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"I expect the health worker to call me"

mHealth for maternal and newborn health in resource-poor and health system settings, Sierra Leone

Feasibility study report

DFID New and Emerging Technologies Research Competition, Phase I

Development Policy & Practice

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Cover photo: Satellite image of Sierra Leone with estimated mobile network antennas of one mobile network operator. Courtesy NatCom.

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Medical Research Centre

Government of Sierra Leone

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TEXT TO CHANGE

Royal Tropical Institute

MDG5 Meshwork

Mannion Daniels

Disclaimer

“I expect the health worker to call me”

— Female health service client, Kenema district

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Abbreviations and acronyms

AIDS	Acquired immune-deficiency virus
ANC	Antenatal care
BPEHS	Basic Package of Essential Health Services
CHC	Community health centre
CHO	Community health officer
CHP	Community health post
CHW	Community health worker
DFID	UK Department for International Development
DHMT	District health management team
DHS	Demographic and Health Survey
EmONC	Emergency obstetric and neonatal care
FGD	Focus group discussion
FHCI	Free Health Care Initiative
HIV	Human immunodeficiency virus
HMIS	Health management information system
HW	Health worker
IDI	In-depth interview
IRC	International Rescue Committee
KII	Key informant interview
KIT	Royal Tropical Institute
M&E	Monitoring and evaluation
MCH Aide	Maternal and child health aide
MCHP	Maternal and child health post
MDG	Millennium Development Goal
mHealth	Mobile communication for health
MNH	Maternal and newborn health
MoHS	Ministry of Health and Sanitation
NET-RC	New and Emerging Technologies – Research Competition
PHU	Peripheral health unit
PNC	Postnatal care
SECHN	State-enrolled community health nurse
SLBC	Sierra Leone Broadcasting Corporation
SRHR	Sexual and reproductive health and rights
SSI	Semi-structured interview
STI	Sexually transmitted infection
TB	Tuberculosis
TBA	Traditional birth attendants
USL	University of Sierra Leone
WHO	World Health Organization

Abstract

Background and purpose Sierra Leone ranks low on the Human Development Index, with high maternal and child mortality figures. Available literature identifies a number of areas where mobile communication technology for health (mHealth) can make a difference in favour of maternal and newborn health (MNH). However, evidence of effectiveness of mHealth strategies is still limited. Therefore, the objective of this study was to assess the feasibility of introducing and operating selected mobile communication technologies for improved communication on MNH, in a fragile health system in resource-poor settings.

Methods The study was mainly qualitative, exploratory in nature and was implemented in two sites, Kenema district and Western Area. Main research methods included semi-structured interviews, in-depth interviews, focus group discussions and literature review. 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.

Findings and conclusions Health workers, clients and other community members alike see much potential in using mobile communication across various mHealth domains, to improve information, service delivery, access, quality, efficiency, responsiveness and, ultimately, health outcomes.

Work-related use of mobile communication for health 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.

While almost all health workers possess a mobile phone, only one-third of interviewed clients 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.

Expectations among both health workers and community members are 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, while also regulator NatCom so far has not been able to share relevant information. This context should be taken into account when pursuing in the field of 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 these and clients; considerations of costs to health staff and clients; and governance issues surrounding ethical issues and confidentiality, public-private partnerships and sustainability.

Keywords – Maternal health, newborn health, mobile health, mHealth, health communication, health systems, Sierra Leone

Contents

Tables and figures

1Introduction

The 'mHealth for maternal and newborn health in resource-poor community and health systems settings – Sierra Leone' 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 would (i) focus on the best ways to responsibly introduce and use relevant, effective and affordable new technologies in resource-poor settings; (ii) identify and deal with barriers that prevent the disadvantaged from benefiting; and (iii) address possible risks in terms of undue effects on development goals. Findings would then be 'translated' into formats that feed into policies, programmes and guidelines.

The DFID programme entails two phases: Phase 1 being a feasibility study which generates understanding and inputs to assist country teams in implementation of more extensive research; the latter would constitute Phase 2.

The consortium that developed and implemented the NET-RC Phase 1 proposal consisted of the Ministry of Health and Sanitation (MoHS), the Medical Research Centre (MRC) and the University of Sierra Leone (USL), all from Sierra Leone; the Netherlands-based Royal Tropical Institute (KIT) and Text to Change; and MannionDaniels (UK).

Phase 1 activities leading up to the feasibility study included (i) an inception phase whereby consortium partners agreed on working arrangements, communication and administrative procedures, the work plan and timeline and the division of tasks; (ii) a brief literature review on mobile communication technologies for health (mHealth) in relation to maternal and newborn health (MNH) and the Sierra Leonean context; (iii) the development of a feasibility study research proposal, including data collection instruments, among others through a stakeholder workshop in Sierra Leone; (iv) training of data collectors and field-testing and adaptation of the instruments, after having obtained ethical clearance in Sierra Leone as well as from KIT, (v) the pilot-testing of selected (mobile) communication applications as well as the actual data collection and data processing; and (vi) data analysis and report writing.

