



# mHealth in Ethiopia

## Strategies for a New Framework



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# Table of Contents

Table of Contents .....	1
List of Tables and Figures.....	2
Acknowledgements.....	6
Methodology.....	7
Report Synopsis.....	8
Introduction/Overview.....	16
Country Overview.....	17
Public Administration and Health Sector Management .....	18
Health Challenges & Health Systems: MNCH & HEWs.....	19
HEW Information and Communication Flows.....	22
Key HEW Information and Communication Needs.....	23
Situation Analysis .....	26
The Promise of mHealth .....	33
Mapping Interventions: Needs and Constraints .....	38
Introducing mHealth: A Phased Rollout .....	40
A Strategic Framework for mHealth in Ethiopia .....	45
Principles and Key Considerations for Interventions .....	54
mHealth in the Digital Health Ecosystem.....	57
The Way Forward: A Path to Sustainable mHealth Interventions.....	62
Conclusions and Next Steps.....	64
Endnotes .....	65

## List of Tables and Figures

Table 1: Ethiopia Opportunities.....	9
Table 2: Intervention Objectives, Benefits and Impact.....	12
Table 3: mHealth Interventions for Ethiopia.....	12
Table 4: mHealth Interventions.....	14
Table 5: Challenge-Need-Intervention Matrix .....	38
Table 6: Mapping Needs to Interventions and Health System Benefits.....	45
Table 7: Attributes, Technology and Programs for Information & Communication Needs.....	46
Figure 1: Situations and Implication .....	10
Figure 2: Phased Rollout Conditions and Actions .....	11
Figure 3: Digital Ecosystem for mHealth .....	13
Figure 4: The <i>Kebele</i> in Ethiopian Life .....	18
Figure 5: Ethiopia and MDGs 4, 5 and 6.....	19
Figure 6: Community-Based Interventions Save Lives.....	20
Figure 7: Health Extension Workers .....	21
Figure 8: HEW Information and Communication Relationships.....	22
Figure 9: Key HEW Information and Communication Needs.....	23
Figure 10: Ethiopian Telecom Ecosystem.....	27
Figure 11: Telecom Infrastructure Assets and Issues .....	28
Figure 12: Key Performance Indicators and Regional Comparison.....	30
Figure 13: MNCH mHealth Applications.....	34
Figure 14: Mobiles to Save Lives.....	36
Figure 15: mHealth Intervention Group User Attributes .....	41
Figure 16: Phasing mHealth Interventions.....	43
Figure 17: Phased Rollout Conditions and Actions .....	44
Figure 18: Referral Solution Examples.....	47
Figure 19: Training and Education Solution Examples.....	48
Figure 20: Supply Chain Management Solution Examples .....	50
Figure 21: Data Exchange Solution Examples.....	51
Figure 22: Consultation Solution Examples .....	53
Figure 23: mHealth Digital Ecosystem.....	58
Figure 24: mHealth Supporting eHealth .....	61
Figure 25: Near-term and system-based mHealth interventions.....	63

## Abbreviations

ACD	Automatic Call Distribution
ANC	Antenatal Care
ARPU	Average Revenue Per User
ASP	Applications, Solutions, Projects
BEmONC	Basic Emergency Obstetric and Newborn Care
CAR	Contraceptive Access Rate
CDC	Centre for Disease Control
CDMA	Code Division Multiple Access
CEmONC	Comprehensive Emergency Obstetric and Newborn Care
C-IMCI	Community Integrated Management of Childhood Illnesses
CPR	Contraceptive Prevalence Rate
EARC	Ethiopian AIDS Resource Centre
EBF	Exclusive Breast Feeding
EDHS	Ethiopia Demographic and Health Survey
EEPCo	Ethiopian Electric Power Company
EFY	Ethiopian Financial Year
EICTDA	Ethiopian Information and Communication Technology Development Agency
EMR	Electronic Medical Record
EPI	Expanded Program of Immunization
ETA	Ethiopian Telecommunications Agency
ETB	Ethiopian birr (currency)
FMOF	Federal Ministry of Finance
FMOH	Federal Ministry of Health
FP	Family Planning
GDP	Gross Domestic Product
GIS	Geographic Information System
GSM	Global System for Mobile Communications
GTP	Growth and Transformation Plan
HAPCO	HIV/AIDS Prevention and Control Office
HCF	Health Care Facility
HDWH	Health Data Warehouse
HEP	Health Extension Program
HFIDB	Health Facility Information Database
HEW	Health Extension Worker
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System

HP	Health Post
HRIS	Human Resources Information System
HSDP	Health Sector Development Programme
IEC/BCC	Information, Education, and Communication/Behavior Change Communication
IMCI	Integrated Management of Childhood Illness
IMR	Infant Mortality Rate
IP	Internet Protocol
ITN	Insecticide Treated Net
IVR	Interactive Voice Response
JSI	John Snow Inc.
LABIS	Lab Information System
LMIS	Logistics Management and Information System
MDG	Millennium Development Goals
mHDE	Mobile Health Digital Ecosystem
mHealth	Mobile Health
MCIT	Ministry of Communication and Information Technology
MNCH	Maternal and Child Care Health
MNH	Maternal and Newborn Health
NGO	Non-Government Organization
PABX	Private Automatic Branch Exchange
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PEPFAR	President's Emergency Plan for AIDS Relief
PMC	Proposal Management Checklist
PMTCT	Preventing Mother to Child Transmission
PPP	Purchasing Power Parity
RCP	Rural Connectivity Program
REDC	Rural Energy Development Center
RH	Reproductive Health
RHB	Regional Health Bureau
SBA	Skilled Birth Attendant
SMS	Short Message Service
SNNPR	Southern Nations, Nationalities and People's Region
STI	Sexually Transmitted Infections
TB	Tuberculosis
TBA	Traditional Birth Attendant
TL	Team Leader
TM	Telemedicine
TOT	Training of Trainers
TT	Tetanus Toxoid

U5MR	Under-Five Mortality Rate
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNICEF	United Nations Children's Fund
VAS	Value Added Services
VSAT	Very Small Aperture Terminal
WFP	World Food Programme
WHO	World Health Organization
XML	Extensible Markup Language

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## Methodology

The methodologies for developing this study include a literature review of documents and studies from the public, multi-lateral and private sectors. Public-sector documents reviewed include plans, reports and analyses from the representative ministries and agencies of the Ethiopian government, including the Federal Ministry of Health (FMOH), the Ministry of Finance and Economic Development (MOFED), the Ministry of Agriculture and Rural Development (MOARD), the Ministry of Communication and Information Technology (MCIT), the Ethiopian National Bank (ENB) and Ethio Telecom (ET). Multi-lateral and bilateral sector reviews include reports and analyses from organizations and funders such as the Bill & Melinda Gates Foundation, The World Bank, the UN Conference on Trade and Development (UNCTAD) and US Agency for International Development (USAID). Private-sector document reviews include reports and analysis from various consulting and operations firms such as Access Capital, 4Afri and Vital Wave Consulting, reviews of mHealth implementation summaries by organizations and initiatives such as Frontline SMS, BRAC, MoTeCH and Africa Aid, as well as survey data from organizations such as SC4CCM/JSI, L10K/JSI and Addis Ababa University/UNICEF.

The study is also informed by nearly 50 face-to-face and virtual interviews with stakeholders in government, multi-lateral and private-sector organizations that are currently active in supporting or developing the health, financial services and agriculture sectors in Ethiopia, and by site visits to health facilities including health posts, health centers and hospitals in Addis Ababa, Oromia and SNNPR. Some of those interviewed included Health Extension Workers (approximately 20), ICT managers of leading development partners in Ethiopia, project managers of on-going health-related collaborations between the public and private sectors, foreign and local ICT entrepreneurs doing business in Ethiopia, and private multi-lateral sector financiers funding development projects in the country. While interviews were conducted with a variety of stakeholders in the concerned sectors, research methods did not include statistically-representative surveys of health-sector workers.

Once research and data collection were completed, information and perspectives gathered from secondary and primary resources were synthesized and analyzed in order to develop the findings, frameworks and conclusions contained in the study.



## Report Synopsis

Ethiopia is at a pivotal moment in its efforts to improve the health status of its people and move the country into a new phase of social and economic development. Even as the country has made progress toward its health-related Millennium Development Goals (MDGs), the government and its partners realize that advances need to be accelerated if targets in maternal and child mortality and infectious diseases are to be achieved.

Mobile technology is one potential avenue for doing so. Throughout the world, health service providers and decision makers are trying to capitalize on the revolution in mobile communications to strengthen health systems and boost efforts to extend the reach of health workers into underserved communities. This study explores the Ethiopian context – the country’s health systems and challenges, as well as its infrastructure and environment – and uses this information to identify critical success factors and create a framework for the introduction of mobile health (mHealth). It also examines how a well-designed mHealth program would integrate into other technology initiatives in the Ethiopian health sector. If managed successfully, mHealth can be an effective tool for advancing the government’s key health initiatives, particularly community-based interventions that have women at their center. This report is intended to serve as an early step that can guide the planning and implementation of projects that will benefit communities throughout Ethiopia.

### Mapping Key Health System and HEW Needs

Even as it makes progress toward the Millennium Development Goals, Ethiopia faces considerable challenges in developing its health system to improve maternal and child health. The Ethiopian Federal Ministry of Health and its partners have identified the following critical health system challenges in their efforts to reduce the country’s rate of maternal and child mortality:

- **Unmet Need for Family Planning**
- **Low Rate of Skilled Birth Attendance**
- **Shortage of Skilled Human Resources**
- **Inadequate Coverage of Emergency Obstetric Services**
- **Poor Referral System**
- **Poor Supply and Logistics Management**

Ethiopia’s Health Extension Program (HEP) was introduced under Health Sector Development Programme (HSDP) II to deliver high-impact interventions at the family and community level and address some of the challenges listed above. The HEP is the primary channel through which health education, basic curative care and preventive components of primary health care reach Ethiopia's population. The HEP’s primary implementers are Health Extension Workers (HEWs), salaried government employees who receive one year of training and are assigned to a rural health post. As the front-line workers in the country’s health system, HEWs interact with communities and families as well as other actors in the health system, and as such they have a variety of information and communication needs, many of which could be addressed by mobile or electronic health tools. Their key information and communication needs are **referrals, data exchange, supply chain management, training and education** and **consultation**. In Table 3, below, the health system challenges described above are shown with the key HEW needs, along with the opportunity for mHealth or eHealth interventions to address them and the challenges and constraints faced by such efforts.

**Table 1: Ethiopia Opportunities**

Challenge	Related HEW Need	mHealth/eHealth Opportunity	Challenges/Constraints
Unmet Need for Family Planning	Data Exchange	Identify and register target population for outreach	Access hard-to-reach populations
	Training & Education	Build HEW knowledge of FP methods, instruction and access through ongoing training and education	Address cultural, educational and linguistic issues to increase FP demand and uptake
	Supply Chain Management	Facilitate inventory management and distribution of needed FP materials and supplies	Reduce supply chain inefficiencies
Low Rate of Skilled Birth Attendance	Referrals, Data Exchange	Identify and track status of pregnant women, especially those at high risk	Access hard-to-reach populations
	Training & Education	Increase awareness of SBA delivery benefits through appropriate educational material	Overcome reluctance to deliver in non-traditional settings
	Referrals	Refer mothers and newborns to facilities and arrange transportation	Mitigate poor transportation infrastructure and ensure care at referral facilities
Shortage of Skilled Human Resources	Training & Education	Increase access to relevant and appropriate training content	Create continually-refreshed, language-specific materials
	Consultation	Allow front line workers to consult with medical professionals	Address overall inadequate supply of trained personnel
Inadequate Coverage of Emergency Obstetric Services	Referrals	Speed women with complications to facilities known to have staff/supplies and support for obstetric first aid	Maintain up-to-date information on transportation and facilities and encourage earlier calls to facilities
	Training & Education	Increase awareness of risk factors and danger signs/complications through campaigns	Create culturally and linguistically-appropriate materials
	Consultation	Improve near-term consultation ability for obstetric first aid while facilities are expanded	Manage training constraints and lack of skills
Poor Referral System	Referrals	Move toward notification of incoming referrals so that hospital care is immediate (reduce third delay)	Address language issues and ensure health staff recognize and act on urgency
	Data Exchange	Create record system and register patients, families, pregnancies (EDD) and births	Overcome technology and non-technology obstacles to records
	Data Exchange	Facilitate transportation to accompany referral	Mitigate poor transportation infrastructure and financial barriers
Poor Supply & Logistics Management	Supply Chain Management/ Data Exchange	Allow tracking of inventory and consumption of key supplies at HPs and HCs	Manage overall insufficiency of necessary supplies
	Supply Chain Management	Facilitate ordering and delivery/pick up of needed supplies	Overcome written language barriers and transportation inadequacies

The

table above indicates that interventions using mHealth (and the larger field of eHealth, of which mHealth is a subset) could indeed play a role in both addressing some of Ethiopia’s larger health system needs while at the same time satisfying the diverse information and communication needs of HEWs, allowing them to perform their jobs more effectively. The last column, however, is a reminder that there are constraints specific to Ethiopia’s current situation that must be considered if interventions are to be effective.

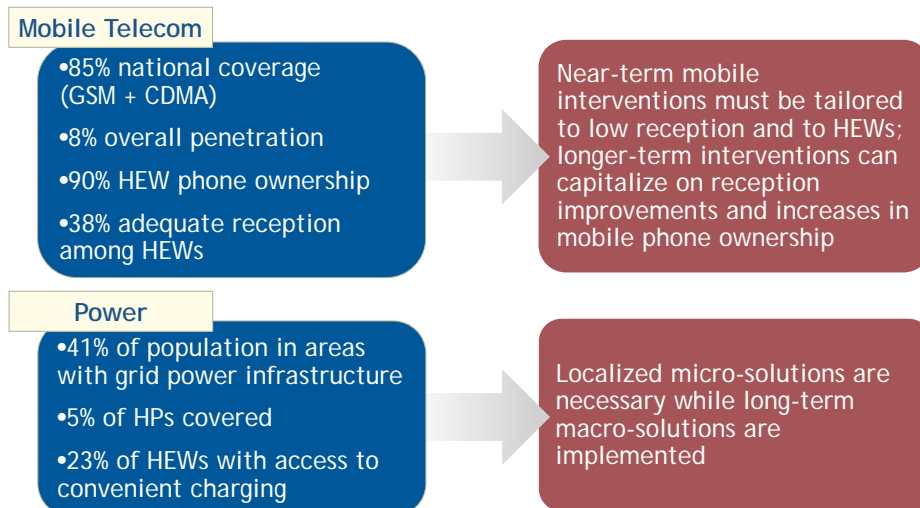
# The Environment for mHealth in Ethiopia

Any analysis of the appropriate mHealth interventions in the Health Extension Program must take into account the telecommunications and physical infrastructure in Ethiopia, as well as the user attributes that determine the sort of interventions that could make an impact on health outcomes. Ethiopia has, over six years, developed an unusual but extensive mixed-capability ICT infrastructure that provides a blended coverage of 85% of the country's population, with the potential to serve 90% of its population. This infrastructure is multivariate and uses CDMA and GSM (2G and 2.5G/GPRS) mobile and fiber technologies – each stand-alone yet interoperable.

- The country's GSM network, which is the network used by the country's seven million mobile subscribers, covers approximately 65% of Ethiopia's population, while the CDMA network that provides the backbone for Ethiopia's Rural Connectivity Program covers 90% of its population.
- Over 500 cities have been connected to fixed-line Internet and every regional capital has fiber connectivity with up to 2Mbps connectivity.
- Electrification rates at the *kebele* level remain low, but national power provider EEPCo has accelerated its progress in connecting towns and cities to the national grid infrastructure.
- Research indicates that nearly 90% of HEWs have mobile phones.

Ethiopia has thus made progress in creating the conditions necessary to support a program of mHealth interventions in its health system. Significant challenges remain, however. Ethiopia continues to have one of the lowest rates of mobile phone ownership on the African continent, with only about 8% of the total population having a subscription, many living in urban areas. The state-owned Ethio Telecom is the sole telecommunications provider, and the resulting lack of competition is likely a significant factor in the country's low mobile phone ownership rate. Reception and network congestion problems are chronic. In rural areas, very few *kebele*-level facilities (including health posts) have electricity, limiting the ability to recharge mobile phones. All these factors have implications for mHealth interventions, as summarized below.

**Figure 1: Situations and Implication**



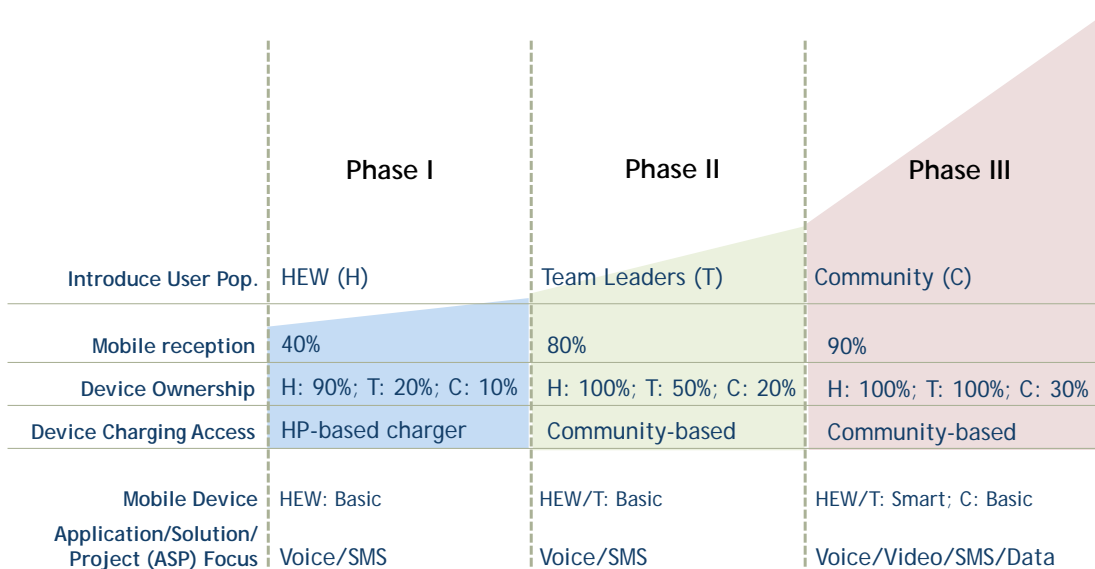
## Why mHealth in Ethiopia?

In many developing countries, much of the population, especially in rural areas, does not have access to the public health care system due to resource constraints, system inefficiencies and a lack of awareness about services that are offered. mHealth is a term used for interventions and programs designed to support medical service provision and public health through mobile technology and devices. The mHealth spectrum ranges from simple mobile phone-based applications for the transfer of health information on basic handsets via short message service (SMS) to highly sophisticated diagnostic applications that rely on advanced equipment and robust back-end data systems. In Africa, most mHealth interventions, especially those targeting general populations rather than health or data workers, have used relatively simple mobile technology and equipment. While the field of mHealth is still young, there have been promising early results and lessons from the dozens of pilot programs that have been conducted in a variety of geographic and health-system settings, many of which may be instructive in attempting to address the needs described above.

## HEWs as the First Phase of mHealth Intervention

It has already been noted that some mHealth interventions have focused on health workers, while others are aimed at members of the community at large. In Ethiopia, considerations about the appropriateness of large-scale interventions center on the fact that about 90% of HEWs own mobile phones, compared to only 8% of the Ethiopian population (even lower in rural areas). In addition, HEWs are generally more suitable for implementing mHealth interventions than members of the community or volunteers/team leaders because they can afford airtime, they adapt quickly to change, and they are usually Latin-language literate. (Most handsets are not Amharic-capable.) The figure below presents the idea of a three-phased approach to rolling out a national mHealth program, with the focus first on workers, then on team leaders and finally on the community at large. As indicators such as mobile phone ownership, mobile reception and device charging access increase, new user populations are introduced. Applications grow in sophistication as mobile network capacity and performance improve, with advances in reception and electricity access making it easier for all users to benefit.

**Figure 2: Phased Rollout Conditions and Actions**



## Matching mHealth Interventions to HEW Needs

If HEWs are the focus of the first phase of mHealth interventions, then which interventions are appropriate for addressing the health system challenges and HEW information and communication needs discussed earlier? The following table illustrates the objective of such interventions according to HEW need, and the health outcome benefits they could be expected to bring.

**Table 2: Intervention Objectives, Benefits and Impact**

HEW Need	Objective	Intervention	Benefits or Impact
Referrals	Identify and refer mothers and newborns to the most appropriate facility quickly and ensure they receive care at arrival	Allow faster communication of referral need through voice or text	Reduce delay in receiving care
Training & Education	Reinforce HEW training and procedure while performing current duties such as pneumonia CCM	Allow access to quizzes or checklists/algorithms during service provision	Improve skills and knowledge while reducing time away from post
Supply Chain Management	Ensure consistent and adequate supplies of needed drugs, kits and equipment	Allow notification and recording of supply needs as well as notification of receipt	Fewer stockouts of critical supplies
Data Exchange	Collect, transmit and receive critical patient and population health data	Facilitate electronic data entry and receipt at post level	Improve data accuracy and timeliness
Consultation	Speak with more highly-trained medical professionals in cases of emergency or urgent treatment	Allow real-time consultation with higher level medical staff	More effective and immediate aid

Table 5, below, illustrates the attributes and technology that these mHealth interventions would adhere to and examples of real-world mHealth interventions that could be used in the Ethiopian context.

