accordingly, this is the area where interventions to improve communication could have the greatest impact upon timely EID and results receipt.

4 Discussion

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

VHWs represent the community link for contacting defaulters and conducting patient follow up. However, the promotion of expanding support for VHW use of cell phones to scale should be treated with some reservation. As noted by Leon and colleagues in their health system framework for decision making about mHealth for community based health services as depicted in Figure 17. The framework adapts and draws on three existing approaches to reviewing various eHealth approaches. The four health system dimensions should be considered when applying a health systems perspective to appraise the challenges of scaling up mHealth: stewardship, organisational, financial and technological. Each dimension has two or more elements that are important to consider when making decisions about acquiring and or scaling up mHealth.

Under this framework, it can be said that Zimbabwe currently faces multiple challenges to large-scale roll out of mHealth for community based programmes. However, the high documented access to and current use of cell phones by Village Health Workers in this evaluation indicates a mHealth agenda community-based health services should be strongly pursued. The Ministry of Health and Child Care in Zimbabwe has demonstrate efforts to strategically approach the use of mHealth through the Zimbabwe’s E-Health Strategy 2012-2017 , efforts which should be expanded upon in the scope of MNCH and HIV services.

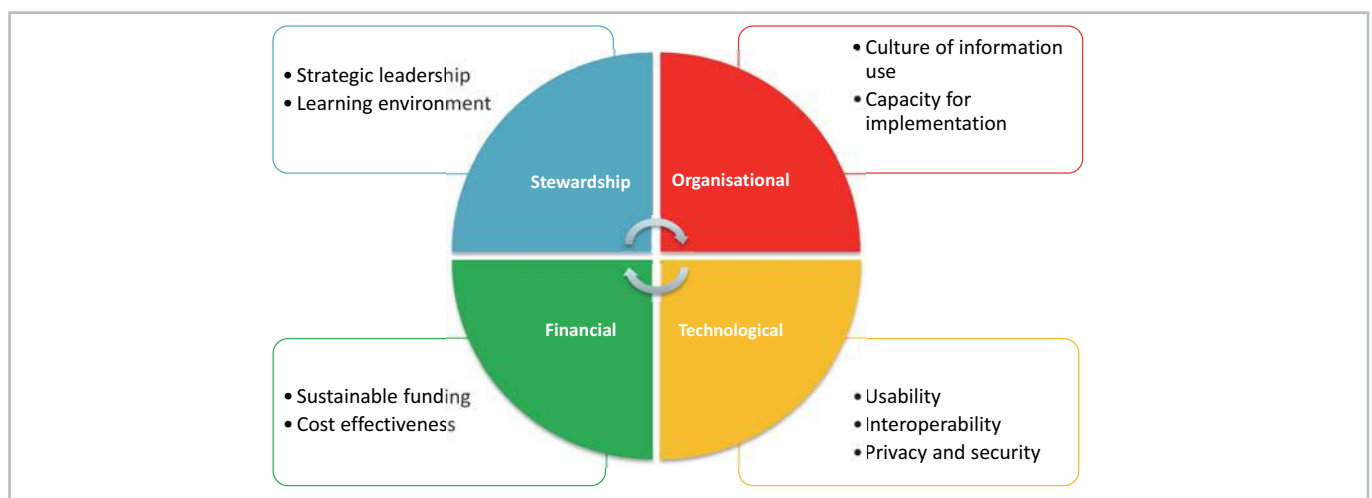
Evidence is required in Zimbabwe to demonstrate the impact of including VHWs in the cell phone communication chain prior to large-scale roll out. Such interventions should be conducted in conjunction with existing national policy and planning, be implemented in a systematic way using clear and properly disseminated SOPs and be evaluated for impact using rigorous implementation science methods.

WHAT NEEDS WORK

Barriers faced by VHWs to optimal cell phone use generally mirror those of health facilities: Findings revealed VHWs face similar barriers to cell phone use as their health site based colleagues. Only 61% of VHWs had daily access to power for recharging, and the informal systems for recharging at local businesses or other homes were complicated and likely also subject to outages and erratic access. Funds for and access to airtime, was identified as one of the greatest barriers faced by VHWs to cell phone use. In addition to not being formally supported with airtime, 70% of VHWs reporting they only had the opportunity to purchase airtime once per month or less.

