Fourth and Final Joint Technical Reporting up to July 31st 2017

Applied research on Health Extension Workers using eHealth to strengthen equitable systems in Southern Ethiopia health

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Acronyms

ANC	Antenatal care
BoFED	Bureau of Finance and Economic Development
FMoH	Federal Ministry of Health
GEHS	Governance for Equity in Health Systems
GZHD	Gedeo Zone health department
HEP	Health Extension Program
HDA	Health Development Army
HEW	Health extension worker
HMIS	Health Management Information System
HSTP	Health Sector Transformation Plan
IDRC	International Development Research Centre
LSTM	Liverpool School of Tropical Medicine
MH	Maternal Health
MCH	Maternal and Child Health
MoST	Ministry of Science and Technology
MoU	Memorandum of Understanding
PHCU	Primary Health Care Unit
PNC	Postnatal care
PWF	Pregnant Women Forum
RHB	Regional Health Bureau
TB	Tuberculosis

SEARCH	Strengthening Equity through Applied Research Capacity building in eHealth
SZHD	Sidama zone health Department
SNNPR	Southern Nations, Nationalities and Peoples' Region
WoHO	Woreda Health Office
ZHD	Zone Health Department

1. Executive summary

Executive summary:

In 2004, Ethiopia launched its flagship community based health program known as the Health Extension Program (HEP) to improve access to primary health service. The HEP run by female community health workers referred to as Health extension workers (HEWs) are recruited from the local community and trained for one year to provide community based services in 16 health extension packages. The Ethiopian Ministry of Health is also pursuing m-health goals and has launched an m-health strategy providing a framework for action.

The implementation research project is a collaboration between REACH Ethiopia, Sidama Zone Health Department (SZHD) and the Liverpool School of Tropical Medicine (LSTM) with the aim assessing the feasibility and effectiveness of using eHealth to strengthen equitable health systems and related governance processes through inter-package linking and integration into the existing HMIS in Southern Ethiopia with a focus on the priority areas of maternal health and tuberculosis.

The project was conducted in Sidama and Gedeo zones in Southern Ethiopia with Sidama zone being the intervention zone and Gedeo the control zone. The project was implemented in six Primary Health Care Units (PHCU) based in six districts, works closely with and is implemented by HEWs, their supervisors, health workers based at the catchment health centers and policy makers at woreda health office and zonal health department. We began with a mixed method quantitative and qualitative baseline. Prior to the project there was no m-health systems in place. The baseline analysis was conducted in the intervention and control zones and revealed many challenges with the HMIS system in its current form (tedious, time consuming and slow) and showed that different health providers were knowledgeable about mobile phone use and its challenges, had less experience with

m-health but were willing to learn. The baseline findings fed into the development of the intervention at all levels. In summary the intervention included:

1. The development, design and launch of an eHealth system
2. Distribution of smart phones and computers within the 6 districts
3. Training and sensitization of the different health workers involved – HEWs and their supervisors and district heads and ongoing communication and problem solving at different levels of the health system for example through a technical work group, district level meetings, catchment based review and meetings with HEWs.
4. Ongoing supervision and communication

The success and impact of the intervention was assessed through mixed method process evaluation. In summary, the eHealth system was successfully established through training and engaging HEWs, supervisors, HMIS focal persons and policy makers to use the data. Over 60 female health extension workers were trained. Data can be collected in real-time and is accessible throughout all levels of the health system. This has helped create stronger links with policy makers for action. Over 200,000 rural women and men benefit from improved health services. From a baseline of no use of m-health technology, the projects impacts include: Over 5000 pregnant women being registered on the system with HEWs receiving 2700 alert messages, and over 1600 TB patients registered with HEWs receiving 500 alert messages. The project has supported the timely flow of more accurate information and reduced error margins and duplication of data; it has improved HEWs skills set and means they can readily respond to clients' needs and follow up in a timely and efficient manner; strengthened decisions making and accountability and improved institutional delivery performance. The qualitative process evaluation which specifically focused on the gendered experiences of HEWs and the technology and revealed that the technology presents an opportunity for female HEWs to upgrade their skills, feel more knowledgeable and confident in their work and participate more in woreda level meetings. They are proud of the technology and suggest that it is rolled out across all 16 essential health packages and distributed to all HEWs in order to streamline the work load more effectively for all health posts.

The project's processes and impacts have been presented at meetings at different levels of the health system where it has been positively welcomes and the impacts appreciated. Other districts have expressed interest in also using the eHealth system. Some of the main challenges identified include network connectivity and loss of mobile phones which lead to discrepancies between paper and server reporting – as well as power failures and differences in the place of registration of pregnant women. In terms of future sustainability discussions are underway including with *policy makers and Ethiopian Telecommunication Authority to* transfer the CommCare based platform to Ethiopian Telecom and identifying resources to scale up and including in the HMIS system and Health Information Transformation Plan.

The project has also been successful with respect to capacity building: 2 PhDs are linked to it (1) Aschenaki Zerihun' s PhD on maternal mortality within Sidama; and Rosie Steege's PhD on gender and close to community providers – which has a case study on gender, technology and HEWs. In addition. Mr. Dawit from FMoH undertook his masters on computer science linked to project and was also part of the team who developed the HMIS at the MoH. As a team, we have written up our findings as peer reviewed literature and presented them at Health Systems Global in Vancouver and at the linked IDRC meeting within Vancouver.

In conclusion, the implementation research process has successfully developed and implemented an eHealth system which has improved the timeliness of data flow and the responsiveness and impact of the health system. Female Health Extension Workers in Ethiopia play a critical interface role between the health systems and rural communities. Providing them with mobile phones and a responsive eHealth system has enabled this importance cadre of health worker to use new technologies and build skills that are positively impacting on community health.

2. Introduction

In 2004, Ethiopia launched its flagship community based health program known as the Health Extension Program (HEP) to improve access to primary health service. The HEP run by female community health workers referred to as Health extension workers (HEWs) are recruited from the local community and trained for one year to provide community based services in 16 health extension packages.

In 2012, the Ministry of Health (MoH) of Ethiopia developed an m-health strategy providing a framework for action: eHealth interventions that could improve the effectiveness of HEWs' primary health care service provision. Currently under the Health Sector Transformation Plan (HSTP), the country is working towards improving health information to improve data quality, data capturing and data use at the community level through improving data capturing mechanisms.

SEARCH is a collaborative research project undertaken by researchers at Sidama Zone Health Department (SZHD) in collaboration with the Liverpool School of Tropical Medicine (LSTM) and funded by the International Development Research Centre (IDRC) through the Governance for Equity in Health Systems call for applications (SEARCH project).

The research aimed to assess best approaches for HEWs to use eHealth to strengthen equitable health systems in Southern Ethiopia, using the government's service integration strategy for its emerging eHealth needs. We have used an implementation research approach to work in partnership with the HEWs to build capacity and more effectively link them to the wider health system, strengthening the reach of services and thereby equity. LSTM has supported SHZD in baseline data generation process, establishment of an eHealth data collection system, implementation and review of the project progress.

The eHealth system focuses on tuberculosis (TB) and maternal health (MH) programs as both programs are the priority areas in Ethiopian health system. The project has been implemented where pre-existing working relationships with HEWs and experience within the health system are in place. Our approach supports Ethiopia's health priorities and the delivery of the HSTP which focuses on information revolution to improve data generation capacity and use at the community level.

We used process evaluation and mixed methods approaches to assess the effectiveness of the eHealth data collection system. The outputs/outcome of the eHealth system was assessed using the information collected for baseline and end-line data. The processes followed during the intervention and the influence of context was explored in depth to generate lessons for scale up to include other health interventions.

This final report presents the activities carried out over 36 months, covering the time period from December 2, 2015 to 1 August 2017. Appendix one contains an overview of the key performances and milestones of the project through time to provide easy reference. In the report, we begin with an overview of the research problem and the aims and objectives of the project. Then we present our approach at baseline, and the key findings. Then we are able to discuss the intervention design in light of these findings before presenting the methods of, and findings from the process evaluation. This demonstrates progress to date and highlights the different strategies and approaches we have utilized to ensure smooth running of the project (including regular engagement with government representatives, working in technical working group, regular support supervision, collaborative catchment meetings and community based awareness and follow up). The final section of the report outlines, from both a regional and international stance, research uptake (capacity building successes of the project), communication (including ongoing engagement and collaborations) and finally a discussion of the sustainability of the project.

3. Aims and Objectives

The context: The HEWs work at health posts based in Kebele (the smallest administrative unit). Two HEWs are assigned in each *kebele* with an average population of 5,000 people (about 1000 households). The HEWs devote 75% of their time to making house-to-house visits. Ethiopia has benefited from the HEP; however, it is still a long way from delivering universal coverage. MH and TB are included in the sixteen packages delivered by HEWs and are both key national priority areas. Improving maternal health outcomes and TB control requires early identification, linkage to facility-based services, follow-up and an improved reporting system whereby local data collection can be acted upon to support service delivery to those most in need.

The existing health information management system (HMIS) depends on paper based reports, transported from health posts to health centers, districts, zones and finally to the region. The routine reporting system faces multiple challenges: delays, incompleteness or inconsistency of data; inadequate data collection tools and monitoring system leading to poor documentation compounded by under-utilization of existing data hindering prompt and responsive action. The data collection system is limited and not accessible to those who need it. There is limited collation, feedback and use of information in order to develop programs and approaches that are responsive to local context.

Our approach: To address this problem, we worked in partnership with key stakeholders to use and adapt existing HMIS formats in the development of our model. The Ethiopian MoH designed an m-Health strategic framework to improve HMIS to provide better health services. Our eHealth system is embedded within this strategic framework, which provides an important facilitative policy backed up for innovation with electronic data systems. The framework discusses how HEWs, being the first port of call for remote populations, should be the driver for the first m-Health roll out phase.

SZHD (REACH Ethiopia) in collaboration with LSTM worked with HEWs to use mobile technology in TB case finding and management (through TB REACH Grants). Within TB REACH, HEWs used mobile phones to contact field supervisors and report that they prepared smears to collect the slides; field supervisors then collect the slides to the laboratory for examination (Yassin *et al.* 2013[1]). The approach has showed a doubling in case finding, improved case holding and reporting. This and other examples suggest that rapidly changing technological contexts are an opportunity for health services at local level to improve data transmission and strengthen equitable health systems in rural areas, improve quality of care and could be potentially scaled up to other national health priorities.

In the SEARCH project, we introduced an eHealth system (with a focus on maternal health and TB) to be used by HEWs in Sidama zone south Ethiopia, and assessed its potential to build a more gender equitable health response embedded within local context. The project has been implemented and monitored within the framework of the MoH to improve the HMIS and the use of data in decision-making, to improve equitable health service delivery. The project is particularly interested in the gender and equity aspects of the experience of HEWs in using new technologies in their role and the gendered experiences of HEWs and their interactions with communities and others in the health system (e.g. supervisors is being explored). **The aim of the research was as follows:**

"To assess the feasibility and effectiveness of using eHealth to strengthen equitable health systems and related governance processes through inter-package linking and integration into the existing HMIS in Southern Ethiopia"

Specific objectives

1. To assess the feasibility of HEWs using eHealth within their core duties initially with a specific focus on TB and MH
2. To work with the HEWs, their supervisors and other HMIS users and decision makers to establish, analyze and periodically refine an eHealth system

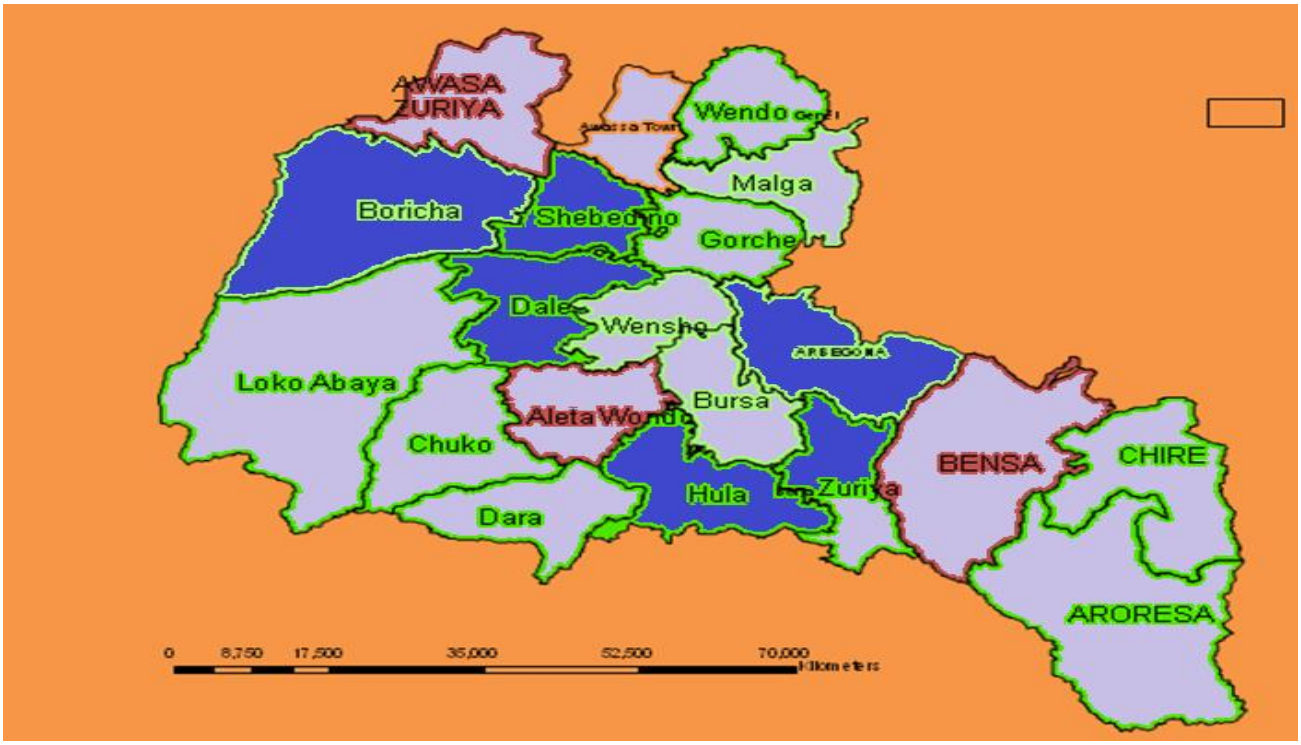
[1] *Yassin M, Datiko D, Tulloch O, Markos P, Aschelew M, Shargie E,Dangisso, M. Komatsu, R. Sahu, S. Blok, L. Cuevas, L.* ***Theobald, S.*** *(2013) Innovative community-based approaches doubled tuberculosis case notification and improve treatment outcome in Southern Ethiopia.* PLoS ONE. *Vol 8, Issue 5, e63174.*

3. To strengthen the culture of data use among HEWs using a system of prompt and responsive M&E and feedback established in the existing HMIS
4. To strengthen capacities among HEWs and HEW supervisors to use the eHealth system and the data contained within it; health systems researchers through graduate level training; and decision-makers to manage and use the system for planning and resource allocation.
5. To evaluate our approach within the Sidama Zone context and make recommendations about how to use eHealth to support HEP HMIS and strengthen equity, participation, accountability and transparency.