**Table 3: mHealth Interventions for Ethiopia**

HEW Need	Attributes	Primary Technology	mHealth Solution
Referrals	<ul style="list-style-type: none"> <li>Relatively simple</li> <li>Easy to use</li> <li>Enables rapid action</li> </ul>	Tech: V, S Device: Basic	<ul style="list-style-type: none"> <li>Closed calling networks</li> <li>Form-based data transmission</li> </ul>
		Tech: F Device: Mid-level	
Training & Education	<ul style="list-style-type: none"> <li>Interactive, or "two way"</li> <li>Responsive, fast</li> <li>User-specific</li> <li>Current</li> </ul>	Tech: S, V Device: Basic	<ul style="list-style-type: none"> <li>SMS-based quizzes</li> <li>IVR systems</li> <li>Phone-based checklists</li> </ul>
		Tech: VD Device: Smart	
Supply Chain Management	<ul style="list-style-type: none"> <li>Matches and informs local supply best practices</li> <li>Simple, clear rules and procedures (checklists)</li> </ul>	Tech: S, V Device: Basic	<ul style="list-style-type: none"> <li>Bulk SMS programs</li> <li>Phone-based checklists</li> </ul>
		Tech: F Device: Mid	
Data Exchange	<ul style="list-style-type: none"> <li>Multi-way</li> <li>Record-based (unique ID)</li> <li>Actionable (goal-oriented and timed)</li> </ul>	Tech: S Device: Basic	<ul style="list-style-type: none"> <li>Form-based data applications</li> </ul>
		Tech: F, V Device: Mid, Smart	
Consultation	<ul style="list-style-type: none"> <li>One-way (bottom to top)</li> <li>Real-time</li> <li>Situation-specific</li> </ul>	Tech: V Device: Basic	<ul style="list-style-type: none"> <li>Closed calling networks</li> <li>Call centers (hotlines)</li> <li>Telemedicine applications</li> </ul>
		Tech: VD Device: Smart	

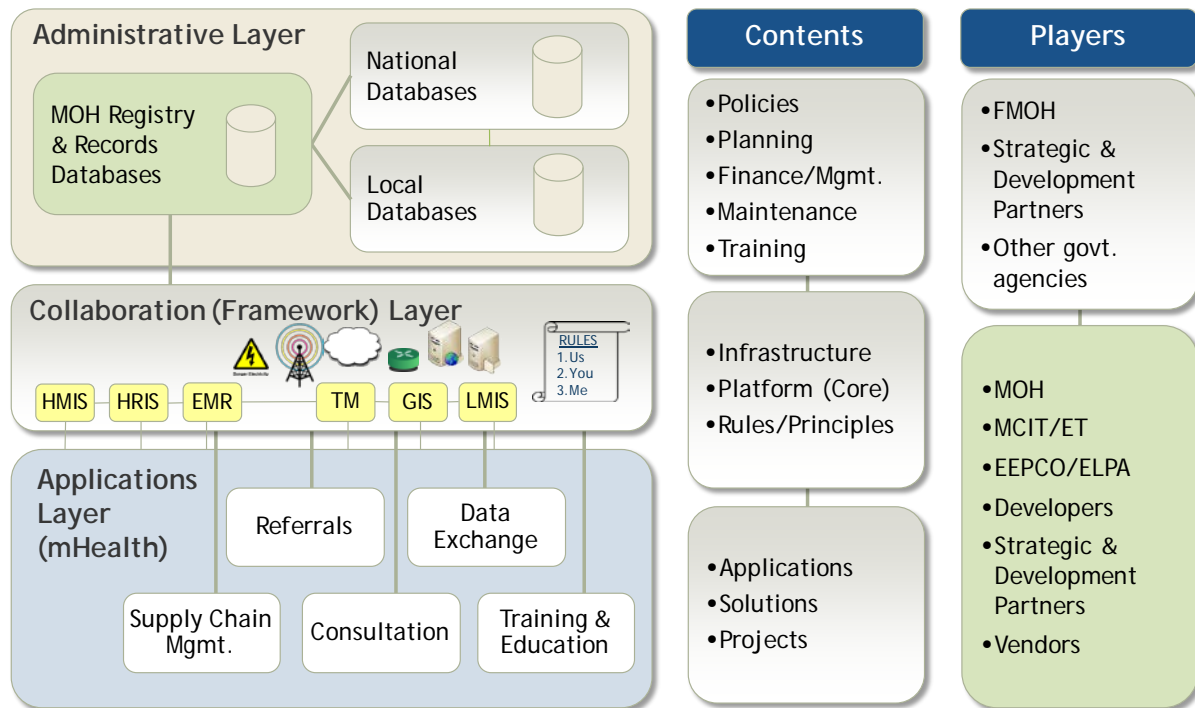
V=Voice F=Forms S=SMS VD=Video  Near term  Long term

# mHealth in the Digital Health Ecosystem

Individual mHealth interventions such as those discussed above can make meaningful contributions to solving the information and communication problems that prevent HEWs from achieving their goals and functioning optimally. Yet mHealth programs cannot fix all organizational or operational issues because they do not exist in a vacuum. Instead, they exist within a larger ecosystem – a “digital ecosystem” – with other health technology initiatives, both current and planned. It is thus imperative that the design and deployment of mHealth applications, solutions and projects happen in alignment with this ecosystem. Solutions that both support and improve on technology initiatives in health information systems, supply chain management and human resources, and that integrate into the country’s health ecosystem will also be most useful to the workers delivering care to communities throughout Ethiopia.

The ideal digital ecosystem should be simple enough to manage yet complex enough to grow. As such, the FMOH mHealth digital ecosystem should be comprised of three layers – the administrative, collaboration and application layers, depicted below.

Figure 3: Digital Ecosystem for mHealth



- Administrative Layer:** In this layer, the prime player is the administrator (FMOH) who is also the ultimate owner of projects. The administrator plans, develops and manages strategies and policies regarding technology, finance, maintenance, training and other content that resides in database servers in a location designated by the administrator.
- Collaboration Layer:** The collaboration layer is a neutral layer comprised of the infrastructure necessary to connect end-users and project managers to applications and solutions provided by developers. Rules meant to ensure alignment with FMOH goals would be developed and applied to

establish a neutral framework within which software and device developers can build applications, solutions and projects that consumers can use. Each application and solution would have to align with the rules and principles to successfully integrate into this neutral layer. The rules would not only qualify (or disqualify) applications and solutions, they would also qualify end-users, linking users to applications and solutions according to their needs and wants.

- **Applications Layer:** The applications layer is a development layer that houses all the applications, solutions and projects (including mHealth interventions ) that may be of interest to end-users. mHealth applications would comply with collaboration layer rules and integrate with Ethiopian health technology initiatives in health information systems, human resources, laboratory management, telemedicine and logistics management.

## A Path to Sustainable mHealth Interventions

This study suggests that there are several main components in an mHealth framework that will move Ethiopia toward mHealth interventions that make an impact on health outcomes. These components are a **multi-phase approach** that begins with HEWs, with subsequent phases targeted to community team leaders or volunteers and members of the general population; a structure that **matches HEW needs with appropriate interventions**; and a **digital ecosystem framework** to ensure mHealth integration into the Ethiopian health system. Once these components are in place, decision makers can begin moving forward with mHealth implementations. Yet the findings in this report make it clear that there are a variety of applications, solutions and projects that can address HEW information and communication needs, as well as those of other health system actors. How can the government of Ethiopia decide which to begin with? The graphic below describes two categories of interventions: near-term **enabling interventions** and longer-term **system-based interventions**.

Table 4: mHealth Interventions

Near-Term Enabling Interventions		System-Based Interventions		
<p><b>Goal:</b> Enable and institutionalize the use of mobile phones by HEWs for communicating with other health system actors</p> <p><b>Method:</b> Enable all HEWs to own mobile phones; decrease or eliminate airtime costs for HEWs and institute procedures for regular communication with other actors</p> <p><b>Interventions:</b></p> <ul style="list-style-type: none"> <li>• Closed networks (existing GSM phones)</li> <li>• Closed networks (purchased CDMA phones)</li> <li>• HP-based CDMA phones (using Rural Connectivity Infrastructure)</li> <li>• Call centers (hotlines)</li> </ul>		<p><b>Goal:</b> Develop and introduce mHealth interventions interoperable with each other and with the larger digital health ecosystem, as well as potentially useful in sectors outside of health</p> <p><b>Method:</b> Develop collaboration layer rules and systems to ensure that applications are deployed which both address HEW information and communication needs and integrate with and support health technology programs and initiatives</p> <p><b>Interventions:</b></p> <ul style="list-style-type: none"> <li>• Bulk SMS programs for supply chain and patient/system data</li> <li>• Form-based or checklist applications for data collection and patient management</li> <li>• Record or identity-based applications or solutions</li> </ul>		
2011	2012	2013	2014	2015

Phasing interventions in this manner brings several benefits. It allows Ethiopia to move ahead with relatively

simple interventions that will demonstrate the ability of mobile technology to empower workers, while providing a source of data and time to create the more robust ecosystem required to reap the full benefits of more sophisticated implementations. It also prevents a “cafeteria” approach in which interventions are selected or implemented in isolation, without regard to the larger system implications of such choices. The findings and conclusions contained in this report can serve as a tool for the FMOH and its partners to choose programs and interventions that maximize the impact of the health system’s front-line workers while improving health outcomes for millions of rural Ethiopians.



## Introduction/Overview

Ethiopia is at a pivotal moment in its efforts to improve the health status of its people and move the country into a new phase of social and economic development. Over the past decade, Ethiopia has marshaled its resources, and those of its development partners, into addressing the health inequities that have held the country back. These efforts have begun to bring results. Yet even as the country has made progress in reaching the health-related Millennium Development Goals (MDGs), the government and its partners realize that these advances need to be accelerated if targets in the areas of maternal and child mortality and infectious diseases are to be achieved.

Mobile technology is one potential avenue for doing so. Throughout the world, health service providers and decision makers are trying to capitalize on the revolution in mobile communications to strengthen health systems and boost efforts at extending the reach of health workers into underserved communities. The severe shortage of trained health workers in many developing countries makes the idea of using mobile technology for this purpose even more appealing. In low-resource settings throughout Africa and the developing world, governments, non-governmental organizations (NGOs) and private-sector actors have piloted programs in which health workers and patients use mobile technology to transmit and receive information that allows them to make better decisions.



The field of mobile health, or mHealth, is still in its early stages, but hundreds of pilot projects, initiatives and experiments have created enough interest that health decision makers are beginning to explore how mHealth could be integrated into health systems more comprehensively. The government of Ethiopia, having invested heavily in expanding the capacity of its health system, is at the beginning of this process. This study explores the Ethiopian context – the country’s health systems and challenges, as well as its infrastructure and environment – and uses this information to identify critical success factors and create a framework for the introduction of mHealth. It also examines how a well-designed mHealth program would integrate into other technology initiatives in the Ethiopian health sector. If managed successfully, mHealth can be an effective tool for advancing the government’s key health initiatives, particularly community-based interventions that have women at their center. This report is intended to serve as an early step that can guide the planning and implementation of projects that will benefit communities throughout Ethiopia.

## Country Overview

Ethiopia is a nation experiencing rapid change. Having emerged from decades of political and economic instability, it is transitioning into a phase of focus on economic growth and social advancement. It has a society characterized by a large, rural and fast-growing population, an economy marked by a strong government presence which maintains ownership of strategic sectors while permitting private sector participation in most other sectors, a government committed to the expansion and provision of publicly-provided social services, and a culture marked by diversity and a value for tradition. **A deeper discussion of Ethiopia's demographic and economic characteristics is included in Appendix C.**

### Demographics

With the second-largest population in sub-Saharan Africa, Ethiopia is a demographic heavyweight in the East Africa region. Several characteristics are particularly salient, especially for any analysis of health interventions, including:

- **A rapidly-growing population of over 80 million, spread over nine regional states and two chartered cities**
- **Significant ethnic and linguistic diversity, with more than 80 ethnic groups and a similar number of languages (with Amharic serving as a national language)**
- **A peaceful religious coexistence between the Christian majority and a large Muslim minority**
- **Low literacy rates and educational attainment, particularly for females**
- **An overwhelmingly rural population despite increasing urban migration**



the

### Economy

While Ethiopia continues to have a low per capita GDP (approximately US\$1,000), it has posted rapid economic growth figures over the past decade as it reaps the benefits of political stability and the improved performance of agriculture, the backbone of economy. Key trends in the Ethiopian economy include:

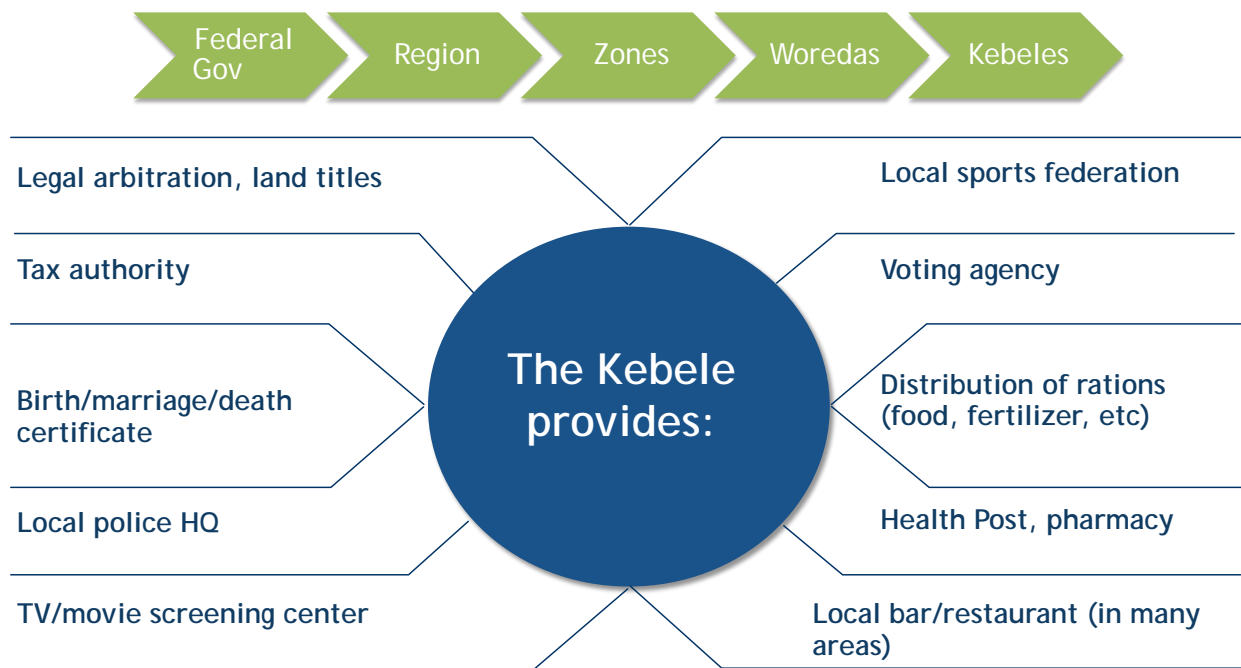
- **Continued support for small farmers, with an increased focus on mechanized and commercial farming**
- **Diversification of the economy with a greater emphasis on services and industry**
- **A gradually increased role for the private sector, but continued state ownership of key sectors such as telecommunications and banking**

# Public Administration and Health Sector Management

Ethiopia’s status as a federal republic with a strong central government shapes both its administrative structure and its provision of services. The country is divided into two chartered cities and nine ethnically-based regional states, which are further divided into 68 zones. The zones consist of over 600 *woredas* with an average population of approximately 100,000. *Woredas* are again subdivided into *kebeles* (or neighborhoods).

This administrative structure provides government reach to all regions and into local neighborhoods at a level proportionate to their population.<sup>1</sup> The rural nature of Ethiopian society means that the *kebele* plays a central role in Ethiopian public life, and is often the highest level of government with which the average Ethiopian interacts.

Figure 4: The *Kebele* in Ethiopian Life

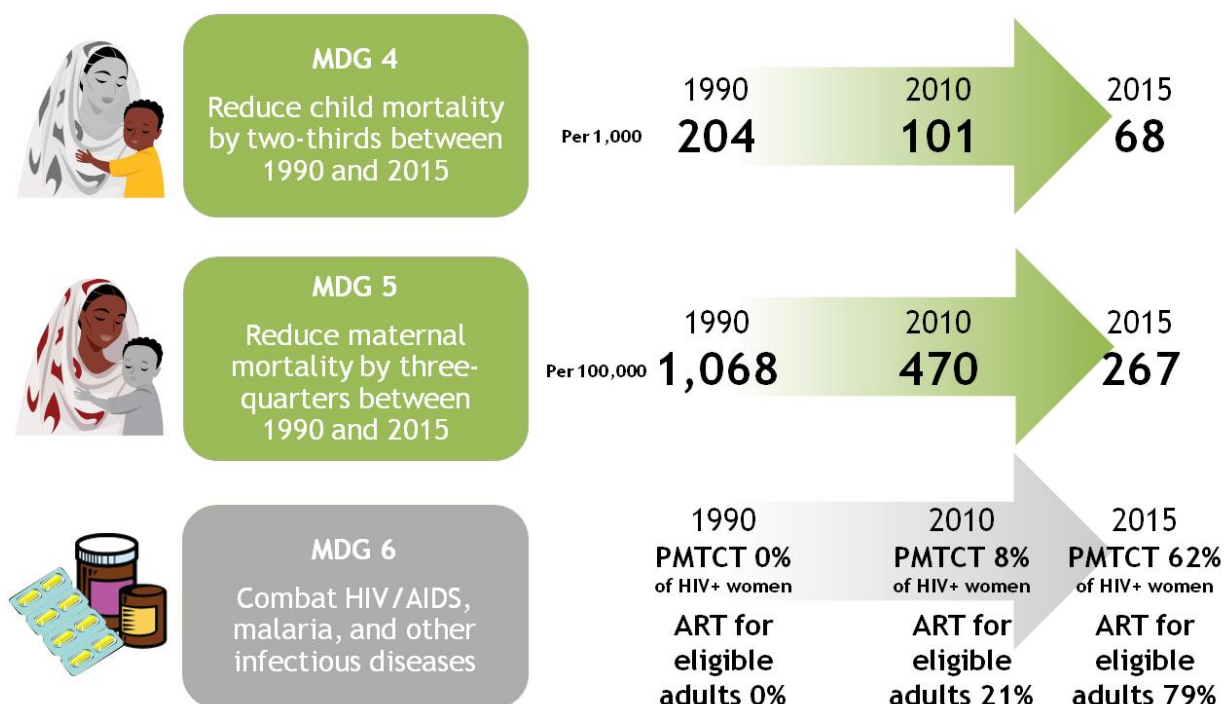


It has been noted that, over the past 18 years, the government has achieved “dramatically enhanced service delivery” to rural areas, which also bolsters government authority.<sup>2</sup> This includes an aggressive rollout of the public health system based on an “access first, quality second” policy, and it guides the steady expansion of the primary health care system down to the *kebele* level.