The non-use of mHealth initiatives shown effective in other settings to increase uptake of maternal health services may lead to wasted resources and missed opportunities at household, community, and system level: The established benefit of mHealth

Figure 17: Health system framework for decision making about mHealth for community based health services



initiatives among health consumers such as text reminders for service use, notification of results ready for collection, or follow up after missed appointments all have relevant applications for communicating with village health structures and patients for EID. With high reported rates of existing contact with community level stakeholders such as VHWs and patients, the extension of mHealth to community level.

mHealth interventions should occur alongside efforts to build a strong national policy and program environment for mHealth: The transition of pilot mHealth interventions demonstrated to be effective to scale should not be taken lightly and should be conducted within a larger policy and mHealth interventions. The framework by Leon and colleagues provides important considerations for decision making about mHealth for community based health services in particular. The importance of taking a considered approach to scale is best articulated by the same researchers.

“In selected areas where organisational capacity for implementation exists, the health department [Ministry of Health] could follow a building blocks approach that involves encouraging the initial implementation of smaller, phased and heavily evaluated ‘lead’ projects, within the routine service environment. Implementation should pay particular attention to the technological issues of end-user acceptability, interoperability with both technical and human resource systems as well as ensuring security and privacy of patient information. This will allow for growing the capacity for implementation and the evidence base on mHealth in mainstream health settings - evidence that can in turn inform future developments in policy and practice.” – Leon et al. BMC Medical Informatics and Decision Making 2012, 12:123

4.2 Early Infant Diagnosis – More than mHealth

WHAT WORKS

4.2.1 Communication along the EID results chain was improved by use of cell phones

Health facilities unanimously reported the perception of improved information flow as a result of provision of cell phones. Specifically, health care workers reported benefits including improved efficiencies due to decreased requirement for physical carrying of messages between health facilities and to community level; improved communication between high and lower health system levels resulting in improved professional relationships; and most importantly, the perception of improved turnaround time along the EID results chain through faster follow up at all levels.

WHAT NEEDS WORK

4.2.2 The greatest perceived barrier to EID is failure to enter the cascade in the first place

The primary barrier to timely EID noted by over half of Health Care Workers and Village Health Care workers alike was **mothers not bringing their children in for testing**. EID appears to be a flashpoint at which HIV-related stigma, discrimination, cultural and gender issues converge. These perceptions are supported by programmatic data showing low uptake rates for EID at less than two months. A rapid assessment conducted by OPHID in January 2014 to determine the proportion of HIV positive mothers in ANC that had accessed EID services for their HIV exposed children indicated only 40.6% of mothers had recorded DNA PCR samples taken for EID.

Low uptake of timely EID, but high uptake for other postnatal services for infants such as 6 week

4 Discussion

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

immunisation rates upwards of 85%,⁴⁷ indicate the need for stronger integration of EID services into the Expanded Programme on Immunisation (EPI) and other standard maternal and newborn health services including community support services. The failure to offer EID while mothers are accessing other services represents a critical missed opportunity for diagnosing HIV infection in children and ensuring early ART initiation. Promotion and support to facilitate access to EID can also be provided during other community-based support initiatives. OPHID Trust has demonstrated the value of integrating HIV testing, care and treatment for orphans and vulnerable children through community-based early childhood development (ECD) playcentres.⁴⁸

The reported reasons for failure to present children for testing highlight the powerful force stigma and discrimination continue to play in the lives of HIV infected mothers, with particular challenges faced by women who have not disclosed their HIV status to their partners. The need for continuing information, education and counselling was noted by both HCWs and VHWs, with many women reportedly not being fully aware of risks of not having EID done for the health of HIV-exposed infants.

Male involvement is critical for supporting all services along the EID cascade, but particularly EID:

The role of men as 'gatekeepers' to uptake of maternal health services, including EID was repeatedly emphasised by VHWs during focus group discussions, a finding demonstrated in other settings.^{49,50}

A VHW's relation of how in desperation following refusal of her husband to have their child tested, an HIV positive mother escalated her request to local traditional leaders to overrule her husband's refusal and provide the culturally appropriate permission required to access EID. This example underscores not only the importance of male partners, but other influential male leaders in rural communities.

Sample transportation and processing continues to contribute to long TATs.

The transportation of DBS

samples to the laboratory continues to pose a major challenge to EID from the perspective of frontline healthcare workers. Improved and consistent implementation of systems intended to improve sample transportation processes should be emphasised among all health care workers, including ensuring the recording of accurate contact details for all patients.

EID Communication is all about Mum – Greatest barriers to communication are at caregiver level -

While the study was not designed to statistically assess significant impact of cell phone provision upon uptake of timely EID, communication was not cited as one the key barriers to EID by participating health care sites. This can be presumably due to the provision of cell phones and recorded use of cell phones for communicating across the EID results chain. Lack of effective systems for communicating with mothers or caregivers of HIV exposed children were paramount among responses regarding the remaining communication barriers for EID. The reported perception that results are ready for collection less than half the time when mothers return to the facility to collect them is a tangible example of how improved communication through text messaging could improve efficiencies along the EID results chain. In resource constrained environments, all efforts should be made to ensure that mothers do not incur unnecessary 'costs of care' (transport, time away from household duties, childcare, income generation activities) if services/results are not available.