4. Study Setting

The project was conducted in Sidama and Gedeo zones in Southern Ethiopia with Sidama zone being the intervention zone.Sidamazone is one of the most densely populated zones in the Southern Nations Nationalities Peoples Regional State (SNNPRS) with a population of about 3.7 million which accounts for about 20% of the regional population. The zone has 19rural districts and 4 town administrations. There are currently 525 health posts, 127 health centers, 3 zonal and 8 primary hospitals providing health services in the zone. The SNNPR regional health bureau is based in Hawassa which is both the capital of the region, as well as the Sidama zone and works in collaboration with the zone in implementation of projects. The project is implemented in six Primary Health Care Units (PHCU) based in six districts, works closely with and is implemented by HEWs, their supervisors, health workers based at the catchment health centers and policy makers at woreda health office and zonal health department.

Gedeo zone (control zone) shares a border with the Sidama zone which shares similarity with Sidama zone in terms of health system functionality, topography and population density. The study sites were selected to capture diversity in geography (distance from zonal headquarters, topography, health service coverage and utilization, population density, and general socio-economic conditions). Three districts from the intervention zone and one district from the control zone were selected.



Map of Sidama Zone: The intervention zone and districts involved (districts highlighted in blue are the intervention districts, the red highlight denotes the control districts).

5. The situation before the study

Prior to the project implementation, community based early-pregnant women identification and linking to care was conducted on a very limited scale and TB case finding was carried out by HEWs. There was no use of mobile to capture date for both health programs for presumptive TB, detected TB and pregnant women in the community prior to the project implementation. **Due to this, there were no presumptive TB, confirmed TB cases and pregnant women registered using eHealth system.**

№	District	Health Center	Population	Number of health posts
1	Arbegona	Bochesa	29410	6
2	Bona Zuria	Worancha	39,031	7
3	Boricha	Yirba	33,076	5
4	Dale	Mesenkela	30,182	4

5	Hula	Teticha	23,746	5
6	Shebedino	Dulacha	38,141	4
	Total		**193,586**	**31**

Table 1. Profile of project implementation districts

6. Baseline data collection methods and results of the findings

Introduction to the mixed methods baseline analysis

Data collection was undertaken using a mixed methods approach. The application of both quantitative and qualitative methods is useful in understanding complex research issues. The main methodological focus, however, was qualitative in order to capture the perceptions and experiences of different purposively sampled participants and how they are shaped by context. Data were collected from policy-makers and health service providers in the health facilities: HEWs from health posts (HPs) in the community; Health Centre Heads (HCH) for TB, MCH and HMIS; District Health Officer (DHO) TB, MCH and HMIS leads; Zonal Health Department (ZHD) representatives; and Regional Health Bureau (RHB) HMIS Officers.

The aim of the baseline was to "Assess the feasibility of HEWs using eHealth within their core duties with a specific focus on tuberculosis (TB) and maternal & child health (MCH) to inform a situational analysis". The specific research objectives which were met through deploying a combination of qualitative and quantitative research methods are as follows:

1. Establish understanding of core role of HEWs and perceived health impact for their community with a specific focus on TB, MCH and gender
2. Explore current modes of communication utilization, advantages and challenges across the health system
3. Discuss the existing role of data, relationship with health management information system and performance management perceived by HEWs, HCH and RHB
4. Compare and contrast awareness, knowledge, perceived benefits and challenges of eHealth across the health system
5. Inform future planning, resource development and interventions to strengthen equitable health systems

Approval of Ethics for baseline

Ethical approval for the baseline was given from the Federal Democratic Republic of Ethiopia (FMoH), Ministry of Science and Technology (MoST), National Research Ethics Review Committee in April 2014. Anonymity of participants is ensured through not publishing any personal data (name, age, specific work location) which might allow the identification of individuals. Confidentiality of the data is maintained through storage on password protected computer systems and personal password protected accounts.

Quantitative Approach

Methodology

Quantitative data were collected through a face-to-face questionnaire developed by REACH Ethiopia and LSTM; one generic questionnaire was developed for all participants (n = 57) with three supplementary questionnaires for HC (health centre) leads in antenatal care (ANC), TB and HMIS. Quantitative research involved collecting demographic data, knowledge of eHealth, technological skills, use and capacity (mobile phones and computers), skills of reporting and HMIS.

In addition we conducted review of records in Sidama Zone health posts (intervention area – see Table 1); Gedeo Zone health posts (control zone, see Table 2) and in Sidama zone health centre (intervention area – table 3) and in Gedeo zone health centre (Control area – see table 4). This was done by reviewing and analysing records either at the health post or centre or through taking copied records back to the main office.

Participants

Participants included within the baseline quantitative study were required to be:

- HEWs from health posts
- HC TB, MCH and HMIS focal persons
- District Health Office TB, MCH and HMIS focal persons

Informed consent was obtained from all participants before the start of the interview. Participants signed a consent form, which was also signed by the researcher, and each party kept a copy.

In total, 57 participants were recruited to the study; their details are displayed below, and also presented as an infographic below the table.

Individual Quantitative Interviews Site

Health Facility Type	Control zone	Intervention zone	Total
District Health Office (HMIS, TB and Maternal Health focal leads)	3	9	12 (21%)
Health Centre (HMIS,TB and Maternal Health focal leads)	3	24	27 (47%)
HEWs	2	16	18 (32%)
Total	**8 (14%)**	**49 (86%)**	**57 (100%)**

Table 2. Participants of quantitative interview from control and intervention zones

Qualitative Approach

Methodology

Data was collected from 16th February to 13th March 2015. Two qualitative interview topic guides (Appendix 7) were developed by SZHD in collaboration with LSTM team to explore feasibility of HEWs using eHealth within their core duties with a specific focus on tuberculosis (TB) and maternal and child health (MCH). One topic guide was for individual interviews and focus groups with HEWs. The second

topic guide was for individual interviews with Health Centres, District Health Officer, Zonal Health Department and Regional Health Bureau

Qualitative methods included face-to-face semi-structured interviews (n = 10) and focus group discussions (FGD) (n = 3). Two qualitative interview topic guides were developed by the SZHD in collaboration with LSTM. One topic guide was for individual interviews and focus groups with HEWs. The second topic guide was for individual interviews with HC, DHO, ZHD and RHB representatives.

Questions concerned background and role of the HEWs, length of service, communication (advantages and challenges), HMIS (components, application, reporting, structure and challenges), performance management and eHealth (knowledge and feasibility) were included in the topic guides. The interview topic guides were piloted by the data collectors and refined further.

Three researchers who have experience in qualitative research, conducting interviews and focus group discussion attended training on familiarization workshop with topic guides in the interview topic guides and key terms used in this study. The field director of REACHOUT project, who has extensive experience in qualitative research participated in conducting the training. Interviews were conducted at health posts, health centres and woreda health offices within private areas to avoid distraction during the interview. Majority of participants of focus group discussions were able to express their ideas freely and facilitators encouraged quieter participants to participate.

Interviews lasted between 50 and 70 minutes. Focus group discussions lasted between 210 to 265 minutes. Interviews were conducted in the office of the field staff where convenient or an alternative quiet place and convenient time for interview was arranged. Focus group discussions were conducted in the districts and offices central to the interview sites, transport was arranged and meeting place was organized by the team leading the interview. Lead interviewers were supported by the assigned person ensuring the successful completion of the topic guides and making sure that points that needed probing were well probed by the interviewers.

Interviews were recorded using digital Dictaphone devices.

Participants

- Gedeo Control Zone – 1 district Wonago

- Sidama Intervention zone – 3 districts Bensa, AletaWondo, Hawassa Bona Zuria

Participants included within the baseline qualitative study were required to be:

- HEWs
- Health Centre heads
- District health office heads
- Regional health office HMIS Officer
- Zonal Health department head representatives
- General health workers

The interview process

Participants signed a consent form, which was also signed by the researcher, and each party kept a copy. All of the qualitative research was undertaken by experienced researchers from REACH Ethiopia who have used interviews and FGDs within the similar contexts previously. Firew Hanke, Nega Teyike,Tadesso Mamo conducted the interviews in the respective field sites and data was transcribed by Nega Teyike and Tadesse Mamo and then translated.

	Individual Interview		**Focus Groups**	
Health Facility	Control	Intervention	Control	Intervention
Regional Health Bureau	NA	1	NA	NA
Zonal Health Department	NA	1	NA	NA
District Health Office	1 Wonago	1 Bensa	NA	1(n=8) Bensa
Health Centre	1 Wonago	1 Bensa 1 AletaWondo	1(n=6) Wonago	1(n=8)AletoWondo 1(n=7)HawassaZuria
Health Post	1 Wonago	1 Bensa 1 AletoWondo	NA	NA
Total	**3**	**7**	**1(n=6)**	**3(n=23)**

Table 3. Showing number of participants recruited form intervention and control zones

Data Analysis

The recordings of the interviews were transcribed verbatim by the data collectors and consequently translated to English by experienced researchers who were not initially involved in data collection. The quality of translation was checked using sample transcripts.

Transcripts were read and re-read by SZHD and LSTM researchers, informing the development of codes for analysis, identifying emerging themes and areas for further exploration. Transcripts were uploaded to transcription software NVIVO and a coding framework developed in a face-to-face meeting of researchers. Initial coding was undertaken as a group activity for two days. The transcripts were then divided and the SZHD and LSTM teams continued to code separately. Through a virtual meeting, a list of prominent emerging themes was identified.

Baseline Results

Multiple themes relating to the feasibility of HEWs using eHealth within their core duties emerged from the interview data. All the themes emerging from the data are compiled as shown below.

Themesemerging from the interview data conducted with HEWs, District Health Office, Regional Health Bureau, Sidama Zone Health Department	
HEW role and duties	Health System – structure and relationships
HEW impact – mortality/morbidity, individual/community, awareness/utilisation	HMIS – role of data
HEW service	HMIS – advantage, challenges, solutions
HEW commitment	HMIS – inputs, outputs, outcomes
HEW training and education	HMIS – performance management
HEW & gender	Communications
HEW challenges	eHealth – awareness, knowledge, benefits, challenges
HEW motivation	
HEW workload	
HEW supervision and feedback	

Table 4: showing the themes that emerged from the baseline data collection

Perceived roles and responsibilities

All HEWs interviewed reported and emphasized that their main role is to effectively deliver, monitor and evaluate their performance in delivering the 16 health packages:

"Besides teaching sixteen health packages, we monitor or follow up the practice or application of what the society has learnt". (HEW FGD Implementation Zone)

Commitment of HEWs

The inspiration of the HEWs comes from perceiving health outcomes they observe within the community, which consequently impact the HEWs' commitment to deliver the services expected from them by the rural communities.

"I have served ::: I have noticed changes up on the society and by myself. This inspires me to serve them more". (HEW FGD Implementation Zone)

Their commitment and inspiration prevails despite the challenges they face related to the topographic barriers, communication difficulties, inadequate supervision, and juggling their role with commitments at home and in the family.

Current modes of communication within the health system

Communication emerged as a strong theme from the quantitative and qualitative data across the range of professionals. Key subthemes were related to mode of communication, with a large focus on mobile phones – factors involved with their use, including the advantages and the challenges (Table 1). All HEWs (n = 18) completing the quantitative questionnaire had access to a mobile phone. Mobile phone communication was valued and used by HEWs for enabling clients to access health facilities, co-ordinating care, sharing information with colleagues and offices, and obtaining resources. Most HEWs (n = 16) reported sending two or more SMS per week for general communication. However, two HEWs reported not knowing how to send a text.

The majority of HEWs (94%, n = 17) were unable to use Internet via mobile phone. Mobile phone communication was perceived by one HEW as contributing to the prevention of maternal and child mortality.

"Labouring mothers call us in the midnight and we soon call ambulance. Hence, it is very useful to save lives of mothers in problem". (HEW FGD Implementation Zone)

It was also perceived by many professionals as a method of sharing information urgently, effectively and efficiently between colleagues and officers.

The baseline analysis from the intervention and control sites was reported previously and presented during the Canadian Conference for Global Health in Montreal and has been written up as follows:

John N. Dusabe-Richards, Hayley TeshomeTesfaye, JarsoMekonnen, Aschenaki Kea, Sally Theobald, Daniel G. Datiko, **Women health extension workers: Capacities, opportunities and challenges to use eHealth to strengthen equitable health systems in Southern Ethiopia ,** Can J Public Health 2016;107(4-5):e355–e361, doi: 10.17269/CJPH.107.5569

7. Learning from the baseline: key issues and implications

Based on analysis of the mixed method baseline research and joint discussion across the SEARCH team we have highlighted the following areas as important for the future of the SEARCH project.

HMIS – current challenges

The HMIS was seen as important and our qualitative research revealed that HEWs mainly see the benefits of HMIS as providing the ability to organise and access information to provide health services effectively for their clients. In contrast, the Health Professionals, Woreda Health Office, Health Centre Heads and Zonal Health Department describe the benefits of a HMIS based on indicators, with a systematic reporting process for monitoring and evaluating activity, assessing outcomes and assessing HEW performance.

The baseline findings from all methods (the questionnaire, record review, and interviews and FGDs) revealed a number of challenges with HMIS in its current form. In summary these relate to information quality, accuracy, reliability and timeliness. Keeping multiple records – often in different formats – in paper form is challenging for HEWs, and some supervisors felt that some HEWs needed to be more committed to data collection. The multiple formats in a paper system was seen as tedious, time consuming and creates a large work burden and can lead to mistakes and inconsistences as observed in the record review process in both the intervention and control areas. An eHealth system if properly embedded and used could enhance the rigor, quality and timeliness of reporting and the responsiveness of the health system. There are however a number of challenges that need addressing to make this a reality.

Knowledge and experience of mobiles, technology and eHealth

Mobile phones were used regularly by all participants in the questionnaires and in the qualitative interviews. For example HEWs used mobiles for both personal and professional purposes for calls, texts, social media and emails although the majority had not used the internet on their mobile phones. HEWs use mobiles to stay in contact with communities including mothers approaching their due date. Beyond the use of mobiles for calls, a number of challenges and technical skills gap in technology use were identified. Most of the respondent's surveyed have limited experience of internet use, technology and eHealth in general although they expressed considerable enthusiasm to learn and improve health services. Compared to HEWs, health professionals had relatively more awareness and knowledge of EHealth and its benefits.

This has implications for training of HEW and their supervisors in terms of pedagogic approach deployed, time dedicated to training and opportunities for ongoing support. These issues will be taken into consideration when training is provided by the project to HEWs and their managers in the districts chosen.

