Royal Tropical Institute

Mobile health: Connecting managers, service providers and clients in Bombali district, Sierra Leone

Intervention study on mHealth for maternal and newborn health in resource-poor community and health system settings, Sierra Leone ♦ *Baseline study report*

DFID New and Emerging Technologies
Research Competition, Phase 2

The consortium partners are the following:

Medical Research Centre

Government of Sierra Leone

University of Sierra Leone

Royal Tropical Institute

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Cover photo: is MCH Aide in Kalangba PHU, Bombali District; photo MRC.

[1] The MDG5 Meshwork for Improving Maternal Health is a cross-sector, cross-disciplinary network of more than thirty organizations based in Sierra Leone, Afghanistan and the Netherlands (www.mdg5-meshwork.org).

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Abbreviations and acronyms

ANC	Antenatal care
ANC1	First antenatal care visit
CHA	Community health assistant
CHC	Community health centre
CHO	Community health officer
CHP	Community health post
DFID	UK Department for International Development
DHMT	District health management team
EDCU Assistant	Endemic disease control unit assistant
FP	Family planning
KIT	Royal Tropical Institute
M&E	Monitoring and evaluation
MCH Aide	Maternal and child health aide
MCHP	Maternal and child health post
mHealth	Mobile communication for health
MNH	Maternal and newborn health
MoHS	Ministry of Health and Sanitation
MRC	Medical Research Centre
Natcom	National Telecommunications Commission
NET-RC	DFID New and Emerging Technologies – Research Competition
PBF	Performance-based financing
PHU	Peripheral health unit
SECHN	State-enrolled community health nurse
SLL	Sierra Leone Leone (currency)
TBA	Traditional birth attendant
USL	University of Sierra Leone
VPN	Virtual private network

Summary

Background and purpose

The intervention study, under the 'mobile health for maternal and newborn health in resource-poor community and health systems settings, Sierra Leone' programme, follows the successful completion of the feasibility study carried out in 2011. The overall research objective is to assess the effect of integrating mobile communication strategies into existing health service packages in Bombali district, Sierra Leone, on maternal and newborn health service utilization. An intervention would be undertaken involving each health facility and related clinical staff in the study district and a limited number of traditional birth attendants in two chiefdoms, as well as antenatal care and family planning clients who decide to participate.

This report describes the results of the baseline study undertaken before the implementation of the mHealth interventions.

Methods

The baseline study collected quantitative data from health facilities and health workers in Bombali district. Facility characteristics (type, level and use of mobile phones) and staffing levels were collected. Information was gathered from facility staff about mobile phone use for initiating and receiving calls and/or text messages, on barriers to the use of mobile phones and on perceptions regarding job satisfaction and related communication. Data will be collected from health workers again at midline and end line to measure changes over time in relation to the phased implementation of the interventions. Because of the phased (step-wedge) design of the Phase 2 study, the information about the health facilities and health workers was analysed between the two wedges, to determine whether the wedges (defined by population density matching) were comparable at baseline.

Findings and implications for midline and end line analysis

Information was collected from 181 health workers, representing 94% of the estimated number of health workers employed at the time of the baseline study. Health workers generally reported good mobile phone network coverage, with 54% indicating coverage 'all the time' and 30% 'most of the time'. Slightly more health workers in the highest level of facility (community health centres) reported better coverage compared to health workers in lower-level facilities, but this was not statistically significant. Most of the health workers (86%) reported that they were able to initiate and receive phone calls/text messages inside the health facility. For the rest, an average walk of 28 minutes was needed to reach network coverage. Almost all the health worker respondents (99%) did not have access to a dedicated facility work phone; all indicated that they made and/or received work-related calls and messages using their personal phones. The health workers used the mobile phone almost exclusively for calling, with only a few who indicated that they also sent text messages. Baseline data show that more than half of the health worker respondents made calls to and received calls from clients, while less than half called and received calls from traditional birth attendants.

Comparison analysis between the intervention wedges shows a large number of similar characteristics for both health facilities and health workers. Some significant differences were found that indicate that Wedge 1 respondents may have to make more of an effort to communicate by mobile phone than those in Wedge 2. This is related to the ability to make calls within the peripheral health

unit and reported availability of network coverage. Multivariate analysis will be used to examine midline and end line effects, to control for baseline differences found.

The baseline analysis provided information that will be used to improve the midline data collection tools and has also contributed to determining additional or adapted topics for midline interviews.

Keywords: health communication, health systems, mHealth, mobile technology, maternal health, mobile health, newborn health, Sierra Leone

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1 Introduction

The 'mHealth for maternal and newborn health in resource-poor community and health systems settings, Sierra Leone – Phase 2' research project is funded by the DFID programme on New and Emerging Technologies Research Competition (NET-RC). This programme aims to realize the potential of new and emerging technologies for poor people by identifying applications from which, directly or indirectly, they can reap tangible benefits such as improved health and reduced risk of disease.

Research under the NET-RC programme (i) focuses on the best ways to responsibly introduce and use relevant, effective and affordable new technologies in resource-poor settings; (ii) identifies and deals with barriers that prevent disadvantaged people from benefiting; and (iii) addresses possible risks in terms of undue effects on development goals.

This current study follows the successful implementation of a first-phase feasibility study, 'mHealth for maternal and newborn health in resource-poor community and health systems settings, Sierra Leone' carried out between December 2010 and August 2011.[2]

1.1 mHealth Phase 1 results

The objective of the feasibility study was to assess the feasibility of introducing and operating selected mobile communication technologies for improved communication on maternal and newborn health (MNH) in a fragile health system in resource-poor settings.

The research was mainly qualitative, exploratory in nature and was implemented in two sites, Kenema district and Western Area. The main research methods included semi-structured interviews, in-depth interviews, focus group discussions and literature review. The main research participants were health workers, health managers and community key informants from the two sites; health service clients and male, female and young community members from the districts; and key informants (health managers and experts) at national level.

Analysis workshop during Phase 1

Photo: Kathy Herschderfer/KIT

The study found that health workers, clients and other community members alike see much potential in using mobile communication across various health care domains, to improve information, service delivery, access, quality, efficiency, responsiveness and, ultimately, health outcomes.

[2] Magbity E, Ormel H, Jalloh-Vos H, De Koning K, Sam EM, Van Beijma H, Kamata SAY, Daniels D, Kargbo S, Hessels P, Dumbuya A, Harteveld L, Kamara A, Herschderfer K, Leigh B and Konteh-Khali N (2011), *"I expect the health worker to call me". mHealth for maternal and newborn health in resource-poor community and health systems settings, Sierra Leone. Feasibility study report. DFID New and Emerging Technologies Research Competition, Phase I*. Amsterdam: Royal Tropical Institute, http://www.dfid.gov.uk/r4d/PDF/Outputs/Misc_MaternalHealth/mHealth-Sierra-Leone-Phase-1-Final-research-report-for-DFID-08Sep11.pdf.

Work-related use of mobile communication for health (mHealth) is already very common among health workers. The preferred mode of communication is voice calls, although half of the health workers also use text messaging (community members do not). Barriers identified relate to external factors such as geographical coverage of the mobile network and literacy levels, but also to factors that could be addressed by the health system, including poor access to battery charging facilities, poor access to a duty phone and poor access to/payment of top-up cards.

Data confirmed that almost all health workers possess a mobile phone; however, only one third of the clients interviewed have one, although another third have conditional access to a family member's phone. Community members consistently mention MNH as the most important area that would benefit from mHealth strategies.

"I expect them to call me and check on my general welfare and to encourage me to visit the clinic frequently, so that the position of my baby can be checked on a regular basis." – Female client, Kenema

Expectations regarding mHealth among both health workers and community members were found to be high, although some health workers fear an increased workload, while confidentiality and privacy issues also raise concerns, especially in view of the practice of 'phone sharing'.

Communicating with and receiving relevant information from mobile network operators regarding coverage data, subscribers and tariffs has been challenging, and the telecommunications regulator, NatCom, has not yet been able to share relevant information. This context should be taken into account when pursuing mHealth in Sierra Leone.

While mHealth is perceived as potentially beneficial in a number of ways, health policymakers and managers may need to prepare for strains and demands on the health system. These include a possible increase in workers' workload; the consideration to establish a 'protocol' for (mobile) communication with clients; standards and systems for an increased information flow among health workers and between them and clients; considerations of costs to health staff and clients; and governance issues surrounding ethical issues and confidentiality, public–private partnerships and sustainability.

1.2 mHealth Phase 2

Building on the Phase 1 results, the 'mHealth for maternal and newborn health in resource-poor community and health systems settings, Sierra Leone – Phase 2' project proposal was submitted and approved by DFID in July 2011. The Phase 2 contract was signed in October 2011, after which implementation preparations started, starting with an inception phase.

The research protocol was subsequently developed, in close collaboration with all consortium partners. It was submitted in parallel to the Sierra Leonean Ethical Review Committee and the KIT Research Ethical Committee. Approval was received from both bodies by May 2012.

The baseline data collection was carried out in May–June 2012 prior to the start of the intervention. This report presents the results of the baseline study.

2 Study design and methodology

2.1 Phase 2 study objectives and methodology

This section contains a description of the overall intervention study objectives, intervention logic and methodology, to which this baseline study is linked.[3]

Objectives
The general research objective is to assess the effect on maternal and newborn health (MNH) service utilization of integrating mobile communication strategies into existing health service packages in one health district in Sierra Leone.

Specific research objectives are:

- to assess changes in MNH/family planning (FP) service utilization by clients, associated with expanded options for client-initiated and provider-initiated mobile communication:
  - for the entire district (engaging all peripheral health units (PHUs) and through the national information line); and
  - in the selected PHU catchment areas that implement the intervention involving traditional birth attendants (TBAs);
- to assess changes in health workers' job satisfaction and control at work, and other self-reported changes due to expanded options for provider–provider communication and provider–client communication;
- to assess changes in MNH referral systems due to expanded mobile communication options;
- to assess changes in maternal death reporting
- to identify implications for the health system of mobile communication initiatives; and
- to make policy recommendations for integration of mobile communication initiatives in district-level MNH service packages.

Interventions
The intervention study contains a number of interventions that were decided on and agreed to, using information from literature review, situation analysis, the outcomes from the feasibility study and the results of a ranking exercise. The intervention involves each health facility and related clinical staff in the study district and a limited number of TBAs in two chiefdoms, as well as antenatal care (ANC) and FP clients who decide to participate. Facilities receive a mobile phone with a SIM card that is part of a virtual private network (VPN), constituting a closed user group of PHUs and district managers (members of the district health management team (DHMT), key hospital contacts and local councils) that allows unlimited calls and text messages among all members without cost to them (and a pre-paid monthly cost per district). Some PHUs also receive a solar-powered battery charger to make it easier to recharge the mobile phone's battery where this would otherwise be difficult. All facilities at some point receive monthly phone credit to enable communication with clients who opt to enrol in the programme. Training, supportive supervision and refresher training is also undertaken. In a small pilot area (two chiefdoms), TBAs are included in this VPN.

The full scope of the interventions can be found in the intervention logic diagram in Annex 1.

[3] The overall research protocol is available on request.

Study design

The Phase 2 intervention study has a quasi-experimental design with a mixed-methods approach (combining quantitative and qualitative research methods). A phased implementation and analysis is carried out by using a step-wedge design, in part including a counterfactual (non-intervention) analysis to allow comparison of outcomes between the intervention and the non-intervention areas. Annex 2 provides an overview of the overall study objectives in relation to research questions, research methods, data collection tools and envisaged research participants for the entire study.

Description of study district

Among several eligible districts (where no VPN or other mHealth-related interventions were in place yet), Bombali district (see Figure 1) was selected, as it is centrally located with relatively easy geographical access to most of its chiefdoms and since it has >90% mobile phone network coverage at the PHU level for at least one (the same) mobile network operator. The district is divided into 13 chiefdoms and has 98 functioning PHUs and five hospitals. Access to some of the health facilities in the district is difficult due to the poor road network, especially during the rainy season. Agriculture, trading and mining are the main economic activities. Literacy levels are low, with 75% of females and 55% of males being illiterate. The main ethnic groups in the district are Temne and Limba. The district is predominantly Muslim.[4,5]

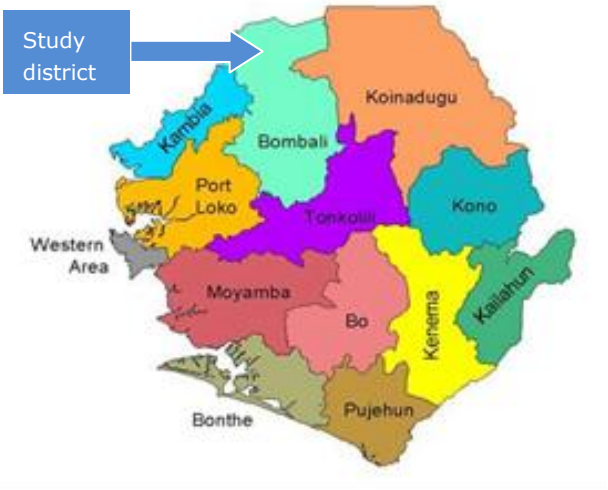


Figure 1: Map of Sierra Leone with Bombali study district

Study chiefdoms and wedge definition

In principle, all 13 of the chiefdoms in the district were to be included in the study. The intervention is implemented in two phases (wedges). Each phase involves an equal number of matched chiefdoms (six in the Wedge 1 group and six in the Wedge 2 group)[6] based on a density ranking (number of PHUs/100,000 population).

During the course of the phased intervention implementation, one chiefdom in each wedge will involve TBAs in the mHealth package of interventions. The TBA pilot intervention chiefdoms are matched to non-TBA intervention chiefdoms for comparison purposes. The choice of TBA pilot chiefdoms and matched non-intervention chiefdoms is based on the PHU density ranking (described above) and on the availability of reported good mobile telephone network reception.

Table 1 shows the overview of the matched pairs of Wedge 1 and Wedge 2 chiefdoms. The TBA intervention and comparison chiefdoms are indicated.

[4] Thomas AC (2010), Population profile of Bombali District and Makeni Town. 2004 Population and Housing Census of Sierra Leone. *2004 Census Publication Series*, Number 3. Freetown: UNFPA/Statistics Sierra Leone, February.