4.3 In support of a more holistic conceptualisation of communication along the EID results chain

A key overarching finding of the current evaluation was that communication for EID is not limited to one health system level, but stretches from National Labs through to household level with individual patient follow-up. We propose that the interconnectedness of this communication chain should no longer be conceptualised as a cascade of communication

between independent stakeholders and service providers as is traditionally presented, but rather as a series of gears in which the seizing of one ‘gear’ effectively arrests communication movement across the entire system (Figure 18). Under this holistic view, all communicators in the system should be considered in plans, have clear standardised procedures for involvement (i.e., conditions for text notifications when results ready) and be supported (as in the case of VHWs) for use of cell phone technology in a sustainable manner (i.e., through procedural guidelines at minimum, or directly through airtime at a maximum).

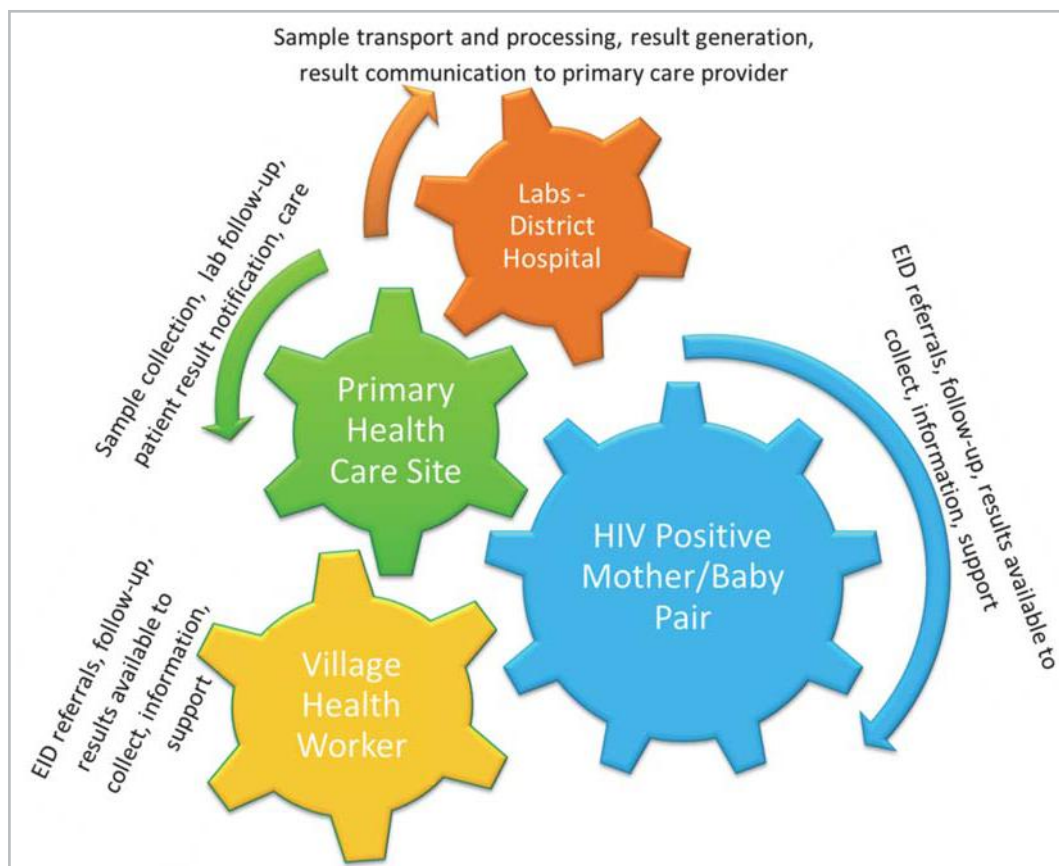
4.4 Study Limitations

As a descriptive process evaluation, no causal linkages can be made between cell phone use and specific

changes or improvements in receipt of results across the EID cascade. Due to the large number of potential confounders (i.e., efforts by MOHCC and its partners to strengthen the EID cascade, complementary programs to improve sample transportation and systems for sending results) and lack of control districts, the capacity to isolate the introduction of cell phones as the determining factor for improvements would be potentially biased.