Challenges with using mobiles

Both the qualitative and quantitative data sets reveal that network coverage and power sources are an ongoing challenge especially in rural areas. We have designed the eHealth system to ensure that it is possible to save data on the phone which can then be submitted once network coverage is

available, whilst also retaining records already submitted (this has necessitated the inclusion of Commcare).

Another challenge relates to concerns about having to pay to recharge airtime balance. This challenge is particularly faced by HEWs and has the potential to adversely affect their ability to use their mobiles in a responsive manner. Our project therefore will use a prepaid system, covered within the project budget, to cover the cost of SMS messages for HMIS use.

Challenges associated with TB and maternal health

TB and maternal health remain as key challenges in Ethiopia and constitute the focus of our eHealth intervention. The main challenges and problems that were revealed within these areas from the baseline include:

- Low coverage of skilled attendance at delivery in both control and interventions zones
- Loss to follow up of women from ANC – 1st to 4th
- Loss to follow up of people already on TB treatment

Data collected has added to the depth of understanding of these issues, and underlines the need for both consistency of reporting and use of data as well as appropriate patient follow-up methods. This project will assess how well these needs can be addressed by the use of the eHealth system.

8. The Intervention

Core components of the intervention

The intervention has been rolled out in the six districts of Sidama zone in Shebedino, Boricha, Dale, Hula, Arbegona and Bona-Zuria.

The key activities happening in the intervention sites are:

- Collect baseline data for intervention and control zone

  In consultation with key stake holders (which includes health program managers, experts working on HMIS, HEWs and community members), we collected baseline data. In depth data collection was carried out by considering into account diversity in terms of geography size and distance from zonal headquarters in order to better understand processes here and where the gaps and bottle necks are.
- Establish eHealth data collection

Based on the identified gaps, the need to collect data and mechanisms required to strengthen the existing HMIS, we in consultation with the key stake holders and established an eHealth data collection system in the intervention zone with the particular focus on TB and MCH

- Training and sensitization

  Awareness creation and sensitization workshops were conducted at zonal level at the start pf the project. The participants of this session were key stakeholders at district level and zonal level. The main focus of the session is about the project work, its importance and use for the community in improving the general health service delivery. This was followed by training of HEWs and General Health Workers (GHWs) on HMIS.

- Introducing eHealth system for MCH and TB

  Designing e-reporting formats for HEWs, adapting them to existing formats and the need for improvement of HMIS. It would generate issues for the decision making and improve the next data generation and utility. In addition, HEWs will be encouraged to do process data analysis to measure their performance, identify gaps and outlines ways forward based on monthly basis.

- Review of TB and MCH focused eHealth system

  The data generated through the new approach was reviewed against baseline data. We assessed its practical implementation in the community and used the lesson learned to improve HMIS.

- Improved eHealth stage; discussion, analysis and change

  This stage was based on the regular stake holder meetings, catchment based reviews carried at HC level which includes HEWs and HC managers and evaluation of the performance of the eHealth system. Analysis and changes done in consultation with different stake holders and are likely to include:- discussions of best ways and processes through which to respond to data generated at local level to respond to need and finding ways of adapting processes to go beyond TB and MCH to strengthen the equity of the broader health system in response to data identified.

- Review meeting and feedback

  The project reviewed the data from the intervention areas and compare this against baseline and with data generated. The review meeting focused on eHealth implementation and

improved eHealth stage which includes improving the eHealth to a more user friendly and focused on improving HMIS and the final improved eHealth stage findings.

- Develop website and health data base

  In order to have efficient health care information systems, the project has developed website and setup health database. The website and health database is meant to serve as a trial base whereby additional activities to strengthening the routine eHMIS is tested before it is made part of the eHMIS

Designing the eHealth intervention

For full detail here please see appendix 1.

- The intervention was designed /developed to function on the CommCare platform
- It was designed to have an easy to use interface that could be mastered with minimal training so it is accessible to the HEWs
- Unfortunately due to language limitations in the software it was only possible to develop in English not Amharic
- Main feature of the software is reminders messages sent to users to ensure they follow up with expectant mothers
- Designed to allow for poor internet connectivity in the region, the data is stored within the software & instantly uploaded to the cloud when in an area of connectivity
- This data is then immediately available to health system staff across levels

Distribution of mobiles and computers for eHealth Project

Cell phones were primarily given to HEWs, Woreda supervisors, MCH, TB and HMIS focal persons at zonal health department, woreda health office and HCs, as well as Heads of Zonal HD and woreda HO, who are involved in program delivery directly/indirectly.

In addition to the cell phones, Desktop computers have also been given to the Health Centers through the District Health Offices, for the purpose of data recording. The table below shows the distribution of the cell phones and computers.

S/N	Name of woreda/group	Item and amount	
		Computer	Cell phone
1	Shebedino	1	9
2	Boricha	1	12
3	Dale	1	11
4	Hulla	1	11
5	Arbegona	1	13
6	Bona-Zuria	1	12
7	Woreda Supervisors		6
8	Zonal Coordinators	2	3
9	Zonal officials		6
10	District Ho Heads		6
11	REACh HQs staffs		8
	Total	8	97

Table 5: Distribution of Cell phones and computers during reporting period

Ongoing support via REACH supervisors

The district field supervisors in the project areas have continued fully supporting the health system in effectively delivering maternal health service and TB prevention and control efforts which are fully captured via the eHealth system to improve its contribution to strengthen HMIS in the 31 health posts in the communities. The field supervisors ride motor bikesand are strategically positioned in the districts and work with the PHCUs contributing to health system strengthening and providing technical support to health service delivery in the districts.

Communication and problem solving across the different levels of the health system

For further detail please see appendix 2.

Technical working group meeting: strengthening partnerships for sustainability

We established a technical working group including experts from RHB, SZHD, telecommunication authority and experts working on TB, maternal Health and HMIS during the software development and evaluation. During this period, we have had program specific meetings with experts in the zone. This has increased understanding about the project and its contribution to the community. The HMIS team closely supports the data collection from the communities and received reports through the health system where they faced major issues with report quality and timeliness.

The introduction of mobile health has resulted in increasing accountability and reduced data inflation or over reporting as it provides real-time data from each community and to different levels (health post, health center, district and province). There is an interest to expand access to the data by administrators and regional team and we are working on this collaboratively to increase accountability and shared responsibility. From the meeting, feedback is given to the program managers and department heads to ensure continued support to improve challenges identified, share lessons learned and strengthen partnership

The project implementation has made it possible to organize meeting with policy makers, technical working groups and conduct regular supportive supervision. Prior to the project, meeting with policy makers was limited to annual review of health programs at the council and there was no regular meeting with policy makers to monitor the progress of the project. Within the current project we were able to meet with policy makers twice a year and evaluate performance in the community. A technical working group meeting format was used to advise the policy makers and put forward action points from the discussions.

District-level stakeholder meeting

In addition, a more specific district level stakeholders meeting was also held to integrating efforts and enhance transparency across the levels within each district. Officials from Sidama Zone Health Department and Zonal Department of Finance and Economic Development Department, woreda offices of both health and DoFED, HC staffs and HEWs were in attendance.

Quality improvement training followed the meeting and was given for different health officials to all project implementation districts. The training was used to describe the benefits of using a systematic approach to monitoring, assessing and improving quality. In addition to this, it improves on data quality. The participants of training are listed below:

Training Participants from all districts:

	Role	Attendees
1	HEWS	47

2	TB Focal	13
3	MCH focal	12
4	HMIS Focal	12
5	WoHO	6
6	HC head	2
7	District HEWS supervisors	6
8	REACH Ethiopia Staff	16
9	Lab technician	5
10	Finance Focal	7
	Total	**126**

Catchment-based review meeting

In addition, as part of integrating efforts across the catchment area and enhancing transparency a review meetings are held. During these sessions, summary of the performance of the catchment, PHCU, is presented by health posts HEWs who discuss on the reports, success stories and challenges identified. The district and health center staffs contribute and work on finding solutions to the problems identified and provide technical support. During this session best performance of HEWs are encouraged to share their experience with the others to learn from them and renew their commitment. The review meeting was held at each catchment with the following participants:

Catchment review meeting Participants from all districts:

	Role	Attendees
1	HEWS	47
2	WoHO head,TB Focals,MCH focals,HMIS Focals	30
3	WBOEFED	6
4	HCs head,TB focals,MCH focal	30
5	Kebele supporters	31
6	Kebele supporters focals	6

7	REACH Ethiopia District supervisors	6
8	REACH Ethiopia Zonal coordiators	2
9	REACH Ethiopia HQ Staffs	6
	Total	**164**

Meetings with HEWs

Finally, ongoing meetings within districts were also held with HEWs to ensure they were given opportunity to share their experiences in a comfortable environment. The meetings occurred over eight times throughout the course of the project with the aim of:

- Evaluating each district's EHealth activities
- Sharing knowledge and experience of EHealth activities
- Provide explanation for, or fill any gaps in data collection
- Evaluate the strengths and weaknesses of EHealth activities for each district
- Check the performance of district supervisors
- Increase common understanding of the project between district health office and REACH Ethiopia

Snapshot of the benefits to the intervention across the levels of the health system

WolaMegane: Bona Zurya district head

"The E- health systems means that we can get data simply for the management system; good for further and other activities, not only TB and maternal health, all activities in one mobile is good and it reduces defaulters as the system reminds people of the need to follow up"

Burka Buche: Worancha health center head

" We welcome this programme: implementing data at the grass roots and we are seeing improvements in TB and maternal health - there is now better integration and identification of pregnant women at the village level, before it was sporadic but now women come more

AlmawGonsamo: Reach Ethiopia supervisor

" using mobile phones for maternal health and TB has improved data access and use timely and improved communication an decision making"

MehretLamisso: HEW from BechaKebele

"We Enter the data covers ANC 1-4, delivery, postnatal care and identification and registration of pregnant women and TB data too. It's easy to use, enter data on the spot, including client location and save the data. It's much easier and quicker than the paper based system

9. Process evaluation

Quantitative Approach

Methodology

Registration and health data relating to TB and MCH is continuously collected by the HEWs as part of their routine work. This is uploaded to the EHealth server data-base that was created in this intervention, where the data is available immediately for analysis. We accessed the EHealth database to calculate the numbers of diagnosed cases and analysed this through time.

The results are presented in graphs below.

Qualitative Approach

To enhance the gender focus of our project, Rosie Steege (LSTM PhD student) has linked part of her PhD to the project. One component of Rosie's PhD was to involve partnership with this project and REACH Ethiopia to analyze the following objectives with fieldwork.

- To understand how/if female HEWs were empowered via introduction of mobile technology
- To explore the unintended consequences of the technology related to gender (to assess the intended reach of the project and to ensure the project is not exacerbating any existing gender inequalities and is transforming the gender relationships in a positive way)
- To describe the extent to which the mobile technology impacts the relationship between health extension workers and the health system through a gender lens in order to address current knowledge gaps relating to eHealth technology.

The ethical clearance was obtained in the UK and Ethiopia, and data collection was completed January- February 2017 and currently the analysis and write up is underway. Data was collected over a 5-week period from January-February 2017. Five qualitative interview topic guides were developed to explore some of the gendered elements of the project as per the table below:

Semi-structured interviews	Focus Group Discussions

HEWs	HEWs
HEW Supervisor	HEW Supervisor
-	Community leaders

Qualitative methods included face-to-face semi-structured interviews (n = 19) and focus group discussions (n = 8).

Questions concerned the HEWs' attitude towards their role in general (reasons for joining/remaining in the programme), the ways in which the mobile phones have helped/hindered their role, but also how they use the phones outside of work and the relevance of this. We also investigated the gendered aspects of their relationships with supervisors.

A female research assistant, fluent in Sidamigna was recruited to ensure HEWs felt comfortable to talk openly. The researcher was trained over 2 days in Hawassa before commencing the data collection. The lead researcher was also present during the interviews to clarify any concerns of the participants or researcher and get a sense of the interviews.

Interview process IDIs			Participants	
District	*Kebele*	*Kebele Name*	*HEW (split phone ownership)*	*Supervisor (M/F)*
Pilot (Shebedino)	a	bona mirenda	1- phone owner	1 government (M)
Shebedino	b	nuredulecha	1 – phone	1 REACH (F)
	c	Dobenegasha	1 – phone	
Dale	a	Tula	1 – phone	1 REACH (M)
	b	debubmesenkela	1 – phone	
	b	debubmesenkela	1 - no phone	
Boricha	a	Yirba (urban)	1 – phone	1 REACH (M)
	b	bona chire	1 - no phone	
	b	bona chire	1 – phone	
	c	konsorearke	1- phone	
Bona Zuriya	a	worancha	1 – phone	1 REACH (M)
	a	worancha	1 - no phone	
	b	(off sick)	1 – phone	
	b	bona kike	1 - no phone	
	c	HP01 (urban)	1 – phone	

	c	off sick	1 - no phone	
total			14	5
TOTAL				19

The IDI interview topic guides for the HEW and Supervisor were piloted by the data collectors and refined further.

Participants

Sidama Intervention zone – 4 districts (Shebedino, Dale, Boricha, Bona Zuria)

- HEWs
- HEW Supervisors
- Community leaders

Interview process FGDs		Participants		
District	*Kebele*	*HEWs (mixed phone ownership)*	*Supervisor (Govt)*	*Kabele Administrator (all male)*
Shebedino	A	1 FGD (2x4particpants per kebele = 8)	1 FGD Shebedino and Dale combined (4 participants per district = 8)	1 FGD (7 participant)
	B			
Dale	A	1 FGD Dale and Boricha combined (4 participants per district = 8)		N/A (participants unavailable)
	B			
Boricha	A		1 FGD (6 participant)	1 FGD (10 participant)
	B			
	C			
Bona Zuria	A	1 FGD (2 participants per Kebele = 8)	1 FGD (7 participant)	1 FGD (7 participant)
	B			
	C			
	D			
total		3	3	3
TOTAL				9

The interview process

Participants read about the study and protocol and signed a consent form, which was also signed by the researcher. Each party kept a copy.

Interviews were conducted at health posts, health centres and woreda health offices within private areas to avoid any distraction during the interview, at a time convenient to the respondent. Majority of participants of focus group discussions were able to express their ideas freely and facilitators

encouraged quieter participants to participate. Interviews lasted between 23 and 51 minutes. Focus group discussions lasted between 37 and 1hr 36 minutes.

Focus group discussions were conducted in the districts and offices central to the interview sites, the meeting place was organized by the team leading the interview and transport was reimbursed.

Interviews were recorded using digital Dictaphone devices.

Data Analysis

The recordings of the interviews were transcribed verbatim by experienced researchers and consequently translated to English by experienced researchers who were not initially involved in data collection. The quality of translation was checked by a member of REACH Ethiopia also fluent in Sidamigna (Aschenaki Zerihun), using sample transcripts.