[5] UNICEF (2011). *Multiple Indicator Cluster Survey 2010*, validated standard tables.

[6] Although included in the intervention, chiefdom Tambaka is excluded from the comparisons, as it is a large and sparsely populated chiefdom with only three PHUs and very poor mobile phone reception.

Table 1: Overview wedges and chiefdoms by density (no. of PHUs/100,000 population)

Wedge 1	PHU density	Wedge 2	PHU density
Safroko Limba	36.8	Libiesaygahun	32.4
Biriwa	30.8	Magbaimba Ndowahun	30
*Paki Masabong	30	*Gbanti Kamaranka	26.5
**Makari Gbanti	29.5	**Sanda Tendaren	23
Gbendembu Ngowahun	20.2	Sanda Loko	18.8
Sella Limba	13.2	Bombali Sebora (including Makeni city)	12.5

**TBA intervention chiefdom (one in each wedge)*
***TBA comparison chiefdom (one in each wedge)*

Health facility sampling
The focus of the mHealth interventions is on primary MNH care; hospitals were not included in the intervention. All functioning health facilities – community health centres (CHCs), community health posts (CHPs) and maternal and child health post (MCHPs) – in the study district were eligible for data collection. One non-functioning facility (Fullah Town II in Bombali Sebora chiefdom) was excluded from the study, leaving a total of 98 health facilities.

Participant selection
According to the DHMT, at the time of the baseline there were 193 registered maternal health workers in the district, including community health officers (CHOs), community health assistants (CHAs), state-enrolled community health nurses (SECHNs), maternal and child health aides (MCH Aides), endemic disease control unit (EDCU) assistants and midwives; and excluding laboratory staff, porters, cleaners, community health workers, TBAs and vaccinators. Sample size calculations showed that a sample size of 225 was needed to detect a 10% difference in outcome. A 'take all' approach (data collection from the universum of health workers in Bombali) was thus decided on.

2.2 Baseline research methodology

This section contains information specifically relating to the baseline study.

Baseline design
Although the intervention study has an overall mixed research methodology, the baseline design is solely quantitative. An overview of the baseline data collection tools in relation to the data collection tools planned for the midline and end line studies can be found in Annex 3. There were five planned modalities for baseline data collection:

- information about individual health workers to be repeated at midline and end line to measure changes over time;
- specific information about health facilities prior to implementation to understand the context of the work situation;
- summary information from maternal death reports;[7]
- specific information from PHUs on gestational age at the first antenatal care (ANC1) visit to use as an outcome indicator for the TBA intervention (further discussed in the study limitations section); and
- health service utilization data derived from the health management

[7] These data are not presented in the current baseline report and will be included in the midline report.

information system (HMIS)/District Health Information System (DHIS).[8]

Baseline instruments

Two survey instruments were developed for the baseline study: a health facility survey and a health worker survey. The short facility survey contained questions about the characteristics of the PHU, including the number and types of health workers employed. It can be found in Annex 4.

The health worker survey gathered information about the health worker, mobile phone use for initiating and receiving calls and text messages, barriers to the use of mobile phones and job satisfaction and communication. The questions on job satisfaction and communication were developed as 22 statements (items) that were categorized into four domains (constructs):

- quality of working life;
- communication with clients;
- communication with peers and seniors; and
- working conditions.

The statements could be answered using an agreement scale[9] and built on earlier work undertaken in Sierra Leone.[10] They can be used to measure changes in perceptions on these issues. This questionnaire is included in Annex 5.

Data collector training

A training workshop was conducted with a group of local researchers from the University of Sierra Leone (students and lecturer) identified and recruited for the data collection fieldwork. Based on the research protocol, they received training in survey techniques, discussed ethical issues, field-tested the data collection tools and adapted them where needed. Organizational and quality assurance issues were also addressed.

Data collection

Data were collected during May and June 2012. Informed consent was obtained from all research participants.

Data entry

Data entry screens were developed for both baseline surveys in EpiData version 3.1. A short data entry training was held for three members of the data collection team who subsequently entered all the data. The individual EpiData files were cleaned, merged and exported into SPSS version 20 for analysis by KIT staff.

[8] These data are not presented in the current baseline report and will be included in the midline report.

[9] Based on previous work in Sierra Leone, a five-point Likert agreement scale was used, range: strongly disagree, disagree, neutral, agree, strongly agree.

[10] Herschderfer K, Sam-Kpakra R, Wolmarans L, de Koning K. (2012), *Psychosocial Counseling for Health Workers to Improve Maternal Health in Kono District – Results from a baseline study; for the Concern Worldwide's 'Innovations for Maternal and Child Health Initiative'*.

Data analysis
Descriptive statistics were compiled for the health worker data collected, and they were reviewed for cross-checking and validation purposes. After further cleaning (involving consistency checks of skip patterns, missing and invalid data), new variables were created for questions with multiple responses, and open-ended questions were coded.

In addition, a comparison analysis of health worker and health facility characteristics was carried out between the chiefdoms designated for Wedge 1 and Wedge 2, to determine whether the wedges are comparable.

Statistical testing for the relationship between two categorical variables was carried out using the Chi-squared test or z-test. An independent samples t-test was used to compare the means of continuous variables. A 0.5 level of significance was used.

Reliability analysis was carried out for scale items/statements using Cronbach's alpha, a coefficient of reliability and commonly used as a measure of the internal consistency of a set of statements on a certain construct or in, for example, psychometric test scores. The results of this can be found in Annex 6.

Quality assurance
To ensure that the data collected were of an acceptable quality, the following measures were taken:

- Oversight for field-testing and finalizing the data collection instruments and the training of data collectors rested with the highly experienced Principal Investigator, who worked closely with expert colleagues from MRC and KIT.
- Only enumerators with previous experience of field data collection were recruited, and these were thoroughly trained in data collection, the importance of respectful attitudes etc.
- Data collectors were supervised during fieldwork, where quality assurance procedures were applied that included checking coding on questionnaires to answers and reviewing surveys for completeness.
- The health worker survey was designed in English and, during the researchers' training, translated and back-translated into Krio using a participatory process, until all terms were understood in the same way by all.
- The baseline instruments were field-tested and adapted prior to data collection.
- The specially designed data entry screens were developed to accommodate the skipping pattern of the surveys and to ensure that all questions were entered. Some questions were developed to accept only probable answers, which reduced entry mistakes.

Research capacity strengthening
A secondary objective of the Phase 2 study is to strengthen research capacity in Sierra Leone with a focus on intervention, action research and realist approaches, as well as on dissemination and effective use of research results. The baseline study provided the opportunity to train a dedicated group of data collectors (from the University of Sierra Leone) who could also collect data for the midline and end line data collection.

Study limitations
Some limitations of this study were identified as follows:

- Data were collected from one district which was purposefully selected from among only a few eligible districts, and so cannot be taken as representative of the current situation in other districts or in the country.

- Chiefdoms (consisting of different numbers of PHUs of varying levels) were taken as the unit of analysis, as opposed to individual PHUs. This was a pragmatic decision taken to align data collection activities with the normal supervision channels used by the DHMT and the CHO (community health officer, in charge of the CHC, who supervises the lower-level facilities within the chiefdom).
- With a small, finite number of chiefdoms in the district, the wedges were not determined by random sampling but, rather, by PHU density (number of PHUs/100,000 population) matching, to reflect the effect of the intervention on service utilization (assuming that low PHU density indicates a larger distance to the facility).
- Information collected relating to gestational age at ANC1 could not be used, as data proved unreliable.[11]
- Obtaining reliable data on the cost of phone top-ups made by health workers to call colleagues and clients proved difficult for the group of data collectors, who did not probe sufficiently. This was discussed, and the data collectors are expected to be able to probe better during the midline and end line data collection. Also, respondents may have provided relatively high figures, anticipating financial support through the project.
- The data collection took longer than planned because, in some cases, the data collectors needed to return to facilities to obtain data from health workers who were absent during the initial visit.

[11] Data collected on the last day of menstruation, needed to calculate the gestational age at ANC1, were not uniformly noted at the PHU level; the alternative data, noting the height of fundus at ANC1, proved to be unreliable during the quality check.

3 Findings

This chapter focuses on the results of the two baseline surveys:

- the *health facility survey* data reporting on the basic characteristics of the individual PHUs in Bombali district; and
- the *health worker questionnaire*, used to obtain data on respondent characteristics, mobile telephone coverage and current use of mobile communication, including initiating and/or receiving work-related phone calls and text messages to other staff in the health sector, to TBAs and to clients. Information on mobile telephone use and job-related satisfaction and communication was also collected.

In addition, this report presents a baseline comparison between the chiefdoms that are part of the two stages of implementation (Wedges 1 and 2). The wedges were compared for health worker characteristics, use of mobile telephones and job satisfaction, as initial differences could contribute to measured effects at midline or at end line. Other baseline data relating to reporting maternal deaths and routine indicator data from the health management information system (HMIS) will be included as part of the midline study report.

Women and children waiting for consultation at a health facility in Bombali

Photo: MRC

3.1 Health facility information

There are three types of PHUs in Bombali district: community health centres (CHCs) are the highest level; community health posts (CHPs), the middle level; and maternal and child health posts (MCHPs), the lowest level.

Specific information about health facilities was obtained from 98 of the 99 health facilities in Bombali district using the health facility survey. One non-functioning facility (Fullah Town II) was excluded from data collection. Additional information was collected using the health worker questionnaires from 95 health facilities. The staff size of the 98 study facilities in Bombali varied from one to five staff members. One facility, with 14 members of staff, is a PHU housed in the same compound as the DHMT and next to the midwifery school; it has a large catchment population. It is formally an MCHP (the lowest level of PHU) but does not represent the staffing situation of MCHPs in general.

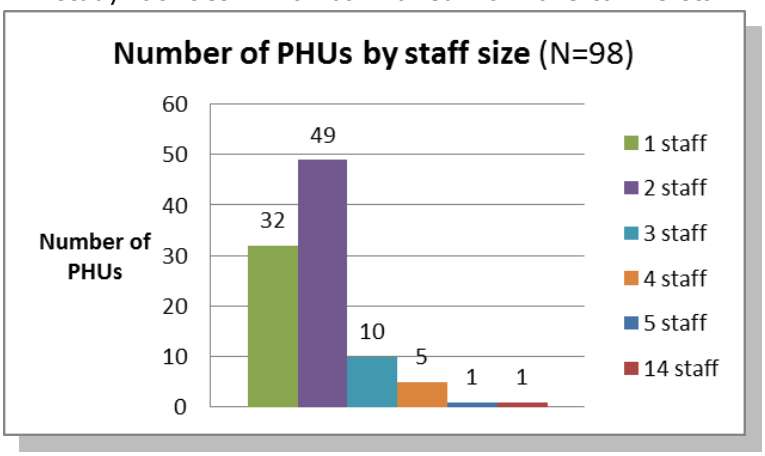


Figure 2: Facility staff size

Figure 2 shows the distribution of facilities by staff size. Almost a third of the PHUs reported having one health worker, while 67% have a staffing level or two or more health workers.

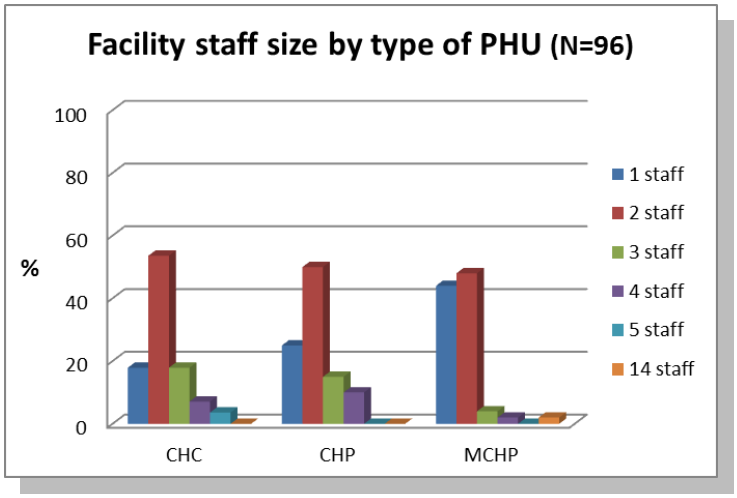


Figure 3: Facility staff size by PHU type

Figure 3 shows the breakdown of the staffing size by type of facility. CHCs and CHPs have the highest staffing levels, as expected. With the exception of the ANC clinic in Masuba with 14 members of staff, almost all of the MCHPs (94%) have two or fewer clinical staff members.

In response to the question if there was a facility mobile phone (dedicated for work-related calls and not personally owed), 97 of the 98 respondent facilities (99%) reported that they did *not* have a facility phone. Matoto is the only facility that reported having a facility phone at baseline.

3.2 Participant characteristics

Information was collected from 181 health worker respondents employed in 95 out of the 99 health facilities in Bombali district. Data were not collected from the non-functioning facility, Fullah Town ll, as previously mentioned. Data were also not collected in a second facility in Bombali Sebora chiefdom (Masory) because information in the field indicated that it was also non-functioning at the time of the baseline.[12] In two other facilities, information was not obtained because the staff were on outreach, in Kiamuinday (Libiesaygahun chiefdom), and because there was a change of staff and new staff were not yet present, in Kagbankona (Biriwa chiefdom).