## Health Challenges & Health Systems: MNCH & HEWs

While substantial declines in maternal, child and neonatal mortality have been achieved in the past two decades, accelerated progress is required in order for Ethiopia to meet the Millennium Development Goals (MDGs) by 2015. The Federal Ministry of Health (FMOH) of Ethiopia has committed to reaching MDGs 4 and 5 and has designated maternal and newborn child health (MNCH) as its highest priorities in the Health Sector Development Programme IV for the period 2010-11 to 2015-16. The graphic below illustrates some of Ethiopia's key MDG objectives. **For a deeper discussion of Ethiopia's health challenges and actions, please see Appendix C.**

Figure 5: Ethiopia and MDGs 4, 5 and 6



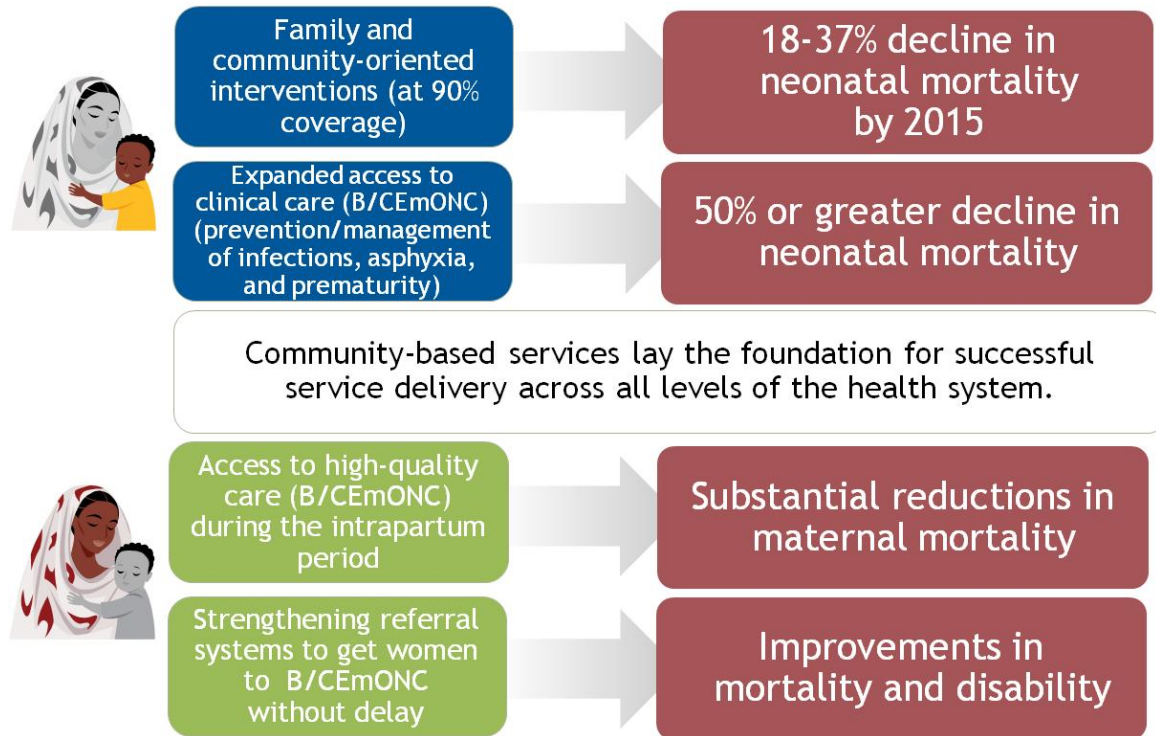
### Maternal and Newborn Deaths are Preventable

The tragedy of the tens of thousands of maternal, newborn and child deaths in Ethiopia each year is that most of these deaths can be prevented with cost-effective community-based health interventions. Reducing maternal mortality and disability depends on identifying and improving those services that are critical to the health of Ethiopian women and girls, including family planning and STI/HIV/AIDS services. The current health policy of Ethiopia demands commitment from all concerned bodies and mainly focuses on prevention and promotion components of health care, and development of an equitable and acceptable standard of health service to reach all segments of the population.

Research has shown that family-focused and community-based health services can reduce the neonatal mortality rate by 17% to 38% by 2015, if 90% coverage of affected populations can be reached.<sup>3</sup> These can be enhanced by scaling up the health extension program to create demand and increase access to integrated health services. Expanded access to basic and comprehensive emergency obstetric and neonatal care (B/CEmONC) for the prevention and management of infections, asphyxia and prematurity can bring about declines of 50% in

neonatal mortality. Similarly, improving access to high-quality care (B/CEmONC) during the intra-partum period and strengthening referral systems to get women to B/CEmONC without delay can result in substantial declines in maternal mortality.

Figure 6: Community-Based Interventions Save Lives



## Health System Challenges and Actions

The Federal Ministry of Health has identified six key challenge areas as it seeks to improve the quality of MNCH services and outcomes. These six challenge areas are:

1. **Unmet Need for Family Planning:** The Ethiopian government aspires to double the contraceptive prevalence rate to 65% by 2015 to allow families to space or limit the number of children they have and reduce the country's birth rate, which should in turn reduce the number of maternal and child deaths, especially during the intrapartum period.
2. **Low Rate of Skilled Birth Attendance:** The HSDP IV envisions nearly quadrupling the percentage of births attended by a midwife, health officer, nurse or physician, from 16% in 2010 to 60% in 2015.
3. **Shortage of Skilled Human Resources:** To increase the number of trained personnel, especially for delivery, the FMOH plans to expand midwifery schools, accelerate the training of health officers and nurses and hasten the build-out of medical schools.
4. **Inadequate Coverage of Emergency Obstetric Services:** Because complications related to childbirth are responsible for so many maternal and newborn deaths, the government and its partners are focusing on upgrading larger health centers to hospitals, building 16 additional blood banks and expanding comprehensive abortion care services.

5. **Poor Referral System:** To address the need for faster and more accurate MNCH referrals, the FMOH is pushing for accelerated construction of roads, effective ambulance services and efficient communication systems between referring and referral units.
6. **Poor Supply and Logistics Management:** Stockouts of essential drugs, kits, report formats and reagents are common due to poor supply and distribution systems. The government is moving toward enhancing commodity security logistic systems, strengthening and ensuring sustainability of essential supplies for MNCH services at all facilities, including the HP level, facilitating inventory management and reordering of MNCH-related supplies.

## Health Extension Program: the Heart of Ethiopia's MNCH Efforts

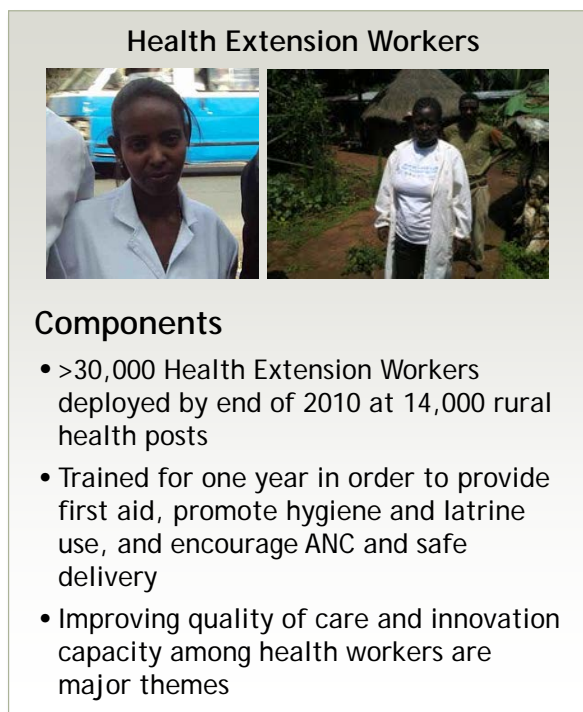
Ethiopia's Health Extension Program (HEP) was introduced under HSDP II to deliver high-impact interventions at the family and community level.<sup>4</sup> The HEP is the primary channel through which health education, basic curative care and key preventive components of primary health care reach Ethiopia's population, particularly in rural areas where access to static health facilities is extremely limited. Basic curative care, including community case management for malaria and pneumonia in young children, has also been incorporated into the HEP program.

The Rural HEP covers primarily farming and rurally-based populations and has four components which together comprise 16 thematic "training packages."<sup>5</sup> These include Family Health (five packages), Disease Prevention and Control (three packages), Personal Hygiene and Environmental Health (seven packages) and Health Education and Communication (one package). The Urban HEP covers urban and peri-urban populations in Ethiopia. It incorporates 15 training packages, including: Family Health (five packages), Disease Prevention and Control (five packages), Hygiene and Environmental Sanitation (four packages), and Accident Prevention, First Aid and Referral (one package).<sup>4</sup> The Pastoralist HEP provides services to the pastoralist regions of the country, primarily in the Afar and Somali regions.

The HEP's primary implementers are Health Extension Workers (HEWs), salaried government employees who receive one year of training and are then assigned to a HP,<sup>6</sup> theoretically in their home area, although in practice this is not always the case.

As of late 2010, more than 30,000 Rural HEWs had been trained and deployed, exceeding the target set under HSDP III.<sup>4</sup> An additional 3,400 Urban HEWs were trained and deployed, along with 948 HEWs who will serve in pastoralist and semi-pastoralist areas. By the fourth year of HSDP III, Ethiopia had achieved a HEW-to-population ratio of 1:2,514.

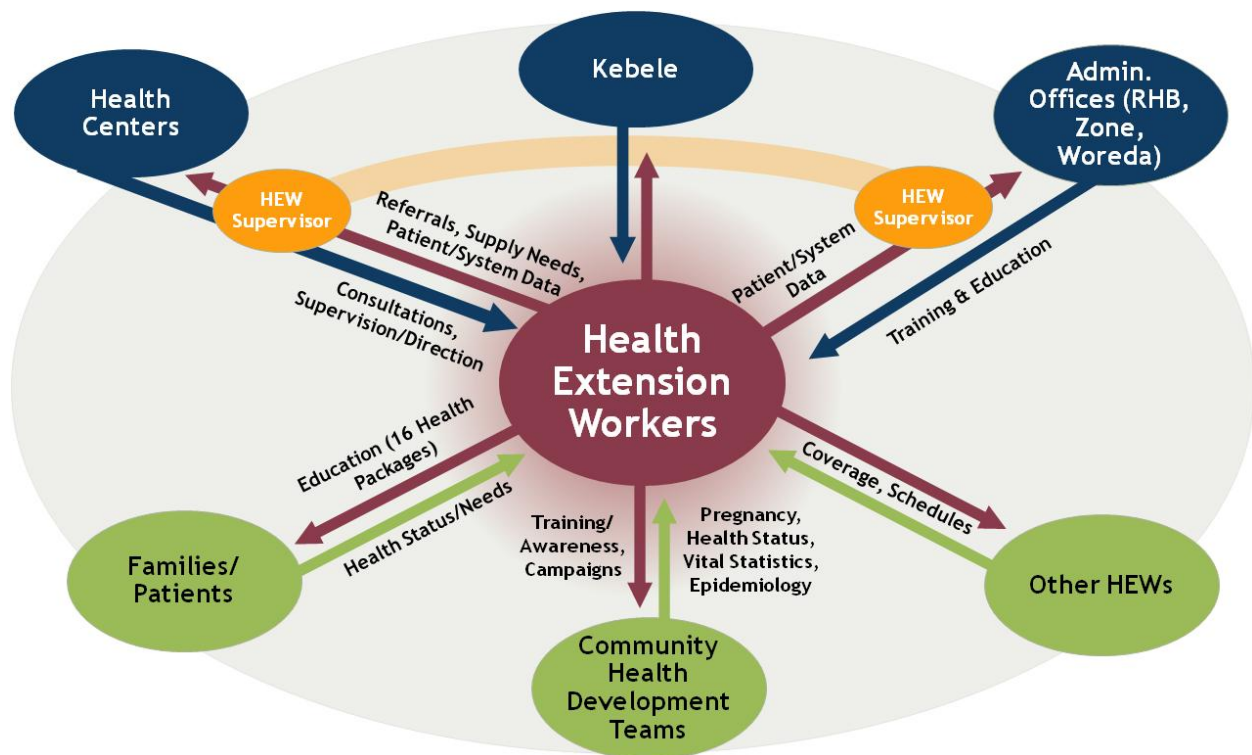
Figure 7: Health Extension Workers



## HEW Information and Communication Flows

Health Extension Workers constitute the “front line” of the Ethiopian primary health system. As such, HEWs shoulder a tremendous responsibility for both providing services and information to families and communities and for collecting and transmitting data on health needs to higher levels of the health system. These workers require a steady flow of information in order to provide services, but they also need to communicate with and provide information to higher-level facilities to ensure appropriate care for patients and adequate health system resources. This study identified the information and communication responsibilities of HEWs as they relate to core HEW duties, several of which also relate to the key health system challenges outlined earlier. These needs are depicted in the graphic below.

Figure 8: HEW Information and Communication Relationships

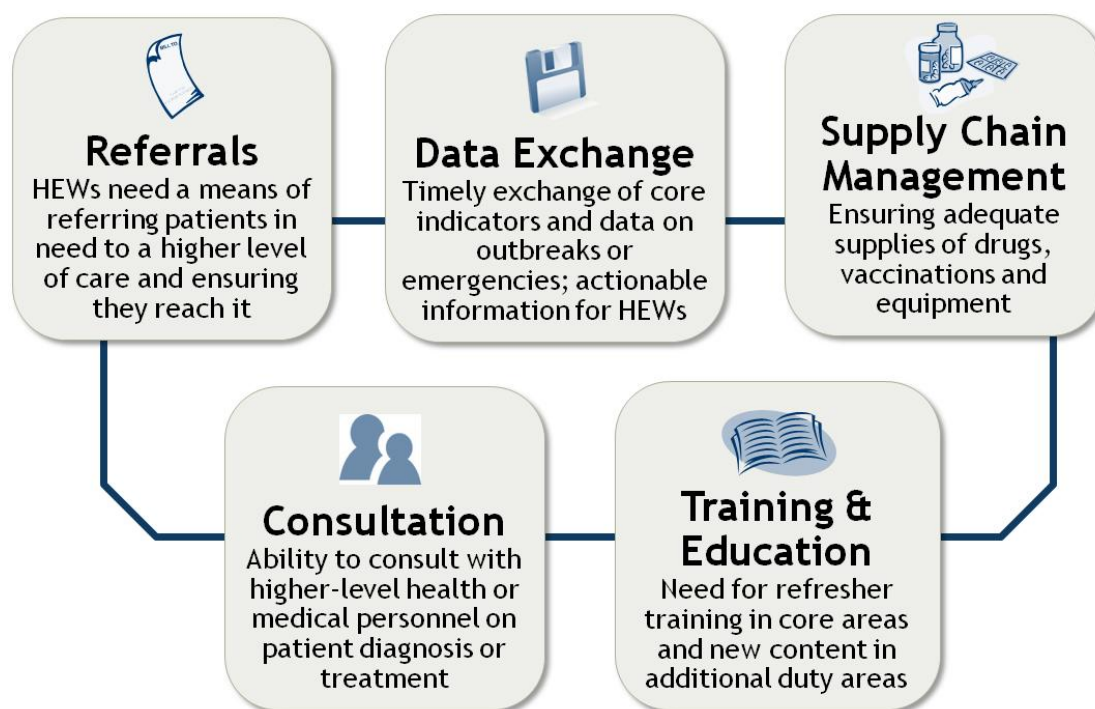


As depicted in this graphic, HEWs interact with a large number of organizations and individuals and have distinct information and communication needs with each of them, ranging from education and training to referrals to data on patient and supply needs. Currently, HEW supervisors act as the point of contact between HEWs and health facilities and administrators above the health post level. This may evolve, eliminating bottlenecks but also increasing the number of individuals with whom HEWs interact.

## Key HEW Information and Communication Needs

Based on these interactions and the health system challenges identified by the FMOH and its partners, five key HEW information and communication needs are highlighted in this section. These critical needs are potentially addressable by mHealth solutions (though some information and communication needs, such as between community health development teams and the families they serve, will continue to be met in face-to-face interactions). They are also interconnected, meaning they touch on related issues and multiple communication relationships, and might even be served by a multi-function solution. The graphic below summarizes these needs.

Figure 9: Key HEW Information and Communication Needs



### Referrals

**Need:** HEWs need a means of referring patients to a higher level of care and ensuring they reach it

#### Current Issues:

- The current referral system requires HEWs to refer patients to the health center (HC), regardless of the center's ability to address the client's condition.
- Higher-level facilities are not typically warned of incoming patients and their needs so they can prepare appropriate staffing and drugs/equipment.
- Complete patient information often does not accompany the referral, impacting continuity of care.

The FMOH has identified improving the referral process as one of the key challenges in the health system. Improving information and communication flows between the HEWs and the HCs is one important part of



addressing this challenge. Facilitating a process in which HEWs are able to transmit timely information on patient needs would improve the likelihood that patients receive appropriate care when they seek it. Non-information and communication factors, such as the ability of the transportation system to transport patients or maintaining appropriate staffing and supply levels at referral facilities, are also highly important conditions for successfully dealing with this bottleneck, especially since they will impact community demand for seeking referral services.

## Data Exchange

**Need:** HEWs need to collect and transmit critical indicators related to health status, health outcomes and system performance for use at all levels of the health system

### Current Issues:

- Data collected by HEWs is often out of date and of little use by the time it is received at the regional and federal levels.
- Data transmission typically moves in only one direction, with workers rarely receiving access to data to inform patient care.
- Inaccurate data is a problem, in part due to multiple points of manual data entry.

Improving the quality of health data is the focus of a major, multi-year health management information system (HMIS) effort involving the government of Ethiopia, its development partners and implementers Tulane University and John Snow Inc (JSI). The rationalization of the paper data collection process and the eventual transition to an electronically-based system have the potential to vastly improve the quality of data in the health system, but there is not currently a comprehensive plan to extend electronic entry and receipt of data to the health post level. Any solution intended to do so will have to integrate with the metrics, goals and requirements of the HMIS. It will also need to further efforts to build more comprehensive patient health records, such as family folders, which are likely to be the source of much health system data in the future.

## Supply Chain Management

**Need:** HEWs need to ensure consistent and adequate supplies of drugs, kits and equipment at health posts.

### Current Issues:

- Supplies of critical drugs and supplies, including family planning material, are often limited or nonexistent, particularly in remote areas of Ethiopia.
- Drugs often expire because of inaccurate usage tracking and supply management or inconsistent methods of tracking expiration dates.

The improvement of the health supply chain system is also the focus of intensive efforts by the government and its partners. The reorganization of the distribution system and the creation of an electronic system for regulating supplies at all levels will result in major changes in how facilities manage their supply needs. While stockouts at the health post level are not solely the result of inadequate communication between HEWs and their supervisors, tools that facilitate the advance communication of supply needs at posts could bring greater efficiency to this reorganized process, resulting in fewer HEW trips to health centers for supply collection and greater predictability of supply levels and needs.

## Training and Education

**Need:** HEWs need to continue to refresh and advance their training while performing current duties on a consistent basis.

### Current Issues:

- HEW responsibilities are growing, especially in the area of delivery, requiring HEWs to increase their skills and knowledge.
- Training days that occur offsite often take HEWs away from their jobs and away from care delivery; the ability to receive training on-site is needed.
- Creating content that is appropriate to duties and in relevant local languages remains a challenge.
- Turnover increases costs associated with training and education.

The ongoing training and education of HEWs is critical to their ability to provide services, but offsite training often takes HEWs away from their posts and thus reduces time spent with volunteers and families. Paper materials can be used to refresh HEW knowledge and skills, but they are not interactive or time-sensitive. Electronic interventions can be used to engage workers with new or refreshed content, while potentially allowing them to continue learning without leaving their service communities.

## Consultation

**Need:** HEWs need to consult with more highly-trained medical professionals in cases of emergency or urgent treatment.

### Current issues:

- Health Extension Workers are frequently confronted with MNCH emergencies in situations where referral is not possible due to lack of transportation or other obstacles.
- HEWs often lack the training needed to provide triage for patients in such cases.

Consultation is a delicate issue touching on the appropriate delivery of care by trained personnel, but the remote location of many Ethiopian rural communities means that patients in emergency situations often do not have time to reach health centers. Real-time consultations with doctors or midwives might result in measures that can extend the time for transportation to an appropriate facility.

## Context is Critical

Many of the needs identified above are common to community health workers (and the health systems in which they work) around the developing world, especially those in rural or remote areas. This prevalence means that they have been the subject of numerous technology interventions, including mHealth solutions. In a subsequent section, this study explores the field of mHealth and how it is attempting to address many of these problems. Yet while needs are common, each context is distinct. In order to determine the appropriateness of any solution, local conditions need to be carefully analyzed along infrastructure, socio-cultural and economic lines. Developing such an analysis is likely to shed light on the steps necessary for choosing or adapting solutions that achieve positive change.

# Situation Analysis

## Infrastructure Challenges and their Impact on HEWs

HEWs' delivery of care is directly dependent on the existence of the infrastructure and environment in which they operate. It would be difficult for them to achieve goals established for them without the proper infrastructure and support elements.

HEWs, and the communities they serve, are affected by infrastructure deficiencies in a number of areas. Lack of electricity limits their ability to provide care at night. Inadequate supplies of clean water inhibit sanitary care and clean delivery. And while the overwhelming majority of HEWs now own mobile phones and use them in the course of their duties, they complain of low mobile reception and an inability to charge their devices at their HPs. Interviews conducted during this study indicate that they typically spend 10-20% of their monthly income on airtime, 50% of which was used for work-related calls and messaging. HEWs also point to the absence of operations-related supplies, despite the presence of basic equipment such as delivery beds in two-thirds of HPs. The low supply delivery level can be attributed in part to inadequate road infrastructure leading from towns to the *kebeles* in which HPs are located. The work of HEWs is also inhibited by cultural barriers to greater health services use by communities, where traditional practices and attitudes often dominate.

Based on these real challenges, the infrastructure picture would seem bleak on first consideration. Closer observation would, however, disclose a story of progress, as the nation's infrastructure has begun developing at a relatively rapid pace over the last five years. While hard infrastructure solutions for such areas as telecommunication and power are being provided by Ethio Telecom, the Ministry of Communication and Information Technology (MCIT) and Ethiopian Electric Power Company (EEPCo), other factors such as social attitudes, cultural norms and the economy have been evolving. Following is a situation analysis of these infrastructure and social concerns and their implications for mHealth interventions in Ethiopia.