Transcripts were read and re-read by the lead researcher, informing the development of codes for analysis, identifying emerging themes and areas for further exploration. Transcripts are being uploaded to transcription software NVIVO and a coding framework is being developed.

10. Project process evaluation quantitative findings

Overall, we have observed improvements in the following areas over the project implementation:

- Improved data accuracy, quality and management
- Improved skill and accountability
- Real time action and local problem solving
- Improved service quality and uptake
- Strengthened key stakeholders engagement

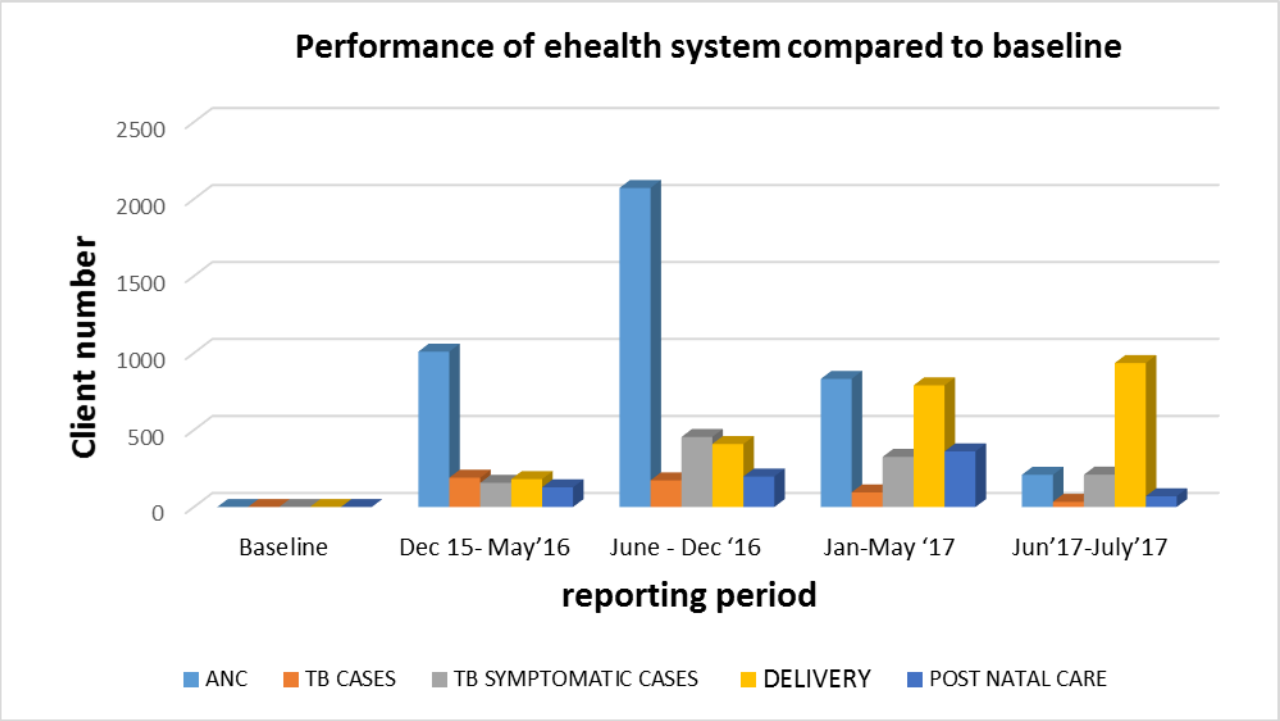
The following tables show the rollout of the project so far, in terms of health centers and health posts involved in the project intervention, the data captured to date in the eHealth system and the number of ANC visits registered as of Dec 2015 to July 2017. The project has improved the quality of data capture at the community level and reduced the error margins where over reporting is easily cross checked and the agreement between the registered data and Health Management Information System has improved. It has contributed to improving report quality and timeliness as required by the Health Sector Transformation Plan under the information revolution needs.

Module	**Baseline**	**Dec 15- May'16**	**June - Dec '16**	**Jan-May '17**	**Jun'17-July'17**
ANC	0	1009	2072	832	209
TB CASES	0	190	173	95	33
TB SYMPTOMATIC CASES	0	157	455	326	210
DELIVERY	0	181	409	790	935
POST NATAL CARE	0	128	198	361	70

Table 6. Data captured by each module during the reporting periods

Prior to the project, there was no data captured using mobile technology for presumptive TB cases, confirmed TB cases and pregnant women. However, the project has resulted in engaging health

extension workers, health workers and policy makers in using mobile technology and increased data capturing and use for the community. As expected, numbers reported for TB cases have decreased as the intervention has continued. This is because at baseline there was no data capture so the initial registration relates to prevalence recording whereas the new registrations are for incidence (new cases) reporting. In addition, some variation within the table can be explained by loss of data holding mobile phones and therefore data by the HEWs before it was able to be synchronized to the server.



Graph 1. Showing the performance of eHealth data capturing compared to baseline

The performance of maternal health indicators has improved during the reporting period as seen in the graph above with skilled delivery increasing until the final reporting of the project. This reporting accompanied by follow up and action taken to remind the mothers to adhere to care. During the reporting period, the capacity of HEWs using the software has improved and engagement with them has resulted in improved performance in the communities. Note that the pregnant woman who has follow up of ANC1 may not reach ANC4. In addition there are pregnant woman who do not follow AnteNatal Care but attend health facilities at the delivery time. As the result we will have some discrepancies on the ANC reporting.

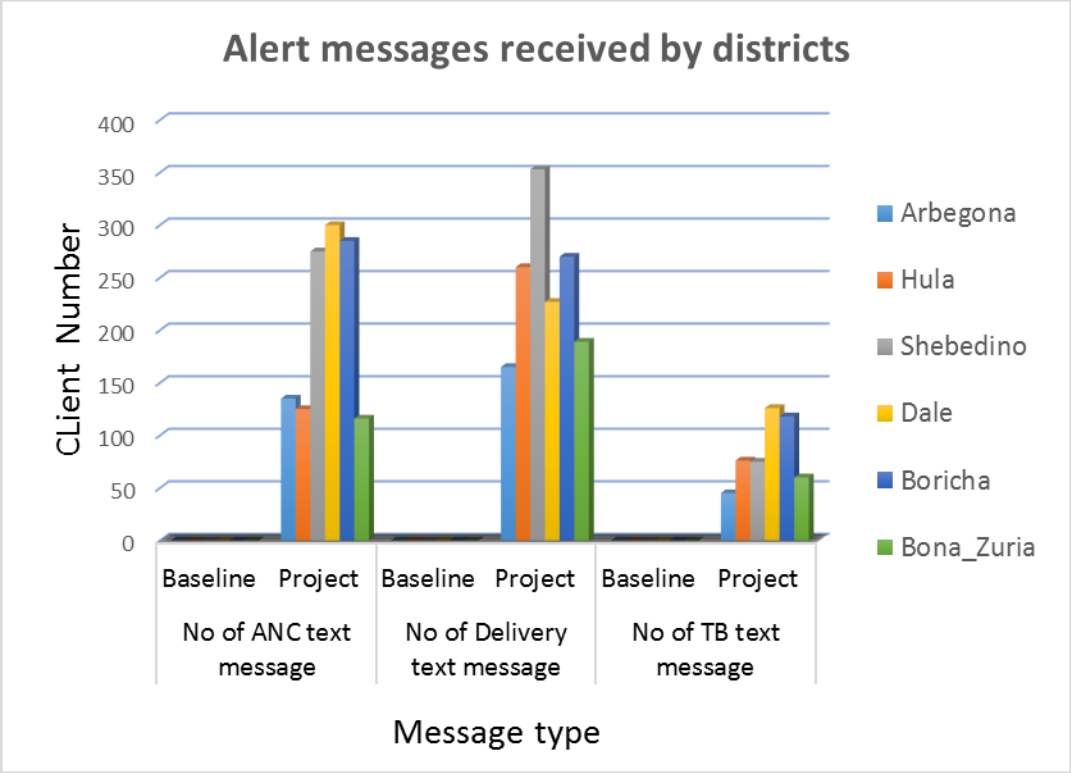
Paper-based ehealth activities

Prior to the project intervention, paper based recording, reporting was the only option and delays of reports, and inconsistency was common. Compared to the baseline, as there has not been any other registration using mobile technology for TB and maternal health the changes registered were project outputs and contribution. The performance varied by districts and the catchment population; but significant numbers of clients and patients were registered using the mobile phones in the community. To evaluate eHealth activity we use not only server-based data but also paper-based data. This is because when network problems arose, the register was used to fill the gap in reporting. However, follow up was still feasible using the paper registers. For more information see the **appendix 3.**

There are differences in the district in terms of numbers of ANC visits sent through the eHealth system. Differences relate to context specific problems, population, burden of TB in the community and the functionality of the health system, and cross district variations will enable us to better understand the issues at stake.

Districts	**№ of ANC text message**		**№ of Delivery text message**		**№ of TB text message**	
	Baseline	Project	Baseline	Project	Baseline	Project
Arbegona	0	135	0	165	0	45
Hula	0	125	0	260	0	76
Shebedino	0	275	0	353	0	75
Dale	0	300	0	227	0	126
Boricha	0	285	0	270	0	118
Bona_Zuria	0	116	0	189	0	60
Total	**0**	**1236**	**0**	**1464**	**0**	**500**

Table 7. Shows the total amount of text alerts received by the HEWs, for maternal health a total of 2700 messages were received (1236 ANC messages and 1464 Delivery messages). For TB a total of 500 messages were sent throughout the project.



Graph 2. Showing the number of text messages during the project period

Graph 4 Number of Alert messages received by HEWs within the districts

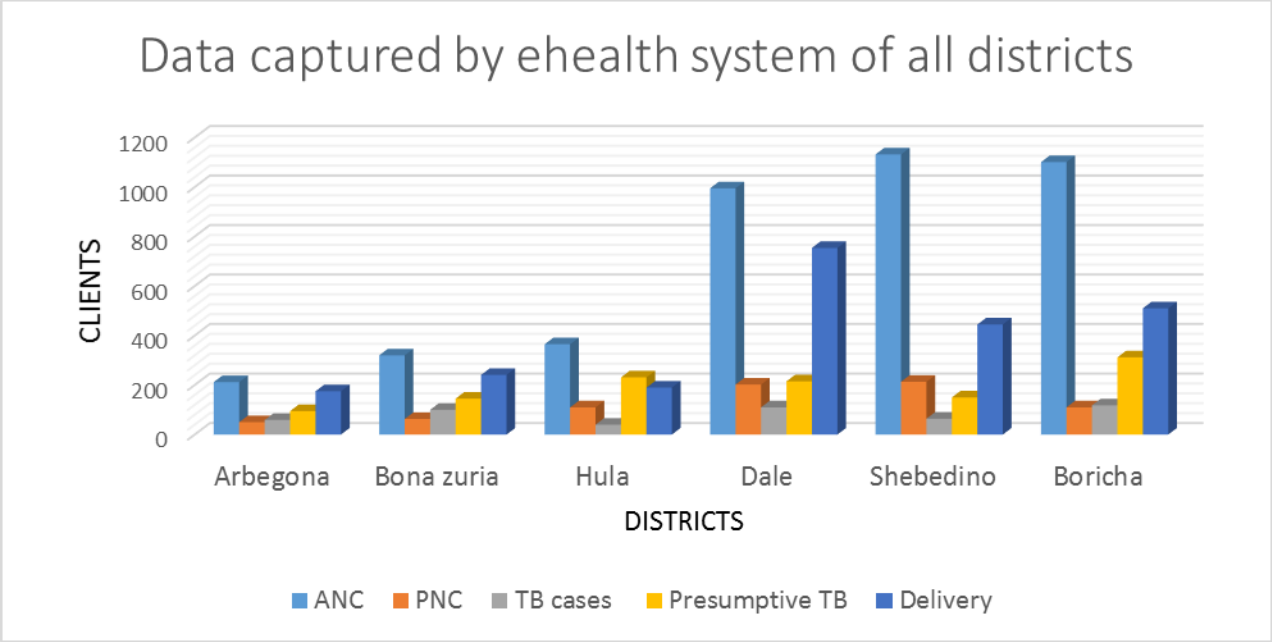
From the graph above, we understand that Dale district Performs better on Antenatal Care & TB than other districts. Shebedino district has good performance on delivery than others. Arbegona and Bona zuria have low performance on TB than others. It is because some HEWs lost their mobiles with encoded data before the data was synchronized to the server. As seen from the graph, at the baseline there was no alert messages received by health officials, As the result, there was less participation in the health system and they were unable to reach all the community. Since the project's implementation time, HEWs and other concerned bodies started to receive these alert messages and use it as a tool to follow up the patients without any disparities and the decision makers receive these alert messages to use it as a tool to make data analysis and some decisions on health issues. As the result these alert messages alleviate health disparities and increased participation and accountability to the system.

11. Improving maternal health and TB prevention and control efforts

Maternal health service delivery and TB prevention and control efforts were among the top public health priorities of the country. Hence, the project is aligned with the national priorities and has continued supporting the implementation in rural districts of Sidama zone. Compared to the baseline data, increases were observed in the number of pregnant women identified, presumptive cases referred and TB cases detected. These activities ultimately increased skilled delivery and TB treatment outcome and hence demonstrate that using mobile data capturing and reminders as main tool support detection, adherence to care and utilization. Below are the numbers of community members who have received services and are registered on the mobile system. Given the that the baseline figures were zero (as there was no data captured from the mobile phones); these demonstrate large increases.

Districts	ANC	PNC	TB cases	Presumptive TB	Delivery
Arbegona	212	50	59	95	175
Bona zuria	320	63	100	145	241
Hula	365	110	40	231	190
Dale	995	202	110	215	754
Shebedino	1132	213	64	150	445
Boricha	1101	110	118	312	510
Total	**4122**	**757**	**491**	**1148**	**2315**

Table 8. Showing the number of data captured using mobile from the project sites



Graph 3. Showing the data captured by the eHealth system in the districts

The graph showing downloaded data from server which is collected and synchronized by distributed mobiles of HEWs of each district. It shows that it is possible to see performances of each districts and help to make data analysis and comparisons between districts.

Process evaluation: findings qualitative

<u>Enhancing the gender focus of the project: interim findings</u>

HEWs face large workloads, as is common with many close to community providers[i], and we need to do our best to ensure that this new technology supports them in their workload and interactions with community members rather than brings new burdens. Some of the findings from Rosie's PhD, exploring the gender aspects of the technology are presented below.

Reasons for joining the HEW programme

Many reported joining the programme due to lack of career opportunities for women, combined with a desire to help their community. However, most HEWs report not having enough information on the role and work-load at that time, with some suggesting they would not have joined the programme if they were aware of the work burden. Other causes of frustration relate to lack of opportunities to transfer, upgrade their education or salary.