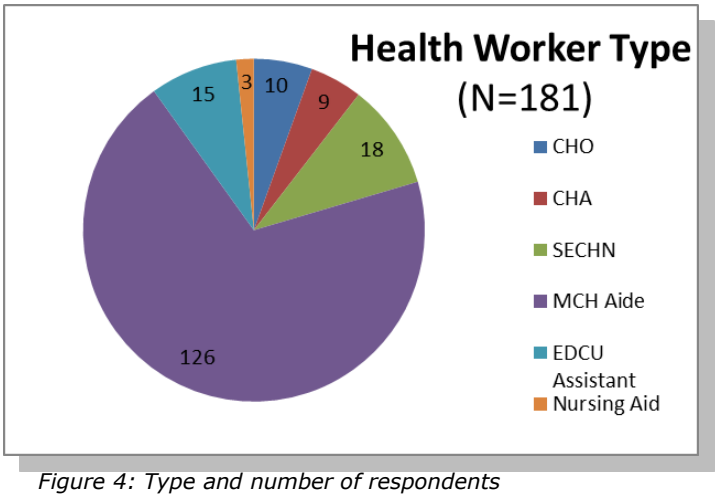


Figure 4: Type and number of respondents

The data on the number of health worker positions in the district from the health facility survey (196) is similar to the data obtained from the District Health Authority (193). The number of health workers surveyed (181/193) represents 94% of the reported clinical staff in the district and was considered sufficient to represent the universum of health workers in the district at the time of the

[12] In retrospect, it appeared that Masory was a functioning PHU, and it will be included in the midline study.

baseline survey. Figure 4 shows the number of health worker respondents by cadre.

The health worker respondents ranged in age from 25 to 64, with an average age of 41. Most of the health workers (83%) were female. CHOs and EDCU assistants were more often male, while there was a 2:1 ratio of women to men in the groups CHAs, SECHNs and nursing aides. All MCH Aides were female. Only six out of the 181 (3%) health workers reported *not* having children.

Almost all of the health workers (94%) had worked at the present facility for more than three months. There is no significant difference between the types of health workers and the length of time working at the present facility. Only six out of the 181 respondents (3%) reported *not* being on the government payroll; half of these were EDCU assistants, and the rest were one CHA, one SECHN and one nursing aide. Annex 7 provides a summary of the background characteristics of the health worker respondents.

Figure 5 shows the distribution (percentages) of the total respondent group by type of health worker and type of health facility. The largest group of health workers, MCH Aides, are found in all types of PHUs but work primarily in MCHPs. All 10 CHOs work only in CHCs, and the CHAs work either in a CHC (2 out of 9) or CHP (7/9). SECHNs, MCH Aides and EDCU assistants are found in all levels of health facility. Nursing aides work generally in hospitals, but the two recorded in our data work in an MCHP and a CHC.

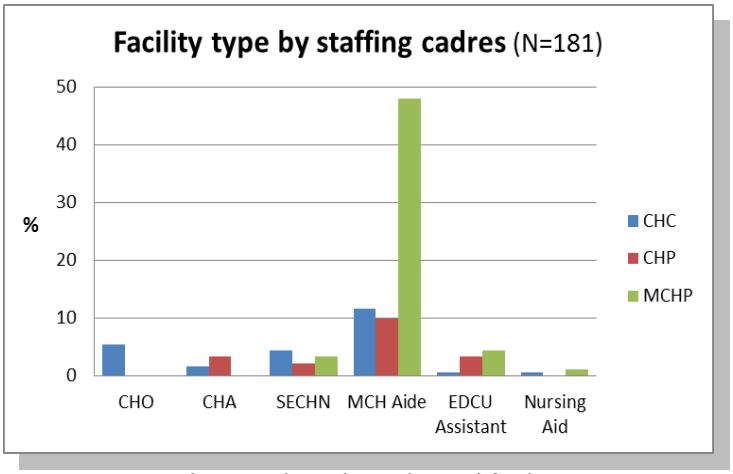


Figure 5: Total respondents by cadre and facility type

Every PHU has a designated in-charge responsible for the management of the facility. In general, the higher the PHU level, the higher the level of in-charge. In total, 92 (51%) of the respondents were recorded as facility in-charge. Figure 6 shows the distribution of the in-charge positions by cadre and facility. Almost all the in-charges of MCHPs were MCH Aides. All cadres except for CHO were noted as in-charge of CHPs. More than 70% of the in-charge positions in CHCs are filled by CHOs.

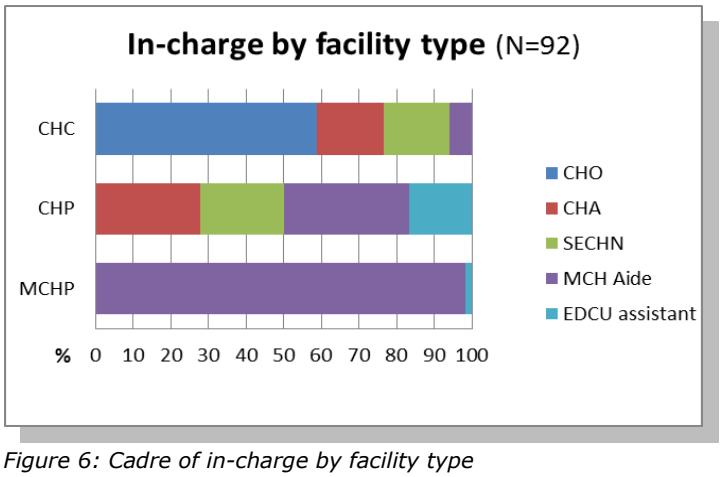


Figure 6: Cadre of in-charge by facility type

3.3

Key characteristics of mobile phone use

This section addresses the type of mobile network provider, network coverage, phone ownership and modes of communication.

Mobile network provider

Table 2 below shows the percentage of health workers reporting availability of network providers in their PHU area. Airtel and Africell were noted as being available by most of the health workers (99% and 77%, respectively).

Table 2: Reported network availability*

Phone networks available	N=180	Percentage*
Airtel	179	99.4
Africell	139	77.2
Comium	33	18.3
Sierratel	8	4.4

** Multiple responses allowed. Percentages do not add up to 100.*

Network coverage

The health workers generally report good mobile phone network coverage, with 54% of the health workers noting coverage all the time, and 30% noting most of the time. Only one health worker in an MCHP indicated that there was almost never coverage at her normal calling location. Slightly more health workers in CHCs indicated that there was mobile phone coverage all or most of the time compared to other types of facilities, but this was not statistically significant. CHCs are usually located in chiefdom headquarter towns, which are more likely to be in the vicinity of mobile network poles.

Network coverage inside the health facility

A large majority of health workers (86%) reported being able to initiate and receive phone calls and text messages *inside* the PHU. There is no difference seen between types of facilities. Of the 25 (14%) health workers who reported *not* being able to make and receive phone calls and text messages *inside* the PHU, the time needed to walk to a place where network coverage was available varied from 1 to 90 minutes, with an average of 28 minutes (the mode – the number most often mentioned – is 30 minutes).

Ownership of phone

Only two health workers reported using a facility phone (defined as a non-personally owned phone for work-related calling and messages); therefore, 99% of the health workers in the study *did not* have access to a work-provided phone. Despite this, almost all the health workers made and received work-related calls and text messages. Table 3 shows the modus of calling/texting for the 179 health workers who did not have access to a facility phone.

All the 179 health workers indicated that they used their own personal phone to make work-related calls and text messages, and almost all of them received calls and messages with their personal phone. Only a few health workers indicated that they used a phone belonging to a co-worker or someone else to either make or receive calls and text messages.

Table 3: Modus of calling/texting without facility phone

	do not make/ receive them		personal phone		colleague's phone		other person's phone	
	N	%*	N	%*	N	%*	N	%*
How do you make work-related calls and messages?	0	*0*	179	*100*	9	*5*	1	*0,6*
How do you receive work-related calls and messages?	1	*0.6*	177	*98.9*	3	*1.7*	0	*0*

** Multiple responses allowed. Percentages do not add up to 100.*

3.4 Calling versus texting

From the responses it is clear that health workers report using a mobile phone more often to call than to send text messages (for personal and work-related use). Among the 181 health workers interviewed, 175 (97%) called more than texted, and only five (2.8%) reported calling and texting about the same amount. Only one health worker reported texting more than calling.

Initiating work-related calls and text messages

Phone calls are initiated more frequently than text messages. Table 4 shows the difference in the reported frequency of making work-related calls and sending work-related text messages.

Table 4: Frequency of *initiated* work-related calls and text messages

	***Make* work-related phone calls N=181**		***Send* work-related text messages N=181**	
	N	%	N	%
Daily	36	19.9	2	1.1
Several times a week	59	32.6	9	5.0
Once a week	28	15.5	21	11.6
Once every two weeks	31	17.1	12	6.6
Less than every two weeks/never[13]	27	14.9	137	75.7

More than two thirds of the 181 health workers reported making work-related calls at least once a week, with 20% reporting that they makes calls on a daily basis. In comparison, health workers report much less frequent use of text messaging, with only two respondents (1%) text messaging on a daily basis. Although facility in-charges make slightly more work-related phone calls and text messages compared to staff that do not fulfil an in-charge position, this is not statistically significant. No major differences were found in the frequency of making and sending calls and text messages between health workers working alone or in a team of two or more, expect for a slight difference with single

[13] The answer categories for this question included an option 'do not know/not sure' that is most likely coded when the answer was 'never' (which should have been included in the answer option 'less than every two weeks'). For this question, there were four cases of making calls and 119 cases of sending messages coded as 'do not know'. It is most likely that an answer 'never' was incorrectly coded as 'do not know', as this corresponds with the information that respondents call more than text. For this baseline report, the improbable answers have been re-coded in the category 'less than every two weeks' for all questions. During the midline analysis, this will be adjusted.

staff members calling more than once a month. No differences were found between the groups of staffing size for sending work-related text messages.

Receiving work-related calls and text messages
Table 5 shows the differences in the reported frequency of receiving work-related calls and text messages. Phone calls are received more frequently than text messages.

Table 5: Frequency of *received* work-related calls and text messages

	Receive work-related phone calls N=164		Receive work-related text messages N=164	
	N	%	N	%
Daily	21	*12.8*	1	*0.6*
Several times a week	45	*27.4*	18	*11.0*
Once a week	25	*15.2*	17	*10.4*
Once every two weeks	32	*19.5*	21	*12.8*
Less than every two weeks/never[14]	41	*25.0*	107	*65.2*

No differences were seen in frequency of received calls and messages between staff and in-charge staff and between staff working alone and those in a team of two or more.

3.5 Frequency of communication between health actors

The findings relating to communication between health staff across the various management and implementation levels of the health system are presented below and include information on initiating and receiving work-related calls and text messages.

Making work-related calls and sending work-related text messages

Figure 7 shows the frequency of initiated calls and text messages as reported by the health workers for the various categories of health staff.[15] Health workers communicated with other staff most often, followed by calls and texts to their own in-charge and to the district with the least communication to the chiefdom in-charge.

Making work-related calls and messages to other PHU staff
Most of the 164 health workers (87%) indicated that they regularly initiate calls or messages to other staff (other than in-charges). Of these 143 respondents, 95 (67%) made calls or messages to other staff at least once every week.

Making work-related calls and text messages to in-charges of their own PHU
Of the 84 health worker respondents who were not in an in-charge position, 64% reported making calls or messages to the in-charge at their own PHU. Of these 54 health workers, 38 (70%) indicated that this occurred once every week or more often.

[14] See previous footnote. For this question, there were eight cases of receiving calls and 71 cases of receiving messages coded as 'do not know' and considered highly unlikely. For this baseline report, the improbable answers have been re-coded in the category 'less than every two weeks' for all questions.

[15] Totals exclude answer category 'not sure/do not know'.

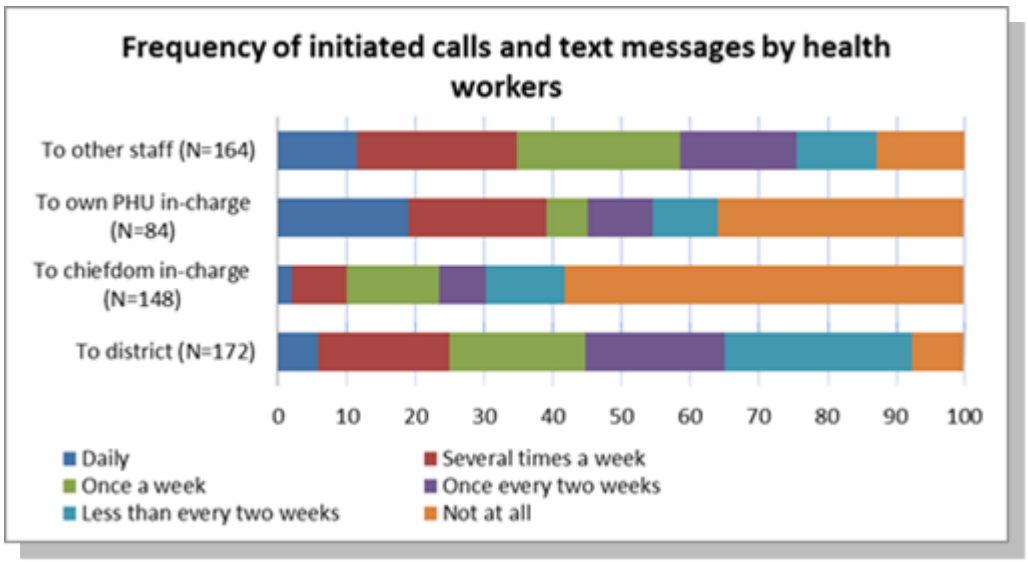


Figure 7: Frequency of calls and text messages initiated by health workers

Making work-related calls and messages to in-charges in chiefdom town
Health workers made calls or text messages to the in-charge in the chiefdom town less often than calls to their own PHU in-charge. Of the 148 health worker respondents who were not in-charge at the chiefdom level, less than half (42%) indicated that they made calls or text messages to the chiefdom in-charge. Of these 62 respondents, more than half (56%) called or texted once a week or more often.

Making work-related calls and text messages to district level
A large majority (92%) of the 172 health workers who responded reported making calls or messages to the district level. Of these 159 health workers, almost half (48%) indicated that they called or texted at least once a week. The persons most often called or texted are the district health sister (86%) and the monitoring and evaluation officer (76%). Almost a third of the respondents mentioned the district medical officer, while other DHMT members mentioned the most were the district logistics officer and the district medical store officer. Only a few respondents mentioned the expanded programme of immunization officer and the nutritionist.

Receiving work-related calls and text messages

Figure 8 shows the frequency of received and initiated calls and text messages as reported by the health workers for the various categories of health staff.[16] Health workers received calls and texts most frequently from other staff and the district level followed by communication from their own PHU in-charge.