The present report documents the outcomes of this process, partly building on the mid-term report that was produced in May 2011 leading up to the NET-RC Phase 2 application. The remainder of this chapter covers the literature review, the justification and focus chosen for the mHealth feasibility study (applications to be tested) and the study objectives. Subsequently, the study methodology is presented, including conceptual frameworks and a reflection on study limitations. Chapter 3 presents study findings; the discussion chapter then concludes this report.

The report will serve as an important guiding document to develop the detailed Phase 2 intervention study protocol, an outline of which was submitted as part of the successful Phase 2 application and is now being included in the award contract with a starting date later this year.

1.1 Literature review

Maternal and newborn health worldwide

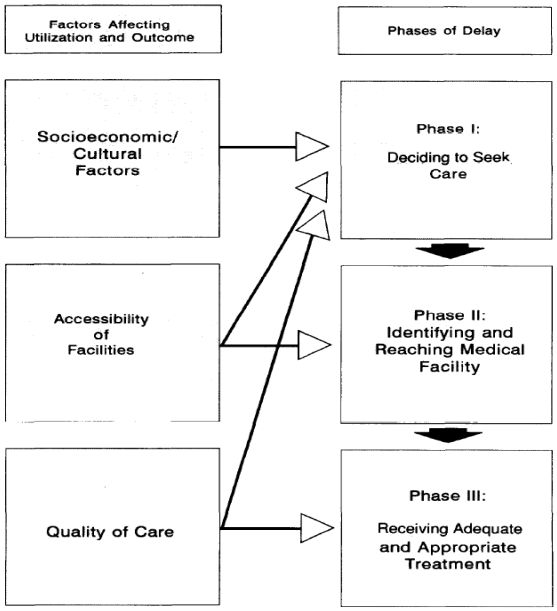
Up to 358,000 women worldwide die each year in pregnancy and childbirth, around a quarter of a million of these in Africa. Most die because they have no access to skilled and emergency care (WHO, 2010a). However, in addition to supply-side factors contributing to maternal deaths, the much-cited Three Delays model by Thaddeus and Maine (1994), presented in figure 1.1, also asks attention for demand-side issues related to socio-economic and cultural factors, access, decision-making, transport and related aspects such as information, perceptions and attitudes.

There has been some progress in sub-Saharan Africa over the last decades, but here a woman's lifetime risk of dying during pregnancy, delivery or post-partum remains very high in comparison with the developed world (1 in 31 as compared to 1 in 4300) (WHO, 2010a).

Besides the human loss, in poor countries a woman's death represents an enormous cost to her nation, community and family. In addition, for every woman who dies from complications related to childbirth, dozens more suffer injury, infection or disease (WHO 2005, WHO 2010c).

The root cause of the extremely high maternal and newborn mortality is the low status of women in many developing countries relating to decision-making power, education, access to resources, nutrition, violence, early, frequent and unwanted pregnancies, low use of family planning and low use of maternal health services.

Figure 1.1 Maternal mortality: the Three Delays model ***(Thaddeus and Maine, 1994)***



One million babies are stillborn in Africa each year, of whom at least 300,000 die during labour. A further 1.16 million babies die in their first month of life – up to half on the first day – and another 3.3 million children will die before they reach their fifth birthday. (WHO undated) Child survival programmes have primarily focused on important causes of death *after* the first four weeks of life – pneumonia, diarrhoea, malaria and vaccine-preventable conditions. However, in the last few years it has become obvious that deaths during the first weeks of life (neonatal deaths) account for an increasing proportion of under-five deaths. Globally, almost 40 percent of under-five deaths are neonatal (WHO 2009).

Africa accounts for 11 percent of the world's population but more than 25 percent of the world's newborn deaths. Of the 20 countries in the world with the highest risk of neonatal death, 15 (75 percent) are in Africa. (WHO undated) As child health programmes succeed in reducing deaths after the first month and year of life, an increasing proportion of under-five deaths will be neonatal, and action must now be taken to reduce newborn deaths. Newborn deaths can be reduced by strengthening newborn care within existing child and maternal health programmes and by better reaching the unreached.

The above factors led to the inclusion of both topics among the Millennium Development Goals (MDGs): MDG 4 aims to reduce child mortality with the specific target: "Reduce by two thirds, between 1990 and 2015, the under-five mortality rate", while MDG 5 aims to improve maternal health with the specific targets to "Reduce by three quarters the maternal mortality ratio and achieve universal access to reproductive health" (United Nations, undated).