## Telecommunications Infrastructure

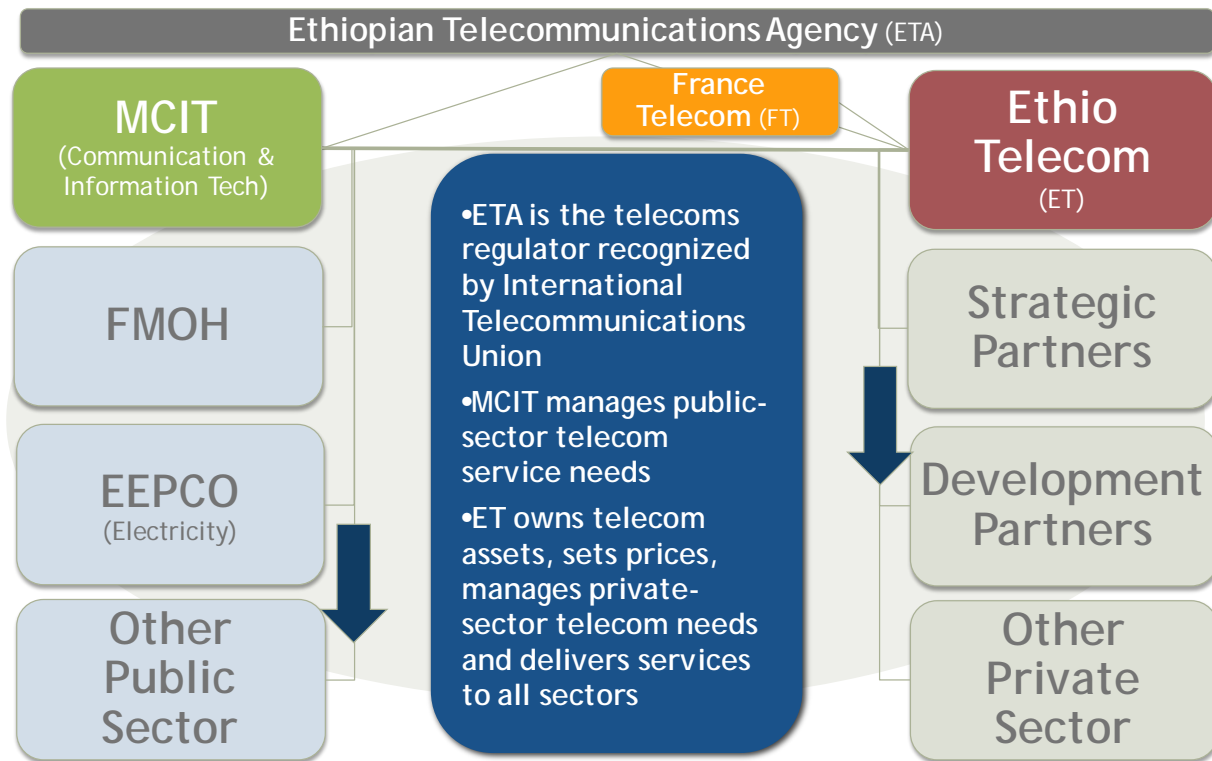
### Regulation and Service Flow

Telecommunications is the most important infrastructure element to the success of mHealth. While an advanced telecommunications infrastructure enables mHealth, an inadequate one hobbles it. Fortunately, Ethiopia's telecommunications program is evolving, providing hope for mHealth prospects, and thus, for HEWs and the state of MNCH in Ethiopia.

Ethiopia has one telecoms operator, newly restructured and rebranded as Ethio Telecom (see Figure 10, below). It is state-owned but, as of December 2010, is run by France Telecom (FT) under a multi-year management agreement. FT's responsibility under the agreement is to expand service options, stimulate demand, grow subscriptions (from 8% mobile penetration to 20%)<sup>7</sup> and revenue, and manage costs to increase earnings, in return for a percentage of the company's revenue stream.

While telecommunications regulation and licensing is still managed by the Ethiopian Telecommunication Agency (ETA), the Ministry of Communication and Information Technology (MCIT) was formed by dividing the former Ministry of Communication and Transportation and adding the Ethiopian Information and Communication Technology Development Agency (EICTDA) to the communications part of this ministry. All private-sector service requests go directly to ET, while public-sector service requests go through MCIT to ET. MCIT then represents the needs of the public sector with ET, negotiating prices, timing and delivery expectations.

Figure 10: Ethiopian Telecom Ecosystem



For example, assuming the FMOH wished to deploy an mHealth program and needed to make use of ET resources at the national, regional, zonal, *woreda* or *kebele* levels, it would make such a request and detail its needs to the MCIT. Those services that can be provided under Ethiopia’s e-government program would be provided directly by MCIT, and those that can only be provided through the national telecommunications infrastructure (networks, call centers and data centers) would be passed to ET by MCIT on behalf of FMOH. This triumvirate would thus cooperate to facilitate mHealth projects.

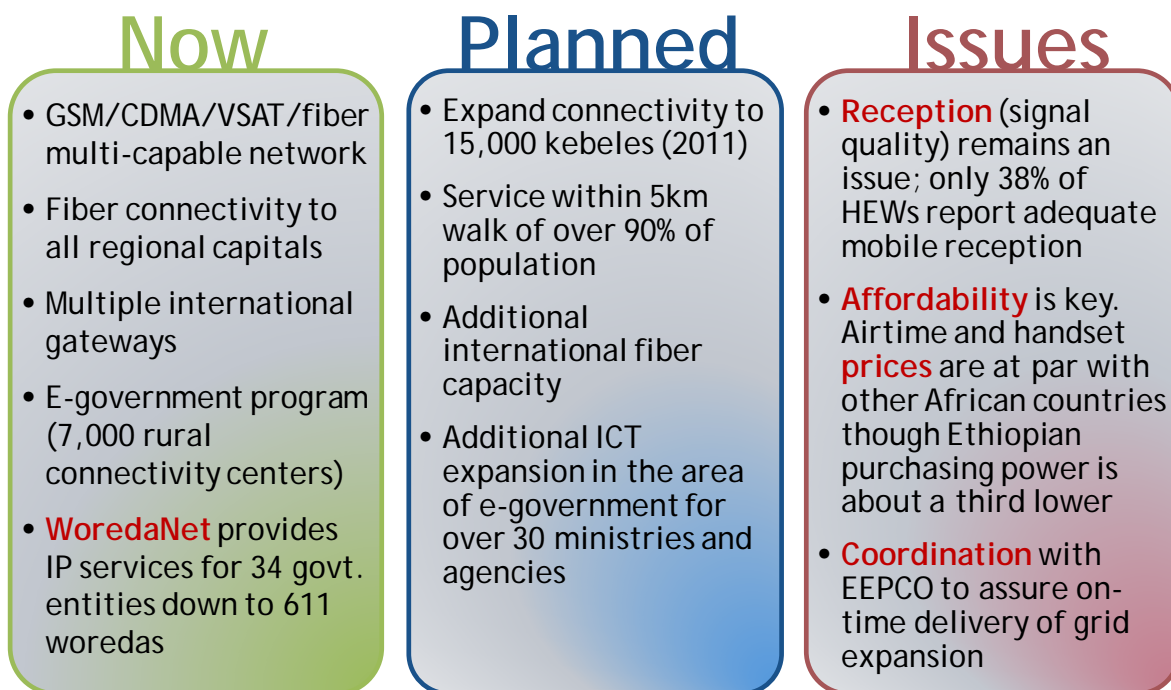
#### Existing ICT Infrastructure: Access Done, Quality Due

As part of the government’s promise of universal access and part of its strategic positioning for economic growth and poverty alleviation, Ethiopia has, over six years, developed an unusual but extensive mixed-capability ICT infrastructure that provides a blended coverage of 85% of the country’s population, with the potential to serve 90% of its population. This infrastructure is multivariate and uses CDMA, GSM (2G and 2.5G/GPRS) and fiber technologies – each stand-alone yet interoperable. Over 500 cities have been connected and every regional capital municipality has fiber connectivity with up to 2Mbps connectivity, according to officials at MCIT. Following is a description of the infrastructure:

- **National CDMA network:** This 450MHz network covers 90% of the country, thus making it the single most extensive telecommunications network in any single African country. The network allows ET to provide mobile voice, SMS, limited data, Internet and video services up to about 156kbps. The Rural Connectivity Program (RCP) was designed to afford every person in the country the ability to call another by having access to a phone within 10km. According to an UNCTAD report<sup>8</sup> and a senior ET administrator, RCP has connected 14,000 *kebeles* using a solar-powered CDMA public

access phone. As a business model, ET contracts one villager to charge for services and keep a 25% commission for protecting the community phone and helping others make and receive phone calls. Given the objective to connect 18,000 *kebeles* by the end of 2010, ET delivered 78% of its target to the Ethiopian public through RCP. RCP was a three-year, US\$1.5 billion vendor-financed project with Chinese company ZTE. The vendor financing helped accelerate the network rollout by alleviating ETC's financial constraints.<sup>9</sup> The RCP network is currently optimized with a capacity of 2.5 million subscribers. It would cost approximately US\$1.5 billion to accommodate the 32 million subscription base envisioned by the RCP. Closing this gap will require additional financing or a compatible bridging solution.

Figure 11: Telecom Infrastructure Assets and Issues

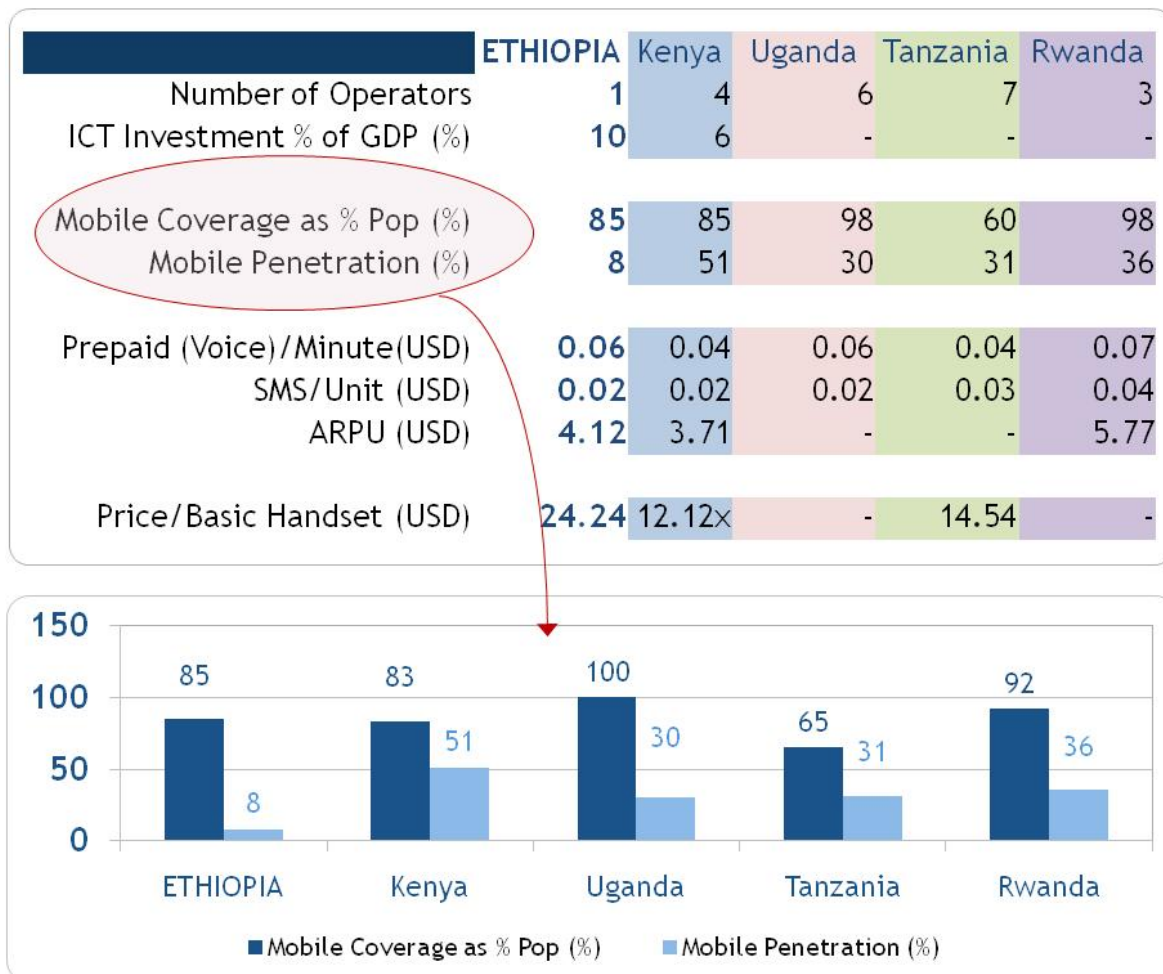


- National GSM network:** According to an ET network manager, this GSM network covers 64% of the country, going down to the town level but excluding many villages. Because of the ubiquity of GSM phones and the GSM standard, this is the network most people are accustomed to using. The GSM network currently has a capacity of about 11.2 million and a subscription base of 6.6 million, with Addis Ababa, Oromia, Amhara and SNNPR representing the largest number of subscribers. It features 2G, 2.5G (GPRS) and 3G capabilities with signal strength remaining strong at speeds beyond 80km/hr within the 900MHz frequency spectrum. Signal strength is relatively consistent even in regions far from the country's largest cities, although it fades in more rural and remote regions. Even in heavily covered areas such as Addis Ababa, dropped calls and busy network messages are a common occurrence.
- National Fiber network:** According to ETA, Ethiopia has about 4,000km of optic fiber lines that interconnect Addis Ababa with all regional capitals and into each *woreda*. In March 2010, SEACOM was commissioned to supply ET with international broadband fiber connectivity via a backhaul link through Djibouti to supplement the international gateways and nearly 200 roaming agreements. The

fiber acts as the backbone for ET broadband and terrestrial transmission as well as for e-government services which include video observation of court cases, online instruction and light Internet access. ET forecasts that it will roll out 10,000km of additional optic fiber by the end of 2011.

- **E-government networks and data center:** Ethiopia's national e-government broadband networks were collaboratively developed by ET, MCIT and the respective sponsoring ministries. Each network functions independently with the interoperability possible as a result of the Internet protocol (IP) foundation. Together, they have the potential to be capitalized on in a way that benefits the rural population.
- **WoredaNet:** Developed to support civic functions at the local *woreda* level and 11 regions, *WoredaNet* connects over 565 government offices. The network brings urban services to local government offices and connect government offices through e-mail, videoconferencing, Voice-over-Internet Protocol (VoIP) and file-sharing.<sup>10</sup> According to MCIT officials, all ministries are encouraged to connect to *WoredaNet*, and when they do, can utilize the network and the accompanying *national data center* to implement projects and campaigns that can reach *woredas* across the country. Court cases, distance learning and municipal Internet access are three of the functions for which *WoredaNet* has been used. Ministries that justify a need to use the broadband network to reach *kebeles* have to make a special request to MCIT and ET to extend the network into the *kebeles*. *WoredaNet* currently serves 34 ministries and agency with all but two ministries (FMOH and the Ministry of Education) not having completed their initial on-site connectivity requirements. *WoredaNet* has encountered service provision difficulties since its inception that the government is working to overcome.
- **SchoolNet:** SchoolNet connects nearly 669 secondary schools and provides them with down-linked streaming audio and video media capability to encourage e-learning. According to MCIT officials, SchoolNet, which primarily connects through VSAT, has been expanded to nine universities and should be available to 22 universities by the end of 2011.<sup>11</sup>
- **AgriNet:** AgriNet connects 49 agricultural research centers across the country. It is designed to be at the center of data collection for an industry considered to be at the core of Ethiopia's economic strategies.
- **Comparative metrics:** The fact that the Ethiopian government dedicates 10% of the GDP to telecommunications investments, where Kenya dedicates 6%, may explain ET's comparable metrics in many areas when compared to countries with multiple operators—Kenya (4), Uganda (6), Tanzania (7) and Rwanda (3). With the exception of its subscription rate (8%), ET's metrics compare favorably with those of its East African counterparts (see Figure 12, below). For example, though its counterparts' subscription rate is a significant multiple above ET's 8%—Kenya (6.4x), Uganda (3.8x), Tanzania (3.9x) and Rwanda (4.5x)—ET's blended network coverage (85%) is at par with Kenya (85%) and exceeds Tanzania's (59%). Likewise, voice (US\$.06) and SMS (US\$.02) rates are at par with those in Uganda, and competitive with those in Kenya (US\$.04 and US\$.02, respectively). As a result, ET's Average Revenue per User (ARPU), at US\$4.20, is on par with that of Kenya and slightly trails that of Rwanda. The expectation is that ET's ARPU will decline as volume increases due to increased subscription penetration into a poorer rural population.

Figure 12: Key Performance Indicators and Regional Comparison



## Power and Electrification

Ethiopia generates power exceeding its own current consumption. Its problems, according to the planning directorate at the Ethiopian Electric Power Corporation (EEPCo) are financing transmission and distribution. According to official data, the overall hydroelectricity potential is 45,000MW. Nonetheless, current output is 2,000MW, and the five-year Growth and Transformation Plan (GTP) foresees an increase to 8,000-10,000MW by 2015. Electricity access stood at 41% of towns and villages in July 2010 according to EEPCo, though household access to electricity is significantly lower. EEPCo forecasts coverage of 75% of towns and villages within 5 years and 100% coverage within 10 years. In fact, EEPCo has already identified the 4,800 towns and villages on which it will focus and is working with local administrations to achieve its goals.

To illustrate its ability to meet its targets, EEPCo points out that, before 2005, the company was electrifying only 30-40 towns per year. However, the rate increased dramatically after 2005 to 200 towns and villages per annum. EEPCo data show that the targets for electrified towns and villages have risen from 916 in 2005-2006 to 6,878 in 2009-2010. EEPCo claims that it was able to meet 75% of its 2010 target (5,163 out of 6,878), a performance it says was constrained by a shortage in foreign exchange. EEPCo sources emphasize that it regularly communicates with regional administrative offices and ministries and is open to prioritizing rollouts to align with other government program priorities and targets.

Rural electrification rates are markedly lower than urban ones. As a result, most HPs do not have power supply. As a result, FMOH has begun installing solar capacity in the HPs.<sup>12</sup> Together with the Rural Energy Development Center (REDC), the FMOH has installed 600-watt solar panel/inverter systems in 200 HPs.<sup>13</sup> Five hundred systems are expected to be installed by June 2011 and 5,000 by mid-2015.

## Cultural Considerations

The situation analysis of the potential for new technologies in health care delivery cannot be complete without a consideration of the socio-cultural context in which these prospective solutions may be implemented. Studies on the effectiveness of information and communication technologies (ICTs) – of which mobile health (mHealth) is one – have shown that an understanding of national and community-specific cultural norms and values are essential to reaching targeted populations and achieving designated goals.<sup>14, 15, 16</sup> Thus, if mHealth technologies in Ethiopia are to have a positive impact on both health care professionals and clients in Ethiopia, mobile health initiatives must be designed complement the underlying values and beliefs of both these communities. Following are some key socio-cultural considerations that must be factored into the planning of an Ethiopian mHealth program.

### Traditional vs. New Illness Models

According to studies, rural women are highly influenced by traditional practices, many of which run contrary to modern health care. For example, 65% of older women, compared to 53% of younger women, said they believe that female circumcision should be maintained.<sup>17</sup> Overall, traditional practices are still widely used and accepted throughout age stratifications. A survey of rural women reported that 60% of women affirmed their use of some kind of traditional measures to promote their health.<sup>18</sup>

### Gender Roles and Women's Issues

Women have traditionally been pressured with both domestic leadership and gender inequality. Research has shown this burden often weighs heavily: “It is the duty of the women to grind flour, to fetch water, to care for the children, to assist in the farm, and so on... When she goes home, the whole household activity including childcare is her responsibility. It is the same in food preparation and petty trading.”<sup>19</sup> Such heavy loads of responsibilities have taken their toll on women's reproductive health. While most women do experience a workload reduction during pregnancy, the rest period after delivery is shockingly brief. For 40.7% of young women, this period was less than thirty days. For women without a daughter to take over their responsibilities, this period was found to be as short as one to three days.



### Spending Habits

As most Ethiopians find themselves with limited disposable income, investment in modern medicine has frequently been a challenge. For example, a study of drug-purchasing habits in Addis Ababa found that 35% patients did not obtain prescribed drugs, citing lack of money as the primary reason.<sup>21</sup> Such practices have been described as adaptive responses to economic and socio-political conditions.<sup>21</sup> Spending habits will also influence behavior related to mobile phone use, and since rural Ethiopians have traditionally had little access to modern communications devices, some may be at first reluctant to spend scarce disposable income on this technology.



## Attitudes to Technology

Instituting mHealth (or any technology) interventions means a change in the way duties are performed and services are received. Even for Ethiopians who own mobile devices, there may be resistance or a lack of comfort with using technology to provide or receive health care. For this reason, it is important that the design of programs puts a heavy emphasis on user-friendliness. The potential for resistance also means that any program of change management and training associated with interventions helps to address and overcome this resistance, by providing thorough and appropriate instruction in their use and by illustrating the benefits of the technology.