Receiving work-related calls and messages from other PHU staff
As with initiating calls and messages, 156 of the health workers (93%) reported that they received calls and messages from other PHU staff (not including in-charges). Of these 145 respondents, more than half (59%) said that they received calls and messages from colleagues at least once every week.

[16] Totals exclude answer category 'not sure/do not know'.

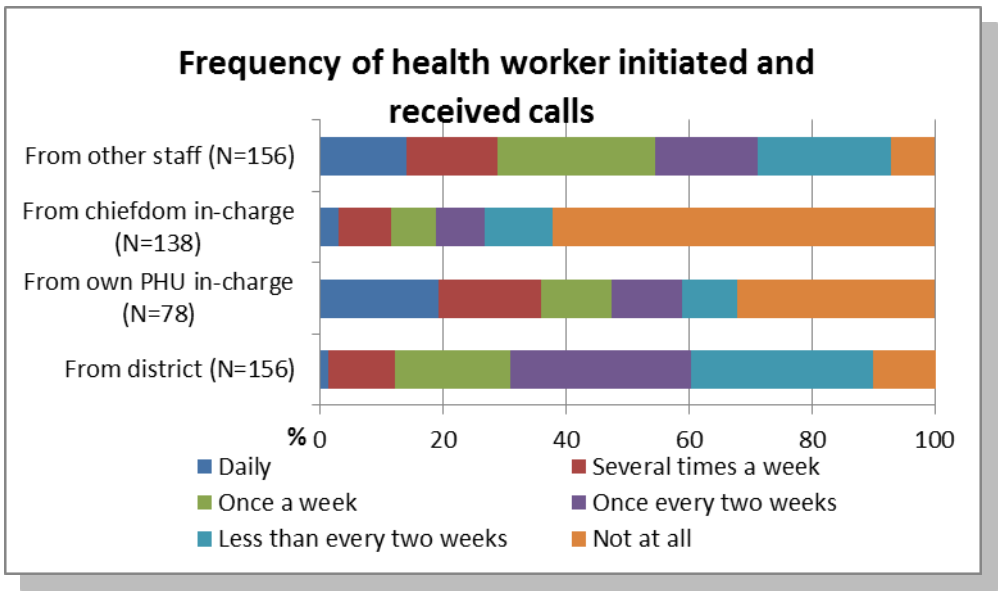


Figure 8: Frequency of calls and text messages received by health workers

Receiving work-related calls and messages from in-charges in chiefdom town
Fifty-two (38%) of the 138 respondents reported receiving calls and text messages from the in-charge in the chiefdom town. From this group, 26 (50%) indicated that they received calls or messages once a week or more often.

Receiving work-related calls and text messages from in-charges in their own PHU
Two thirds of the group of responding health workers (53 out of 78) reported that they received calls and text messages form their own PHU in-charge. From this group, 70% indicated that this occurred once a week or more often.

Receiving work-related calls and text messages from district level
As with initiating calls and texts to district level, most of the 156 respondents (90%) reported receiving calls or text messages from the district level. Of these 140 health workers, a little more than a third (34%) received calls and texts at least once a week, which is less than the reported frequency of initiating calls and texts. The same DHMT members were mentioned as for initiating calls: district health sister (76%), monitoring and evaluation officer (73%) and the district medical officer (20%). Other district staff mentioned the most were also similar and included the district logistic officer and the medical store officer.

3.6 Reasons for communication between health actors

The frequency of the various reasons for communication between health actors varied for the different operational levels of the health system and often within the levels when initiating and receiving calls and text messages were compared. Figures 9 to 12 below show an overview of these differences.

The most important reason given for initiating calls and text messages in all the categories is clinical advice. It is also an important reason for receiving calls and messages, especially in the categories that involve facility staff (including in-charges). More calls and messages about disease surveillance and drugs and supplies are made to and received from district and chiefdom in-charge level than the other categories.

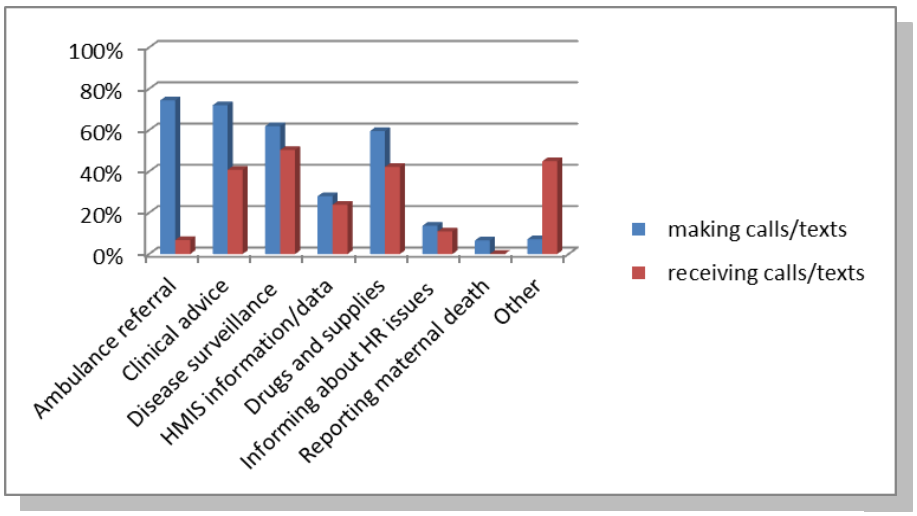


Figure 9: Reasons for communication with district-level managers

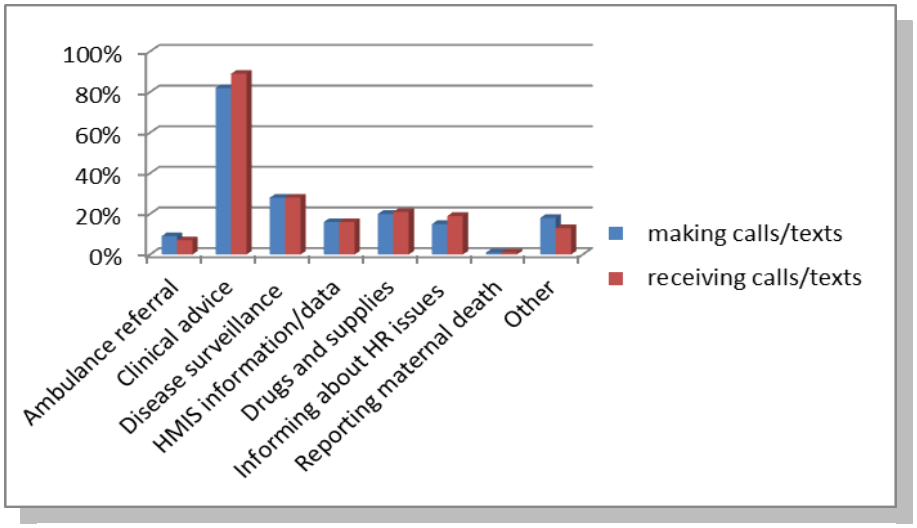


Figure 10: Reasons for communication with health staff (excluding in-charges)

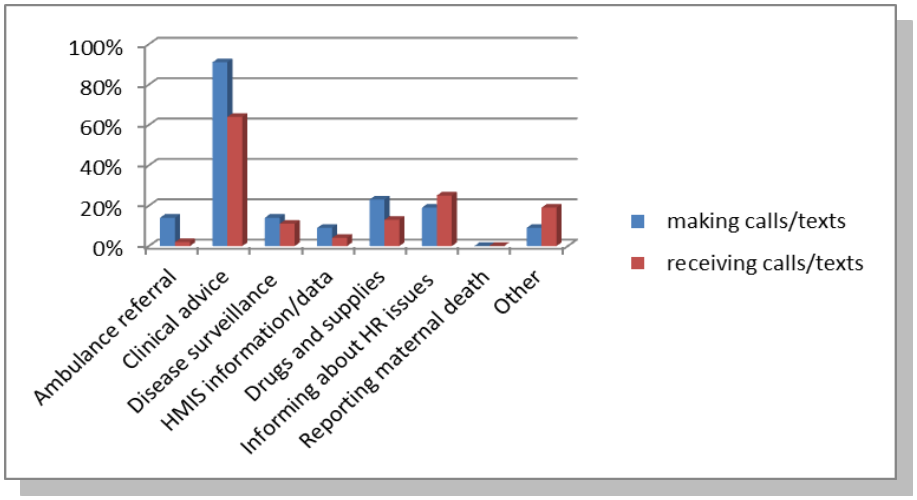


Figure 11: Reasons for communication with in-charges at own facility (PHU)

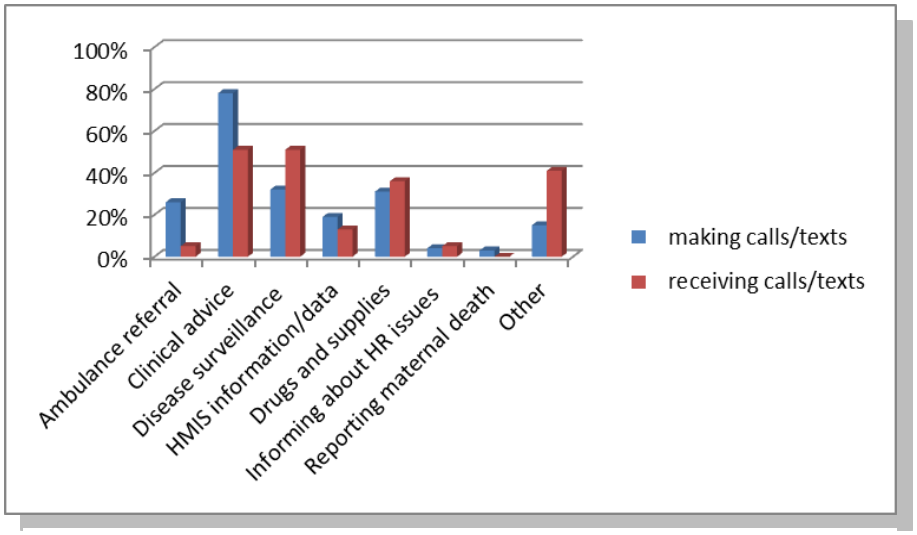


Figure 12: Reasons for communication with in-charges at chiefdom (CHC)

It appears that calls and texts for all reasons are equally initiated and received between health staff (excluding in-charges), while more calls and texts are initiated to district level than received. A similar pattern for most of the reasons is seen between initiated and received calls and messages when comparing between communication with in-charges of the health workers' own PHU and in-charges of the district PHU. Health workers indicate that they receive calls and texts more often than they initiate calls to the chiefdom in-charge, while the opposite is seen for their own facility in-charge.

A large portion of the received calls and texts relate to information about meetings, workshops and training and come from the district and in-charges (own PHU and chiefdom PHU).

3.7 Communication between health workers and clients

The findings relating to communication between health workers and clients is presented below and includes information on initiating and receiving work-related calls and text messages. The reasons that health workers give for the communication are also reported.

Figure 13 shows the frequency of work-related initiated and received calls and text messages as reported by the health workers in relation to clients.

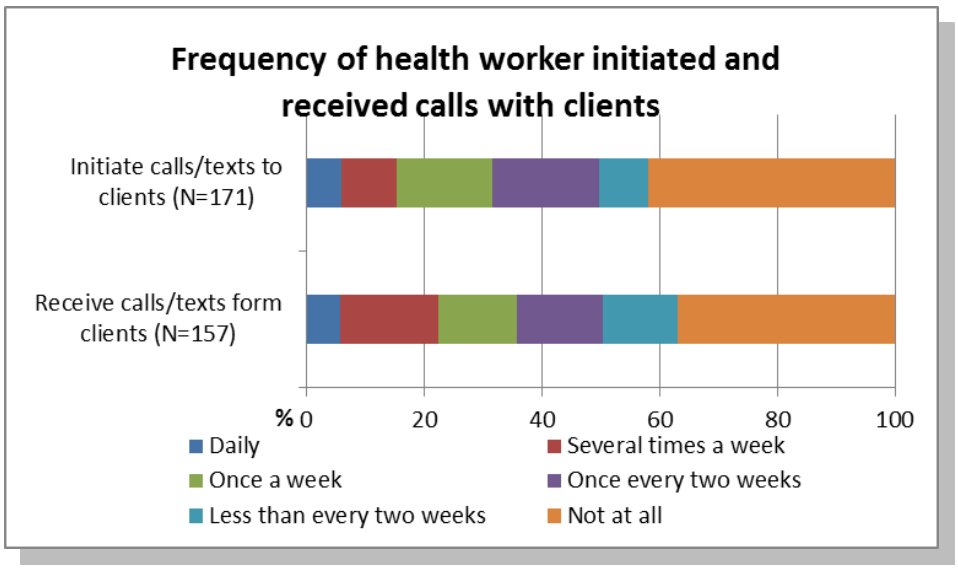


Figure 13: Frequency of calls and text messages between health workers and clients

The reasons mentioned the most by health workers for initiating calls or text messages with clients is for follow-up after seeing them at the facility. About half of the health workers also mentioned calling or texting clients in relation to appointments, either to remind clients about upcoming appointments or to enquire about missed appointments. Another reason mentioned by some respondents was to inform clients about outreach activities. Many health workers indicated that they received calls and messages from clients to make appointments and to inform them about missed appointments. Another frequently mentioned reason for being contacted by clients is for advice. One health worker indicated being contacted by clients to show their appreciation. See Table 6 below.

Table 6: Reasons for communication between health workers and clients

Reasons for communication between health workers and clients	Making calls/messages		Receiving calls/messages	
	N=98	%*	N=100	%*
Remind about upcoming appointment	53	*54*	-	-
Inform about missed appointment	49	*50*	48	*48*
Follow-up	92	*87*	-	-
Advice about illness	-	-	81	*81*
Make appointment	-	-	73	*73*
Other	12	*12*	8	*8*

** Multiple responses allowed. Percentages do not add up to 100.*

3.8 Communication between health workers and TBAs

The findings relating to communication between health workers and TBAs are presented below and include information on initiating and receiving work-related calls and text messages and the reasons for these.

Figure 14 shows the frequency of initiated and received work-related calls and text messages as reported by the health workers for clients and TBAs.