An additional limitation that required acknowledging is that cell phone utilisation data presented in this evaluation regarding the person and reason for calls made is self-reported and not cross-referenced against actual phone records. The limitations of paper-based registries of phone calls made include not only questions about accuracy of data, but also appropriate use of health care worker time. More effective systems to monitoring mHealth programs should be investigated through PPPs.

Figure 18: Communication along the EID results chain



5 Recommendations

A number of recommendations at various health system and operational levels can be made based on *mHealth for strengthening communication along the EID results chain* study findings.

5.1 Recommendations for action

5.1.1 Policy Level

1. **Government investment in cell phones for health communications over alternative methods:** With the demonstrated dominant use of cell phone technology at health sites, with land lines and radios generally reported as non-functioning, the Ministry of Health and Child Care should be supported to investigate the cost-effectiveness of formalising and prioritising health care communications budgets for funding the use of cell phones for external communications at health sites across the country. Such processes would require standardisation and additional systems required to optimal use of cell phones by health care workers through guiding policy frameworks.
2. **Strategic capacitation of health system frameworks for the use of mHealth in community based health services.** Pursue an eHealth strategy for PMTCT/MNCH in partnership with MOHCC and in line with existing and planned eHealth strategies.
3. **Formalise Public Private Partnerships for mHealth in Zimbabwe –**
 - a. Ministry of Health and Child Welfare and its funding and implementation partners should engage with local service providers and private companies to develop and support strategies to expand mHealth in Zimbabwe. Such partnerships should be conducted with the intention of ensuring the development of programs with potential to cost-effectively go to scale should evidence demonstrate effectiveness.
 - b. As mHealth becomes an increasingly prevalent tool for improving health systems in Zimbabwe, efficient systems of monitoring and evaluating the use of technology must be developed/implemented in a more centralised

and systematic manner. This will likely best be achieved through Public Private Partnerships (PPPs) with cell providers and the Ministry of Health and Child Care (MOHCC).

- c. PPPs are also required to access current and most cost effective technology for overcoming noted barriers to cell phone use including efficient and durable solar chargers suitable for rural use, methods for automatic/electronic top up of airtime for rural subscribers and systems for monitoring the use of cell phones for health care duties.

5.1.2 Health systems and program level

1. **Develop Standard Operating Procedures for Cell Phone use by healthcare workers:** In cooperation with Ministry of Health and Child Care, explore most effective means of integrating clear standard operating procedures for cell phone conditions of use for improving communication for improving patient care. Such SOPs should include topics such as cell phone storage and access, conditions under which cell phones should be used for follow-up at different health system levels, issues of confidentiality for transmitting patient information over cell phones, and provide MOHCC approved templates for how to send information using cell phones.
2. **Introduce innovation into utilisation monitoring systems:** Utilisation monitoring systems require innovative approaches make effective use of human and technological resources for monitoring cell phone use. Potential methods for consideration include random tracing of phone records at health care sites to ensure paper registers match phone records. In addition, posting of clear SOPs for cell phone use that explicitly state conditions of use and those uses considered as mismanagement of health facility communication resources (personal calls, HCWs taking phones home with them) to guide use of cell phones by all staff.
3. **There is need to capitalise on the value of text messages:** Only 2% of recorded cell phone communications in this assessment were in text

form. In time sensitive situations such as EID for early ART, the potential of text messages for sending reminders before appointments are missed and patients default should be explored. Lessons from UNICEF supported initiatives such as, Project Mwana in Zambia used short message service (SMS) texts to significantly reduce EID result notification from sample collection to results notification to both health facilities and caregivers.

4. **Stronger integration of EID into standard MNCH services:** The common perception among HCWs and VHWs that caregivers bringing their children in for testing is the greatest barrier to EID indicates missed opportunities to integrate EID into standard MNCH services such as baby-weighing, immunisations and general health appointments. Integrated service provision through programmes such as within the current UNICEF-funded Prevention and Treatment of HIV and Under-nutrition in Infants and Young Children project should be enhanced and specific health service opportunities for the provision of timely EID explored.
5. **Higher levels of the EID cascade still require attention:** While the main perceived barriers to EID were cited at the patient/community level, continued difficulties in sample transportation and processing emphasise that the Ministry of Health and Child Care should be provided with further support to strengthen the laboratory sample transportation, particularly from rural health care sites.

5.1.3 Community level

1. **Extend mHealth support to community level:** The gaps identified in communication along the EID results chain at community and patient level indicate the need to extend the mHealth net to include VHWs and patients. The provision of formal support to Village Healthcare Workers to use cell phones within the scope of their community activities should be further pursued by the Ministry of Health and Child Care and its partners. Standardised systems should be developed to guide healthcare workers in the use

of cell phones to improve communication with HIV positive mothers/caregivers of HIV-exposed children (i.e., in what context to use text notification, time before EID is due to send reminder, maintaining patient confidentiality, etc).