"Sometimes I think as we are not recognized by government. This is evidenced by when we ask our salary, we are considered as the one does not perform his/her works. Also we are considered as selfish rather than considering our rights and we are serving community. I am the one who upgraded my education in the first round, only Bona and Bensa woredas that have not correcting our salary. We are surviving only by the help of God. However, we are from this community we want to help them. Additionally we have been doing our best to reduce both maternal and child mortality. After I became health extension worker, most of teachers and development agents updated their educational status to degree level and shifted their work places. Sometimes I feel deep sorrow. If I am not comfortable by my work and getting attractive salary, I will not be respected by my family/husband."

[IDI, HEW, no phone]

Women's role in society

Many HEWs stress the work burden facing them in their roles but that they are motivated by the results in the community, the introduction of the mobile and the opportunity to have work.

"Since I am alone and I have work burden. Sometimes I have stress due to my work burden so I sometimes feel that how can I be successful in my work. We have a plan to make our kebele model so we are working hard. I have been working all the day so our business is going well. In spite of the work burden, I don't have any plan to leave my work. This occupation is good especially for female so I will not leave my work."

[IDI, HEW]

HEWs also report work burden in the home. They report being responsible for numerous household tasks such as cooking, cleaning and farming.

"There is a work burden on women. She starts her routine work early in the morning and continues working till night and no one understand her problem. She prepares food, feeds their children, caring for her children and cleans the compound. She cannot feed herself properly even. She cannot eat together with her husband. "

[IDI, HEW]

However, several participants also suggest that certain tasks like washing the children are shared with their husbands, or that they are teaching their husbands to help more with household duties. There is a general feeling that this is changing over time and more women are involved in decision making, whereas more men are becoming involved in household activities and chores.

> *"Woman who is living in our community is non- educated and she cannot decide in everything as to me. Our culture even does not allow her to decide. Moreover, there is still a negative attitude that is woman cannot participate in meeting, discussion although there is some improvement."*
>
> *[IDI, HEW]*

Benefits from the EHealth technology

The use of the mobile phone technology provides many benefits in terms of accuracy of reporting, reminding them to visit mothers and HEWs see it as a helping hand to their work.

> ***"****Yes. It is good to work. For example I may miss the appointment date of pregnant woman when I have work burden that time the mobile remind me by the alarm. And also it is better if provided for other health extension workers who do not have this mobile. Because as other health extension workers are also to help mothers it is better to provide this mobile to them. Sometimes I think/feel them as other person while I working"*
>
> *[HEW Boricha IDI]*
>
> *"We are getting a lot of benefit. My commitment on my work is improved. The data quality is improved, I develop self-confidence on my work, and the skill of using the technology is improved. My data handling is also improved. I can say the phone is my friend."*
>
> *[HEW Bona Zuria IDI]*

The phone has also provided an opportunity to upgrade their skills and knowledge and many HEWs report gaining confidence and are now more willing to participate in woreda meetings. This has also been extended to both all HEWs within the kebele, not just for the HEW that keeps the phone.

Q: *Do you think you get the chances to participate in different meetings after getting this mobile?*

A: *Yes. Not only me but also the other health extension worker who works with me as she took training on this mobile. This shows participation rate increased not due to handling the mobile but presence of this mobile service in particular kebele. Therefore, there is great variation in participation rate from health extension workers who work in kebele where no mobile service program.*

[IDI, HEW]

This sense of pride and empowerment may also have impacted the HEWs within their households. HEWs serving in rural areas report that many women in their communities may not own phones, whereas it is common for male heads of households to own phones as they have their own income whereas and the women are their dependents. Yet, although the HEWs themselves are also part of these communities when asked about their own phone use they speak quite differently, setting themselves apart, even stating that they don't allow their husbands access to the phone.

Q: *Your husband does not use this mobile?*

A: *I never permit him even to touch it. Due to this reason sometimes he says as what kind of the mobile you have given.*

[HEW, IDI]

HEWs reported receiving recognition from the community since the arrival of the mobiles, and that this is equally spread between the two HEWs at the health post (i.e. not by phone ownership). However, one HEW reported that with this comes more expectation from the community now they have the phone.

HEWs and supervisors also report using the phones outside of work, for reading the bible, listening to music, accessing Facebook and taking photos. In particular, almost all HEWs reported taking photos of the pregnant women in the pregnant women's forum. The reasons for this were not explored explicitly; perhaps this is done for recording purposes or alternatively, it may serve as an element of bonding and celebrating the pregnancy.

Potential pitfalls of the technology

However, although phone was given to both to avoid duplication of data only one participant reported this as a reason. Many without the phones feel that they are not upgrading their skills in the same way as, despite taking part in the initial training, they don't have opportunity to practice using the phones. Notwithstanding this, no participants reported problems with working together and some reported utilizing their supervisors to help fill in any skill gaps they felt they needed to address with regards to the technology.

> *" Yes, for example she increased her knowledge and skill about the mobile and also she increased her own work performance. Additional she can use Face book as well as she can take a picture".*
>
> *[IDI, HEW]*
>
> *" She felt uncomfortable as not getting this mobile. Not only to her but also her husband. I myself too if in place of her. However, I showed her about how to feed data so no problem in our work."*
>
> *[IDI, HEW]*

One area of consideration, that will need to be addressed if the technology is rolled out across all essential health packages is the duplication of tasks for the HEWs who do have the phone. Participants reported that they must spend time inputting the data, as they are still required to fulfil paper based reporting duties.

> *"I like this mobile very well. However, once the health extension worker that handles the mobile comes to the health post, she never does anything other than feeding the information of those pregnant mothers and TB patients. In some cases, it is difficult to give services to mothers and children when the other health extension workers are in charge"*
>
> *[IDI, HEW]*

Financially, the phones may also inadvertently burden HEWs – most report that they are paying for the air time charges themselves, which they don't mind as they consider the phones to be their

possessions and they also use the airtime for personal calls or data. However, HEWs reported being fearful in the case of a lost or stolenphone as they would have to bear this cost themselves which may place unnecessary stress or pressure on these women who may have limited socio-economic means.

> *A: If it is stolen you will pay so this one of the threat. For instance, since the phone which was provided for my colleague was stolen, she is paying for it.*
>
> *[IDI, HEW]*

Relationships with supervisors

Almost all report positive relationships with their supervisors (who are predominantly male), and they appreciate the practical benefits of having a male supervisor in terms of freedom of movement and less maternity leave. However, when probed, many HEWs state they would prefer a female supervisor due to personality traits that they perceive to be inherently female – such as approachability, patience and attention to detail. HEWs also felt having a female supervisor would confer benefits in cases where the supervisor would step in to the HEWs role and visit pregnant mothers in the community who may be less accepting of male health care workers. Although, it is suggested that this attitude is changing with time and women in communities are more accepting of male health workers. Interestingly, none of the HEWs reported having a female supervisor (i.e. a woman in a leadership position) as a motivating factor. Perhaps due to the limited career progression opportunities for HEWs this was perceived to be too far removed and their views on the gendered aspects of supervision were far more pragmatic.

> *"I prefer female supervisor because she can support me properly, she approaches in friendly manner and encourages me but male supervisor is easily provoked and undermines us. Female health extension worker is better than male health extension worker since female approach in a friendly manner to women."*
>
> *[IDI, HEW]*

However, most male supervisors considered that their position as a male afforded them benefits to the role that females would not have, in terms of freedom of movement and less competing demands with home life.

A: Most of the time our community associates the tasks of female time they are supposed to do their tasks. For example if male worker is want to do his work at night time, he can do that work. But in case of female she might fear go to work at night time. Even if she decided to, she may need someone who helps her.

***Q:** What about in the case of urban [HEWs]?*

***A:** Still I prefer male to female. This is because of she might be pregnant, give birth for natural/biological reason and may not be able to drive motor bicycle. But this is not an issue in the case of males. Unless there is sever case, it is possible male to perform particular task. Therefore male is more tolerant to things than females.*

Supervisor, Male

Final stages: sustainability and research uptake within Ethiopia

Now that we have learned from the process of software development and implementation of the eHealth, we conducted partners meeting from national to local level to share our experience and get further view about the projects and its potential. We shared the data generated and the perspectives from different people at different levels of the health system, including the voices and perspectives of HEWs and the communities and clients they serve.

National level meeting

The national meeting was held with different participants from the community level up to Federal levelin order to share experiences to date and capture perspectives on the project and its potential to improve health reporting in Ethiopia. Participants included Federal, Regional, Zonal and district health staff who are working on HMIS, TB& MCH in addition to this heads of Zonal, district health office heads, HEWs, Partners and Clients (community members) were present. This meeting was conducted in July 25,2017 at Central Hawassa Hotel for the following purposes:

- Share experiences & findings of the research
- Review results and lesson learned
- Discuss the way forward of using eHealth in other primary health care activities.

We shared the data generated by the project so far and captured the perspectives from different people at different levels of the health system. We have generated a range of outputs from this work including case findings, briefs, blogs and create platform to write papers on project implementation and experiences.

Picture 1. Panel discussion with HEWs and other stake holders at National level meeting

In addition, Aster, a HEW from Bona Zuria described the phone: *"My mobile is my friend. It's not only mobile device, it is a "person" that helped me to a lot by solving my work load".*

This is because:

- 1 mobile can do the work of 10 persons
- I don't think of it as material, it's more than that
- I am motivated by mobile texts; my work interest has improved
- I have gained confident

Mr. Derese zonal Health Office head said that since our government is at the time of information revolution time, this project helps our community by transferring this technology to HEWs at the right time so HEWs will be easily adapted to related technology that comes in the community. Recently because of the alert messages that we received by our mobiles we participate not only in the follow up of the patients but also we started to evaluate the performance of each districts easily.

Dr.Daniel REACH Ethiopia Executive director said that since this is the pilot project, the government takes the responsibility to extend this project task to other catchments and it can use HEWs to capacitate other HEWs by giving training on how to use electronic data manipulation.

Continued SMS and review of activities

The m-health system will continue working afterwards for one year through SMS alert messages sent to the HEWs and all concerned bodies at different level. This will ensure the sustainability and uptake of the technology by the health system. In addition there is a consensus with zonal health department and woreda health offices to jointly carryout supervision and support the implementation of the project using the existing expert knowledge and skill beyond the project life.

However, despite the advantages, there are some limitations. The main challenges include:

a. **Network connectivity**. There was a problem of network connectivity and most of the project sites were having problems with network connection and data synchronization became a major issue. This also affected the number of text messages received by HEWs and the required action to be taken.

b. **Place of registration.** Some patients and pregnant mothers prefer to cross to other villages which make it difficult for registration. However, we have decided to register clients at the facility they attend, rather than necessarily in their own village.

c. **Power failure.** In some villages due to power shortage they fail to charge their phones. Some villages have generators which lengthen access to power, and others are forced to travel to nearby areas with power for recharging.

d. **Poor connectivity.** Power failure in some communities has problems with network connectivity. The supervisors support them to use their cards to get connected to internet to send data.

e. **Delayed transfer of finances.** In order to effectively conduct project activities in the districts. Sometimes account balances run out immediately after recharging money

For further information on lessons learnt and continued improvement of the project, please see **appendix 3.**

Summary of objectives and corresponding performances

This table summarises the findings and learning of the project and process evaluation against the project objectives.

Summary table indicating key performances and milestones of the project

Objectives	***Performance related to objectives***
1. To assess the feasibility of HEWs using eHealth within their core duties initially with a specific focus on TB and MCH	*Baseline and feasibility assessment of HEWs using eHealth system was completed both in intervention and control sites*
2. To work with the HEWs, their supervisors and other HMIS users and decision makers to establish, analyze and periodically refine an eHealth system	*eHealth system is established by engaging HEWs, supervisors, HMIS focal persons and policy makers to periodically use the data*
3. To strengthen the culture of data use among HEWs using a system of prompt and responsive M&E and feedback established in the existing HMIS	*Real time data collection and use in the community and linking with the policy makers for action is created and ongoing*
4. To strengthen capacities among HEWs and HEW supervisors to use the eHealth system and the data contained within it; health systems researchers through graduate level training; and decision-makers to manage and use the system for planning and resource allocation.	*Capacity is built in the projected sites (HEWs, supervisors and policy makers) and data used for decision making. Post graduate studies at MSC and PhD levels are undergoing in the project sites.*
5. To evaluate our approach within the Sidama Zone context and make recommendations about how to use eHealth	*The process of data availability to HEWs, health workers and policy makers from community to province has made it possible to create transparency*

to support HEP HMIS and strengthen equity, participation, accountability and transparency.	*and accountability related to the next steps and data use for action. In addition, improved access to women, use by women HEWs and reaching TB patients in the community contributes to improving access. However, the system has created accountability and participation of stakeholders in data use and action.*

Summary table indicating key performances and milestones of the project

Steps	Project period	Key activities	Key performances
Step 1: Collect baseline data for intervention and control zones	Months 1 - 3	Collect baseline data from the intervention and control sites	▪ Baseline data was collected, analyzed and reported ▪ Baseline data was used to shape the design of the software and benchmark the performances
Step 2: Establish eHealth data collection system	Months 4 – 6	Establish an eHealth data collection system in the intervention zone with a particular focus on TB and MCH	▪ Developed software in consultation with stakeholders ▪ eHealth tool capturing data for presumptive TB, diagnosed TB and pregnant women was developed pretested and being used ▪ training was given to the health workers using the phone and policy makers ▪ facilitated the use of eHealth in the community
Step 3: Training and sensitization	Month 7 - 9	Conduct awareness creation and sensitization workshops Training of HEWs, health	▪ Conducted kick off session at province and awareness creation sessions in the districts and catchment health centers ▪ Trained HEWs, HEWs supervisors, program

		workers, program focal persons and policy makers	focal points and policy makers
Step 4: introducing eHealth system for MCH and TB: Month 8 - 20		Introduce e-reporting formats for HEWs, adapting them to existing formats Conduct catchment area meetings Data analysis to including details of data generated, its completeness, timeliness and interpretation of reported analyses will be carried out at the level of the local community.	▪ Data capturing using the eHealth system is going on and text messages were sent and used for action: follow up and decision making ▪ Conducted regular catchment area meeting to review the performance of the system ▪ Preliminary data analysis and feedback was given during catchment meeting and written feedback was given ▪ Final data analysis and comparison will be done later
Step 5: Review of TB and MCH focused eHealth system	Month 20 – 22	Review the data compared to the baseline Carry out the assessment of the project implementation and use the lesson learned	▪ Preliminary review of data is done and shared in the report ▪ Final data analysis and qualitative impact assessment and comparison will be done
Step 6: Improved eHealth stage; discussion, analysis and	Month 23 - 34	Review results and lesson learned and further customization and include other programs	▪ Review results and lesson learned and customization of the system will follow final data analysis ▪ Customization of the eHealth system

change			based on the review results
Step 7: Final evaluation	Months 35 – 36	Review the data, compare against and improve the eHealth to a more user friendly and expands to other programs Highlight the way forward of using eHealth in other primary health care activities. Share experiences, findings of the research and write papers	▪ Customization of the eHealth system based on the review results ▪ One paper is published and abstracts shared on conferences ▪ Future publication outline is undergoing

Regionally: Meeting with policy makers

The project implementation was closely supported by policy makers from two sectors of the governmentSZHD (Federal Ministry of Health) and DoFED of Sidama (underthe Ministry of Finance and Economic Development) and responsible for project signing with partners, evaluation and representing the government for policy and decision making and budgeting for the activities in the future).