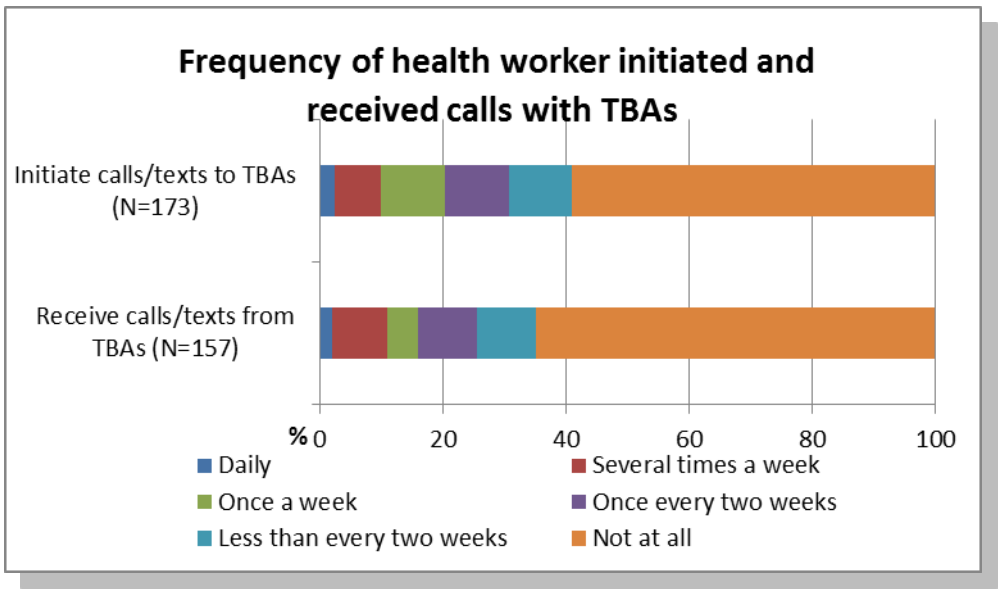


Figure 14: Frequency of calls and text messages between health workers and clients

The reasons mentioned most frequently by health workers for contacting TBAs were to request that they come to help out at the clinic and to inform them of meetings and workshops. A few health workers also mentioned calling or texting TBAs to remind them to bring in clients due for delivery or check-ups. The most frequent reason mentioned for receiving calls or texts from other TBAs was to request assistance when the TBAs were dealing with a difficult case. Less frequent reasons mentioned are to notify about deliveries and to enquire about meetings and workshops. An overview of the reasons is shown in Table 7.

Reasons for communication between health workers and TBAs	Making calls/messages		Receiving calls/messages	
	N=71	%*	N=56	%*
Inform about meetings and workshops	56	*79*		
Request to come help out at the clinic	61	*86*	-	-
Request to help with a difficult case	-	-	56	*100*
Other	7	*10*	9	*16*

Table 7: Reasons for communication between health workers and TBAs
** Multiple responses allowed. Percentages do not add up to 100.*

3.9 Perceived barriers to mobile phone use

To better understand the barriers associated with mobile phone use, the respondents were asked about costs and other barriers to using mobile phones.

All but one health worker (180 of the 181) reported having to pay for work-related phone calls and text messages. A few indicated that they are reimbursed from the performance-based financing funds. The reported costs for phone credits (top-ups) varied greatly, with an average of SLL14,000 (approximately €2.46 or US$2.80[17]) per week.[18] Buying phone credit takes

[17] Exchange rates: €1 = SLL 5701.00; SLL 1 = USD 0.0002 (15 December 2012)

time, as health workers indicated that they had to walk for an average of 20 minutes to do this. A few health workers indicated that they have to walk for up to 90 minutes. Charging mobile phones is not easy either. As only 8% of the health workers indicated that they could charge a phone at the PHU, more than 90% had to charge elsewhere. Ninety per cent of all the health workers indicated that they had to pay to have their phone charged. The reported costs for charging varied from SLL1,000 to SLL10,000 each time. Rates between SLL1,000 and SLL1,500 were reported by more than 80% of the respondents, with the amount most reported (by 60% of the respondents) being SLL1,000 (approximately €0.17 or US$0.20).

3.10 Job-related satisfaction and communication

As previously described in the methodology section, information on job-related satisfaction and communication was obtained through 22 statements with an agreement scale. Annex 6 shows the statements, the domains to which they belong and the results of the reliability analysis that was carried out. From the four domains, three were shown to be reliable: *quality of working life, communication with peers and seniors,* and *working conditions*. These items were used to calculate a score for each domain that is standardized with scores from 0–100 (a higher score indicates a better perceived quality of working life, better perceived communication with peers and seniors and better perceived working conditions).

Table 8 below shows the mean, mode and scoring range of the three domains.

Table 8: Average combined scores for communication and job satisfaction

Domain	**Mean** *(average score)*	**Mode** *(most frequent score)*	**Range** *(lowest/highest score)*
Quality of working life	74.5	80	46–93
Communication peers and seniors	76.5	80	40–96
Working conditions	63.3	64	32–88

The scores for quality of working life and communication with peers and seniors are comparable, both in the medium high range. The score for domain working conditions was on average lower than the other domains.

Each domain was analysed for differences between various characteristics, type of facility, type of health worker, being in an in-charge position, sex, and size of facility staff. Table 9 shows the average scores for each domain for the various types of facilities and health workers. Although small differences are seen, only two categories of characteristics showed a statistically significant difference: type of facility in the *quality of working life* domain, with MCHPs scoring lower (p=.01) than the other two types of facilities, and type of health worker in the *communication with peers and seniors* domain, where EDCU assistants and nursing aides scored much lower than the other types of health workers (p=.00). The shaded areas indicate the statistically significant differences.

[18] The large variation in answers could imply that the information is not reliable, as the answers could have been influenced by health workers' expectations regarding the intervention; they may have thought that they would receive money to buy credits along with the mobile phone. Most data collectors did not probe further when large amounts were mentioned.

Table 9: Average combined scores for job satisfaction and communication domains by health facility and health worker characteristics

	QWL[a]	CPS[b]	WC[c]
Significant differences highlighted	Mean scores		
Type of facility			
CHC=44	76.8	78.7	66.0
CHP=35	76.8	75.1	64.5
MCHP=102	72.7	76.0	61.2
Type of health worker			
CHO=10	76.0	82.4	60.8
CHA=9	75.8	76.9	59.6
SECHN=18	73.1	77.3	67.1
MCH Aide=126	74.5	77.2	62.7
EDCU=15	73.6	65.9	68.8
Nursing aid=3	79.3	73.3	57.3
In charge			
Yes=93	75.4	77.8	62.9
No=88	73.5	75.2	63.8
Sex			
Female=149	74.1	76.8	63.3
Male=32	76.5	75.3	63.1
Facility staff size			
Single staff (N=31)	76.6	76.6	62.7
2 or more staff (N=149)	74.1	76.4	63.4

[a] *Quality of working life*
[b] *Communication with peers and seniors*
[c] *Working conditions*

As mentioned above, the scale items in the *communication with clients* domain scored unreliable and could not be used as a combined score for analysis. The two most reliable statements of the three were analysed separately, and Table 10 shows these results. A large majority of health workers indicated that they can easily contact individual clients for services and that they have the means to contact the clients directly.

Table 10: Results of communication with clients

	Disagree		Neutral		Agree	
	N	%	N	%	N	%
Contacting individual clients in the community for ANC, FP and other services is easy (N=181)	21	*11.6*	15	*8.3*	145	*80.1*
I have the means to contact individual clients directly (N=181)	20	*11*	14	*7.7*	147	*81.2*

When these questions were analysed further for differences within the characteristics of health workers and health facilities, no significant differences were found for type of health worker, type of facility, sex, and size of facility staff.

3.11 Comparison between wedges

The description and justification of the determination of the comparison wedges can be found in Section 2. In the 12 study chiefdoms, information was obtained from 92 health facilities, 53 in Wedge 1 and 39 in Wedge 2. The distribution of the 176 health worker respondents into wedges is shown in Figure 15: 94 (57%) are in Wedge 1, and 82 (43%) in Wedge 2.

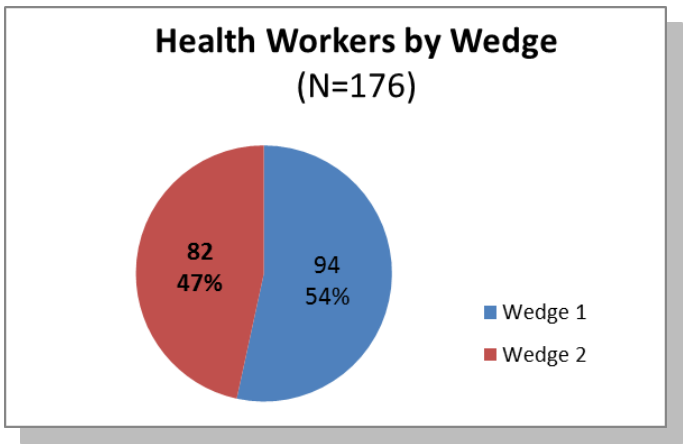


Figure 15: Number of health workers by wedge

To determine if the chiefdom wedges are comparable at baseline, they were compared for a number of facility and health worker characteristics, for use of mobile phone, for making and receiving calls and for job satisfaction and communication.

Health worker and facility characteristics

The wedges are comparable for all facility and health worker characteristics, as no significant differences were found for type of facility, type of health worker, number of in-charge positions, government payroll, gender, age, staff size and length of time working at the facility. The wedges were further comparable for perceived frequency of calling versus texting, frequency of making work-related calls, paying for work-related phone calls and telephone charging, and the place to charge phone.

Mobile phone coverage and use

Some significant differences were found between the wedges relating to mobile phone use. Wedge 2 respondents indicate that there is more often network coverage at the normal calling location. Some differences were found for making and receiving calls and messages to/from the other health actors in the system and community members.

No differences were found in mobile reception inside the PHU, in making and receiving calls to/from in-charges and making and receiving calls to/from TBAs.

Job satisfaction and communication

The average composite scores for the domains *communication with seniors and peers*, *working conditions* and *quality of working life* did not significantly differ between the wedges. Analysis of the two single statements concerning communication with clients showed a difference between the wedges for the statement relating to having the means to contact clients directly, with more respondents in Wedge 2 in agreement with this statement compared to the respondents in Wedge 1.

A summary of the differences including all the significant differences is shown in Table 11. A full overview table with the data for each items analysed in the wedge comparison exercise can be found in Annex 8.

Table 11: Overview of significant differences and similarities between wedges

Indicator/variable	Wedge 1	Wedge 2
Facility and health worker characteristics	↔	
Network coverage at normal calling location		↑
Frequency of making work-related calls		↑
Frequency of making work-related text messages		↑
Paying for work-related calls and charging	↔	
Make calls to district		↑
Receiving calls from district		↑
Making/receiving calls to/from in-charges	↔	
Making calls to other staff	↔	
Receiving calls from other staff		↑
Making calls to clients	↔	
Receiving calls from clients		↑
Making/receiving call to/from TBAs	↔	
Scores for quality of working life, working conditions and communication with peers and seniors	↔	
Has the means to contact individual clients directly		↑
Contacting individual clients in the community is easy	↔	

↔= no difference in frequency; ↑= more frequent

3.12 Comparison of TBA intervention chiefdoms

As previously described in the methodology section, in each wedge a TBA intervention and comparison chiefdom was selected for midline and end line comparison of the effect of the intervention. Figures 16 and 17 show the distribution of the health worker respondents within these chiefdoms for Wedge 1 and Wedge 2.

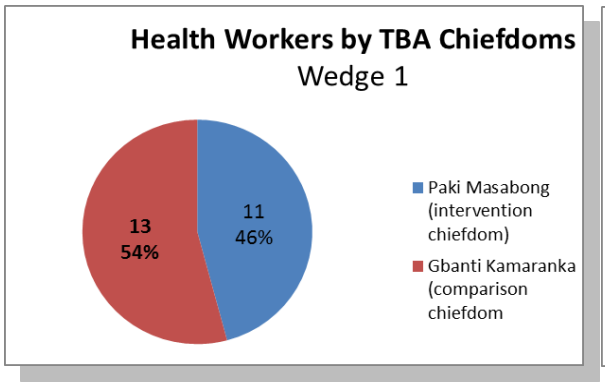


Figure 16: Number of health workers in TBA chiefdoms in Wedge 1

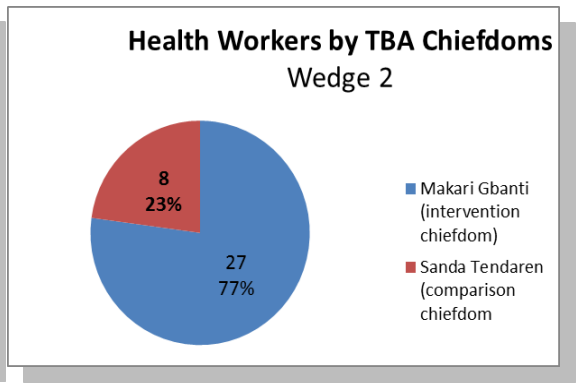


Figure 17: Number of health workers in TBA chiefdoms in Wedge 2

In total, there were 24 health worker respondents in the TBA intervention and comparison chiefdoms for Wedge 1 and 35 for Wedge 2.

At baseline, the intervention and comparison districts in each wedge were compared with each other. In both Wedge 1 and Wedge 2, the intervention and comparison TBAs chiefdoms were comparable for all facility and health worker characteristics, as no significant differences were found for type of facility, number of in-charge positions, government payroll, gender, age, number of children and length of time working at the facility.

No significant differences were found between the TBA intervention and comparison groups in each wedge for the health workers' reported frequency of making and receiving calls and text messages to/from TBAs.

4 Conclusions and implications for midline and end line analysis

Baseline information

Bombali district was chosen for this implementation study because information indicated that there were no other mHealth programmes in this district and it was assumed that (most) facilities did not have access to a work-related telephone. It was also assumed that there was reasonable network coverage in the district. The baseline results confirmed these assumptions.