2. **Community-based efforts to increase uptake of timely EID should focus on providing information and support to women at household level in a culturally acceptable and feasible manner.** Stigma and discrimination issues should continue to be embedded within all PMTCT and MNCH activities. The problem of non-disclosure underscores the importance of promoting male involvement in PMTCT both during pregnancy and the postnatal period. Overcoming myths and misconceptions regarding testing infants, which including traditional leaders through community dialogues will be important for building community based support for women to bring their infants in for EID. Strategic efforts such as community dialogue series, community radio, engagement with traditional and local leaders are urgently needed to increase awareness of benefits of timely EID to increase uptake of this essential service for improving survival and outcomes among HIV-exposed children.

5.2 Future Research

With the goal of understanding what, why, and how interventions work in “real world” settings and to test approaches to improve them, recommendations resulting from implementation research should identify areas requiring further research to better inform effective implementation. Based on the current evaluation, remaining/identified gaps between evidence and practice in Zimbabwe for the effective use of cell phone technology for health care communications in general and for improving communication along the EID results chain in particular include the need to:

1. **Establish impact of mHealth on turnaround time across the EID results chain.** The main limitation of the current study was the inability to report on the impact of cell phone use upon TAT at different

5 Recommendations

Usage patterns, facilitators and barriers to the use of mobile technology by rural health care workers

stages of the EID results chain. Future research should employ randomised designs that enable attributions regarding impact of cell phone use on changes in TAT.

- 2. Determine cost-effectiveness of mHealth over existing methods.** The cost-effectiveness of different communication methods should be established to inform potential standardisation of mHealth applications.
- 3. Pilot the impact on the support to cell phone use as part of VHW duties.** Impact and cost effectiveness of alternative strategies for supporting VHW communications should be explored. Other mHealth applications should also be pursued such as use of mobile technology by VHWs for the provision of information, data capture, GPS mapping and reporting. All pilot assessments should be designed to provide specific information regarding cost and feasibility to inform MOHCC about transitioning to scale at national level.
- 4. Patient level mHealth applications should be piloted and rigorously evaluated:** The potential of mHealth applications for text reminders and other forms of patient communication require further study. Such research should not only focus on effectiveness, but also involve process evaluations as to inform program design. mHealth initiatives should not be confined to standard cell phones, but also explore the potential of smart phone technology for improving the provision of all health services, including EID.

- 5. Develop effective networks of mHealth implementers to share lessons for developing a common evidence base and maximising the impact of mHealth –** mHealth is a rapidly expanding method of providing health information and services in Low and Middle Income Countries (LMICs) around the globe, and in sub Saharan Africa in particular. Organisations engaged in mHealth projects in Zimbabwe should be involved in local, regional and international networks designed to share lessons and avoid duplication of initiatives previously proved to be of limited impact or cost effectiveness.
- 6. Greater research is required to understand the barriers to EID from the perspective of HIV positive mothers.** Responses from VHWs indicated the social consequences of being found to test her infant for HIV for a mother who has not disclosed her HIV status are perceived to be greater than the risks of not testing. Greater research regarding the barriers and facilitators to EID from the perspective of mothers and caregivers of HIV-exposed infants should be further explored for the development of culturally appropriate responses to support caregivers to uptake timely EID.
- 7. Knowledge, attitudes and beliefs of male partners and traditional leaders to HIV testing and treatment of infants need to be documented.** Such research is required to identify how major myths and misconceptions, cultural practices, beliefs and power structures may act as barriers or facilitators to timely EID of HIV.

6 Conclusion

The *mHealth for strengthening communication along the EID results chain: Usage patterns, facilitators and barriers of the use of mobile technology* study findings revealed a number of valuable insights regarding the feasibility and acceptability of mHealth applications for improving communication along the EID results chain in program areas. Health care workers clearly valued the contribution cell phones had made to their daily working lives, and perceived increases in efficiency and turnaround time in receiving results. While not an explicit part of the program, the surprisingly high use of cell phones to contact VHWs and patients at community level demonstrates an underutilised link in the mHealth communication chain that requires further investigation.

The importance of community structures for EID was a crosscutting theme of study findings. VHWs currently use cell phones regularly in the scope of their duties, though no formal systems exist for supporting or guiding their mHealth activities. By far, the most neglected player in the EID results communication chain is that of HIV positive mothers and caregivers of HIV-exposed infants. The potential of mHealth and use of cell phones for appointment reminders, follow-up of missed appointments, notification when results are ready for collection, and provision of other important information are currently untapped. Other interventions unrelated to mHealth to support uptake of EID were identified, with involvement of male

gatekeepers and addressing important issues surrounding stigma, discrimination and disclosure requiring further research and program attention.