## Diversity

Finally, Ethiopian people represent many languages, religions and ethnicities, even within *kebeles*. This would make it difficult to create a “one size fits all” solution that accounts for and is sensitive to cultural variability. This is particularly important with regard to languages because the ability of health workers and populations to absorb information and adopt positive behavior change depends on their ability to understand the information being conveyed to them.<sup>20</sup>

## Implications for mHealth Implementation

For mHealth implementation to succeed, FMOH, MCIT, ET and EEPCo will have to leverage Ethiopia’s ICT and power infrastructure assets and monopoly status to redefine private-sector involvement and innovation through applications development and research. Where Ethiopia lacks a critical mass of human resources and companies to develop or administer innovative mHealth applications, FMOH will have to encourage partnerships between local and foreign players to facilitate short and long-term technology transfer.

Also, the fact that mobile ownership among HEWs is currently above 90%<sup>1</sup> makes them a good starting point for the design of a national mHealth initiative. By intersecting cross-industry indicators specific to the *kebele* and HEWs, near-term mHealth initiatives can be designed around 30,000 HEWs while longer-term initiatives can capitalize on future reception improvements and increases in phone ownership. Additionally, the fact that only 5% of HPs have electricity and 23% of HEWs can conveniently charge their phones (though 41% of towns are electrified), indicates the necessity to exploit localized micro-solutions such as solar phones or chargers for near-term implementations. In this light, the RCP community model may be worth duplicating.

Further, both the RCP and e-government networks offer a useful platform to implement health care-related data services for rural populations. They give the FMOH the technical infrastructure necessary for an ambitious mHealth initiative and also enable them to collaborate across government sectors. With proper planning, smartphones and netbooks can be usefully employed to leverage the RCP and *WoredaNet* and adequately address the five areas of HEW information and communication needs.

Finally, the analysis of socio-cultural circumstances presented above has implications for the creation of an mHealth framework that would allow for interventions tailored to the Ethiopian context. In order for a situation analysis to be relevant and usable over time, it must take into account developments in both physical infrastructure and the culture that might impact the outlook for mHealth interventions. The following sections build on the implications noted above to move toward a strategic framework and guidelines for mHealth that will both address the Ethiopia’s health needs and be specific to the conditions present in the country.

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<sup>1</sup> A study by SC4CCM/JSI conducted in 2010 of 241 HEWs in Oromia, Amhara, Tigray and SNNPR found that 90% of HEWs have access to mobile phones at their health posts, while smaller surveys conducted by Addis Ababa University and UNICEF indicate that about 90% of HEWs actually own mobile phones. Other anecdotal data obtained during this study indicated a similar level of HEW mobile phone ownership. The percentage is likely lower in the outlying regions and pastoral areas of the country.

## The Promise of mHealth

In many developing countries, much of the population, especially in rural areas, does not have access to the health care system due to resource constraints, system inefficiencies and a lack of awareness about services that are offered. The inadequate presence of health facilities and providers in many communities has been compounded by a lack of access to modern communication technologies, which further limits citizens' awareness of how to receive health services and education and providers' ability to deliver them. Yet a number of developments will change this situation. Increased efforts by governments to strengthen health systems are bringing access to care closer to the people who need it, and the revolution in mobile communications is providing a way to further strengthen the health system and bridge gaps that still exist. At the confluence of these trends lies mobile health (mHealth).



mHealth is a term used for interventions and programs designed to support public health through mobile technology and devices. The term is most commonly used in reference to using mobile communication devices, such as mobile phones and wirelessly-enabled PDAs, to deliver health services and transmit health-related information. The mHealth field has emerged as a sub-segment of eHealth, which is the use of information and communication technology (ICT), such as computers, mobile phones, satellite communications, patient monitors, etc., for health services and information.<sup>21</sup>

The mHealth spectrum ranges from simple mobile phone-based applications for the transfer of health information on basic handsets via short message service (SMS) to highly sophisticated diagnostic applications that rely on advanced equipment and robust back-end data systems. In Africa, most mHealth interventions, especially those targeting the general populations rather than health or data workers, have used relatively simple mobile technology and equipment. While the field of mHealth is still young, there have been promising early results and lessons from the dozens of pilot programs that have been conducted in a variety of geographic and health system settings. mHealth is not a solution to all of the problems confronting health systems in countries like Ethiopia, but it does hold the potential to greatly improve the efficiency of communication, reduce life-threatening delays in the delivery of care and extend the reach of the health system to underserved communities.

### mHealth as Part of eHealth

In the 2009 study *mHealth for Development: The Opportunity of Mobile Technology for Health care in the Developing World*, mHealth is examined in the context of the broader field of eHealth. The report states:

*“mHealth and eHealth are inextricably linked – both are used to improve health outcomes and their technologies work in conjunction. For example, many eHealth initiatives involve digitizing patient records and creating an electronic ‘backbone’ that ideally will standardize access to patient data within a national system. mHealth programs can serve as the access point for*

*entering patient data into national health information systems, and as remote information tools that provide information to health care clinics, home providers and health workers in the field. While there are many stand-alone mHealth programs, it is important to note the opportunity mHealth presents for strengthening broader eHealth initiatives.”*

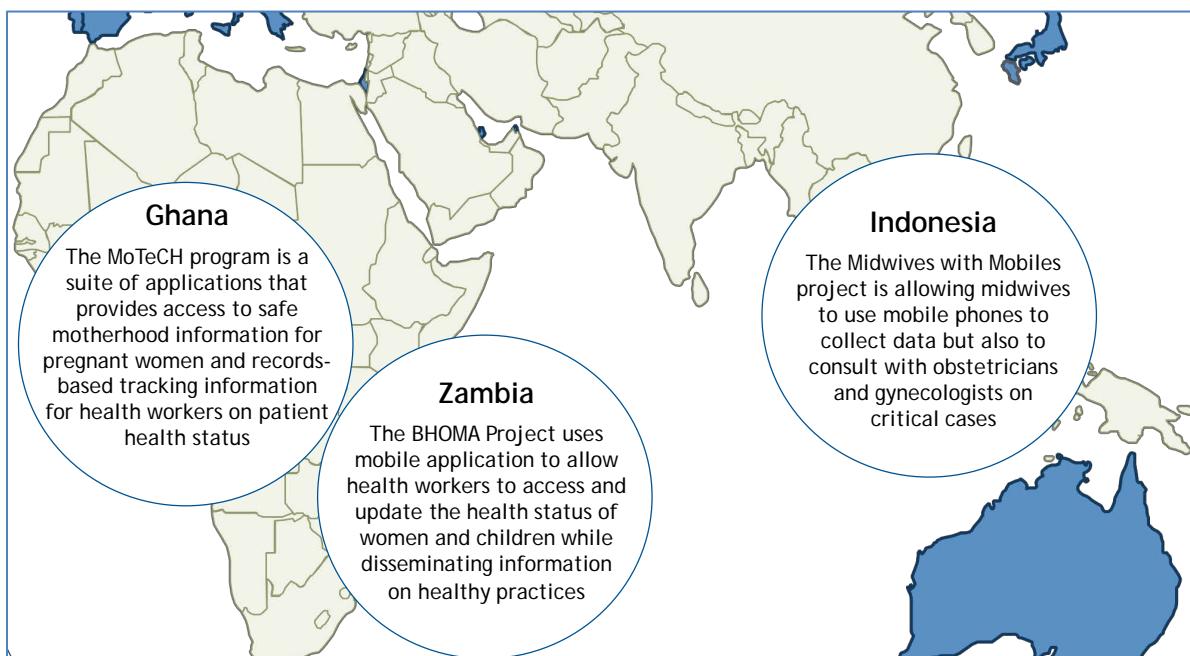
A subsequent section in this report looks at mHealth interventions in the context of broader eHealth initiatives in Ethiopia, and how mHealth programs can serve as the ‘last mile’ of these initiatives, particularly in areas where ICT infrastructure such as desktop computers and servers do not reach.

## mHealth Interventions in Emerging and Developed Settings

The spread of mobile technology and networks in low-income countries has brought modern communications access to populations that have been excluded from the underdeveloped fixed-line telephone and Internet systems in many of these societies. This development has made possible the proliferation of mHealth implementations over the last several years. Governments, NGOs and private-sector companies have introduced dozens of mHealth interventions in areas such as education and awareness, remote data collection and monitoring, health worker communication and training, disease and epidemic tracking, diagnostic and treatment support and supply chain management. More research needs to be done in terms of impact assessment, but mHealth pilot programs have achieved impressive results in areas such as patient adherence to drug regimes and awareness of HIV testing and counseling services.

mHealth projects are being deployed in the area of MNCH in a variety of low-resource settings. Some of the projects currently being deployed are indicated in the graphic below.

**Figure 13: MNCH mHealth Applications**



Recognizing that access to regular ante-natal care and safe delivery are essential for reducing maternal and child mortality, the applications above focus on increasing health worker information on the pregnancy and health status of women and families and on improving women’s awareness of the steps that lead to healthy pregnancies and deliveries. Projects such as MoTeCH target both workers and communities at large, while

others rely on the health worker as the key conduit of information to women and families. Though Ethiopia has its own unique set of circumstances and needs, the types of projects displayed above could offer models for the country to consider as it moves toward launching its own programs and services.

Much attention has been focused on the use of mHealth as a transformative technology in low-income societies, but it is growing in importance in high-income countries as well. Increasingly, health systems in nations such as the United States, Britain and Australia are using mobile technology to improve management of chronic diseases such as diabetes and heart disease, and to reach high-risk populations that are often excluded from the formal health sector. In Australia, the mobile provider Telstra launched a mobile-enabled service to track and transmit diabetes patients' blood sugar levels, while in the United States a service called Text4Baby sends text messages to high-risk expecting mothers on staying healthy during pregnancy. These services not only hold the potential to improve health outcomes, they will become critical tools as wealthy, aging societies seek to rein in soaring health costs with low-cost, high-impact measures. In addition, technologies deployed in industrialized countries will be useful to emerging markets like Ethiopia as disease burdens shift toward the management of chronic diseases.

## Critical Success Factors in mHealth

A 2009 Vital Wave Consulting landscape analysis of mHealth implementations around the developing world for the UN Foundation and Vodafone Foundation looked at over 50 mHealth projects in Africa, Asia and Latin America and identified several critical success factors associated with successful pilot programs, including:

- **Forging strong partnerships:** Because partners from the public, private and non-profit sectors bring diverse strengths to each project, ensuring that each partner advances its organizational goals through the project can increase the odds of success.
- **Tailoring messages to specific audiences:** Analysis of specific mHealth implementations reveals that communication is more effective when tailored to specific social, ethnic and demographic groups. Examinations of HIV/AIDS prevention programs demonstrate that colloquial language and references to pop culture may be effective in reaching teenagers, while older populations may prefer a more formal approach.
- **Choosing the appropriate technology model:** Many mHealth applications rely on open-source technology, while others use proprietary technology. Open-source solutions have advantages that include a lack of licensing fees, significant customizability and the potential for local participation in solution design, while proprietary solutions may include support or security features that appeal to users. Determining the most important features of an application is an important step in choosing the appropriate model.
- **Designing with the end user in mind and maintaining a focus on usability:** Applications and devices must take the users' environment and preferences into account in the design phase. Applications with overly complex user interfaces may be rejected by the populations they are intended to benefit.
- **Building a long-term funding plan:** Implementations that have relied on one-time sources of funding are typically unsustainable, even when they produce desirable outcomes. Determining a long-term business model or funding plan is essential.

- **Setting measurable goals:** A review of previous projects reveals that by setting interim and long-term goals, mHealth projects can demonstrate success, allowing them to secure ongoing support and funding for expansion.

It is important to note that while the report highlights these success factors, it also finds that there have been very few mHealth projects that have achieved long-term viability on a national or regional scale, even as pioneering organizations have demonstrated success in smaller-scale implementations. Part of this is due to the relative youth of the field. Understanding and integrating some of the best practices listed above may help Ethiopia overcome the obstacles encountered in other countries.

## Mobile Use in the Ethiopian Health System Today

While there are few major mHealth initiatives in MNCH currently under way in Ethiopia, mobile phones already play a role in the country's health system. As noted in the previous section, although mobile phone ownership in Ethiopia as a whole remains low, approximately 90% of HEWs have mobile phones. And, in spite of coverage and energy constraints, HEWs are already using their mobile phones to facilitate their work. They use mobile devices to communicate with supervisors, health centers, *kebele* heads and other HEWs and to discuss emergency situations and protocols. In cases of emergency, they are contacted on their mobile phones, and when vaccines are running in short supply, they sometimes call health centers for replenishment.

Yet mobile communication protocols and procedures are ad-hoc and the effectiveness of mobile phones is not being fully realized. Furthermore, HEWs spend their own money for work-related phone use. A recent study revealed that none of the HEWs working at resupply points are equipped with Internet access on the mobile handsets they use, limiting their use of supply chain management software.<sup>22</sup>

Among the general population, despite the shortcomings in reception, there is evidence of programs that use the telecommunications infrastructure for interventions. One such program, the Wegen AIDS Talkline, is a toll-free hotline that provides information, telephone counseling and a referral service on HIV/AIDS, STI's and TB-related topics, all anonymously. The hotline has language specific counseling available covering 14 local

Figure 14: Mobiles to Save Lives

### Using mobiles to save lives and money



A first-time father who lives near Ambo in the state of Oromia, Elias traveled over 12km with a friend to accompany his pregnant wife to the closest health center. They decided to bypass the health post in search of better service and quality at the health center. The couple made the same trip for each checkup and for several incidents involving minor pains during his wife's pregnancy. When his wife went into labor, he quickly arranged for transportation and his wife delivered her child within 20 minutes of arrival. The couple spent 24 birr for travel and 30 birr for food, and Elias noted that he could have saved time and money if he was able to communicate with HEWs and other health staff about the situations involving pain during his wife's pregnancy. While the vast majority of Ethiopians do not own mobile phones, Elias' situation illustrates both the role of husbands as decision makers and the ways in which mobile phones will be able to play a role in increasing deliveries at facilities and potentially avoiding unnecessary visits to health centers and hospitals once access to mobile technology is more widely available.

languages.<sup>23</sup> Since its inception in 2004, calls received by the hotline have multiplied three-fold, with over one million calls received in 2009. Most Ethiopians that use the line do so on their mobile phones, signaling a receptiveness to the idea of getting health-related information through this channel.

## **From Mobiles and Health to mHealth**

The government of Ethiopia and its development partners have put considerable resources into expanding access to health care through the creation of the Health Extension Program (HEP). Extensive planning and consideration were required to put the infrastructure and human resources to support the HEP in place. The development of an effective mHealth strategy, one that will build on advances in Ethiopia's health system and its telecommunications infrastructure, will also require a comprehensive planning process that takes into account the goals that such a strategy would accomplish, as well as the phasing and requirements associated with it. The following sections explore these considerations, as well as the next steps that would be required to move forward with implementations.

## Mapping Interventions: Needs and Constraints

The first section of this report identified needs in Ethiopia’s health system: the major issues involved in reaching the country’s MDG targets, the key challenges that the FMOH has highlighted in doing so, and the information and communication needs of HEWs serving the communities that are the focus of these efforts. The subsequent section detailed the constraints of the Ethiopian environment – specifically, the infrastructural and cultural conditions that affect health technology interventions. Finally, the previous section identified the promise of mHealth and its potential to improve service delivery and health outcomes for the Ethiopian people by reducing maternal and child mortality and morbidity (MDGs 4 and 5). The table below brings these sections together in a matrix that illuminates the intersection of needs and constraints, and provides a blueprint for the mHealth frameworks that follow.

**Table 5: Challenge-Need-Intervention Matrix**

Challenge	Related HEW Need	mHealth/eHealth Opportunity	Challenges/Constraints
Unmet Need for Family Planning	Data Exchange	Identify and register target population for outreach	Access hard-to-reach populations
	Training & Education	Build knowledge of FP methods and where to access them through education campaigns	Address cultural, educational and linguistic issues to increase FP demand and uptake
	Supply Chain Management	Facilitate inventory management and distribution of needed FP materials and supplies	Reduce supply chain inefficiencies
Low Rate of Skilled Birth Attendance	Referrals, Data Exchange	Identify and track status of pregnant women, especially those at high risk	Access hard-to-reach populations
	Training & Education	Increase awareness of SBA delivery benefits through appropriate educational material	Overcome reluctance to deliver in non-traditional settings
	Referrals	Refer mothers and newborns to facilities and arrange transportation	Mitigate poor transportation infrastructure and ensure care at referral facilities
Shortage of Skilled Human Resources	Training & Education	Increase access to relevant and appropriate training content	Create continually-refreshed, language-specific materials
	Consultation	Allow front line workers to consult with medical professionals	Address overall inadequate supply of trained personnel
Inadequate Coverage of Emergency Obstetric Services	Referrals	Speed women with complications to facilities known to have staff/supplies and support for obstetric first aid	Maintain up-to-date information on transportation and facilities and encourage earlier calls to facilities
	Training & Education	Increase awareness of risk factors and danger signs/complications through campaigns	Create culturally and linguistically-appropriate materials
	Consultation	Improve near-term consultation ability for obstetric first aid while facilities are expanded	Manage training constraints and lack of skills

Challenge	Related HEW Need	mHealth/eHealth Opportunity	Challenges/Constraints
Poor Referral System	Referrals	Move toward notification of incoming referrals so that hospital care is immediate (reduce third delay)	Address language issues and ensure health staff recognize and act on urgency
	Data Exchange	Create record system and register patients, families, pregnancies (EDD) and births	Overcome technology and non-technology obstacles to records
	Data Exchange	Facilitate transportation to accompany referral	Mitigate poor transportation infrastructure and financial barriers
Poor Supply & Logistics Management	Supply Chain Management / Data Exchange	Allow tracking of inventory and consumption of key supplies at HPs and HCs	Manage overall insufficiency of necessary supplies
	Supply Chain Management	Facilitate ordering and delivery/pick up of needed supplies	Overcome written language barriers and transportation inadequacies



# Introducing mHealth: A Phased Rollout

## Four User Attributes that Enable Near-term mHealth Interventions

The research identified four user attributes that enable near-term mHealth interventions. Those attributes are:

- Mobile ownership – The user must own or have access to a mobile phone.
- Ability to afford services (airtime) – The user must be able to afford airtime at the market or pre-agreed subsidized rate.
- Ability to adapt to change – The user must be able to adapt to change (such as the introduction of mobile phones to longstanding practices) in an environment in which rules, regulations, resources and technologies are ever changing.
- Literacy (Latin alphabets) – The user must be able to read and comprehend Latin alphabets, since Amharic-capable handsets are not widely used or deployed in Ethiopia.

The ideal user is one that possesses all four attributes; though a user need not possess all four of the attributes, targeting users that possess the attributes will raise the possibility of success for near-term mHealth interventions.

In a comparative feasibility analysis of the four attributes that considered three prospective user groups (HEWs, volunteer team leaders<sup>2</sup> and communities), HEWs were found to possess more of these attributes and thus considered the user group best suited for near-term mHealth interventions (see Figure 15, below). Team leaders within volunteer or community development teams ranked second and members of the general population were deemed least suitable for near-term mHealth interventions. This result stems from several factors.

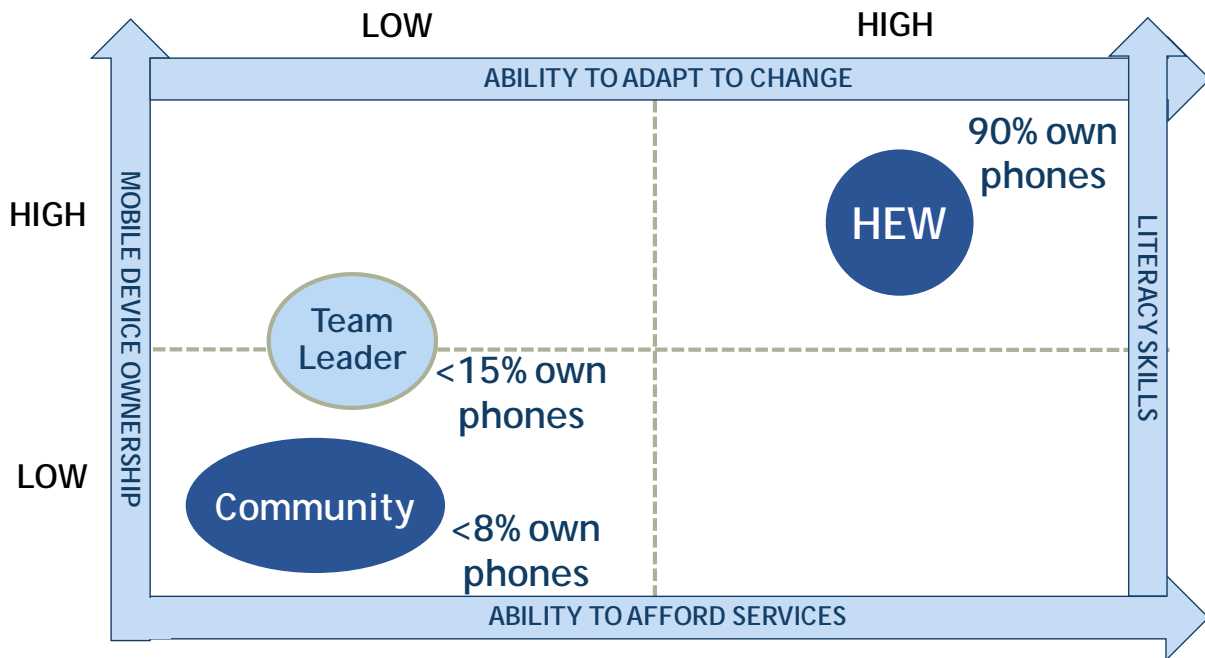


First, HEWs are much more likely to own a mobile device than any of the other groups. Whereas 8% of community members (and even fewer in rural areas) and 10% to 20% of community health development team leaders own mobile devices, approximately 90% of HEWs own or have regular access to mobile devices, according to surveys of HEWs conducted by development organizations in Ethiopia. While community member device ownership remains low, team leaders tend to be early adopters of mobile phones. HEWs interviewed for this study report that they often had to save four to five months to save the ETB400 (US\$24) necessary to purchase their 2G and 2.5G phones. Despite the fact that only 23% of HEWs reported having a

<sup>2</sup> HEWs in Ethiopia are given support by volunteer community health workers, who serve as their liaison to households and who keep track of health status and vital events such as births, deaths and pregnancies. The role and structure surrounding these volunteers is currently being evaluated, with proposed ideas to create community health development teams headed by a team leader, who have responsibility for communicating messages about health care and other government services to households. In this study, volunteers are referred to as team leaders (TL). Ethiopians who are receivers of care are referred to here as community members.

convenient place to regularly charge their devices in a separate survey of 241 HEWs, those interviewed for this study said that they generally find the devices adequate for the voice and SMS functionalities they use most.