One of the major findings of this study was that, despite not having a dedicated work-related phone, health workers communicate regularly with other health actors (district-level management, facility in-charges and other staff) by phone. This implies that the mHealth intervention package that will be implemented will be acceptable for the health workers and will have a low threshold for use in relation to phone use. The availability of the facility phone, how it is actually used and how use is distributed between health workers will be a process indicator that will be measured through the health worker surveys. The baseline study identified some barriers such as costs of charging and costs of phone credit (top-ups). These issues and other factors that influence use of mobile phones for work-related issues will be explored further during the midline and end line qualitative data collection through interviews with health workers, clients and TBAs.

The baseline data indicate that health workers are using (personal) phones for work-related calling much more than for work-related text messaging. As there is a potential for an increase in texting (both making and receiving) within the intervention and although this will be captured in the midline and end line data when measuring impact, the factors that contribute to a possible change in attitude towards texting will be addressed in the midline and end line interviews. Also, the factors influencing preference for calling, texting and/or flashing (deliberate 'missed call') will be explored.

The baseline data also show that prior to the intervention health workers and clients are already communicating with each other by calling and/or texting (although less frequently than communication among health staff and between these and the various management levels). This could mean that one aspect of the mHealth intervention (health workers and clients communicating with each other by phone) may have a low acceptance threshold, resulting in the effects of the intervention being measurable after a short period of implementation (at midline) as well as at the end of the study period.

Although less frequently than between health workers and clients, some health workers and some TBAs also communicate with each other by phone. While the intervention will be measured in the health worker surveys in terms of frequency of communication with TBAs, interviews with both health workers and TBAs will explore the process of the intervention and describe the lynchpin function that the TBAs are expected to play in the intervention chiefdoms between health facility and community.

The job satisfaction and communication domain scores will be compared during and after implementation, to measure the effect of the mHealth intervention. The baseline analysis shows a lower quality of working life reported by MCH Aides than by other health workers. This phenomenon has been shown in previous work in Sierra Leone.[19]

[19] Herschderfer K, Sam-Kpakra R, Wolmarans L, de Koning K. (2012), *Implementing Quality Circles in Kailahun District-Results from a baseline study*; for the Concern Worldwide's 'Innovations for Maternal and Child Health Initiative'.

Wedge comparison data
The wedge comparison shows some significant differences between the respondents in the corresponding chiefdoms. Wedge 1 respondents may have to make more of an effort to communicate by mobile phone than Wedge 2 respondents, as they report that they are less often able to make/receive calls inside the PHU, have less network coverage at their normal calling location and do not have the means to contact individual clients directly.

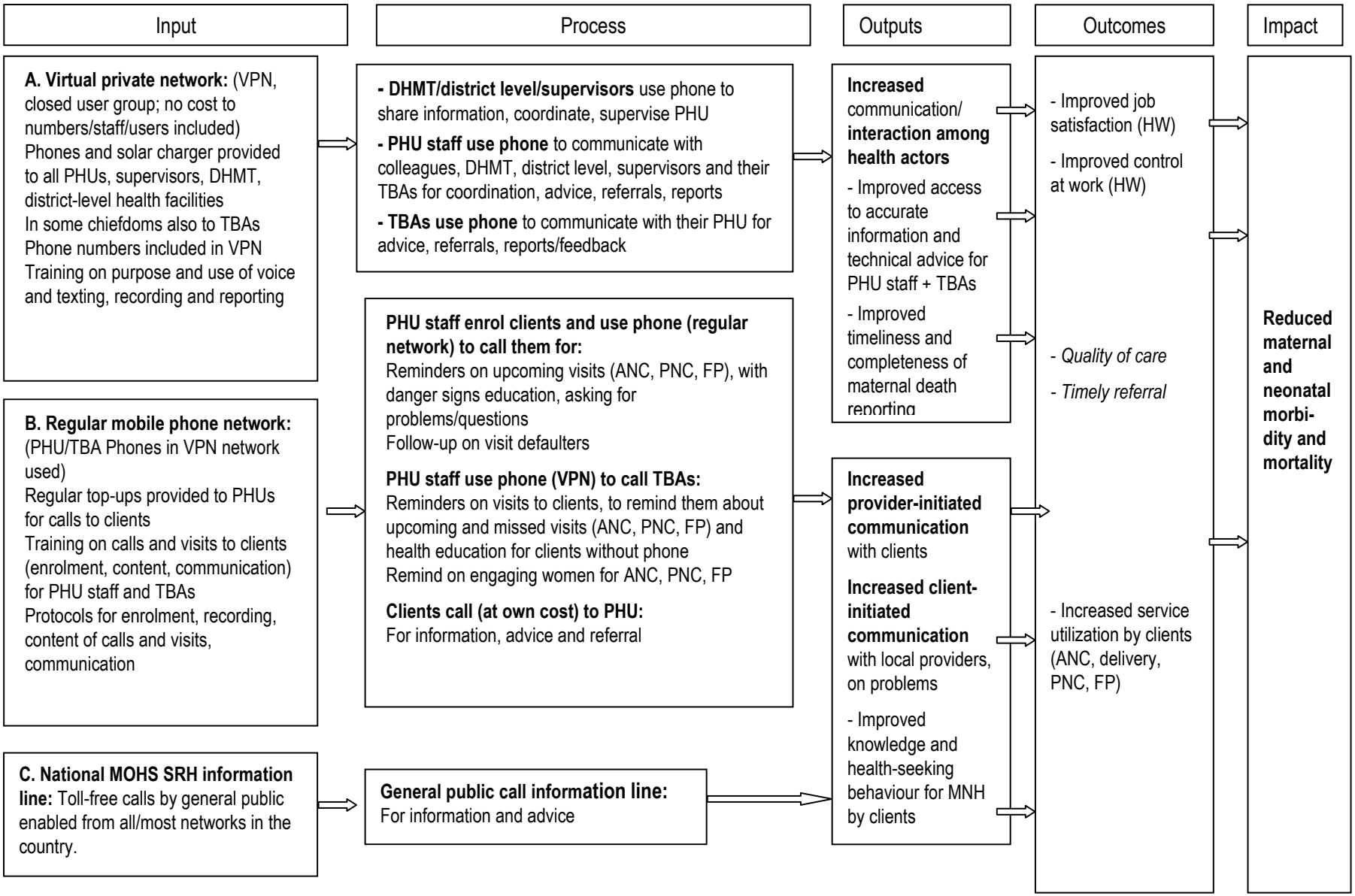
This also appears to result in Wedge 1 respondents making less frequent calls than Wedge 2 respondents to some of the other health workers and to community members, although this is not the case for all types of health workers and community members and could be related to the frequency of calls that are made.

Multivariate analysis will be used to examine midline and end line effects, to control for the baseline differences found.

Implications for survey tools
Although, in principle, the midline and end line survey tools with be as identical to the baseline tool as possible, this analysis showed that changes would be necessary for a few questions. One change involves the inclusion of a new answer category (never) for two questions as described related to Tables 4 and 5. The second change is the deletion of the unreliable question in the domain *communication with clients*.

This analysis also proved valuable in providing topics for the design of the midline interview topic guides that are intended to collect information that will be used to understand better how the health workers and clients perceive the mHealth interventions in terms of barriers and facilitators.

Annex 1 – Intervention logic diagram



Annex 2 – Phase 2 intervention study research table

Objectives	Indicators, variables, issues	Research methods	Data collection tools	Research participants
1. To assess changes in MNH/FP service utilization by clients, associated with expanded options for client-initiated and provider-initiated mobile communication: a. for entire district (engaging all PHUs and through the national information line) b. in the selected chiefdoms that implement the intervention involving TBAs	Average gestation stage of pregnant woman at first ANC visit	PHU records analysis and calculations	DAT-1 Data collection tool for PHU/DHMT records	All PHUs in one TBA intervention chiefdom and one TBA comparison (non-intervention) chiefdom. Purposive sampling of TBA intervention chiefdom, pairing with comparable comparison chiefdom.
	Percentage of pregnant women having 1, 2, 3 or 4 ANC visits	HMIS data analysis and calculations	District-level HMIS data records	All PHUs in Bombali district
	Percentage of pregnant women with delivery at health facility	HMIS data analysis and calculations	District-level HMIS data records	All PHUs in Bombali district
	Percentage of pregnant women having 1,2 or 3 PNC visits	HMIS data analysis and calculations	District-level HMIS data records	All PHUs in Bombali district
	Number of new FP clients enrolled and existing clients who continue	HMIS data analysis	District-level HMIS data records	All PHUs in Bombali district
	Number of clients enrolling in mobile phone reminders (with registry of being contacted and their response)	PHU records analysis and calculations	DAT-3 Data collection tool for PHU/DHMT records	All intervention PHUs (step-wedge sequence)
	Client views on client-initiated and provider-initiated communication; and related improvements in access to information, advice and referral and perceived changes in health-seeking behaviour (including national information line, client calls to PHUs and interaction/communication)	Semi-structured interview	SSI-1 Interview guide clients enrolled mobile phone reminders	Total 25–30 clients enrolled in mobile phone reminders, divided over responders (clients who could be reached) and non-responders (clients who could not be reached by phone or who were reached but declined to talk to the HW); from 8 different PHU catchment areas (2 urban, 2 semi-urban, 2 remote, 2 near the feeder road)

Objective 1 (see above)	Community views on client-initiated and provider-initiated communication; and related improvements in access to information, advice and referral an perceived changes in health-seeking behaviour (including national information line, client calls to PHUs and interaction/communication)	Focus group discussion	FGD-1 Topic guide community	4 PHUs catchment areas selected (1 urban, 1 semi-urban, 1 remote, 1 near the feeder road). Each area 1 male and 1 female FGD, total 4 F + 4 M = 8 FGDs; each with about 8–10 participants
	Non-enrolled women's views on improved communication options, whether they have made use of them, whether have been reached by HW/TBAs, and why this has not led to them using relevant services	Semi-structured interview	SSI-6 Topic guide non-enrolled clients	20–25 pregnant women who were eligible (=having (access to) a phone) but declined, from same 8 different PHU catchment areas as SSI-1.
	TBA views on usefulness of phones to strengthen their work and improve clients' earlier use of services and self-reported changes (including national information line, client calls to PHUs and interaction/communication)	Semi-structured interview	SSI-2 Interview guide TBAs	15 TBAs with intervention phone in TBA intervention area (from 4–6 different PHUs)
	HW views on client-initiated and provider-initiated communication; and related options to improve clients' use of services and self- reported changes	Semi-structured interview	SSI-3 Interview guide HW	Total 15–20 health staff (working at PHUs, various levels of staff; from same chiefdoms of SSI-1, SSI-6 and FGD-1) until no new information emerges for both intervention and non-intervention areas
		Survey	SUR-1 Questionnaire HW	All PHU clinical health workers in Bombali District (includes MCH Aides, SECHNs, CHOs, CHAs), total around 150

Objective 1 (see above)	Health manager (HM) views on client-initiated and provider-initiated communication; and related options to improve clients' use of services and self-reported changes	Semi-structured interview	SSI-4 Interview guide HM	Total 5 district health managers (various types, e.g. DMO, DHS, M&E officer, Hospital manager etc.)
	Male partners' perspectives on benefits and issues regarding their wives' more intense involvement in communication with health staff	Semi-structured interview	SSI-5 Interview guide male partners	Total 20–25 male partners of female clients enrolled in mobile phone reminders (but not partners of female clients interviewed)
2. To assess changes in health workers' job satisfaction and control at work, and self-reported changes due to expanded options for provider–provider communication.	HW use of mobile communication options; perceptions on benefits and challenges of the new options available; on improvements in their job satisfaction and control at work; and ultimate benefits to clients	Survey	SUR-1 Questionnaire HW	All PHU clinical health workers in Bombali district (includes MCH Aides, SECHNs, CHOs, CHAs)
	Idem – more in-depth	Semi-structured interview	SSI-3 Interview guide HW	Total 15–20 health staff (working at PHUs, various levels of staff; from same chiefdoms of SSI-1, SSI-6 and FGD-1) until no new information emerges for both intervention and non-interventions areas
		Semi-structured interview	SSI-4 Interview guide HM	Total 5 district health managers (various types, e.g. DMO, DHS, M&E officer, Hospital manager etc.)
3. To assess changes in MNH referral systems due to expanded mobile communication options	Perceptions of clients, HW and health managers	Semi-structured interview	SSI-1 Interview guide clients	Total 25–30 clients enrolled in mobile phone reminders, divided between responders (clients who could be reached) and non-responders (clients who could not be reached by phone or who were reached but declined to talk to the HW); from 8 different PHU catchment areas (2 urban, 2 semi-urban, 2 remote, 2 near the feeder road)

		Semi-structured interview	SSI-2 Interview guide TBAs	15 TBAs with intervention phone in TBA intervention area (from 4–6 PHUs)
		Semi-structured interview	SSI-3 Interview guide HW	Total 15–20 health staff (working at PHUs, various levels of staff; from same chiefdoms of SSI-1, SSI-6 and FGD-1) until no new information emerges for both intervention and non-interventions areas
4. To assess changes in maternal death reporting	Number of maternal deaths reported	PHU/DHMT records analysis and calculations	DAT-2 Data collection tool for PHU/DHMT records	All PHUs and DHMT M&E office
	TBA views and self-reported changes in reporting of maternal deaths	Semi-structured interview	SSI-2 Interview guide TBAs	15 TBAs with intervention phone in TBA intervention area (from 4–6 PHUs)
	HW views and self-reported changes in reporting of maternal deaths (including timeliness)	Semi-structured interview	SSI-3 Interview guide HW	Total 15–20 health staff (working at PHUs, various levels of staff; from same chiefdoms of SSI-1, SSI-6 and FGD-1) until no new information emerges for both intervention and non-interventions areas
	HM views and self-reported changes in reporting of maternal death (including timeliness)	Semi-structured interview	SSI-4 Interview guide HM	Total 5 district health managers (various types, e.g. DMO, DHS, M&E officer, Hospital manager etc.)
5. To identify implications for the health system of mobile communication initiatives	Facilitating and constraining factors in implementation of the various mHealth applications	Semi-structured interview	SSI-3 Interview guide HW	Total 15–20 health staff (working at PHUs, various levels of staff; from same chiefdoms of SSI-1, SSI-6 and FGD-1) until no new information emerges for both intervention and non-interventions areas
		Semi-structured interview	SSI-4 Interview guide HM	Total 4–5 district health managers (various types, e.g. DMO, DHS, M&E officer, Hospital manager etc.)
		Semi-structured interview	SSI-4 Interview guide HM	Total 2–3 mHealth system managers (from RH/FP programme and Department of Planning and Information)