Moving forward, mHealth activities for MNCH, including EID, should take place within a policy and program environment led by the Ministry of Health and Child Care. This study provided clear evidence of the value of supporting cell phone use for external communications at health sites. The merging and systematic roll-out of clear procedural guidelines for using and documenting cell phone activities within existing Standard Operating Procedures will provide health care system actors with required frameworks to guide use of cell phone technology for improving communication for routine patient care, including timely EID. Finally, further research is required to develop required evidence to guide transition of those mHealth interventions shown to be effective to scale.

“By harnessing the increasing presence of mobile phones among diverse populations, there is promising evidence to suggest that mHealth can be used to deliver increased and enhanced health care services to individuals and communities, while helping to strengthen health systems.” – Leon et al., 2012

References

- ¹ World Health Organization. Towards universal access: Scaling up priority HIV/AIDS interventions in the health sector. Progress Report.2010. Available at <http://www.who.int/hiv/pub/2010progressreport/report/en/index.html>, accessed on July 20, 2011.
- ² Newell ML, Coovadia H, Cortina-Borja M, Rollins N, Gaillard P, Dabis F. Mortality of infected and uninfected infants born to HIV-infected mothers in Africa: a pooled analysis. *Lancet* 2004;364:1236-43.
- ³ Violari A, Cotton MF, Gibb DM, et al. Early antiretroviral therapy and mortality among HIV-infected infants. *N Engl J Med* 2008;359:2233-44.
- ⁴ Bhattacharya AA, Mangwiro A, Bhattacharya G, Radmard F, Rusakaniko S, Mushavi A, Mtapuri-Zinyowera S, Mujuru HA. Getting DNA PCR results to the caregiver: an analysis of sample-to-results turnaround time for early infant diagnosis in Zimbabwe. 19th International AIDS Conference; 2012 July 22-27; Washington, DC. Poster Abstract: MOPE033
- ⁵ Nyathi M, Shroufi A, Saint-Sauveur JF, Taziwa F, Ferreyra C, Viñoles MC. Starting ART early: Progress and lessons from Zimbabwe's largest child cohort. 19th International AIDS Conference; 2012 July 22-27; Washington, DC. Poster Abstract: MOPE195
- ⁶ Mushavi A. PMTCT overview: current-scale efforts and challenges in operations and implementation. Public Satellite Session at the 6th IAS Conference on HIV Pathogenesis, Treatment and Prevention (IAS 2011). 17 July 2011 Rome, Italy.
- ⁷ WHO. Consolidated guidelines on general HIV care and the use of antiretroviral drugs for treating and preventing HIV infection: recommendations for a public health approach.(June 2013 version). 2013. Available at: http://apps.who.int/iris/bitstream/10665/85321/1/9789241505727_eng.pdf , accessed on Jan 5, 2014.
- ⁸ World Health Organization. Antiretroviral therapy for HIV infection in infants and children: Recommendations for a public health approach (2010 version).2010. Available at <http://www.who.int/hiv/pub/paediatric/infants2010/en/index.html>, accessed on February 21, 2011.
- ⁹ World Health Organization. Principles and recommendations for infant feeding in the context of HIV and a summary of evidence.2010. Available at http://www.who.int/child_adolescent_health/documents/9789241599535/en/index.html, accessed on July 20, 2011.
- ¹⁰ Creek T, Tanuri A, Smith M, et al. Early diagnosis of human immunodeficiency virus in infants using polymerase chain reaction on dried blood spots in Botswana's national program for prevention of mother-to-child transmission. *Pediatr Infect Dis J* 2008;27:22-6.
- ¹¹ Ciaranello AL, Park JE, Ramirez-Avila L, Freedberg KA, Walensky RP, Leroy V. Early infant HIV-1 diagnosis programs in resource-limited settings: opportunities for improved outcomes and more cost-effective interventions *BMC Medicine* 2011;9.
- ¹² Unite for Children Unite for AIDS. Scaling up Early Infant Diagnosis and Linkages to Care and Treatment. Briefing Paper. January, 2009. Available from: <http://www.unicef.org/aids/files/EIDWorkingPaperJune02.pdf> [Accessed 13 Sept 2012]
- ¹³ UNAIDS. Global plan towards the elimination of new HIV infections among children by 2015 and keeping their mothers alive: 2011-2015. Geneva, UNAIDS, 2011.
- ¹⁴ World Health Organization. Progress Report 2011: Global HIV/AIDS response: epidemic update and health sector progress towards universal access.2011. Available at http://www.who.int/hiv/pub/progress_report2011/en/index.html, accessed on 2012, January 26.
- ¹⁵ MOHCW. Early Infant Diagnosis of HIV in Zimbabwe: 2007-2012 Report. National Microbiology Reference Laboratory, Harare, Zimbabwe.