Maternal and newborn health in Sierra Leone

Sierra Leone currently ranks 158 out of 169 countries on the Human Development Index, with unacceptably high maternal and child mortality figures (UNDP 2010, Statistics Sierra Leone and ICF Macro, 2009). The lifetime risk of a woman dying from complications of pregnancy and childbirth is one in eight (UNICEF 2009). The health system in Sierra Leone is characterized by inadequately qualified health care workers, insufficient supply systems, poor coordination and management (MoHS 2009).

Reproductive and child health is one of the priorities of the MoHS, so the Reproductive and Child Health Strategic Plan was developed in 2008 with a focus on low-cost, high-impact interventions. As part of the implementation of the strategic plan, the Basic Package of Essential Health Services (BPEHS) was developed and launched in March 2010. The package serves as a guide in the provision of standards of services and human resource needs at each level of care and competency training needs, and it provides the basis for the development of operational plans including budgets. It covers services that have greatest impact on the major health problems, especially maternal and child health problems.

The interventions in the Reproductive and Child Health Strategic Plan and BPEHS also deal with the three delays relevant for addressing maternal deaths: delay in seeking appropriate care (traditional beliefs and practices, awareness of danger signs, decision-making, perceptions of access to and quality of services), delay in accessing care (distance, costs, transport, communication) and delay in receiving timely and appropriate quality care (Thaddeus and Maine, 1994; Herschderfer et al. 2011).

According to the Sierra Leone Demographic and Health Survey (DHS) (2008), more than 85 percent of the pregnant mothers attended antenatal care (ANC) services at least once in their most recent pregnancy, but delivery at a health facility remains low at 25 percent, and only 42 percent had skilled attendance at delivery. (Statistics Sierra Leone and ICF Macro, 2009) Insufficient numbers of health facilities are equipped and staffed according to standards to provide emergency obstetric and neonatal care (EmONC). Thus the EmONC needs assessment conducted in 2008 showed that no peripheral health units (PHUs) qualified as a basic EmONC facility and that most hospitals do not qualify as comprehensive EmONC facilities (MoHS, 2008a). There is no functional referral system in many districts, leading to delays in provision of comprehensive EmONC.

Although family planning is recommended as one of the strategies for reducing maternal mortality, the current contraceptive prevalence rate in the country is low. In the 2008 Sierra Leone DHS, it was shown to have risen from 4 percent to 6.7 percent, with a total unmet need for family planning of 36 percent (Statistics Sierra Leone and ICF Macro, 2009). The total fertility rate is high, at 6.0 children per woman.

Meanwhile, access to maternal and child health services has improved after the launch in April 2010 of the Free Health Care Initiative (FHCI) for pregnant and lactating women and children under five years of age. This in turn has improved the utilization of health services, with an increase of 32 percent in institutional delivery and a 150 percent increase of attendance of under-fives.

However, there are challenges, as members of staff are overwhelmed with work and logistics are under pressure, therefore, the quality of care and outreach services has declined (MoHS 2011).

MNH services are provided at all levels. Three levels of PHUs provide preventive and curative primary health care services: maternal and child health posts (MCHPs), community health posts (CHPs) and community health centres (CHCs). The PHUs work very closely with community health workers, including traditional birth attendants (TBAs), to provide health services at community level. Secondary-level services are provided at district hospitals, with tertiary care provided at regional and national referral hospitals.

Priorities for MNH in Sierra Leone

Priorities for MNH in Sierra Leone were spelled out in the Reproductive and Child Health Strategic Plan (MoHS, 2008b):

- improve coordination and collaboration of/for MNH services;
- improve coverage, utilization and quality of MNH services, especially at community level, using BPEHS;
- integration of MNH services and scaling up of high-impact interventions, especially in the area of malaria, malnutrition, HIV and TB;
- strengthen human resources for MNH services;
- strengthen health systems to support MNH services;
- strengthen monitoring and evaluation (M&E) of MNH services, including building capacity for data for action; and
- implement operational research on MNH, including capacity-building for research.

At a workshop involving key expert stakeholders from government, university, civil society, the private sector and development partners, organized in February 2011 in Freetown as part of the preparatory activities for the present feasibility study, a number of issues were identified as key community and health system issues that affect MNH in Sierra Leone, identifying both demand-side and supply-side factors as referred to above (see Table 1.1).