Annex 3 – Overview data collection tools and timing

Tool	Code	Participants	Baseline	Midline	End line
Semi-structured interview guides	SSI 1	Clients enrolled	-	x	x
	SSI 2	TBAs (TBA intervention area)	-	x	x
	SSI 3	Health workers	-	x	x
	SSI 4	Health managers	-	Only district level	Both district and national level
	SSI 5	Male partners of enrolled clients	-	-	x
	SSI 6	Eligible clients not enrolled	-	x	x
Focus group topic guides	FGD 1	Community (male/female)	-	-	x
Quantitative survey	SUR-1	Health workers	x	x	x
Quantitative data collection	DAT-1	PHUs (gestation age at ANC1) TBA intervention/ comparison areas	x	x	x
	DAT-2	PHUs (Maternal death reports)	x	x	x
	DAT-3	PHUs (number of clients enrolling)	-	x	x
	DAT-4	Facility information questionnaire	x	-	-
	DAT-5	Data collection tool national information line	-	x	x

Annex 4 – Health facility information questionnaire

Date……

(fill in one for each facility)

1.	Name of facility:			
2.	Name of Community :			
3.	Chiefdom:	1= Bombali Sebora 2= Makari Gbanti 3= Libiesaygahun 4= Paki Masabong 5= Safroko Limba 6= Biriwa	7= Gbendembu Ngowahun 8= Magbaimba Ndowahun 9= Sanda Tendaren 10= Sanda Loko 11= Sella Limba 12= Tambaka 13= Gbanti Kamaranka	|___|
4.	Population Catchment Area		----- ----- -----, ----- ----- -----	
5.	Do you have a facility mobile phone (one dedicated for work-related calls and not personally owned?)	○ ○	*1=YES* *2=NO*	|___|
6.	Type and number of staff at health facility			

6.1	CHO	|___|	6.8	Vaccinator	|___|
6.2	CHA	|___|	6.9	Lab technician/lab assistant	|___|
6.3	S ECHN	|___|	6.10	Porters, security, cleaner	|___|
6.4	Nursing Aide	|___|	6.11	TBA	|___|
6.5	MCH Aide	|___|	6.12	CHW	|___|
6.6	Midwife	|___|	6.13	Other, ……..	|___|
6.7	EDCU assistant	|___|	6.14	Other, ……..	|___|

Annex 5 – Baseline health workers questionnaire

Interview Code:			Interviewer's initials:

Health Workers Questionnaire for Baseline
SUR 1-Mhealth phase 2

Date:	*Write DD/MM/YYYY*		|___|___| / |___|___| / |___|___|___|___|
Chiefdom:	1= Bombali Sebora 2= Makari Gbanti 3= Libiesaygahun 4= Paki Masabong 5= Safroko Limba 6= Biriwa	7= Gbendembu Ngowahun 8= Magbaimba Ndowahun 9= Sanda Tendaren 10= Sanda Loko 11= Sella Limba 12= Tambaka 13= Gbanti Kamaranka	|___|___|
Community :	*Where the facility is located (please write carefully, spell correctly)*		…….
Name of facility:	*(please write carefully, spell correctly)*		…….
Type of health facility:	◯ ◯ ◯ ◯	*1=CHC* *2=CHP* *3=MCHP* *9=Other, specify* ……..	|___|
Section I: Information Health Worker			
1.1	Type of (clinical)health worker *This category includes health workers who provide antenatal, delivery, postnatal and Family Planning services and does <u>not</u> include Community Health Workers, porter, vaccinators etc.*	◯ ◯ ◯ ◯ ◯ ◯ ◯	*1=CHO* *2=CHA* *3=SECHN* *4=MCH Aide* *5=EDCU Assistant* *6=Nursing Aid* *9=Other, specify* ……	|___|
1.2	Are you the in-charge of the facility?	◯ ◯	*1=YES* *2=NO*	|___|
1.3	Are you on the government payroll?	◯ ◯	*1=YES* *2=NO*	|___|
1.4	Sex of respondent	◯	*1= Female*	|___|

		◯	*2=Male*	
1.5	Age of respondent	*In whole years at last birthday*		|___||___|
1.6	Do you have children?	◯ ◯	*1=YES → Go to 1.6.1* *2=NO → Go to 1.6.4*	|___|
1.6.1	How many children do you have?	*Fill in number ……..*		|___||___|
1.6.2	How many children are below the age of 18?	*Fill in number ……..*		|___|
1.6.3	How many children below the age of 18 are NOT living with you?	*Fill in number ……..*		|___|
1.6.4	How many years have you worked in this facility?	◯ ◯ ◯	*1= less than one month* *2= between 1-3 months* *3= 3 months or more*	|___| |___| |___|
Section II: Mobile Phone Use				
2.1	What mobile phone network is available in your PHU area? *(multiple answers allowed)*	◯ ◯ ◯ ◯	*1= Airtel* *2= Africell* *3= Comium* *4= Sierratel*	|___| |___| |___| |___| *Fill in code if ticked*
2.2	Are you able to make and receive phone calls and text messages inside the PHU?	◯ ◯	*1=YES →Go to 2.3* *2=NO→ Go to 2.2.1*	|___|
2.2.1	How many minutes do you need to walk to reach a place where network coverage?	*Number of minutes ……*		|___|___|
2.3	Indicate how often you have network coverage at your normal calling spot.	◯ ◯ ◯ ◯	*1= all the time* *2= most of the time* *3= sometimes* *4= almost never*	|___|
2.4	Indicate which statement reflects your work-related use of the telephone	◯ ◯ ◯	*1= I call more often than I send text messages* *2= I call and send text messages about the same amount of times* *3= I send text messages more often than I call*	|___|
2.5	Do you make use of a phone that is provided to the facility (this is not a personally owned phone) for work-related calls and text messages?	◯ ◯	*1=YES → Go to 3.1* *2=NO → Go to 2.5.1*	|___|

2.5.1	If you are <u>not</u> using a facility phone, how do you **make** work-related phone calls and text messages? *(multiple answers allowed)*	○ ○ ○ ○ ○	***1= Do not make them*** *2= <u>Personal phone</u>* *3=<u>Phone from other health worker/volunteer in clinic</u>* *4= <u>Phone from someone else</u>* *9= <u>Other, specify</u>* ……..	|___| |___| |___| |___| |___| *Fill in code if ticked*
2.5.2	If you are <u>not</u> using a facility phone, how do you **receive** work-related phone calls and text messages? *(multiple answers allowed)*	○ ○ ○ ○ ○	***1= Do not receive them*** *2= <u>Personal phone</u>* *3=<u>Phone from other health worker/volunteer in clinic</u>* *4= <u>Phone from someone else</u>* *9= <u>Other, specify</u>* ……..	|___| |___| |___| |___| |___| *Fill in code if ticked*
NOTE: If 2.5.1 AND 2.5.2 are **BOLD ANSWERS** →Go to 6.1 If 2.5.1 is **BOLD ANSWER** and 2.5.2 is <u>underlined answer</u> →Go to 4.1a Otherwise continue to next section → 3.1a				
Section III: Making calls and text messages				
3.1a	How often do you **make** work-related phone calls	○ ○ ○ ○ ○ ○	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= do not know/not sure*	|___|
3.1b	How often do you **send** work-related text messages?	○ ○ ○ ○ ○ ○	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= do not know/not sure*	|___|
District Level				
3.2	How often do you **make** work-related calls/text messages to someone at the district level?	○ ○ ○ ○ ○ ○ ○	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= never → Go to 3.3* *7= do not know/not sure*	|___|

3.2.1	Who do you call/text at the district level? *(multiple answers allowed)*	○ ○ ○ ○ ○ ○	*1= DMO* *2= DHS* *3= M&E Officer* *4= Coordinator MCH Aide training* *5= Other DHMT member, specify* …… *9= Other person(s), specify* …… ……	|___| |___| |___| |___| |___| |___| *Fill in code if ticked*
3.2.2	For what reasons do you **make** work-related calls/text messages to someone at the district level? *(multiple answers allowed)*	○ ○ ○ ○ ○ ○ ○ ○	*1= Ambulance referral* *2= Clinical advice* *3= Surveillance (notifiable diseases)* *4= HMIS information/data* *5= Drugs and supplies* *6= Informing about staff human resources issues (sickness, absence, leave)* *7= Reporting maternal death* *9= Other, specify* …… ……	|___| |___| |___| |___| |___| |___| |___| |___| *Fill in code if ticked*
PHU Level				
If the respondent in an in-charge → Go to 3.4				
3.3	How often do you **make** work-related calls/text messages to your in-charge of your own PHU?	○ ○ ○ ○ ○ ○ ○	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= never → Go to 3.4* *7= do not know/not sure*	|___|
3.3.1	For what reasons do you **make** work-related calls/text messages to the in-charge at your own PHU? *(multiple answers allowed)*	○ ○ ○ ○ ○	*1= Ambulance referral* *2= Clinical advice* *3= Surveillance (notifiable diseases)* *4= HMIS information/data* *5= Drugs and supplies*	|___| |___| |___| |___| |___|

		○	*6= Informing about staff human resources issues (sickness, absence, leave)*	|___|
		○	*7= Reporting maternal death*	|___|
		○	*9= Other, specify*	|___|
			……	*Fill in code if ticked*
			……	
If the respondent is an in-charge at a CHC → Go to 3.5				
3.4	How often do you **make** work-related calls/text messages to your in-charge of the CHC in your chiefdom?	○ ○ ○ ○ ○ ○ ○	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= never → Go to 3.5* *7= do not know/not sure*	|___|
3.4.1	For what reasons do you **make** work-related calls/text messages to the in-charge of the CHC in your chiefdom? *(multiple answers allowed)*	○	*1= Ambulance referral*	|___|
		○	*2= Clinical advice*	|___|
		○	*3= Surveillance (notifiable diseases)*	|___|
		○	*4= HMIS information/data*	|___|
		○	*5= Drugs and supplies*	|___|
		○	*6= Informing about staff human resources issues (sickness, absence, leave)*	|___|
		○	*7= Reporting maternal death*	|___|
		○	*9= Other, specify*	|___|
			……	*Fill in code if ticked*
			……	
3.5	How often do you **make** work-related calls/text messages to other PHU staff (others than mentioned above)	○ ○ ○ ○ ○ ○ ○	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= not at all → Go to 3.6* *7= do not know/not sure*	|___|
3.5.1	For what reasons do you **make** work-related calls/text messages to other PHU staff (others than mentioned above)? *(multiple answers allowed)*	○	*1= Ambulance referral*	|___|
		○	*2= Clinical advice*	|___|
		○	*3= Surveillance (notifiable diseases)*	|___|
		○	*4= HMIS information/data*	|___|
		○	*5= Drugs and supplies*	|___|

		◯ ◯ ◯	*6= Informing about staff human resources issues (sickness, absence, leave)* *7= Reporting maternal death* *9= Other, specify* …… ……	|___| |___| |___| *Fill in code if ticked*
Community Level				
3.6	How often do you **make** work-related phone calls/text messages to clients?	◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= not at all → Go to 3.7* *7= do not know/not sure*	|___|
3.6.1	For what reasons do you **make** work-related calls/text messages to clients? *(multiple answers allowed)*	◯ ◯ ◯ ◯	*1= Remind about upcoming appointments* *2= Inform about missed appointments* *3= Follow-up* *9= Other, specify* …….. ……	|___| |___| |___| |___| *Fill in code if ticked*
3.7	How often do you **make** work-related phone calls/text messages to TBAs?	◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= not at all → Go to 3.8* *7= do not know/not sure*	|___|
3.7.1	For what reasons do you **make** work-related calls/text messages to TBAs? *(multiple answers allowed)*	◯ ◯ ◯	*1= inform about meetings and workshops* *2= Request for come help out at clinic* *9= Other, specify* …… ……	|___| |___| |___| *Fill in code if ticked*
3.8	Do you receive work-related phone calls/text messages?	◯ ◯	*1=YES →Continue* *2=NO→ Go to 6.1*	|___|

Section IV: Receiving calls and text messages				
4.1a	How often do you **receive** work-related phone calls?	◯ ◯ ◯ ◯ ◯ ◯	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= do not know/not sure*	|___|
4.1b	How often do you **receive** work-related text messages?	◯ ◯ ◯ ◯ ◯ ◯	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= do not know/not sure*	|___|
District Level				
4.2	How often do you **receive** work-related calls/text messages from someone at the district level?	◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= not at all → Go to 4.3* *7= do not know/not sure*	|___|
4.2.1	Who do you **receive** the work-related calls/text messages from at the district level?	◯ ◯ ◯ ◯ ◯ ◯	*1= DMO* *2= DHS* *3= M&E Officer* *4= Coordinator MCN Aide training* *5= Other DHMT member, specify* *……* *9= Other person(s), specify* *……* *……*	|___| |___| |___| |___| |___| |___| *Fill in code if ticked*
4.2.2	For what reasons do you **receive** work-related calls/text messages from someone at the district level? *(multiple answers allowed)*	◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= Ambulance referral* *2= Clinical advice* *3= Surveillance (notifiable diseases)* *4= HMIS information/data* *5= Drugs and supplies* *6= Informing about staff human resources issues (sickness, absence, leave)* *7= Reporting maternal death* *9= Other, specify*	|___| |___| |___| |___| |___| |___| |___| |___|