We have conducted evaluation of other projects and discussed the progress of this project during the site visits. This has resulted in renewing commitment for the sectors and support for future scale up and use. The two sectors play a key role in the council of the province for policy and decision making. They represent the province in the regional government and contribute to policy and decision making and including best practice in the Southern Nations, Nationalities and Peoples' Regional State. During our supervisory visits and catchment area meeting we received positive feedback from a range of different policy makers, one illustrative example from a District health office head is as follows:

'Since health is fundamental right of the community, the project serves the community equally by reaching unreachable areas'.

Picture 2. Meeting with policy makers

Important milestones for sustainability

1. *Continued discussion with policy makers and Ethiopian Telecommunication Authority*
2. *Transition to transfer the CommCare based platform to Ethiopian Telecom*
3. *Identify resources to bridge the transition to scale up including in the HMIS system and Health Information Transformation Plan*
4. *Work towards including other health programs to the software design and lead the development of community based eHealth in country. Given the success of the project in TB and maternal health, the stakeholders would like to see the project expanded to include other health issues too, such such as Malnutrition, Childhood, Malaria and the like)*
5. *Continued SMS alert message and joint supervision and review*

We continued collaboration with DawitBirhan, who supports the MOH to ensure buy-in and that the project implementation and monitoring is within the framework of the MoH to improve the HMIS.

Sustainability and way forward

The involvement of all stakeholders: target beneficiaries, target woredas , zones and regional pertinent and funding partner in all project cycle form a common understanding of the project phase in. In addition to these, clearly spelled out each stakeholder responsibility in the project agreement and signed by all concerned parties also figure out a proper ground for the intended project phase in strategy. We closely worked with the MoH at all levels using the existing health structure which would make it easy to undertake.

It is the responsibility of the government to continue undertaking the health service delivery in the community. We will take our responsibility to ensure and fill the gaps to address the common health problems to service our community. The project work started with a clear understanding among all the stakeholders and will be paralleled by informing the progress to the respective bodies regularly which will create a platform.

The program implementation modality is based on working in partnership with local actors. This modality by itself facilitates a smooth and its effective phase out of programs. The primary stakeholders are engaged in the project Planning, Implementation, monitoring and evaluation processes. We will play work in close partnership to facilitate project implementation which will be executed and managed entirely by MoH and the line offices at last.

From the beginning of the project, we initiated discussions with the MoH authorities about sustainability and scale-up of best practices at local and national levels together with key stakeholders. We will explore the possible sources of external funding to support the activities for smooth transition or scale up. We will closely work with the stakeholders to ensure that the best practices coming from the project will be incorporated in to policy and practice through the technical working groups in which we will be taking part. Moreover, we will work on local capacity building to ensure the availability of trained expertise to continue to contribute running such projects even after the projects are handed over to the line ministers.

Communicating Internationally: Attendance of Health Systems Global Conference and SEARCH meeting, Vancouver

Aschenaki Zerihun from REACH Ethiopia attended the4th Health System Research Symposium and the linked SEARCH meeting held in Vancouver; Canada from 14-18 November 2016. Professor Sally Theobald and Rosie Steege from LSTM also attended the symposium and SEARCH meeting. At the SEARCH meeting our team faciliated a session on gender analysis for eHealth. At the symposium, we presented 3 posters led by Aschenaki Zerihun, Dr. Daniel Gemechu and Elias Michael and were presented by Mr. Aschenaki Zerihun, Rosie Steege and Elias Michael. The presentations created an opportunity to discuss on future networking with partners and organization.

The titles of the posters were:

1. Factors influencing motivation of community health workers: The case of Ethiopia health extension workers: A qualitative study
2. Women health extension workers: core players using eHealth to strengthen equitable health systems by responding to community health needs in Southern Ethiopia
3. Community engagement for maternal health: lessons learned from southern Ethiopia

Below are the photos of the team engaging in both the SEARCH and HSG meetings. The project made it possible to support the presentation of the findings of engaging HEWs in uisng mobile technology for health.

Pictures 3 Describing the poster on HEW tasks at the 4th Health System Research Symposium

12. Capacity development support in SEARCH

We are grateful to IDRC for allowing AschenakiZerihun Kea to pursue his study in a joint PhD program undertaken between Hawassa University and Bergen University, Norway. A Memorandum of Understanding (MoU) was signed between REACH Ethiopia and Hawassa University as a binding document for Aschenaki's PhD study. The course work will be taken in two universities while the field work will be carried out in Ethiopia. Currently the PhD fund has been transferred to both universities through the LSTM. The PhD project is jointly supervised by Universities of Hawassa and Bergen and REACH Ethiopia. The focus of the PhD is summarised below and links to this project by utilizing the data of the project to assess the effect of mobile technology in improving the uptake of skilled delivery.

Proposed project:

To measure maternal mortality in Sidama zone, South Ethiopia

Aim

1. *This study tries to assess the magnitude of maternal mortality using population based household survey method in Sidama zone south Ethiopia. The study will provide information to understand the magnitude of maternal mortality that will inform the design of appropriate intervention to create better maternal health outcome.*

2. *Specific objectives*

   a) *To estimate maternal mortality using population based household survey*

   b) *To measure access to facility delivery using Geographic information system*

   c) *To assess the availability and use of life saving emergency obstetric care in primary health care units*

   d) *To assess the effect of mobile technology in utilization of ANC and facility delivery*

We are grateful to IDRC to support capacity building to Mr. Dawit Berhan. Mr. Dawit is from FMoH and was part of the software development for the project. Mr. Dawit was also part of the team who developed the HMIS at the MoH. He has completed his masters on M-health to improve MH and TB care in the Sidama zone of Southern Nations, Nationalities and peoples' region of Ethiopia.This further strengthens the links with MoHand supports the sustainability of our approach.

In addition, with respect to capacity building Rosie Steege's PhD is linked to the project. Hayley Teshome Tesfaye has also benefited from being linked to the SEARCH project in her placements as LSTM as part of her training as Specialty Registrar in Public Health. Hayley wrote to REACH Ethiopia: *"I have really enjoyed working with you all on the SEARCH project over the last year. Thank you for all your collaboration and support - I have gained so much knowledge and new skills."*

There was local capacity building in the project in the institution mainly focused on supporting research and implementation. The project implementation has supported MSc in computer science, two PhDs - data collection undergoing in the community and the second under preparation. We have also supported one of our staffs coordinating maternal health services in the province were also supported during his research work for MA in leadership.

13. Conclusion

This report presents mobile technology implementation research findings on maternal health and TB in Sidama zone south Ethiopia. It has been implemented at primary health care unit level, which is the first point of contact for rural community in Ethiopia health system. The baseline data collection showed that an eHealth system was feasible to implement among HEWs who were excited by the prospect of the technology and how it could help their data collection. Therefore, an eHealth system was successfully established via engagement of HEWs, supervisors, HMIS focal persons and policy makers. It was evident that our implementation research improved data accuracy, quality, management and accountability for community health. It has also improved service quality and uptake and the engagement of key stakeholders and policy makers for community health and strengthened the culture of data-collection and accountability.

For the HEWs the technology presents an opportunity to upgrade their skills and improve the accuracy and timeliness of their data collection. It has also provided an opportunity to improve access to women in the community, by female HEWs, and has improved the reach of TB patients. Aside from the HEWs and their supervisors, the project also provided an opportunity for capacity development among the research staff involved in the project, with postgraduate studies at M.Sc. and PhD level occurring within the project.

Poor network connectivity and power failure were the main challenges that hampered the implementation of the project. Hence, the government of Ethiopia should work towards the improvement of poor network connectivity and repeated power failure to realize m-health strategy in the country. Effort should also be made to ensure the roll out of this technology across all 16 programmes within the essential health package to streamline the workload for HEWs.

Appendix 1: How the technology works

a. SMS Messaging and functionality

"Local use of health information and data" is one of the ministry's mottos regarding health data collected from the community. SMS messaging demonstrates how we provide information back to the end users right after they feed data in to the application. This gives a sense of ownership to the application and responsibility when feeding data to it. SMS is one of the most appreciated functionalities of the system since it supports health extension workers' roles and responsibilities and we discuss below how this can be used to improve treatment adherence for TB, follow up on ANC etc. We have reminders, alerts and broadcasting functionalities in the application deployed and how these can be used is discussed below: (below is a picture showing reminder SMS messages sent to TB cases and pregnant women. We have removed the names of clients for confidentiality reasons).

Maternal Health Follow up Alert Messages

TB Client Follow up Alert messages including Local language

Picture 4: Alert messages that HEWs and concerned body receive

The following diagram shows the different levels and flows within the eHealth system. SMS reminders sent to the mobile phones of HEWs & supervisors. The alert message includes the name of the client, district, village and due dates for action. The different aspects of functionality are discussed below.

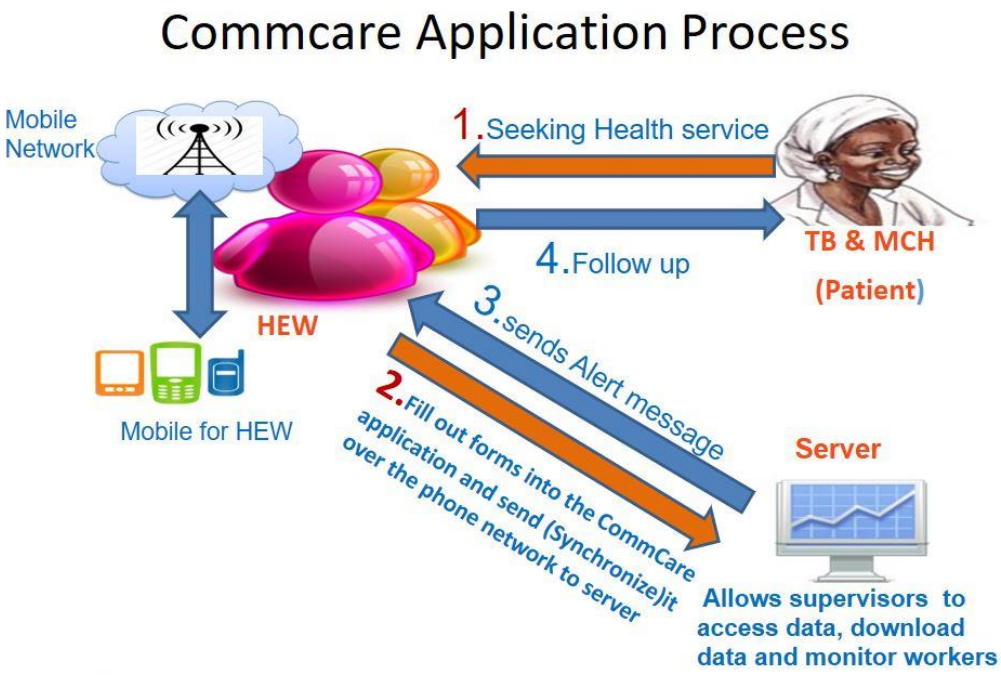


Diagram1. Commcare application process

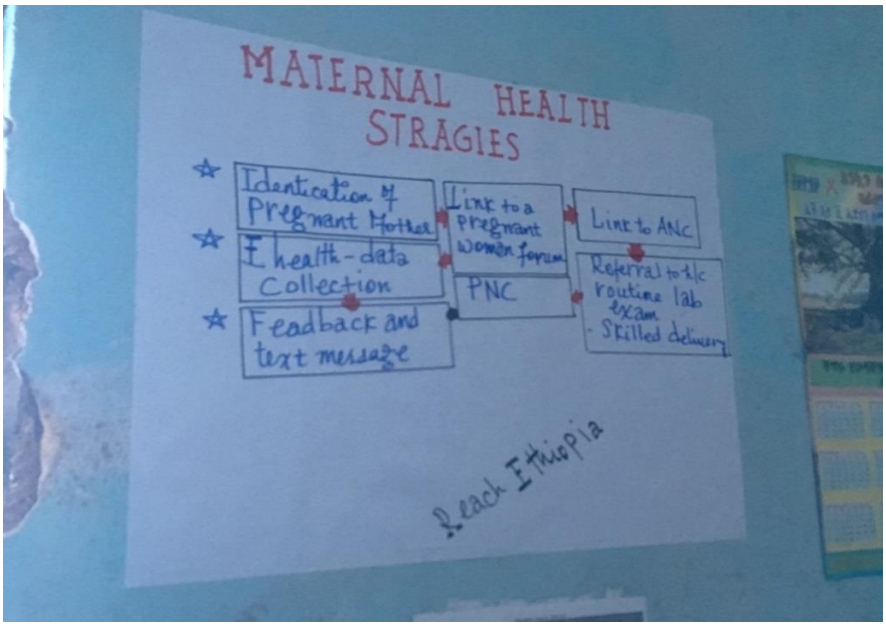


Diagram 2. Summary of the intervention as depicted at a health centre in Bona Zuria

b. Reminders

The server sends different alert messages of TB & Maternal health to the HEW/different health Officials. This is done according to the Patient appointment schedule that HEWs encode to their mobile. The reminder gives responsibility for action to patients, HEWs and others. It also serves to strengthen the links between HEWs & HDA follow-up to patients.

Alerts: The system is geared by inbuilt alert system where the standard follow up dates are inserted to the system to give send reminder text message to HEWs, TB and maternal health focal persons and heads at health center, district and province offices. The text messages are received at the same time by the HEWs, catchment health center district and province to ensure real time information for action and improve the accountability at all levels. After December 2017, we have worked to increase the confidentiality and privilege of accessing the data only by respective HEWs of respective districts, policy makers and reduced the number of text messaging sent to recipients.

c. Worker activity data

This is data which informs how and when the health extension workers are submitting forms/data. The data can indicate the performance of every HEW assigned for the project and based on that supervisions could evaluate how they are performing. Supervisors and managers can easily get all the raw data from all the modules in the server and they can down load it by any specific time range. This data can be sent to the catchment area to supervisors in soft copy and they can view it by the computers provided to them as part of the project. From the worker activity data, it is possible to get information like which worker submitted which forms and how many, how long it took to complete the form and when is the data sent to the central server. It is possible to filter the data by case type, date range, users (HEWs).