- ¹⁶ Seidenberg P, Nicholson S, Schaefer M, Semrau K, Bweupe M, Masese N, Bonawitz R, Chitembo L, Goggin C, Theaa D. Early infant diagnosis of HIV infection in Zambia through mobile phone texting of blood test results. *Bull World Health Organ*. 2012 May 1; 90(5): 348–356.
- ¹⁷ David-West O. *Esoko Networks: facilitating agriculture through technology*. New York: United Nations Development Project; 2011 (GIM Case Study No. B061). Available from: <http://cases.growinginclusivemarkets.org/documents/116> [accessed 16 March 2012].
- ¹⁸ Africa Farming [Internet]. *M-farm*. Nyahururu: Africa Farming; 2012. Available from: <http://africafarming.info/m-farm> [accessed 16 March 2012].
- ¹⁹ allAfrica [Internet]. Zambia: climate information alerts boost poor farmers. Krugersdorp: allAfrica; 2012. Available from: <http://allafrica.com/stories/201107141317.html> [accessed 16 March 2012].
- ²⁰ Next billion, development through enterprise [Internet]. S.A. farmers use weather SMS. Ann Arbor: William Davidson Institute; 2005. Available from: <http://www.nextbillion.net/archive/newsroom/2005/08/22/s-a-farmers-use-weather-sms> [accessed 16 March 2012].
- ²¹ Cash and vouchers. Rome: World Food Programme; 2011.
- ²² Krishna S, Boren SA, Balas EA. Healthcare via cell phones: a systematic review. *Telemed J E Health* 2009;15:231-40.
- ²³ Deglise C, Suggs LS, Odermatt P. Short Message Service (SMS) Applications for Disease Prevention in Developing Countries. *J Med Internet Res* 2012;14:e3.
- ²⁴ Van Wyck E GJ, Roberts C, Crankshaw T, Geddes R, Bassett I, Butler L. Abstract # 1049. The Efficiency of Opt-Out HIV Testing Compared with Provider-initiated Voluntary Counselling and Testing in an Antenatal Clinic: Durban, South Africa. Conference on Retroviruses and Opportunistic Infections; San Francisco; 2010.
- ²⁵ Kunutsor S, Walley J, Katabira E, et al. Using mobile phones to improve clinic attendance amongst an antiretroviral treatment cohort in rural Uganda: a cross-sectional and prospective study. *AIDS Behav* 2010;14:1347-52.
- ²⁶ da Costa TM, Salomao PL, Martha AS, Pisa IT, Sigulem D. The impact of short message service text messages sent as appointment reminders to patients' cell phones at outpatient clinics in Sao Paulo, Brazil. *Int J Med Inform* 2010;79:65-70.
- ²⁷ Shet A, Arumugam K, Rodrigues R, et al. Designing a mobile phone-based intervention to promote adherence to antiretroviral therapy in South India. *AIDS Behav* 2010;14:716-20.
- ²⁸ Project Mwana: Using Mobile Technology to Strengthen Health Services for Mothers and Infants. Available at <http://projectmwana.posterous.com/>, accessed on January 30, 2012. S Interventions in the Health Sector. Progress report, 2011
- ²⁹ N. Segaren, T. Lewis, O. Desinor, E. Simeon. The distribution and use of cell phones to mothers of HIV-positive infants identified by the Haiti National Early Infant Diagnosis of HIV program (EID): a model for increasing adherence? 19th International AIDS Conference; 2012 July 22-27; Washington, DC Oral Abstract: WEA0301
- ³⁰ Dillabaugh L, Lewis Kulzer J, Owuor K, Ndege V, Oyanga A, Ngugi E, Shade S, Bukusi E, Cohen C. Towards Elimination of Mother-to-Child Transmission of HIV: The Impact of a Rapid Results Initiative in Nyanza Province, Kenya. *AIDS Res Treat*. 2012; 2012: 602120.
- ³¹ Tejiokem M, Faye A, Penda I, Guemkam G, Ndongo F, Chewa G, Rekacewicz C, Rousset D, Kfutwah A, Boisier P, Warszawski J. Feasibility of Early Infant Diagnosis of HIV in Resource-Limited Settings: The ANRS 12140-PEDIACAM Study in Cameroon. *PLoS One*. 2011; 6(7): e21840
- ³² GuroI-Urganci I, de Jongh T, Vodopivec-Jamsek V, Car J, Atun R. Mobile phone messaging for communicating results of medical investigations. *Cochrane Database Syst Rev*. 2012 Jun 13;6:CD007456.