			…… ……	*fill in code if ticked*
PHU Level				
4.3	How often do you **receive** work-related calls/text messages from your in-charge of your own PHU?	◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= not at all → Go to 4.4* *7= do not know/not sure*	|___|
4.3.1	For what reasons do you **receive** work-related calls/text messages from the in-charge at your own PHU? *(multiple answers allowed)*	◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= Ambulance referral* *2= Clinical advice* *3= Surveillance (notifiable diseases)* *4= HMIS information/data* *5= Drugs and supplies* *6= Informing about staff human resources issues (sickness, absence, leave)* *7= Reporting maternal death* *9= Other, specify* …… ……	|___| |___| |___| |___| |___| |___| |___| |___| *Fill in code if ticked*
4.4	How often do you **receive** work-related calls/text messages from your in-charge of the CHC in your chiefdom	◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= not at all → Go to 4.5* *7= do not know/not sure*	|___|
4.4.1	For what reasons do you **receive** work-related calls/text messages from the in-charge of the CHC in your chiefdom? *(multiple answers allowed)*	◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= Ambulance referral* *2= Clinical advice* *3= Surveillance (notifiable diseases)* *4= HMIS information/data* *5= Drugs and supplies* *6= Informing about staff human resources issues (sickness, absence, leave)* *7= Reporting maternal death* *9= Other, specify*	|___| |___| |___| |___| |___| |___| |___| |___|

			…… ……	*Fill in code if ticked*
4.5	How often to you **receive** calls/text messages from other PHU staff (others than mentioned above)	◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= not at all → Go to 4.6* *7= do not know/not sure*	|____|
4.5.1	For what reasons do you **receive** calls/text messages from other PHU staff (others than mentioned above) *(multiple answers allowed)*	◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= Ambulance referral* *2= Clinical advice* *3= Surveillance (notifiable diseases)* *4= HMIS information/data* *5= Drugs and supplies* *6= Informing about staff human resources issues (sickness, absence, leave)* *7= Reporting maternal death* *9= Other, specify* …… ……	|____| |____| |____| |____| |____| |____| |____| |____| *Fill in code if ticked*
Community Level				
4.6	How often do you **receive** work-related phone calls/text messages from clients?	◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= not at all → Go to 4.7* *7= do not know/not sure*	|____|
4.6.1	For what reasons do you **receive** work-related calls/text messages from clients? *(multiple answers allowed)*	◯ ◯ ◯ ◯	*1= Advice about illness* *2= Inform about missed appointment* *3= Make appointment* *9= Other, specify* …… ……	|____| |____| |____| |____| *Fill in code if ticked*

4.7	How often do you **receive** work-related phone calls/text messages from TBAs?	◯ ◯ ◯ ◯ ◯ ◯ ◯	*1= daily* *2= several times a week* *3= once a week* *4= once every two weeks* *5= less than every two weeks* *6= not at all → Go to 5.1* *7= do not know/not sure*	|____|
4.7.1	For what reasons do you **receive** work-related calls/text messages from TBAs? *(multiple answers allowed)*	◯ ◯	*1= Request to help with difficult case (including referral)* *9= Other, specify* …… ……	|____| |____| *Fill in code if ticked*
Section V: Mobile Phone Barriers				
5.1	Do you have to pay for work-related phone calls/text messages?	◯ ◯	*1=YES → Go to 5.1.1* *2=NO → Go to 5.2*	|____|
5.1.1	How much do you pay per week for work-related phone calls/text messages	*Le……*		
5.1.2	Who pays the costs of work-related phone calls/text messages? *(multiple answers allowed)*	◯ ◯ ◯ ◯	*1= myself* *2= PBF fund* *3= Other non-personal funds* *9= Other, specify* ……	|____| |____| |____| |____| *Fill in code if ticked*
5.1.3	How do you buy credits (top-up) for the phone?	◯ ◯ ◯ ◯	*1= buying phone voucher* *2= buying top-up card* *3= both answers above* *4= Other, specify* ……..	|____|
5.1.4	How far do you have to walk to buy top-up credits for the phone?	Number of minutes ……..		|____||____|
5.2	How can you charge the phone that you use for work-related calls/text messages?	◯ ◯ ◯	*1= charge at PHU* *2= charge at home* *3= charge somewhere else*	|____|
5.3	Do you pay to have the phoned charged?	◯ ◯	*1=YES →5.3.1* *2=NO →6.1*	|____|
5.3.1	How much do you pay to have the phone charged?	*Fill in …… SLL*		

Section VI: Satisfaction and Communication				
6.1	My employer provides me with what I need to do my job effectively	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.2	It is easy for me to get information to the DHMT on time	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.3	I am more productive than other people who do a similar job to me	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.4	I am able to discuss difficult cases with other colleagues	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.5	The working conditions are satisfactory	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.6	Contacting DHMT members in no problem for me	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.7	The people who are important to me outside of my work support my work commitments	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.8	Patients show appreciation for what you do for them	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.9	I enjoy my work	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.10	The facility I work in offers enough space to do the work	◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral*	|___|

		◯ ◯	*4= Agree* *5= Strongly agree*	
6.11	I feel motivated to do my best in my current job	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.12	Communicating with other colleagues helps me in my work	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.13	Overall, taking everything into consideration, I am satisfied with my job as a whole	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.14	DHMT contacts me to get my input on certain issues	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.15	I work in a safe environment	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.16	Contacting individual clients in the community for ANC, FP and other services is easy	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.17	I am concerned that pregnant women do not sufficiently use the services they need	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.18	I am satisfied with the overall quality of my working life	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.19	Essential drugs are available	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.20	My colleagues contact me to get my opinion on certain issues	◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral*	|___|

		◯ ◯	*4= Agree* *5= Strongly agree*	
6.21	I have the means to contact individual clients directly	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|
6.22	I am able to achieve a healthy balance between my work and home life	◯ ◯ ◯ ◯ ◯	*1= Strongly disagree* *2= Disagree* *3= Neutral* *4= Agree* *5= Strongly agree*	|___|

Annex 6 – Reliability analysis job satisfaction and communication scale items

Reliability analysis using Cronbach's Alpha test to determine the internal consistency of scale items concerning: Quality or working life (9 items), Working conditions (5 items), Communication with clients (3 items) and Communication with peers and seniors (5 items). These items were rated by health workers on a 5-point Likert scale with the following answer categories: 1) strongly disagree, 2) disagree, 3) neutral, 4) agree, and 5) strongly agree. The Cronbach's Alpha test was used to measure internal consistency for scale items in order to conduct further analysis based on the composition of combined scores for each domain. The following parameters were used for the Cronbach's Alpha:

- <0.6 is too low and unacceptable. The scale items are probably not measuring the same construct (domain), and revisions of questions may be needed
- >0.6 – 0.8 is good
- > 0.8 – <0.95 is excellent
- >/= 0.95 is not desirable because it indicates that questions are redundant

Three of the four domains scored well. Further analysis in the domain *communication with clients* showed that if one statement were dropped, the internal consistency of the domain would score well. As this would leave the domain with the scores of only two statements to be calculated into a combined score, it was decided to analyse each statement separately.

Construct (Domain)	Cronbach's Alpha
Quality of working life (9 items) -I am more productive than other people who do a similar job to me -I am able to discuss difficult cases with other colleagues -The people who are important to me outside my work support my work commitments -Patients show appreciation for what I do for them -I enjoy my work -I feel motivated to do my best in my current job -Overall, taking everything into consideration, I am satisfied with my job -I am satisfied with the overall quality of my working life -I am able to achieve a healthy balance between my work and home life	0.678
Working Conditions (5 items) **-**My employer provides me with what I need to do my job effectively **-**The working conditions are satisfactory **-**The facility I work in offers enough space to do the work -I work in a safe environment -Essential drugs are available	0.623
Communication with clients (3 items) -Contacting individual clients in the community for ANC, FP and other services is easy -I am concerned that pregnant women do not sufficiently use the services *(D)* -I have means to contact individual clients directly	*0.458**
Communication with peers and seniors (5 items) -It is easy for me to get information to the DHMT on time -Contacting DHMT members is no problem for me -Communicating with other colleagues helps me in my work -DHMT contacts me to get my input on certain issues -My colleagues contact me to get my opinion on certain issues	0.654

**Unreliable domain* *(D)=item dropped*

Annex 7 – Background characteristics of health worker respondents

		CHO		CHA		SECHN		MCH Aide		EDCU Assistant		Nursing Aide		TOTAL	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
Sex of respondent	Female	1	*10.0*	6	66.7	12	*66.7*	123	*100*	2	*13.3*	2	*66.7*	146	*83*
	Male	9	*90.0*	3	33.3	6	*33.3*	0	*0*	11	*84.6*	1	*33.3*	30	*17*
Children	Yes	7	*70.0*	9	100	18	*100*	121	*98.4*	12	*92.3*	3	*100*	170	*96.6*
	No	3	*30.0*	0	0	0	*0*	2	*1.6*	1	*7.7*	0	*0*	6	*3.4*
Number of months worked at facility	<one month	1	*10.0*	1	11.1	1	*5.6*	1	*0.8*	0	*0*	0	*0*	4	*2.3*
	Between 1–3 months	2	*20.0*	0	0	3	*16.7*	1	*0.8*	0	*0*	0	*0.0*	6	*3.4*
	3 months or more	7	*70.0*	8	88.9	14	*77.8*	121	*98.4*	13	*100*	3	*100*	166	*94.3*
On government payroll	Yes	10	*100*	8	88.9	17	*94.4*	123	*100*	10	*76.9*	2	*66.7*	170	*96.6*
	No	0	*0*	1	11.1	1	*5.6*	0	*0*	3	*23.1*	1	*33.3*	6	*3.4*
Facility in-charge	Yes	10	*100*	8	88.9	7	*38.9*	63	*51.2*	3	*23.1*	0	*0*	91	*51.7*
	No	0	*0*	1	11.1	11	*61.1*	60	*48.8*	10	*76.9*	3	*100*	85	*48.3*
Type of facility	CHC	10	*100*	2	22.2	8	*44.4*	20	*16.3*	1	*7.7*	1	*33.3*	42	*23.9*
	CHP	0	*0*	7	77.8	4	*22.2*	16	*13*	5	*38.5*	0	*0*	32	*18.2*
	MCHP	0	*0*	0	0	6	*33.3*	87	*70.7*	7	*53.8*	2	*66.7*	102	*58*

Annex 8 – Overview data for wedge comparison

		Wedge 1		Wedge 2	
		N	%	N	%
Health worker and health facility characteristics					
Type of facility	CHC=42	22	52.4	20	47.6
	CHP=31	15	48.4	16	51.6
	MCHP=103	57	55.3	46	44.7
Type of health worker	CHO=10	5	50.0	5	50.0
	CHA=9	4	44.4	5	55.6
	SECHN=18	7	38.9	11	61.1
	MCH Aide=123	71	57.7	52	42.3
	EDCU Assistant=13	6	46.2	7	53.8
	Nursing Aid=3	1	33.3	2	66.7
Facility in-charge	Yes=91	52	57.1	39	42.9
On government payroll	Yes=170	92	54.1	78	45.9
Sex	Female=146	80	54.8	66	45.2
	Male=30	14	46.7	16	53.3
Staff size	single staff=32	18	56.3	14	43.8
	staff team of 2 or more=144	76	52.8	68	47.2
Months at facility	< 1 month=4	2	50.0	2	50.0
	Between 1–3 months=6	4	66.7	2	33.3
	3 months or more=166	88	53.4	78	47.0
Age	mean (average)	41.2		41.3	

Mobile phone coverage and use		**N**	**%**	**N**	**%**
Make and receive calls inside PHU	yes=154	80	51.9	74	48.1
Coverage at normal calling spot*	all the time=96	37	38.5	59	61.5
	most of the time=51	35	68.6	16	31.4
	sometimes=28	21	75.0	7	25.0
Frequency making calls	daily=36	12	33.3	24	66.7
	several times a week=58	38	65.5	20	34.5
	once a week=27	13	48.1	14	51.9
	once every 2 weeks=31	15	48.4	16	51.6
	less than every 2 weeks=24	16	66.7	8	33.3
Frequency sending messages	daily=2	0	0.0	2	100.0
	several times a week=9	3	33.3	6	66.7
	once a week=21	3	14.3	18	85.7
	once every 2 weeks=12	11	91.7	1	8.3
	less than every 2 weeks=132	77	58.3	55	41.7
Pay for calls	yes=175	94	53.7	81	46.3
Pay for charging	yes=158	84	53.2	74	46.8

Calls to district	once a week or more=77	34	44.2	43	55.8
	less than once a week=80	52	65.0	28	35.0
Calls to in-charge of own facility	once a week or more=38	18	47.4	20	52.6
	less than once a week=16	7	43.8	9	56.2
Calls to chiefdom in-charge	once a week or more=96	20	57.1	15	43.9
	less than once a week=54	17	63.0	10	37.0
Calls to other staff	once a week or more=96	41	42.7	55	57.3
	less than once a week=47	27	57.4	20	42.6
Calls to clients	once a week or more=54	19	35.2	35	64.8
	less than once a week=45	24	53.3	21	46.7
Calls to TBAs	once a week or more=35	19	54.3	16	45.7
	less than once a week=36	20	55.6	16	44.4
Receives calls from district*	once a week or more=48	19	39.6	29	60.4
	less than once a week=92	60	65.2	32	43.8
Receive calls from in-charge of own facility	once a week or more=37	16	43.3	21	56.8
	less than once a week=16	9	56.2	7	43.8
Receive from chiefdom in-charge	once a week or more=26	15	57.7	11	42.3
	less than once a week=112	61	54.5	51	45.5
Receive calls from other staff*	once a week or more=85	40	47.1	45	52.9
	less than once a week=60	39	65.0	21	35.0
Receive calls from clients*	once a week or more=57	19	33.3	38	66.7
	less than once a week=43	23	53.5	20	46.5
Receive calls from TBAs	once a week or more=25	12	48.0	13	52.0
	less than once a week=30	16	53.3	14	46.7

Job satisfaction and communication combined average scores		N	%	N	%
Communication with peers and seniors	average score	94	77.8	82	75.3
Working conditions	average score	94	62.2	82	63.5
Quality of working life	average score	94	75.3	82	73.1
Contacting clients is easy	Disagree=21	13	61.9	8	38.1
	Neutral=14	10	71.4	4	28.6
	Agree=141	71	50.4	70	49.6
Have the means to contact clients directly	Disagree=21	15	75	5	25
	Neutral=14	10	71.4	4	28.6
	Agree=141	69	48.6	73	51.4