Daily form activity is also another way of seeing how HEWs are submitting data each day. This is a refined form of the worker activity report. It shows the number of submission of forms by each HEW each day. We have discussed the importance of using this data in ways that is supportive and empowering, focusing on data quality and the quality of the interactions with clients, rather than it being seen as a way or rewarding those who enter the most data. Learning from our sister project REACHOUT, highlights the importance of gender aware and supportive supervision processes, that enable close to community providers (such as HEWs) to better manage their workloads and prioritize

different tasks. Group supervision occurs at a review meeting which happens every two months with all supervisors at REACH Ethiopia, headquarters in Hawassa, and this is a good opportunity to review emerging challenges and issue in supervision and discussion solutions.

Monitoring of the workers' activities shows how the health workers delivered the targets for the programs on weekly and monthly basis and indicate the progress towards the indicators set for the programs. In addition, it gives clues to the main challenges within different catchment area and indicates the level of support required for the catchment health center and higher levels to improve the service delivery in general, supportive supervision gives due attention to find solutions to the programs related to the workers' activities. We have removed the names of the clients and HEWs for confidentiality reasons.

Presumptive TB and diagnosed case data from server

A	B	C	D	E	F	G	H	I	J
form.Sex	form.District	form.Name_of_Kebele	form.age	form.Development_group	form.Name_of_HC	form.full_name(Patient)Client	username(HEW	received_on	caseid
Female	Dale	Soyama	30	02 Abecho	Mesenkela Health			2016-02-22 12:38:11	9762f2d4-6e37-41cf-914c-4b
Female	Shebedino	Dulecha teberako	20		Dulecha			2016-06-07 17:59:23	2874f409-433a-4963-b581-fc
Male	Dale	Semen mesenkela	20		mesenkela			2016-06-15 12:29:14	21f0bcaf-1891-4114-987c-3e
Male	Hula	Shako	61	dande				2016-07-18 06:24:10	8be66d74-4aac-4a77-b4be-2
Female	Shebedino	Dulecha teberako	30		Dulecha			2016-06-07 17:08:56	36e201fd-005b-4425-836c-c2
Male	Boricha	yirba 01	18		yirba			2016-07-31 08:56:55	f2575f0a-e5cb-4d79-a53d-3(
Female	Shebedino	Bonoya miride	31		Dulecha			2016-06-07 17:39:14	61029be7-c84a-43c0-bdbe-5
Female	Bona_Zuria	bona kike	45	2 chiriko	worancha			2016-02-04 07:46:23	b36b210a-84f9-400f-b0ba-b
Female	Hula	Sororo	38		Teticha			2016-06-25 08:17:01	7af3c3b3-a203-4df7-9fe9-58
Female	Hula	Shako	45	Odako	Teticha			2016-06-04 10:05:22	14dd463c-cefa-46a8-888c-e5
Male	Boricha	Bonoya chire	15		Yirba			2016-07-31 08:47:46	6d3d5688-7200-4fd4-ae11-8
Female	Boricha	Sadamo dikicha	22		yirba			2016-07-31 08:59:08	bfe59977-cc0a-4cc8-b9d9-8t
Female	Shebedino	Dulecha teberako	23		Dulecha			2016-06-07 17:11:41	d2ef3d67-995d-489b-b95f-d
Male	Bona_Zuria	bona kike	12	kotano	worancha			2016-05-12 12:00:45	85a6d3d6-6157-46b8-964f-7
Male	Boricha	Yirba duwancho	30		Yirba			2016-07-31 08:46:59	ee218673-da43-4752-ac81-8
Female	Dale	Tula	53	05	Mesenkela			2016-06-14 13:41:50	debb9ced-4231-4e05-b94c-7
Male	Bona_Zuria	becha	10	adawa	worancha			2016-07-10 15:49:34	7907eb7d-0e9d-43ce-8f18-f
Female	Shebedino	Dulecha teberako	25		Dulecha			2016-06-07 16:17:43	908c8e22-183e-4268-b8b2-f
Male	Boricha	yirba 01	30		yirba			2016-07-31 08:43:54	d984b6a2-26dc-45ed-b8bb-(
Female	Bona_Zuria	bona kike	35	holo	worancha			2016-05-12 11:58:54	981ffdc5-00ba-4b1e-bea4-d
Male	Shebedino	Dobe Negasha	22		Dulecha			2016-06-07 16:39:54	4e661f92-5a38-48ee-816f-a(

ANC client data completed on the server

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
form.Date_of_Visit	form.District	form.Kebele	form.Name_of_Health_Devt_Tear	form.Gravida	form.Pa	form.Gestational_Age_by_week	form.ag	form.edd_calc	form.Development_group	form.Im	form.full_name	completed_time	started_time	username(HEW)	caseid
2016-01-27	Shebedino	N/Dulecha		1	0	14	26	2016-04-19	Lefa sidama	2015-07-14		2010-01-01 05:1	2010-01-01 0		a7f07d14-f49
2016-06-07	Shebedino	du		2	1	18	26			---		2016-06-07 14:3	2016-06-07 1		81d29bb1-288
2016-03-01	Shebedino	Bonoya	miride	2	1	26	24	2016-03-16		2015-06-10		2016-06-05 12:2	2016-06-05 1		a0fc754b-bb8
2015-10-31	Hula	Sororo	Shito	3	2	20	24		11	---		2016-05-26 00:4	2016-05-26 0		c64094e1-7d6
2015-12-21	Shebedino	N/Dulecl	Marta	1	0	14	24	2016-05-27	Zeleke	2015-08-21		2016-06-04 18:2	2016-06-04 1		a2a05992-8ff3
2016-11-09	Dale	debub m	asinakech	3	2	20	26	2017-03-16	adila	2016-06-09		2016-12-08 18:0	2016-12-08 1		dc609f35-8ca
2016-02-24	Bona_Zuria	dilla sun	taramo			20	24		borata taramc	---		2016-05-20 18:2	2016-02-26 2		c0bfb37f-1c37
2015-12-15	Shebedino	N/Dulecl	Debiritu	1	0	28	24	2016-03-18	Sificha lega	2015-06-12		2016-06-04 17:2	2016-06-04 1		c091dffd-abd
2015-11-18	Shebedino	Dobe Ne	Genet	4	3	17	26	2016-04-22	Amanako	2015-07-17		2016-06-02 16:3	2016-06-02 1		d2dfbd4e-68
2015-11-13	Hula	Shako	Mulu Shabare	5	4	32	29		18	---		2016-02-14 09:2	2016-02-14 0		20fbe964-4e0
2016-06-02	Shebedino	nure dul	echa				26			---		2016-06-02 11:2	2016-06-02 1		a8a0e543-bf4
2016-06-21	Hula	Teticha	Etenesh	4	3	24	29	2016-10-20	01	2016-01-14		2010-01-21 20:2	2010-01-21 2		4cb6028a-ad7
2015-11-13	Hula	UDESA	KANA DUGUNA			20	30	2016-03-17	09	2015-06-11		2016-01-27 08:0	2016-01-27 0		f1e63b44-d65
2016-04-26	Hula	Teticha	Birke	3	2	18	24		11	---		2016-05-31 19:0	2016-05-31 1		67b0023e-0ff
2015-11-19	Hula	Shako	Genet sancho	6	5	19	25		01	---		2016-02-14 09:0	2016-02-14 0		45ed42c3-7ff
2015-10-27	Hula	Teticha	Kasech	5	4	16	30		1	---		2016-05-28 02:1	2016-05-28 0		79689c64-8af
2016-11-08	Dale	debub m	hana	3	2	24	28	2017-01-28	gale koete	2016-04-23		2016-12-08 17:5	2016-12-08 1		b55f5eae-4fd
2015-10-14	Shebedino	Dobe ne	Birtukan	1	0	23	20	2016-02-09	Holo	2015-05-05		2016-06-02 15:3	2016-06-02 1		c3113e52-04e
2016-06-16	Hula	Sororo	Enu	4	3	28wk	28	2017-04-18	15/Gonowa	2016-07-12		2010-01-01 03:4	2010-01-01 0		3d767e8a-d4c

Appendix 2: Continued Process evaluation and embedding the intervention

Supportive supervision to the project sites

Prior to the project implementation there was integrated supportive supervision conducted by the health department on quarterly basis, which did not include review of activities related to mobile technology use. There was no indicator to capture the implementation of mobile technology in the community.

During this period, we have conducted regular and quarterly supportive supervision to districts, health center, health post and households. A team composed of experts from maternal health, TB and HMIS carried out supportive supervision in the six districts. The team held discussion sessions with district office policymakers and health center staffs about the implementation process, contribution of the eHealth system to both programs and HMIS and key challenges identified and possible solutions.

The team also conducted a review of registers at both the health center and health post level to see the documentation of the maternal health and TB indicator and clients, reminders sent and action taken. This is compared with the software reported clients to assess consistency with the HMIS reports. The supervisory team also visited some households of clients to see the action taken by the HEWs once they received a text message(s).

There is increased commitment and use of the mobiles for the program and follow up reminders to improve adherence of patients and clients to the standard of care: sputum follow up, ANC and delivery. Some other Catchments expressed their interest and started discussions with their respective health workers and HEWs, which is encouraging and shows interest in scale up.

The feedback from the supportive supervision was delivered to the HEWs and health centers and discussed with the district health office. In addition, it is shared with experts and policy makers at the provincial level to identify possible solutions for key challenges encountered. The following photos illustrate how the project has included action at different levels.

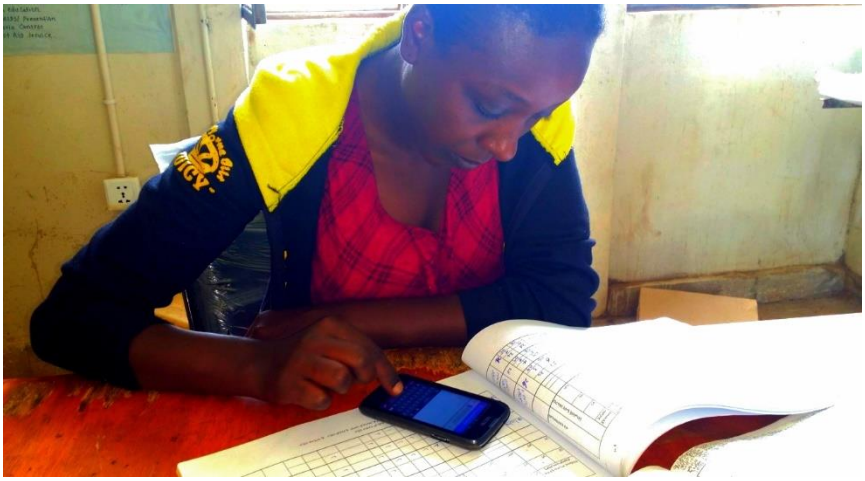
Regular supportive supervision to the districts, health center, health posts and households was conducted to ensure successful implementation of the project and learn from the implementers about the contribution of the project to improve the health system.

Picture 5. TB Patient family Home visit for TB screening by HEW & supporter

Picture 6. Community Awareness Creation about TB and MCH

Picture 7. House to house visit of maternal health

Picture 8. Supportive supervision at HPs and Community level for TB, MCH and use of eHealth



Picture 9. HEW, using her phone to encode &synchronize data from the health post

Catchment area meeting at health centres

Prior to project implementation, the catchment area meeting was used to collect reports and discuss health-related campaigns. There was no program specific and targeted meeting to review activities. During the project implementation, catchment area meetings are conducted at health centers by bringing HEWs and districts policy makers to discuss performance at health posts. The participants in the meeting include: Zonal Health Department officials and experts, Zonal DoFED officials and experts, District Health office officials and experts, District DoFED officials and experts, Health Centers staffs, Health Extension Workers, District supervisors of REACH Ethiopia, REACH Ethiopia zonal coordinators and REACH staff from the HQs.

During this session, summary of the performance of the catchment, PHCU, is presented by health posts HEWs who discuss on the reports, success stories and challenges identified. The district and health center staffs contribute and work on finding solutions to the problems identified and provide technical support. During this session best performance of HEWs are encouraged to share their experience with the others to learn from them and renew their commitment. This session is usually chaired by district health office head, health center head or program managers. HEW supervisors are also part of the meeting and supervision reports are presented to discus identified problems to improve the performance of the catchment area.

Picture 10. Catchment based review meeting

Community based awareness creation sessions

Community based awareness creation session and follow up of the activities at the community and household level has continued. The main community extension process in conducted in collaboration with health development army (HDA) where one household is linked to five households to discuss plan and conduct health related activities as stipulated under the health extension packages.

These activities aim to increase awareness of the community and promote health, identifying pregnant women and presumptive TB case and link them to care and support pregnant women forum (PWF) for discussion about pregnancy related health services. Awareness creation has contributed to improved participation of pregnant women in the PWF and increased participation of HDAs in the monthly meeting with HEWs. This is linked with REACHOUT project where we focus on community engagement and support the health system to monitor quality of the service delivery.

We have established quality improvement (QI) teams at health centers and districts to monitor the activities carried out to improve maternal health service delivery. This Team is composed of:

- Health Center Head (HCH)

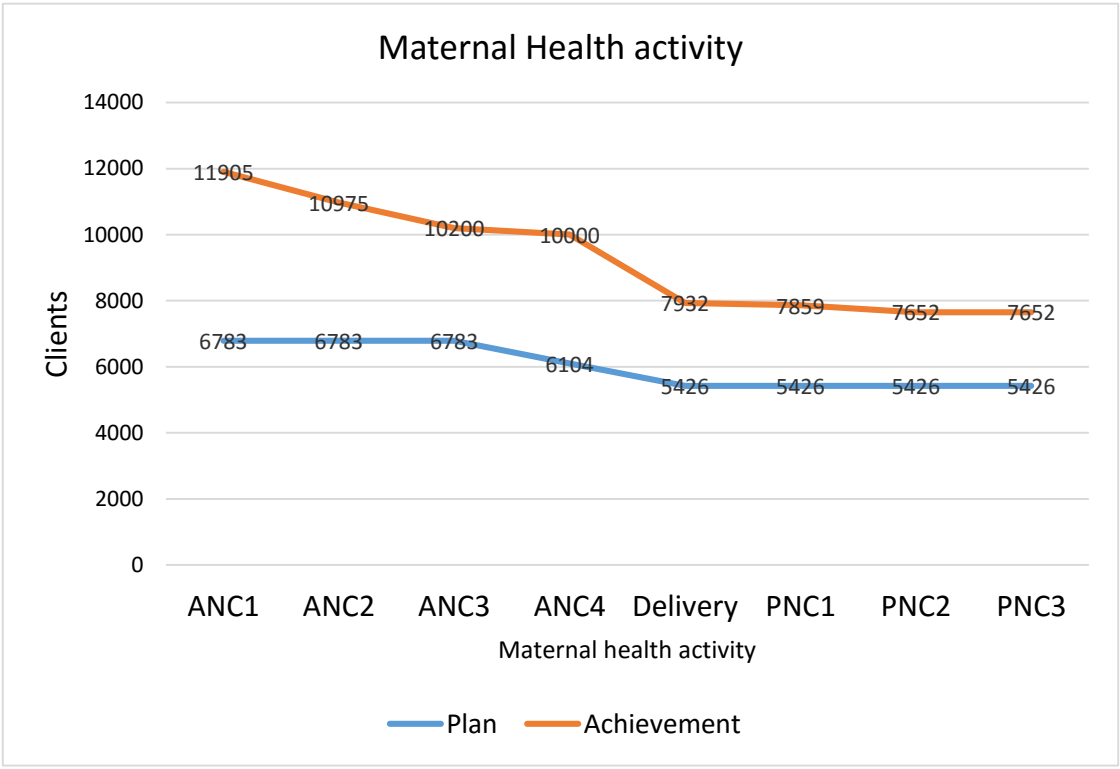
- Health center HMIS coordinator
- Health Center Maternal Health coordinator
- HEWs supervisor coordinator,
- Woreda Health Office focal persons (who coordinates specific assigned Health Centers)

Maternal health focal persons were trained for each health center and district and continue to review their performance on regular basis. The QI team at the health center comprises health professionals from different disciplines and departments. The QI team meets regularly, review the quality of services using indicators focusing on quality of services. The QI team also supervises the HEWs periodically for data quality verification and strengthens the use of eHealth for improving patient and client care and adherence to care with increased sense of accountability.