References

- ³³ World Health Organisation. *mHealth: New horizons for health through mobile technologies: second global survey on eHealth*. Geneva, WHO: 2011.
- ³⁴ Tomlinson M, Solomon W, Singh Y, Doherty T, Chopra M, Ijumba P, Tsai A, Jackson D. The use of mobile phones as a data collection tool: A report from a household survey in South Africa. *BMC Med Inform Decis Mak*. 2009; 9: 51.
- ³⁵ Hirschhorn LR, Ojikutu B, Rodriguez W. Research for change: using implementation research to strengthen HIV care and treatment scale-up in resource-limited settings. *J Infect Dis*. 2007 Dec 1;196 Suppl 3:S516-22.
- ³⁶ O'Brien, R. (2001). An Overview of the Methodological Approach of Action Research. In Roberto Richardson (Ed.), *Theory and Practice of Action Research*. João Pessoa, Brazil: Universidade Federal da Paraíba. (English version) Available: <http://www.web.ca/~robrien/papers/arfinal.html> (Accessed 23/5/2012)
- ³⁷ Creswell JW: *Research Design- Qualitative & Quantitative Approaches*. Sage Publications; 1994, 173-192.
- ³⁸ Provost S, Pineault R, Tousignant P, Hamel M, Borgès Da Silva R. Evaluation of the implementation of an integrated primary care network for prevention and management of cardiometabolic risk in Montréal. *BMC Fam Pract*. 2011; 12: 126.
- ³⁹ Grimshaw J, Campbell M, Eccles M, Steen N. Experimental and quasi-experimental designs for evaluating guideline implementation strategies. *Fam Pract*. 2000 Feb;17 Suppl 1:S11-6
- ⁴⁰ Bradley EH, Curry LA, Devers KJ. Qualitative data analysis for health services research: developing taxonomy, themes, and theory. *Health Serv Res* 2007;42(4):1758–1772.
- ⁴¹ Berg, M. et al. 2009, Every Child Counts- The Use of SMS in Kenya to Support the Community-Based Management of Acute Malnutrition and Malaria in Children Under Five, ChildCount.org
- ⁴² Tolly, K.d., Skinner, D., Nembaware, V., Benjamin, P. 2011, Investigation into the Use of Short Message Services to Expand Uptake of Human Immunodeficiency Virus Testing, and Whether Content and Dosage Impact, Telemedicine and e-Health, doi:10.1089/tmj.2011.0058.
- ⁴³ Lenoir, M. 2010, Tanzanian Health Worker Uses Mobile for Distance Diagnosis in Remote Areas, IICD, 24 Nov. 2010
- ⁴⁴ Kagumire, R. 2009, How Uganda's Health Care Problems Can End with a Phone, The Independent Uganda, 16 Jun. 2009
- ⁴⁵ Leon N, Schneider H, Daviaud E. Applying a framework for assessing the health system challenges to scaling up mHealth in South Africa. *BMC Med Inform Decis Mak*. 2012 Nov 5;12:123.
- ⁴⁶ MOHCW. Zimbabwe's E-Health Strategy 2012-2017 (Draft).
- ⁴⁷ ZDHS 2010-2011.
- ⁴⁸ Patel D, Matyanga P, Nyamundaya T, Chimedza D, Webb K, Engelsmann B. Facilitating HIV testing, care and treatment for orphans and vulnerable children aged five years and under through community-based early childhood development playcentres in rural Zimbabwe. *J Int AIDS Soc*. 2012 Jul 11;15 Suppl 2:17404.
- ⁴⁹ Story WT, Burgard SA. Couples' reports of household decision-making and the utilization of maternal health services in Bangladesh. *Soc Sci Med*. 2012;75(12):2403-11. Epub 2012/10/17.
- ⁵⁰ Vallieres F, Hansen A, McAuliffe E, Cassidy EL, Owora P, Kappler S, et al. Head of household education level as a factor influencing whether delivery takes place in the presence of a skilled birth attendant in Busia, Uganda: a cross-sectional household study. *BMC pregnancy and childbirth*. 2013;13:48. Epub 2013/02/26.
- ⁵¹ Peters DH, Adam T, Alonge O, Agyepong IA, Tran N. Implementation research: what it is and how to do it. *BMJ*. 2013;347:f6753. Epub 2013/11/22.



20 Cork Road, Belgravia, Harare, Zimbabwe
+263 4 252772/791
<http://www.ophid.co.zw/>