Figure 15: mHealth Intervention Group User Attributes



Second, HEWs are more likely to be able to pay for a mobile device than the next best contending group. Unlike community members and volunteer team leaders, HEWs are paid a monthly salary of ETB575 (US\$35), allowing them to afford airtime “top ups” of ETB50 (US\$3) from time to time. In fact, HEWs interviewed for this study report that they spent up to 20% of their monthly income on mobile recharges, with about half of the airtime being used for work-related issues and the balance for personal needs.

Third, HEWs are more likely to be able to adjust to change associated with social, work and technological issues. HEWs perform in a high-pressure environment in which they are, according to one interviewee, “overworked, under-guided and undercompensated.” They have been described as “creative” when the needs of patients at the HPs demanded this of them. One pair of HEWs from Gambella region discussed how they often trekked five kilometers to the nearest town to charge their phone.<sup>24</sup> Such is the adversity HEWs are accustomed to overcoming in order to use their mobile devices.

Finally, HEWs are better educated than the general population. Most HEWs have at least had primary education and some secondary, and are trained for an additional year in 16 specific preventative health packages before they are posted to the field. Educational levels for HEWs differ by region, with many HEWs in Somali region having only a fourth-grade education, while urban HEWs typically have post-secondary education. This means that the vast majority of HEWs are literate in their own language, and they typically have some familiarity with English-language reading and writing, even if very few are fluent in English.

## Prioritizing and Phasing Focus of mHealth Interventions Based on User Attributes

Having determined that successful mHealth implementation is influenced by infrastructure conditions, user attributes and appropriate technologies, any such implementation should prioritize user groups, with early efforts focused upon the user group that most completely exhibits the aforementioned user attributes.

To mitigate risks, reduce waste and increase possibilities for program success, a three-phase rollout might be adopted. The introduction of each phase would be triggered by the presence of a minimum level of mobile coverage, power service, device ownership and reception of network signal. Furthermore, considerations regarding device and applications types would be made for each user group in which a component of the mHealth program is to be implemented. Finally, the success of phases two and three would be dependent on the foundation established in phase one.

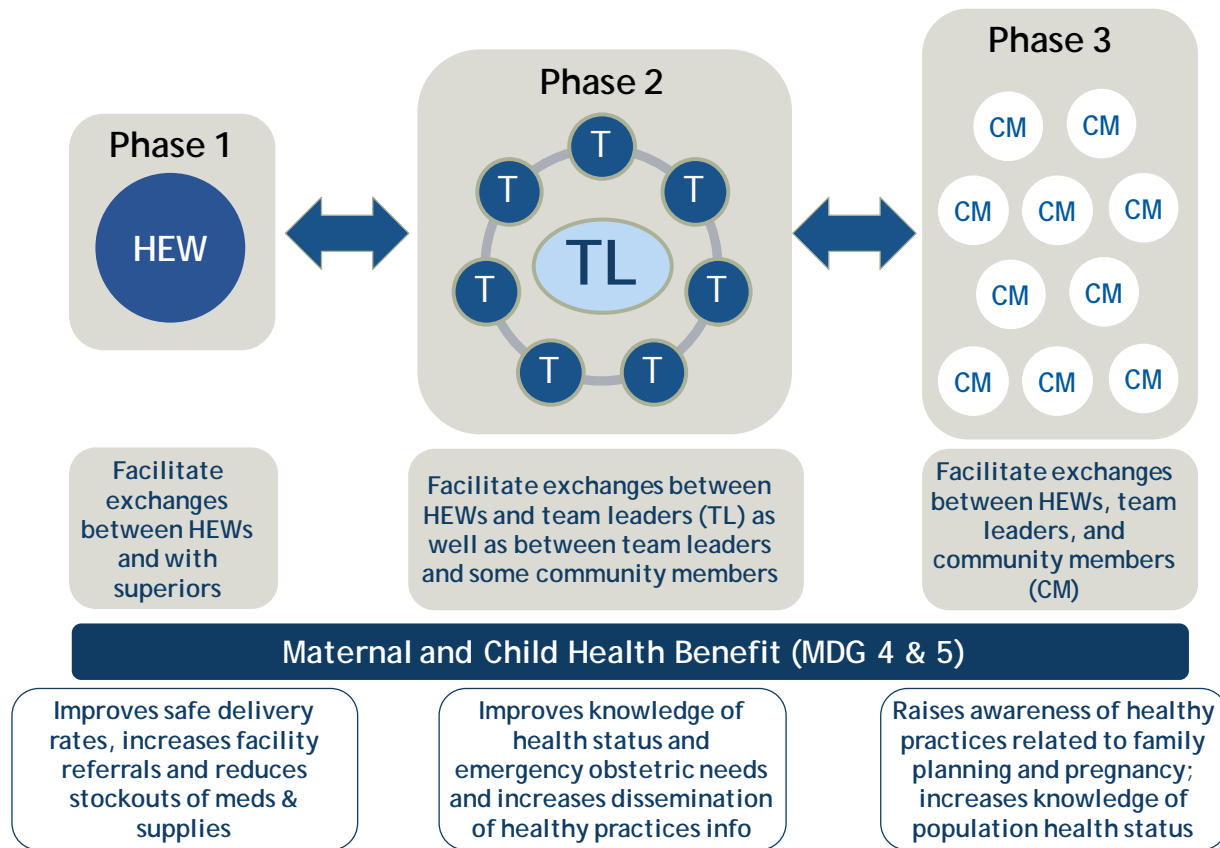
Phase one would focus on HEWs, enabling them to communicate with colleagues in other HPs as well as with their superiors at the HCs and at *Woreda* Administrative Offices regarding the health status of community members, referrals, supply needs, consultations and administrative matters. Voice-based applications are likely to be more appropriate for satisfying urgent or complex communication needs, while SMS-based solutions should be built around shorter, simpler transmissions of data (such as supplies of individual items) that do not require advanced Latin-alphabet skills.

This phase is made possible by the fact that over 90% of HEWs currently own or have access to mobile devices (GSM-enabled phones) in an environment in which there is 85% network coverage (90% CDMA coverage and 64% GSM coverage). There is, however, currently inadequate GSM reception at the *kebeles*, where HEWs only receive overflow GSM signals from the nearest towns. Also, very few HPs have electricity and HEWs still have to walk or find transportation to town to charge their mobile devices. EEPCo is aggressively rolling out capacity and has indicated that it can prioritize rollout according to the stated needs of the FMOH. Their projection is to have 75% of towns and villages electrified by 2015 and 100% by 2020, though the definition of electrification varies. Given that EEPCo reached 75% of its targets in 2010 and 41% of towns and villages are electrified (according to an interview with the Directorate of Planning in December 2010), it is likely that the device charging situation will improve over the long term.

Because it realizes that its goals and initiatives cannot wait while the electricity situation improves, FMOH is in the process of rolling out 600-watt solar panel/inverter systems for the HPs. Thus far, they have deployed 200 units and project the deployment of 500 by June 2011, with a goal of 5,000 deployed by 2015. It is possible that a portable near-term solution (e.g., solar phones or chargers) will have to be implemented at each HP to ensure that infrastructure deficiencies do not impede HEWs' ability to access mHealth capabilities.

Device selection takes into account this deficiency in electricity as well as the mismatch of device-network capabilities. About 90% of HEWs have mobile phones, but not the right phones for the rural CDMA network that covers 90% of the country. Further, Ethio Telecom has rolled out solar-powered, fixed-base community phones to 14,000 *kebeles* which function on the CDMA network. And the existence of broadband capabilities only 10 kilometers from each HP (as a result of the availability of *WoredaNet*) means that the FMOH has at least two options when determining device types and complexity based on network availability. Either way, the ideal would be to start off simply while maintaining the capability to expand functionality over time.

Figure 16: Phasing mHealth Interventions



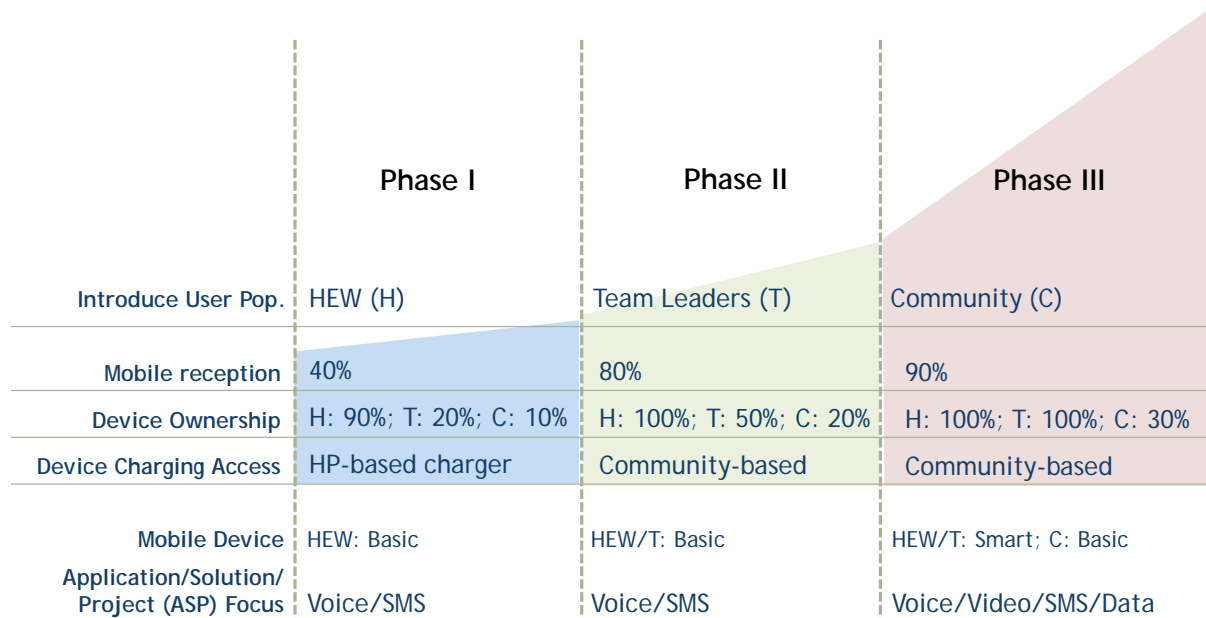
Most HEWs currently use SMS at least occasionally, so that is an obvious default application type for them to use in the near-term. However, to resolve text language barriers in the mid- and long-term, interactive voice response (IVR) or XML-based application types might prove more appropriate. According to the Vital Wave Consulting mHealth application database, implementations may have to first start with SMS given that most applications rely on this technology. However, as XML and video become the standard for global applications, mHealth applications will also move in that direction.

Phase two would continue to grow services among HEWs while focusing on enabling community volunteers and exploring needs and demand among rural community members. During this phase, team leaders could use phones to inform the HEWs with whom they work of emergencies and patient health status and needs while receiving voice-based health messages that they could disseminate to the families they serve.

Likewise, phase three would continue to grow and deepen services among community volunteers while expanding to rural communities as a whole. Interventions targeted at community members during this phase could enable a larger range of applications and solutions that provide health education and awareness directly to community members, as well as collecting health status and diagnostic indicators for use by HEWs and other health workers.

Such a phased rollout approach would not only allow public resources to match individual circumstances, but it would also focus *kebele*-level HEP efforts around the HEWs and make them active participants in the implementation of mHealth beyond the HPs, among volunteers and into communities. The figure below displays some of the conditions that might facilitate the introduction of each phase.

**Figure 17: Phased Rollout Conditions and Actions**



# A Strategic Framework for mHealth in Ethiopia

In an earlier section, the key information and communication needs of Health Extension Workers (HEWs) were identified. As part of any attempt to address those needs through mHealth interventions, it is important to state explicitly the nature of each need, what an mHealth intervention would attempt to accomplish and the benefit that would be realized if this intervention were successful.

**Table 6: Mapping Needs to Interventions and Health System Benefits**

HEW Need	Objective	Intervention	Benefits or Impact	FMOH Challenge Addressed
Referrals	Identify and refer mothers and newborns to the most appropriate facility quickly and ensure they receive care at arrival	Allow faster communication of referral need through voice or text	Reduce delay in receiving care	R, EmONC, SBA
Training & Education	Reinforce HEW training and procedure while performing current duties such as pneumonia CCM	Allow access to quizzes or checklists/algorithms during service provision	Improve skills and knowledge while reducing time away from post	HR, SBA, FP, EmONC
Supply Chain Management	Ensure consistent and adequate supplies of needed drugs, kits and equipment	Allow notification and recording of supply needs as well as notification of receipt	Fewer stockouts of critical supplies	SC, FP
Data Exchange	Collect, transmit and receive critical patient and population health data	Facilitate electronic data entry and receipt at post level	Improve data accuracy and timeliness	R, FP, SBA
Consultation	Speak with more highly-trained medical professionals in cases of emergency or urgent treatment	Allow real-time consultation with higher level medical staff	More effective and immediate aid	HR, EmONC

R=Poor Referrals System

SBA=Low Rate Skilled Birth Attendance

HR=Shortage of Skilled Human Resources

FP=Unmet Need for Family Planning

EmONC=Inadequate Coverage of EmONC

SC=Poor Supply & Logistics Management

This table, and the subsequent section, identifies the benefits that would result from effective interventions, but it is important to note that effective tools and programs for information and communication are only one piece (albeit a very important one) of what is required to achieve these benefits. For example, timely communication of supply needs at health posts is critical to preventing stockouts, but this communication will not bring benefits if the supplies in question are not in stock at higher levels of the system, or if bottlenecks in the transportation system result in delays in supplies reaching providers.

In addition to identifying the benefits of interventions, it is also critical to think about the attributes that technology applications or programs would need to have to successfully fulfill the functions required of them in the Ethiopian context, especially as these conditions may change over time. The table below looks at each of the HEW information and communication need areas and the types of device and transmission technology that might be appropriate in near-term interventions, as opposed to longer-term ones. The table also references the type of mHealth solutions that might fit the attribute criteria for each area (which are described in further detail in this section).

Table 7: Attributes, Technology and Programs for Information & Communication Needs

HEW Need	Attributes	Primary Technology	mHealth Solution
Referrals	<ul style="list-style-type: none"> <li>• Relatively simple</li> <li>• Easy to use</li> <li>• Enables rapid action</li> </ul>	Tech: V, S Device: Basic	<ul style="list-style-type: none"> <li>• Closed calling networks</li> <li>• Form-based data transmission</li> </ul>
		Tech: F Device: Mid-level	
Training & Education	<ul style="list-style-type: none"> <li>• Interactive, or “two way”</li> <li>• Responsive, fast</li> <li>• User-specific</li> <li>• Current</li> </ul>	Tech: S, V Device: Basic	<ul style="list-style-type: none"> <li>• SMS-based quizzes</li> <li>• IVR systems</li> <li>• Phone-based checklists</li> </ul>
		Tech: VD Device: Smart	
Supply Chain Management	<ul style="list-style-type: none"> <li>• Matches and informs local supply best practices</li> <li>• Simple, clear rules and procedures (checklists)</li> </ul>	Tech: S, V Device: Basic	<ul style="list-style-type: none"> <li>• Bulk SMS programs</li> <li>• Phone-based checklists</li> </ul>
		Tech: F Device: Mid	
Data Exchange	<ul style="list-style-type: none"> <li>• Multi-way</li> <li>• Record-based (unique ID)</li> <li>• Actionable (goal-oriented and timed)</li> </ul>	Tech: S Device: Basic	<ul style="list-style-type: none"> <li>• Form-based data applications</li> </ul>
		Tech: F, V Device: Mid, Smart	
Consultation	<ul style="list-style-type: none"> <li>• One-way (bottom to top)</li> <li>• Real-time</li> <li>• Situation-specific</li> </ul>	Tech: V Device: Basic	<ul style="list-style-type: none"> <li>• Closed calling networks</li> <li>• Call centers (hotlines)</li> <li>• Telemedicine applications</li> </ul>
		Tech: VD Device: Smart	

V=Voice    F=Forms  
 S=SMS     VD=Video

Near term     Long term

The third column, Primary Technology, refers to the technology that mHealth interventions would use, both in the near term and the longer term. In the near term, interventions may rely on simpler transmission technologies, such as voice and SMS, with which HEWs are highly familiar, and on more basic handsets, which are less costly to purchase and less energy-intensive. As Ethiopia’s mobile technology networks and markets develop, more advanced applications that use phone or web-based forms or video become more feasible. Decreases in feature or smartphone prices and service rates may also facilitate the use of more advanced applications.

## Referrals

Improving the referral system for patients has frequently been cited as a necessity for Ethiopia to improve the delivery rate at facilities and, consequently, to raise the percentage of births by skilled birth attendants, especially for high-risk pregnancies. Currently, HEWs may fill out referral forms for patients to bring to higher-level facilities, though in practice this often does not happen. An effective mHealth intervention in this area would allow HEWs who need to refer patients to health centers or hospitals to easily communicate with these facilities. Such communication could facilitate transportation via ambulance or other means, while allowing facilities to ensure they have the staff and equipment available to accommodate incoming patients. This is critical to reducing the “third delay” of care, the delay that occurs between the moment a person seeks care and when she receives it.

mHealth programs or applications that would improve the referral system have several key attributes. The time-sensitive nature of referrals, especially in emergencies, means that they need to be relatively simple (i.e., not require great technological complexity), easy-to-use and capable of enabling rapid action. SMS-based applications have the advantage of creating a record that could potentially be attached to a patient record or used to review facility performance, while voice-based systems would allow for real-time communication with

facilities to ensure readiness for incoming patients or additional consultation. In the longer term, form-based transmission of referral information, by entering information via mobile or online patient records, could create a more seamless integration of patient history data. The most essential requirement for these mHealth interventions is that the information reaches facilities quickly and care is provided promptly when patients reach the health center or hospital.

Finally, it is critical that the referral system in which these technology applications are operating function from an operational and human resources perspective. Effective communication of referral needs is of little use if women in labor are not able to reach a facility quickly, or if facilities are not able to provide appropriate care when they are reached.

**Figure 18: Referral Solution Examples**

<p><b>Solution Type:</b> Closed network</p> <p><b>Description:</b> SIM-based network allows free calling and/or SMS to other in-network users, such as HEW supervisors and health center staff</p> <p><b>Requirements:</b> Rationalization of referral process, basic handsets, participation by telecom provider in creating user groups</p> <p><b>Advantages:</b> Low operational and training costs; simple; voice-based; real-time</p> <p><b>Disadvantages:</b> Not linked to other data exchanges</p>	<p><b>Solution Type:</b> Form-based data transmission</p> <p><b>Description:</b> Referral forms can be digitized and health centers/hospitals can receive them from HEWs, alerting them to incoming patients</p> <p><b>Requirements:</b> Rationalization of referral process, Java-enabled phones for GPRS transmission; digitization of HIS records</p> <p><b>Advantages:</b> Can be tied to health records; integrated into patient data</p> <p><b>Disadvantages:</b> Requires more advanced phones, training and back-end systems; literacy may be an issue</p>
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**Key considerations:**

- The organizational and logistical system supporting referrals, including referral protocols, transportation solutions and ability to provide care at referral facilities, must be optimized.
- SMS or form-based transmission of referral information has the potential for integration into patient or facility records, but voice-based transmission is faster, ensures verification of receipt and allows for consultation.

In India, Boruka Charitable Trust worked with Frontline:SMS to convert a paper referral system for HIV testing and other services into an SMS-enabled form, allowing it to better track those who did (or did not) report for the referred service and to target follow-up visits as needed. In Bangladesh, the Bangladeshi Rural Advancement Committee is connecting expecting mothers and families with referral facilities using mobile phones to increase access to emergency obstetric services.