Appendix 3: paper-based reporting

S.N	Activities	Plan	Achievement(Gov't)	Percentage (%)
1	ANC1	6783	4837	71
2	ANC2	6783	4256	63
3	ANC3	6783	3512	52
4	ANC4	6104	4004	66
5	Delivery	5426	2354	43
6	PNC1	5426	2251	42
7	PNC2	5426	2012	37
8	PNC3	5426	2039	38

Table 9: Maternal Health Activity

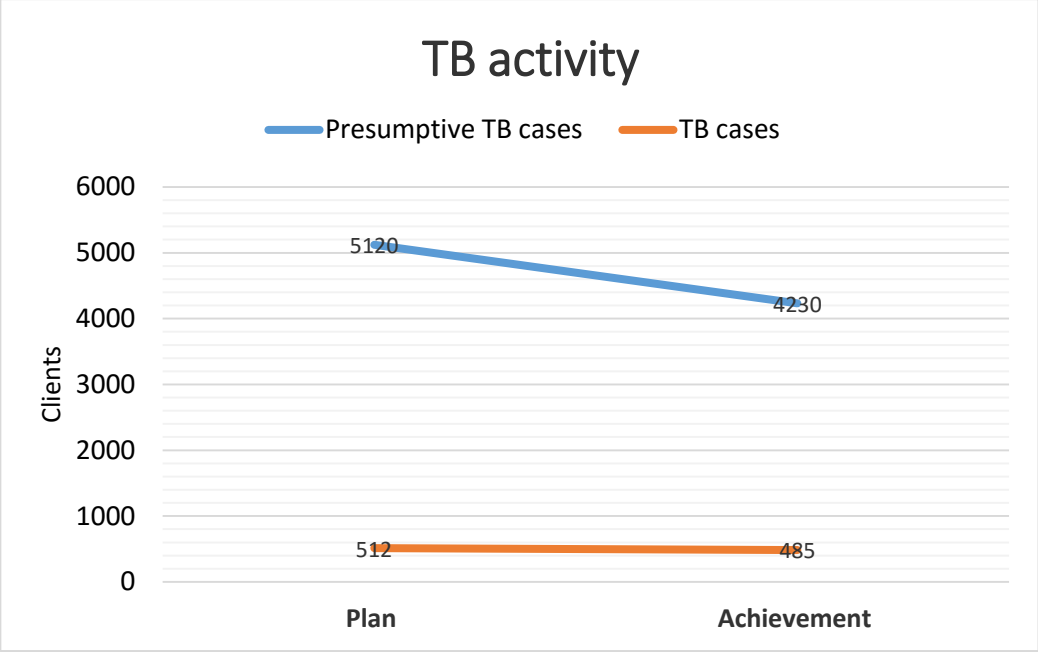


Graph 4. *Plan VS Achievement of Maternal health (**NB** plan refers to government health system plan)*

The blue color from graph 4 above describes plan of government health system and red color describes the achievement made by the project during its implementation in the districts. The project is outperforming the government plan and in addition to this it describes pregnant woman have good follow up at the very first Antenatal care but we have good performance on ANC4 and Delivery when compared with government plan.

TB activity

SN	***Activities***	***Plan***	***Achievement (Gov't)***	***Percentage(%)***
1	*Presumptive TB cases*	*5120*	*3120*	*61*
2	*TB cases*	*512*	*372*	*72*



Graph 5. *Plan VS Achievement of TB*

Graph 5 showing that the project works by taking the plan of the government and we evaluate our performance due to their plan. From the graph above there is improved performance TB and

presumptive TB cases. This shows house to house visit, contact tracing, and Awareness Creation and Social Mobilization is done well.

Note that

Our achievement was evaluated by using the government health system plan.

There is some difference when compared with the data from the server. This is due to the following reasons:

- All data from registers may not be encoded to mobiles. This is due to HEWs being over-loaded with government tasks and some other health campaigns
- There are network problems which prevent the data being uploaded to the server
- Mobiles may not always be charged due to lack of electricity (solar power is often used but will not work in early morning)
- Since HEWs are new to this technology there has been some adjustment period as they adapt to this technology
- HEWs may lose their data holding (encoded)mobiles before synchronizing to the server. As the result it affects eHealth performance.

Appendix 4: Learning from the implementation

National meeting

Genet (HEW) from Arbegona district presented at this meeting from her experience. As per Genet's presentation, the eHealth project benefitted her work by:

- Reminding clients appointment date
- Reducing false report & reduces report repetitions
- Increases participation of different stake holders
- since it sends alert delivery messages, it reduces home delivery

She mentioned problems related to electricity has been reduced performance of their work. However, the problem solved in Bochessa catchment with the help of REACH Ethiopia supervisor. After the installation of the solar system energy has improved the performance TB and Maternal health care in

particular. E- Health has improved the integrity of 1 to 5 networks with HEWs, thus improved in early identification of pregnant women and peoples having symptoms of TB to be referred early to Health center for diagnosis and follow-up.

Picture 11. Presentation by HEW, Genet, on case study of the TB client and the patient/client health status due to eHealth project

In addition to this Genet presented the case study that was done on the client called Wote Wansara who is a woman in the community where she works.

"There was a woman whose name is Woto Wansara – She is 29 years old female client In Sidama Zone Arbegona District in charicho kebele Manadame Goti, She presented with cough more than a month on 29/11/2016 to Charicho HP, she has massive weight loss, poor appetite and continuous headache. her husband died in 2006 E.C after defaulting DOTs , she took DOTs only for 27 days, with this history and presented chief complaint we(Genet and REACH Ethiopia supervisor 'Belachew kanafa') took her sputum slide to yaye Hospital on 21/08/2016 and she becomes SS +

She started DOTs on 25/08/2016 in Charicho HP. when she start DOTs her weight was 34kg. Now she gained 8kgs in six months and now her weight is 42kg , her DOTs adherence was very good, We took

sputum follow-up reminder SMSs at 2nd,5th and 6th month. we did follow-up sputum at 3rd and 6th and her result was negative. On 13/02/2017 she declared cure."

Picture 12. Follow up done by HEW Genet and REACH Ethiopia Supervisor Belachew

Picture 13 New life after she is cured. She married and have a child

Picture 14. Presentation by eHealth coordinator Webalem Mengesha on the project case objectives and findings to FMH, RHB, SZHD, ZOFED, DOFED, Partners and other stakeholders.

Describing about ***"applied research on Health extension workers using eHealth to strengthen equitable health systems in southern Ethiopia"*** project/research objectives, benefits of eHealth, baseline studies, control and intervention zones, reporting, further customization of the results and lesson learned, findings of research, the way forward of utilization of eHealth on other health care activities.

The lesson learned from the intervention of the project thus far indicates that using mobile phones for data capturing and follow up of pregnant mothers, presumptive TB cases was possible in rural communities. The HEWs were able to capture the data and use the cell phones to synchronize data

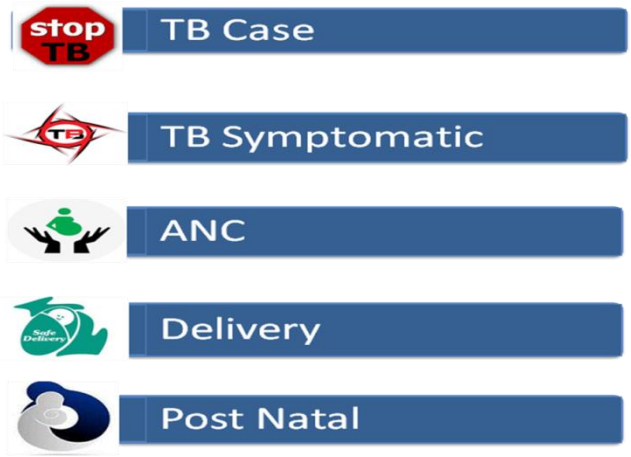
and send it to the server which in turn comes back as alert messages to all with the privilege. This has exceedingly helped to provide timely services to eligible targets and to supply the health system with reliable as well as well-timed information.

Reminders appear for pregnant mothers indicating the due date is approaching; the system gives one week reminder. One week period is issued to do delivery preparedness discussion with the pregnant mothers and identify any risk factors. The mothers get ready to make decision for delivery place of preference.

Continued improvement of the software and its use

The development of software and its use demands continued customization based on the needs arising during the process of implementation. The software sends text messages to mobile users and sometimes text messages on mothers from other districts appeared on mobile phones in other districts. This time we had reduced the number of unnecessary text messages going to other users or districts and increased confidentiality of the information shared about the clients. In addition to this the system did not send the name of kebele/village of the TB client, now it sends the name of village/kebele of the client so the client is easily identified.

The software includes these modules



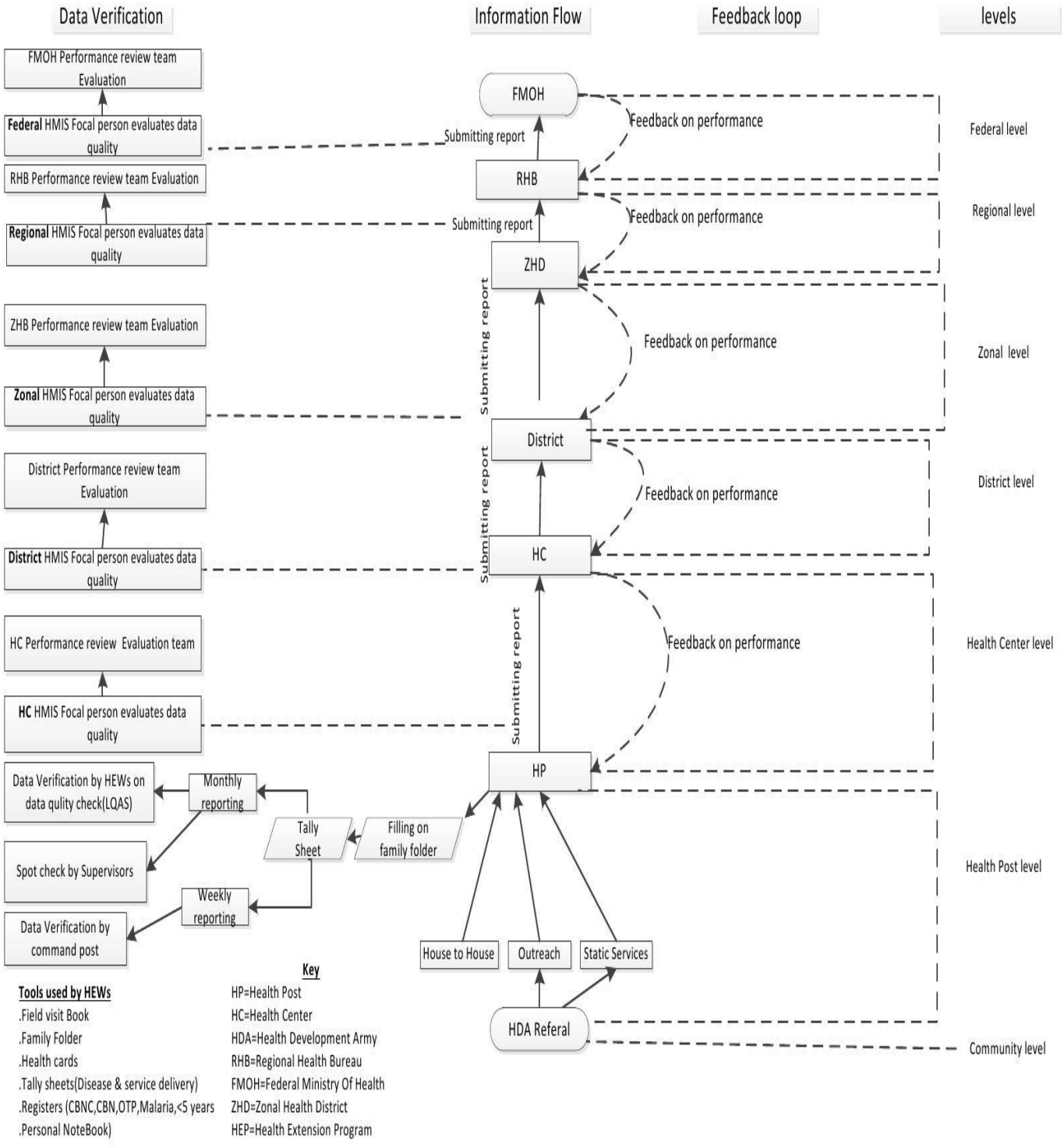
During this period, the eHealth expert has conducted supportive supervision to the sites and conducted on site training and support to the districts and health posts visited. There is increased use of the information to improve the service delivery in the community which is encouraging.

Ongoing areas for improvement

The project implementation is aligned with the HSTP and information revolution resulting in increasing interest from policy makers about the potential capacity to increase the coverage beyond the project sites and expand to other health programs. Some have requested the use of their own phones to be included and as they would like to receive text messages to make sure that the service is made available to their community. There is clear understanding that the telecommunication authority of the country has the capacity to deliver the service if consensus is reached at the level of policy makers. We made a review of the overall performance to share the experience and lessons learned from the project so that the policy makers can make informed decisions about scale up and working in partnership with these groups at different levels supports buy in and interest.

However, we have indicated the cost implications and the support required to scale up the activities in other areas. This cost implication includes purchase of mobile phones, cost for software development, installation and configuration, HEW capacity building and continued Monitoring and server cost. We will continue discussion with policy makers and administrators in the districts and province to show the importance of the approach and will try to engage them to raise their voice to be included as part of the information revolution to highlight the importance of supporting HEWs and the communities they serve with new technologies for data flow, responsive services and accountability.

Information flow Mapping-HEP Ministry of Health of Ethiopia



Systematic data flow from HEWs to the health system