## Training and Education

HEWs in Ethiopia require ongoing training in order to provide services to their communities. Workers often attend off-site trainings that refresh or expand their knowledge in their core duty areas. While some off-site training is necessary and desirable, it is recognized that frequent trainings have the effect of pulling HEWs away from their health posts, reducing the amount of time they can devote to care. Static refresher materials are available to many HEWs, but they demand little urgency and are not easy to update.

mHealth programs in this area should be interactive, current, relatively fast and responsive, and specific to the user receiving training. Interactivity and responsiveness encourage participation by the health worker, while targeting the user with material that is both specific to their needs and current increases the value of the training. In the near term, SMS-based quizzes can be used to refresh HEW knowledge, while letting supervisors determine who might need more training. Interactive voice response (IVR) systems can also be used to provide training or quiz workers, although costs for such systems are often considerable. In the longer term, video-based modules which permit visual instruction and have greater content allowances than SMS may be deployed.

Figure 19: Training and Education Solution Examples

<p><b>Solution Type:</b> SMS-based quizzes</p> <p><b>Description:</b> Interactive quizzes that can be sent to users' phones and which allow feedback based on answers</p> <p><b>Prerequisites:</b> HEW or FMOH analysis of results and gaps in training</p> <p><b>Advantages:</b> Customizable; simple interface; basic handset requirement</p> <p><b>Disadvantages:</b> Potentially high costs; language limitations; character limit</p>	<p><b>Solution Type:</b> Phone-based checklists</p> <p><b>Description:</b> Workers can be guided through questionnaires or checklists on their phones and be prompted or reminded to take action based on results</p> <p><b>Prerequisites:</b> Java-enabled handsets</p> <p><b>Advantages:</b> Relatively low-cost device; serves as both job aid and data collector</p> <p><b>Disadvantages:</b> Language limitations; management of back-end data</p>
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The use of mobile phones for education is at a relatively early stage. More advanced devices such as laptops bring considerably greater capability, but with much greater costs. Language is central; training provided via text must be done in a language accessible to users or it will not be useful. This has particular implications for training provided in Amharic, as Amharic-enabled handsets are not widely available in Ethiopia.

### Key considerations:

- Basic handsets have limited capacity via voice or SMS; more advanced devices cost significantly more.
- Providing training in the appropriate language is key.

The HealthLine project in Pakistan allows semi-literate community health workers to access a speech recognition-based menu system to access pre-recorded information in their local language on a variety of diseases and treatment options.

## Supply Chain Management

Ensuring that frontline health workers have adequate supplies for medical treatment, family planning and disease prevention is a challenge in many developing country health systems. The government of Ethiopia and its partners are taking steps to improve logistics and inventory management in a system that must reach even the most remote locations, despite considerable distances and geographic challenges. The current system for managing inventory at health posts tends to favor ad hoc resupply of HEWs when they visit health centers explicitly for this purpose or in the course of other business. Yet there is often little advance warning of supply needs, which can result in stockouts of critical supplies, and lack of adequate tracking systems sometimes leads to expiration of vaccines and medications.

mHealth interventions in supply chain management are most effective when they align with (and inform) local best practices for supply and follow simple, clear rules for ordering or inventory management. The use of mHealth applications for managing supply needs accounts for a significant number of the mHealth interventions that have been conducted in different parts of the world. Programs or applications like RapidSMS and FrontlineSMS allow frontline health workers to send text messages related to supply use and needs to a central server connected to a mobile-enabled modem, allowing organizers to track needs quickly and allocate resources accordingly. One such pilot was conducted in Ethiopia in 2008 by UNICEF, using RapidSMS to track emergency food distribution during a food shortage. Such applications are appealing because they use basic handsets and simple transmission technologies and require relatively little training. More advanced form-based applications can allow tracking of multiple supplies and enable checklist-like functionality, although these may require more advanced devices and more training.

As with referrals, information and communication of supply needs at the health post level are essential, but they will not be sufficient to prevent supply disruptions if the system onto which mHealth applications are overlaid is not functioning. If supplies of any given medication or equipment are insufficient nationwide, for example, an effective system for communicating health post supply needs will not solve the problem. For this reason, early mHealth interventions in this area may benefit from focusing on items for which there is adequate supply. In addition, managing multiple supply needs (health posts stock dozens of items) quickly adds complexity, so the scope of items covered in any intervention must be carefully considered.

Figure 20: Supply Chain Management Solution Examples

**Solution Type:** Bulk SMS programs

**Description:** Free-form or structured text messages that allow health workers to report on supply status or needs and receive messages back

**Requirements:** Basic handset, GSM-modem equipped computer/server for data processing and aggregation

**Advantages:** Low device and training costs

**Disadvantages:** SMS costs can be high

**Solution Type:** Form-based programs

**Description:** Similar to above, but using GPRS rather than SMS transmission in some cases

**Requirements:** Data-capable device, computer/server for data processing and aggregation

**Advantages:** Greater volume of information; potential checklist capability

**Disadvantages:** More advanced handsets required

**Key considerations:**

- Product scope and supply considerations (such as supply availability) are critical to successful implementations.
- More advanced devices and technologies increase both capabilities and costs.

In Tanzania, the SMS for Life program allows health workers to use their mobile phones to send a weekly SMS stock-count message about anti-malarial medicine into a centralized database, while in Nigeria, the RapidSMS program has been used to track the distribution of millions of bed nets.

## Data Exchange

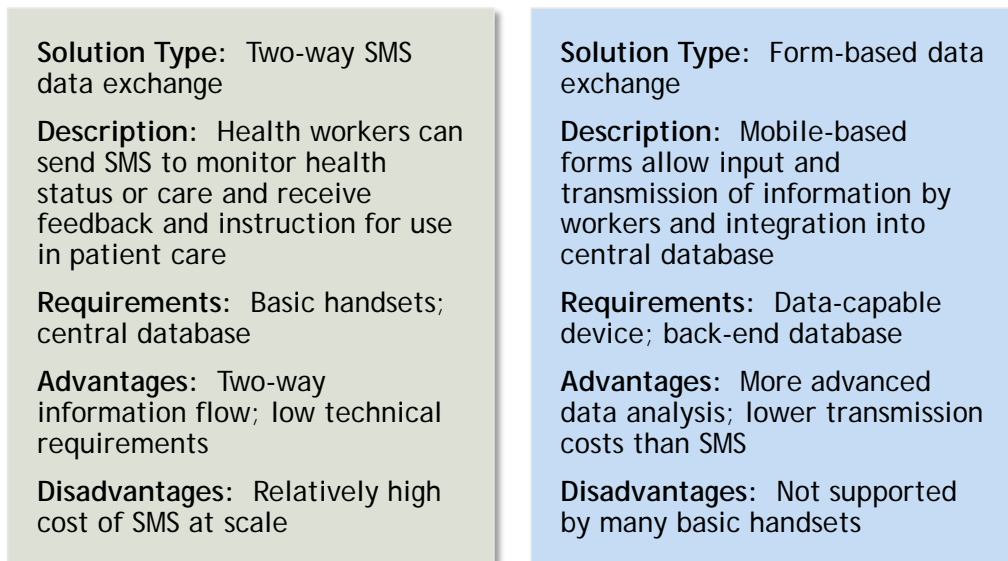
The capture and exchange of health data, including vital statistics, disease tracking, individual patient data and health system performance, are an integral part of improving patient outcomes and allocating resources more efficiently. Yet in many places this data is often inaccurate, out of date, or non-existent due to cumbersome or redundant collection practices and overburdened health workers, or because the data collected is of little practical use to these workers. Rationalizing and improving Ethiopia's health management information system (HMIS) is the focus of a massive effort by the Ethiopian government, its aid partners and implementing partners Tulane University and JSI. The effort has focused first on improving the functioning of the paper-based data collection system and then on a shift toward an electronically-based system that will reduce the need for multiple manual entry of data while improving accuracy and timeliness.

mHealth applications that focus on the capture and transmission of data are most effective when the information flow is two-way (i.e., information goes back down to workers instead of only moving up to higher levels of the system), based on patient records and enables action by either health officials or health workers. Such applications have been deployed in settings around the developing world. Some are relatively simple SMS-based programs that allow transmission of disease or outbreak data, while others, such as MoTeCH in Ghana, use individual patient records as the basis for collecting information via mobile phones that can then be used by

community health workers to follow up with pregnant women or new mothers. In Ethiopia, Tulane is experimenting with low-cost netbook computers that HEWs can use to enter data into HMIS forms and transmit through mobile Internet channels, an option which raises device costs, but also expands functionality beyond that offered by most mobile phones.

Using mobile technology to advance the collection, analysis and use of health data could have a dramatic impact on the accuracy and usability of Ethiopia’s health information system, but several considerations have to be weighed when moving forward with interventions in this area. Applications designed to collect data must be aligned with the processes, goals and objectives of the HMIS. Deployment of such interventions would also have to be considered in light of the substantial HMIS changes being implemented currently to avoid disruptions. The use of patient records in such implementations is another consideration. The distribution of family folders throughout Ethiopia is a step toward moving such records to a central place in data collection, which has the potential to make data collected by HEWs much more actionable. Yet making these records central is in and of itself a major endeavor that has implications beyond the mHealth intervention.

**Figure 21: Data Exchange Solution Examples**



**Key considerations:**

- Alignment with and optimization of HMIS processes, goals and objectives is essential.
- Patient-record based applications could increase the utility but also the complexity of any intervention.

In the Philippines, to address the problem of two-way data communication utilizing simple mobile phones in rural settings, the M-DOK project developed an end-to-end mobile tele-health system composed of a mobile Java application and a Windows-based receiver application. The system featured health information modules stored offline on mobile phones, a mobile electronic patient record, and a lightweight mobile encryption algorithm transferring instructions and data into PDF files accessible by mobile phones

## Consultation

The deployment of paid, trained health workers was a major step forward in Ethiopia's health extension program. Yet HEWs have only a year of formal training and many have only a secondary school level of education, meaning that many of the mothers and pregnant women they see must be referred to higher-level facilities for care. Yet because of ongoing deficiencies in the transportation system, many women in emergency labor situations are not able to reach such facilities in time. In such cases, HEWs may need to consult with medical professionals to determine treatment steps until direct care by a medical professional becomes available.

mHealth interventions that are aimed at facilitating consultations must be real-time, especially in emergency situations, and they must be situation-specific, meaning that HEWs must speak to the appropriate individual with respect to a medical situation. A number of mHealth programs allow real-time consultation with doctors. Closed calling networks allow people in designated networks to call each other free of charge, reducing concern about using personal money for work-related calls or the possibility that calls are dropped due to lack of airtime credit. Such a program, MDNet, links doctors in both Ghana and Liberia. They are able to call each other for consultation on cases outside of their expertise as part of a single nationwide closed network. Similarly, toll-free hotlines (or "warmlines") allow health workers to call medical experts stationed at call centers for advice and consultation. As mobile networks develop and camera-equipped mobile devices become more common, telemedicine applications that use photo and video features may allow for more sophisticated consultation.

As noted earlier, promoting consultation capabilities is a complicated subject because it entails HEWs potentially delivering care in areas outside of their formal training. But even in non-emergency consultations, call centers or closed networks could improve the accuracy and timeliness of referrals. The requirement for a successful consultation application is the availability of qualified personnel, either at a call center or in a network, to address health workers' needs. Lack of personnel could undermine its utility. A closed network, however, could have multiple uses, allowing for communication about referrals, supply needs and consultation.

Figure 22: Consultation Solution Examples

<p><b>Solution Type:</b> Call centers (toll-free)</p> <p><b>Description:</b> Health workers are able to call toll-free call centers to consult with trained staff on problems beyond skill set or experience</p> <p><b>Requirements:</b> Fully-staffed call center; basic handsets</p> <p><b>Advantages:</b> Real-time advice in urgent situations; basic handsets</p> <p><b>Disadvantages:</b> Large start up and telecom, training and operational investment</p>	<p><b>Solution Type:</b> Telemedicine solutions</p> <p><b>Description:</b> Use of mobile video applications for remote diagnosis and consultation</p> <p><b>Requirements:</b> Camera/video-enabled devices; hospital/medical staff able to assist staff</p> <p><b>Advantages:</b> More advanced diagnosis and advice possible; training/education benefits for workers</p> <p><b>Disadvantages:</b> More advanced devices and network</p>
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**Key considerations:**

- Adequate availability of expert or higher-level medical staff is critical, especially in emergency situations.
- Consultations can lead to HEW action outside of core training areas.

In Ghana and Liberia, MDNet uses a closed calling network to allow doctors to call other doctors free of charge in cases where a patient's condition requires outside expertise or consultation.

# Principles and Key Considerations for Interventions

The previous section discussed some of the key attributes required for mHealth interventions in Ethiopia, as well as some of the relevant types of programs and applications that could enhance HEWs' ability to deliver services to families and communities. The importance of introducing interventions that align with and help to build the country's digital ecosystem is also very important, as discussed during the previous section. Yet there is a whole range of financial, capacity and cultural considerations that must be taken into account with each new program. In addition, these considerations should be guided by certain principles that would govern the planning and implementation of the program to increase cohesion, improve resource management and increase the likelihood of scalability and sustainability. This section discusses the principles and central considerations that decision makers must keep in mind in developing an mHealth program.

## The Five Core Principles

In early 2010, a team of health care and technology professionals convened in Greentree, a conference center in New York State, to discuss the management of developmental health initiatives. The result of their conference is a set of principles designed to encourage relevance and control quality in the development of digital frameworks, enterprise architectures, and ecosystems. The five core principles, also known as the *Greentree Principles*, are:

1. **Health centric:** The design should be people-oriented, meaning that the technology is designed to meet the health needs of people, rather than making health needs fit the technology.
2. **Field-based systems:** The system should be non-theoretical and based on field evidence.
3. **Collaborative and parallel processes:** The architecture should encourage transparency, local control and open competition.
4. **Digital technology:** The technology architecture should be open-standards, interoperable, agile, iterative and rapid.
5. **Sustainability:** The system should be supported by adequate resources to ensure scalability and sustainability.

**Key implication:** To increase the probability of scalability and sustainability, the FMOH mHealth programs, should be developed using the *Greentree Principles* or documents with similar conclusions.

## Financial Considerations

- **Airtime:** Airtime (voice, SMS and data use) costs are one of the most significant cost categories associated with any mHealth deployment. Anticipating costs requires creating models that can predict the airtime associated with any application. Ensuring adequate funding may entail negotiating lower rates or volume discounts with Ethio Telecom.
- **Device costs:** While device costs constitute a smaller percentage of project costs than is often assumed, the cost of acquiring (and replacing) devices on a large scale is considerable. As with airtime, negotiating lower prices or volume discounts with providers can reduce costs.

- **Training:** Any new program or change to current practices requires a thorough training program in order to succeed. The cost of paying trainers and the time lost by HEWs to attend training are major components, as is continuing or refresher training and the creation of training materials.
- **Maintenance:** Devices break and need to be fixed, while back-end systems require updating and maintenance in order to function properly. Paying for continuous support may constitute a quarter or more of the total cost of ownership (TCO) for a technology deployment.
- **Capital expenditures:** In addition to device costs, equipment such as servers and peripherals may need to be purchased to support an mHealth program.
- **Operating expenditures:** Costs related to the distribution of devices, the creation of content and the administration of programs are often overlooked but can be substantial.
- **Business model:** In order to be sustainable, an mHealth program requires a business model that will ensure adequate balancing of revenues and expenditures, which may help determine funding needs beyond initial grants or program revenues.
- **Return on investment:** An analysis of the return on investment, including not only all costs associated with a deployment, but also health outcome benefits and potential savings resulting from an intervention, is critical to determining whether an mHealth program or application is worth the resources it would require.

**Key implication:** A total cost of ownership assessment, along with an analysis of projected benefits, can help determine the financial viability of any mHealth solution.

## Capacity Considerations

- **Data capacity:** mHealth interventions often involve substantial data transmission, storage and processing. Current systems must be assessed for their capacity to handle the requirements of any proposed solution.
- **Human capacity:** Human resources are required to ensure the functioning of any implementation, including technical, managerial, administrative and operational skills. Given the early age of mHealth, locating and retaining experienced professionals in the field can be challenging.
- **Infrastructure:** Implementations will only succeed if the required infrastructure is in place to support them. Program requirements thus must be compared to current capacity.
- **Technical capacity:** Trained support staff, whether outsourced or provided in-house, is needed to support any program or initiative.
- **Administrative capacity:** In addition to the human capacity needed to implement programs, administrative structures need to be in place to ensure program functioning.

**Key implication:** A thorough analysis of current capacity, as well as that required for a proposed intervention, is necessary for creating the adequate enabling environment for mHealth programs and services.

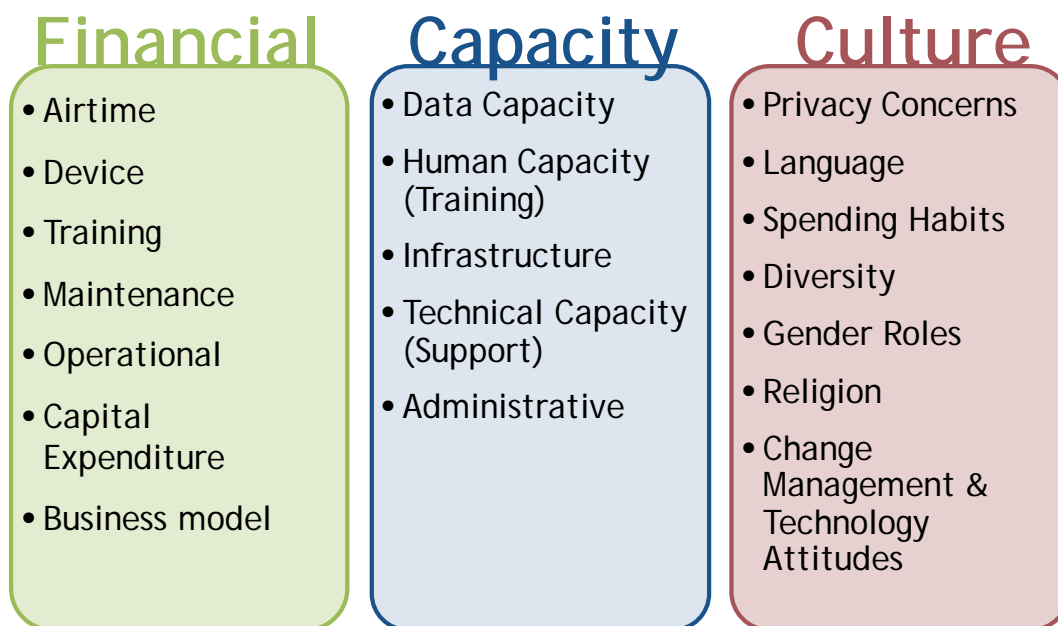


## Culture Considerations

- **Privacy concerns:** Successful mHealth programs address concerns about the confidentiality of sensitive patient data that may be relayed using mobile technology. This is particularly important with respect to HIV and other STIs.
- **Language:** Transmitting information in a language that is understood by the user population is critical to attaining program uptake and data accuracy.
- **Spending habits:** Understanding how targeted intervention groups think about spending related to mobile communications is key to creating a business model that is scalable and sustainable.
- **Diversity:** Sensitivity to the vast diversity of Ethiopian culture, religion and practices can help to create tailored approaches to deployment that increase the odds of success.
- **Gender roles:** Respect for norms and attitudes towards gender roles, pertaining to both HEWs and patient populations, is essential.
- **Change management and attitudes to technology:** Introducing new technologies requires introducing changes to processes and overcoming resistance to those changes, and to technology in general.

**Key implication:** Cultural considerations can make or break the success of any technology intervention. Careful planning integrates and addresses cultural concerns.

Figure 20: Key Considerations for mHealth Interventions



## mHealth in the Digital Health Ecosystem

Individual mHealth interventions, such as those discussed in the previous section, can make meaningful contributions to solving the information and communication gaps that prevent HEWs from achieving their goals and functioning optimally. Yet mHealth programs cannot fix all of the organizational or operational issues that exist because they do not exist in a vacuum. Instead, they exist within a larger ecosystem – a “digital ecosystem” – with other health technology initiatives, both current and planned. These initiatives affect resource and operational efficiency within the health system in general, and the HEP in particular. It is thus imperative that the design and deployment of mHealth applications, solutions and projects happens in concert with other elements of this ecosystem. This section explores the place of mHealth in the broader digital ecosystem along the guidelines of the aforementioned principles and conditions.

### It Takes a Team to Make mHealth Work

Despite the preparative steps for mHealth to work, there ultimately needs to be a working multi-player alliance between the FMOH, other ministries and agencies (ET and MCIT, for example), development partners, and the private sector. This alliance needs to leverage existing resources while generating and attracting new ones to develop and maintain a digital ecosystem that supports the administration of health interventions.

The FMOH has developed a number of applications in an effort to create a digital health information system that fully supports the HEP vision. Among these applications are:

- Health Management Information System (HMIS)
- Electronic Medical Records (EMR)
- Human Resource Information System (HRIS)
- Geographic Information Systems (GIS)
- Telemedicine (TM)
- Health Data Warehouse ( HDWH )
- Logistics Management Information System (LMIS)
- Laboratory Information System (LABIS)
- Health Facility Information Database (HFIDB)

mHealth is the most recent initiative envisioned to simplify and improve the work of HEWs in their efforts to improve MNCH and quality of life in Ethiopia’s *kebeles*. Given the commitment of the Ethiopian government evidenced by prior and continued efforts, now is the time to leverage the success of FMOH to integrate existing applications within a sustainable, emerging growth environment

An example of mobile-related collaboration is the Wegen AIDS Talkline, a toll-free hotline that provides information, telephone counseling and a referral service on HIV/AIDS, STIs, TB and related topics. The 12-hour per day operation has 24 lines, 64 full-time paid counselors, 18 volunteers and five supervisors. Clients can access counselling services by dialing 952,<sup>32</sup> a toll-free line through which 16 million calls have been made during five years of operation. Wegen’s success results from the collaboration of the Ethiopian and United States governments and academia. The Talkline is supported by the Ethiopian AIDS Resource Center (EARC) through the HIV/AIDS Prevention and Control Office (HAPCO), the President’s Emergency Plan for AIDS Relief (PEPFAR) through the Center for Disease Control (CDC) and implemented by Johns Hopkins University. The same call center also houses the Fitun Warmline, a project implemented by the UCSF National HIV/AIDS Clinicians’ Consultation Center and supported by PEPFAR and EARC. The Warmline provides HIV-related consultation to clinicians in Ethiopia and has provided over 2,400 consultations to health workers in Ethiopia since its inception. Both are examples of successful use of telephone technology (a call center in this case) to create an ecosystem for preventive health interventions.<sup>33</sup>

within the current and planned *digital ecosystem*.

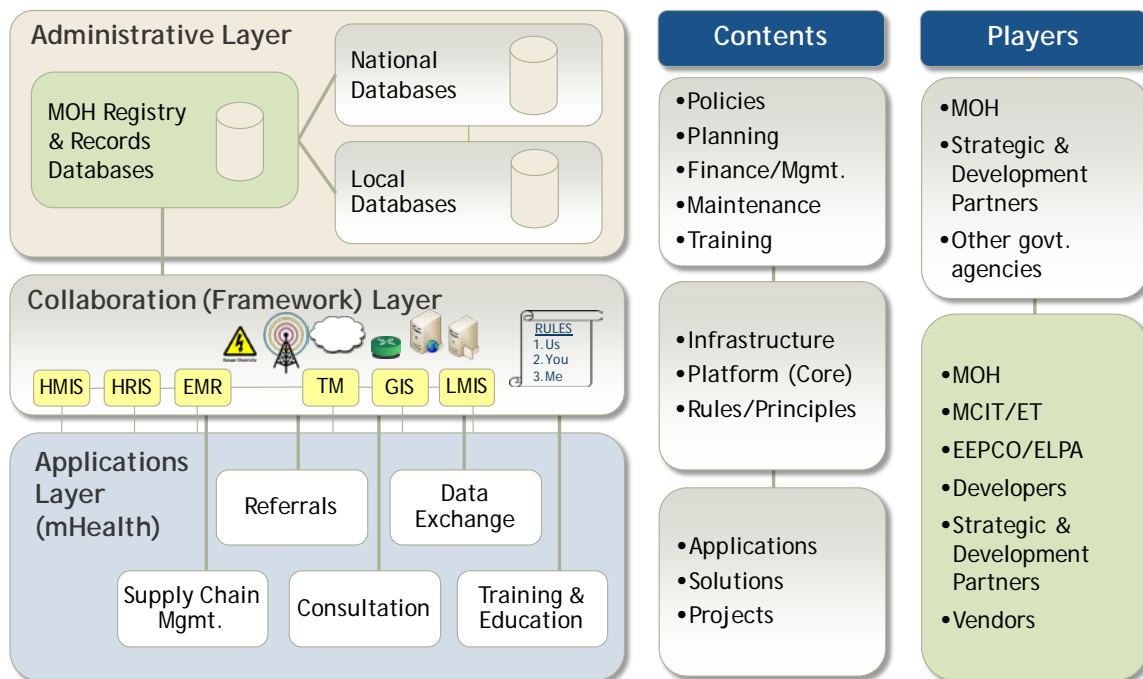
## The mHealth Digital Ecosystem Enterprise Architecture and Interaction Layers

The ideal digital ecosystem should be simple enough to manage yet complex enough to grow. As such, the FMOH mHealth digital ecosystem (mHDE), should be comprised of three layers – the administrative, collaboration and application layers. The players, content and functionality of each layer would be as follows:

- Administrative Layer:** In this layer, the prime player is the administrator who, in this case, is the FMOH. To ensure efficacy, the FMOH could outsource the administration or partner with another entity, public or private. From its position, the administrator would plan, develop and manage strategies and policies regarding technology, finance, maintenance, training and other content that would sit in database servers in a location designated by the administrator.

Among those servers would be an FMOH registry and records database servers that would be linked to national and local databases, existing elements of the *WoredaNet* located at their respective data centers. Because of the sensitivity of the data in FMOH servers, great caution would have to be observed in implementing security protocols for this system. To succeed, the administrator would have to collaborate with other agencies such as the Ministry of Finance (FMOF), MCIT and EEPCo and such quasi-private organizations as ET. It would also have to liaise with development partners, private vendors and contractors that may supply, install and assist in funding the servers and the organization of the data that would sit in them.

Figure 23: mHealth Digital Ecosystem



- Collaboration Layer:** The most protected layer, the collaboration layer is a neutral layer comprised of the infrastructure necessary to connect end-users and project managers to applications and

solutions provided by an ever-growing list of developers. The major players in this layer would be the administrator, telecommunications network operator(s) and other network owners. In the case of the FMOH mHDE, the major players would be the FMOH (or its designee), ET and MCIT. EEPCo would be a minor player.

While ET would provide access to its CDMA, GSM and fiber network, MCIT would provide access to *WoredaNet* and interoperation with other e-government networks that may become relevant. ET's and MCIT's networks would become the core platforms upon which information would flow, with data-sharing occurring in the server clouds that reside in ET and MCIT data centers. These servers would link horizontally to the FMOH servers and would be vertically accessible to applications and solutions developers through keys and passwords provided by FMOH (or its designee), courtesy of ET.

Rules (algorithms and standards) that align with the Greentree Principles would be developed and applied to establish a neutral framework within which software and device developers can build applications and solutions that consumers can use. Each application and solution would have to align with the rules and principles to successfully integrate into this neutral layer. The rules would not only qualify applications and solutions, they would also qualify end-users, linking them according to the needs and wants stated within their profiles. It is through this neutral layer that all applications, solutions and end-users would find and make use of one another.

Again, the administrator would liaise with development partners, private vendors and contractors that may supply, install and assist in funding the missing components and integration of the neutral collaboration framework layer.

- **Applications Layer:** The least protected layer, the applications layer is a development layer that houses all the applications, solutions and projects that may be of interest to end-users.

The end-users could be HEWs, volunteer team members or community members. The end-user could also be a developmental partner, such as UNICEF, that may want to integrate several applications to implement a project in, for example, the Afar region. The end-user could equally be an Ethiopian student in the Addis Ababa Public Health program who has a great idea for a project she wants to implement, but does not know how to code and finds the appropriate application on the FMOH Application database, using her mobile phone.

Applications would include the Health



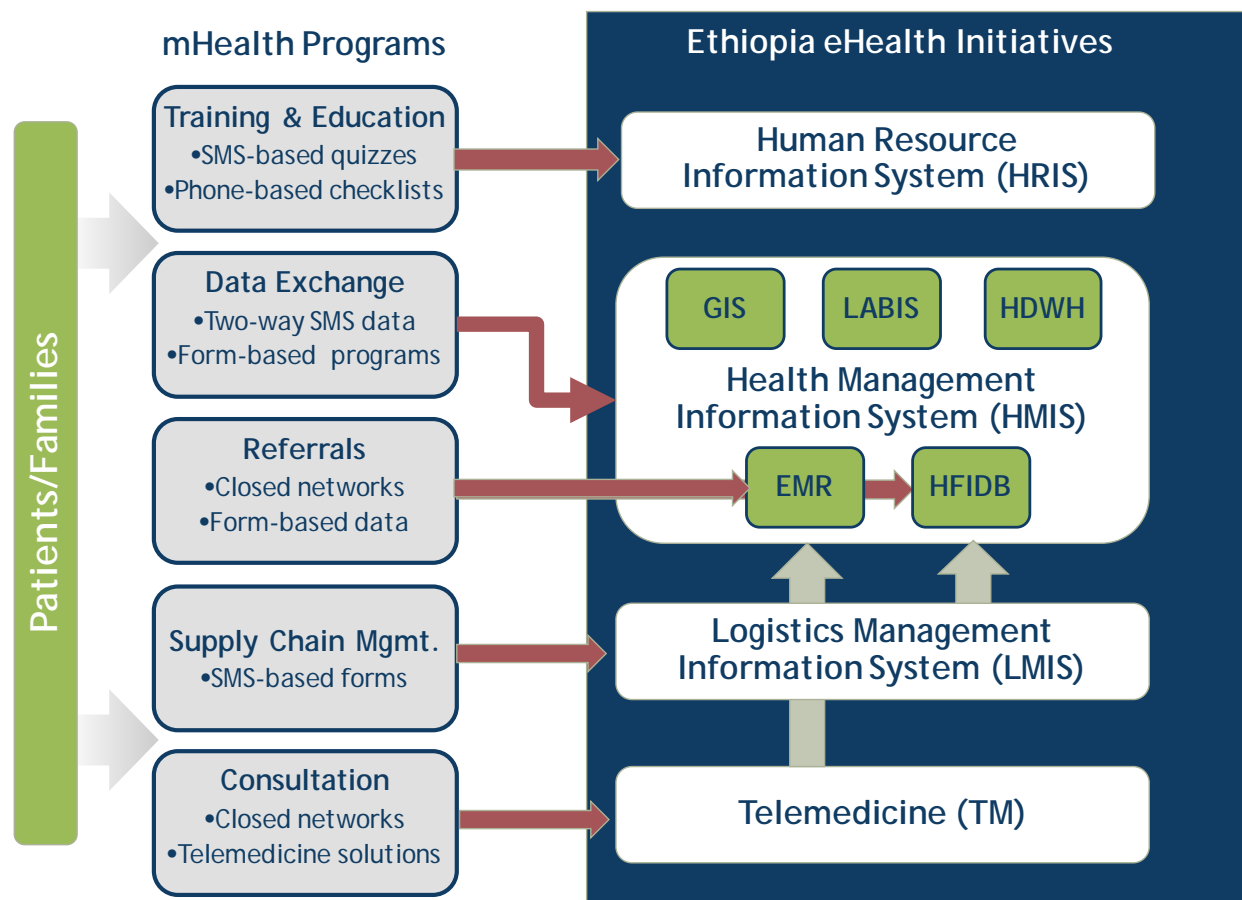
Information System suite that the FMOH currently has, including HMIS, EMR, HRIS, GIS, TM, HDWH, LMIS, LABIS and HFIDB. More importantly, the layer would also invite applications that address the five key areas of information and communications needs faced by HEWs as they attempt to deliver MNCH services in Ethiopia's *kebeles*. These areas are: referrals, consultation, training and education, data exchange and supply chain management. Software and device developers would be able to submit applications and solutions they believe address these needs. The relevance of the submissions would then be ranked based on their adherence to the rules and principles framework, and the applications and solutions would be made available to project developers accordingly.

For the applications layer to succeed, it needs ubiquity and should be populated by many applications, solutions and projects created by many developers, each competing for the attention, time and money of end-users. Survival of the fittest is the rule in this layer because end-users will only use an application that adequately addresses their needs and wants in a balanced manner. The applications that generate critical mass will find critical appeal and financial support. Some may even become valuable enough to command a fee for use. On the other hand, applications and solutions that do not generate critical mass will dissipate.

## mHealth Supporting eHealth

In the system described above, mHealth applications exist not just as standalone solutions to the needs of HEWs and the communities they serve. Rather, because they align with rules established in the collaboration layer, they can feed into the larger eHealth structure of Ethiopia and can extend that structure into rural or remote areas where the backbone of the eHealth system – computers, servers, technical expertise – does not reach. The graphic below depicts the way in which the mHealth programs cited earlier can feed into and support the larger eHealth programs taking root in Ethiopia today.

Figure 24: mHealth Supporting eHealth



In this scenario, data collected from patients and families using mHealth applications flows into the larger eHealth ecosystem, enabled by the rules and parameters of the collaboration layer. For example, the reach of telemedicine solutions that are today limited to a relatively small number of facilities could be expanded by enabling the capture of photos or even video using mobile devices used by HEWs. Similarly, patient data captured using mHealth applications for data exchange would flow into Ethiopia's revamped health management information system (HMIS), resulting in electronic storage and transmission down to the health post level. The potential for mHealth solutions to extend the reach of these eHealth initiatives is one of the main arguments for pursuing them, and means that compliance with collaboration layer rules and guidelines is especially critical.

# The Way Forward: A Path to Sustainable mHealth Interventions

The findings of the previous sections suggest that there are several main components in an mHealth framework that will move Ethiopia toward scalable, sustainable mHealth interventions that make an impact on health outcomes. These components are:

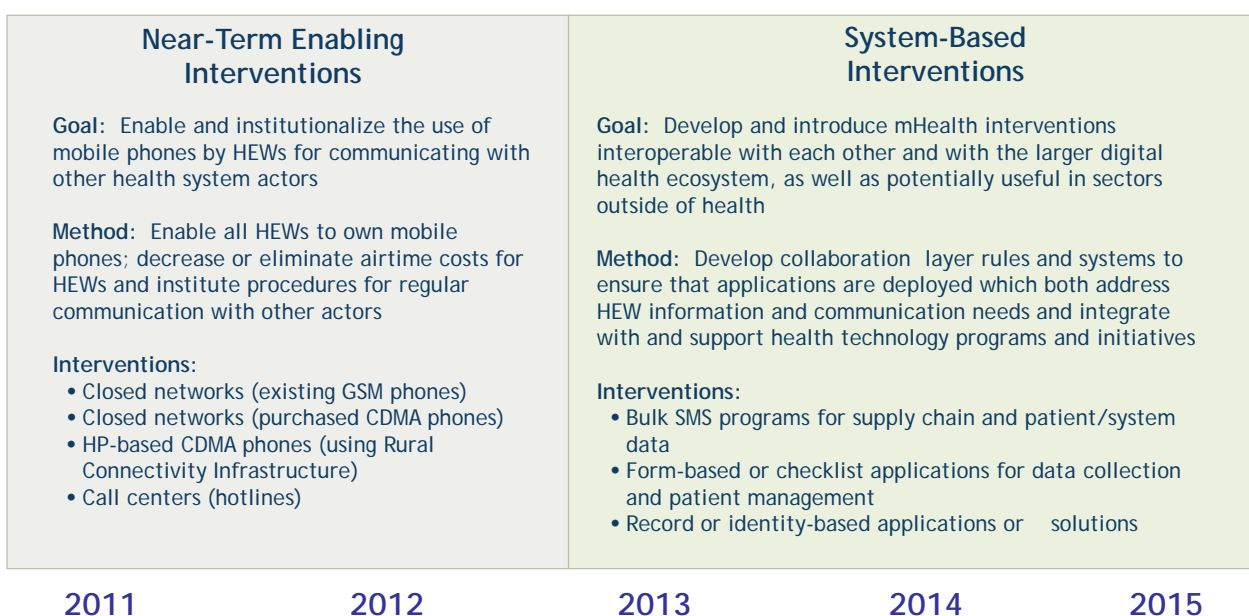
- **A multi-phase approach:** Given that certain conditions increase the likelihood of mHealth success, the deployment of mHealth applications, solutions and platforms in the Health Extension Program would begin with HEWs, the group that demonstrates attributes like mobile phone ownership, literacy and the ability to adapt to change. Subsequent phases would target community team leaders or volunteers and members of the general population.
- **A structure that matches HEW needs with appropriate interventions:** Interventions must both address HEW information and communication needs and use appropriate technology and communication. An understanding of the intervention attributes needed in each area will allow decision makers to select mHealth interventions that have the best chance of succeeding.
- **A digital ecosystem framework to ensure mHealth integration into the Ethiopian health system:** Just as HEWs form part of a larger health system structure, mHealth interventions will occur within the context of a greater technology infrastructure. Because of this, mHealth interventions must be designed according to principles that ensure harmonization with other technology programs and initiatives, especially since these interventions may interact with or impact those initiatives.

Once these components are in place, decision makers can begin moving forward (or allowing their partners to move forward) with mHealth implementations. Yet the findings in this report make it clear that there are many applications, solutions and projects that can address HEW information and communication needs, as well as those of other health system actors. How can the government of Ethiopia decide which to begin with? In considering this question, it is helpful to divide mHealth interventions into two major categories:

**Near-term enabling interventions:** These interventions are aimed primarily at increasing access to mobile communications for HEWs (or other health system actors). They facilitate more rapid and regular communication between actors and may impact health outcomes by easing bottlenecks caused by lack of communication. Such interventions would decrease or eliminate the cost of communication by allowing free or reduced-rate calling and they would also institutionalize communications procedures to ensure that once access is increased, it is used. An example of near-term enabling interventions in Ethiopia would be the creation of closed networks, either using HEWs' current GSM-standard phones or newly-purchased phones that operate on the more widely-available CDMA network, allowing HEWs to communicate with their supervisors and health professionals at health centers. The installation of fixed-base CDMA phones at health posts (which leverage the Rural Connectivity Program infrastructure) would also qualify as a near-term enabling intervention, as would toll-free hotlines that connect HEWs with call center-based professionals. Near-term enabling interventions are a critical first step because they are relatively simple and they institutionalize the use of mobile phones as a work tool. They also allow for collecting further data about HEW attitudes and habits regarding mobile devices, which can then be used as inputs for system-based interventions.

**System-based interventions:** While near-term enabling interventions focus on introducing and solidifying the role of mobile devices for HEWs, system-based interventions seek to go beyond addressing immediate HEW needs to integrate information collected during the course of worker duties for use in the greater digital health ecosystem. This characteristic makes them more sophisticated and potentially increases their impact on health outcomes, but it also requires that each of them is developed in such a way that it is interoperable with other health technology programs and systems. This in turn necessitates a robust collaboration framework that can pull information from these applications and inform wider health system actions. Strict adherence to collaboration framework rules is thus a requirement for these interventions. Bulk SMS programs or form-based applications used for supply chain management or data exchange fall into this category, because they touch on wider health system considerations. Record or identity-based solutions are the most fundamental system-based intervention because they mobilize information for use in responding to patient, worker and facility needs.

**Figure 25: Near-term and system-based mHealth interventions**



This phasing brings several benefits. It allows Ethiopia to move ahead with relatively simple interventions that will demonstrate the ability of mobile technology to empower workers, while providing a source of data and time to create the more robust ecosystem required to reap the full benefits of more sophisticated implementations. It also prevents a “cafeteria” approach in which interventions are selected or implemented in isolation, without regard to the larger system implications of such choices.



## Conclusions and Next Steps

This study has highlighted the areas in which mHealth interventions could make a difference in not only the performance of Ethiopia's Health Extension Workers, but also on the health outcomes of millions of Ethiopian people. It also identified some of the key attributes and requirements of successful interventions, as well as the elements of the larger environment and ecosystem that need to be in place to support them. The next step is to distill some of the frameworks created here into a set of practical guidelines that will inform the introduction of specific mHealth applications or programs in the Ethiopian HEP.

Before doing so, it is useful to reiterate some of the main conclusions of what has been presented in this paper, which have implications for the guidelines and tools that accompany the report.

**Non-technology processes and systems are critical:** Technology interventions attract attention because of their potential to improve efficiency, but it is important to remember that technology is a tool, not a cure-all for poorly-designed systems. In order for an mHealth intervention to succeed, it must be introduced into systems that have been optimized from an organizational and operational perspective. Ethiopia has recognized the importance of this in its business process reengineering (BPR) initiatives. Technology can be a part of such a process, but if overlaid onto a faulty system, it will not solve problems.

**Successful interventions match needs with conditions:** Programs or interventions must be designed to address a specific set of needs, but they must also be adapted to the conditions in a particular environment. In Ethiopia, this means targeting mHealth interventions to the appropriate group (HEWs, initially) and in the appropriate geographic locations (those *woredas* and *kebeles* with a minimum standard of mobile reception and electricity access).

**More advanced applications bring both greater sophistication and greater cost:** mHealth solutions with a variety of capabilities and functions may help to address multiple needs, but they may also increase costs, not only from a device or airtime perspective, but also from a training, administrative and organizational standpoint. In order to ensure sustainability, a thorough assessment of all of the costs (and returns) associated with an mHealth intervention must be conducted.

**Designing with the larger digital ecosystem is essential:** New mHealth programs can have a major impact on the processes and procedures in the health system, and their ability to solve problems can be compromised if they are not compatible with existing or planned technology initiatives in the health system. In order to ensure that they are, clear principles and guidelines must be provided and adhered to so that mHealth interventions have the opportunity to scale and succeed.

The findings and conclusions contained in this report can serve to evaluate the programs and interventions that the FMOH and its partners wish to pursue, through the creation of guidelines that adhere to the principles, conditions and parameters outlined in the previous sections.

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