Table 1.1 Demand and supply factors affecting maternal and newborn health in Sierra Leone
(Source: stakeholder meeting, Freetown, 16 February 2011)

Community/client issues	***Health system/provider issues***
Teenage pregnancy Unwanted pregnancies Unsafe abortion Recurrent spontaneous abortion Absence of birth preparedness plan Late first ANC visit Poor knowledge of SRH Issues Poor knowledge of health education issues Poor knowledge of expected date of delivery Poor knowledge of normal and danger signs of pregnancy and delivery Poor involvement of men in RH issues of women Poor knowledge of men on RH issues Low level of facility delivery Low level of postnatal visits Low early and exclusive breastfeeding High defaulter rate for immunization High malnutrition rate	Low ANC coverage Low family planning coverage Poor client satisfaction Absence of adolescent-friendly services Not enough knowledge of community health workers in handling complications Late referral Poor knowledge/skills of providers of neonatal resuscitation and newborn care Lack of basic and comprehensive EmONC facilities Low immunization coverage Not proper information on referral systems Poor outreach visits by providers

This analysis is substantiated by the result of an assessment conducted in 2007 on the maternal and child health situation in Sierra Leone (Agongo, 2006).

mHealth in the international context
The notion that mobile communication technologies can be used for public health purposes (mHealth) has rapidly gained momentum over the past few years. It is based on the quick rise in mobile phone use among rural and other traditionally disadvantaged populations in developing countries (made possible by increasing mobile network coverage and falling costs) and expanding communication technology options.

The main rationales for using mHealth as a strategy are to improve access to services, disease diagnosis and treatment, quality of care and cost-effectiveness. However, few scientific studies have been undertaken that evaluate health outcomes (Mechael et al., 2010).

Adapting and expanding the approaches used in three recent reviews, current and potential usage of mHealth-related approaches can be categorized according to the nine domains presented in Table 1.2.

Table 1.2 mHealth domains framework
(Source: own elaboration based on inputs from Mechael et al., 2010; Vital Wave Consulting, 2009; and Sloninsky, 2008)

Domain	Description
Health service domains	
1. Education and awareness	disease prevention, health promotion, community mobilization, creating a virtual community
2. Point-of-care support	for diagnosis, screening, clinical care and referral
3. Client monitoring	e.g. treatment adherence support, appointment reminders/tracking
4. Emergency medical response system	accidents, emergency obstetric care, disaster management
Health system domains	
5. Disease and epidemic outbreak surveillance	real-time tracking of diseases
6. Health management information system (HMIS)	including programme monitoring, supply chain management
7. Human resources for health (HRH) management, supervision and professional development	staff management, distance learning and continuing professional development for health care workers (including 'mLearning')
8. Health financing	e.g. use of smart cards, vouchers, insurance and other mobile payments
9. General coordination	improving communication among health managers and service providers for general information and coordination purposes

Furthermore, the literature reviewed indicated that a number of issues need to be taken into account or addressed when assessing and selecting specific communication strategies based on mobile communication applications, and when designing and implementing an mHealth programme. Some of the key issues are presented in Table 1.3.

The scope for mHealth to improve maternal and newborn health
In June 2010, a global coalition[1] called for the innovative use of mobile communication technologies for public health (mHealth) in order to strategically contribute to broader efforts to improve maternal and newborn health (MNH) (UN Foundation, 2010). These technologies address MDG 5 (reduction of maternal mortality) as well as Target 6 of MDG 8, which aims to narrow the 'digital divide' between the global South and North.

[1] Supporters of this initiative include the mHealth Alliance; the Partnership for Maternal, Newborn and Child Health (PMNCH); Family Care International; the GSM Association; Johns Hopkins School of Nursing and Bloomberg School of Public Health; PATH; and the White Ribbon Alliance. See http://www.unfoundation.org/press-center/press-releases/2010/mobile-tech-to-reduce-maternalnewborn-mortality.html [accessed 30 June 2010].

Table 1.3 Key aspects to be addressed in mobile communication programmes *(Source: own elaboration based on all mHealth-related references listed)*

Key aspect	Description
1. Technology	Technology type/level in relation to users' phone technical capacity (standard, smart), user-friendliness and cost to user
2. Inter-operability	Using open-source software may improve inter-operability: the degree to which an application and communication strategy can be accessed by clients of diverse mobile network operators
3. Cost	Zero-rating (providing services free of charge to end-users) is deemed an important precondition for reaching large segments of under-served populations
4. Battery charging	Logistics related to battery charging, in areas where no regular electricity is available
5. Phone credit top-up	Logistics related to how to obtain phone 'credit' (recharge vouchers or otherwise)
6. Privacy and confidentiality	Message contents in relation to client identification, privacy and confidentiality: application users may share the phone with others, not own a phone themselves, or own more than one phone
7. Literacy	Communication channels in relation to client literacy levels, e.g. automated voicemail and voice-response systems may be more effective than text message-based systems
8. Language	Communication language in relation to the language with which users feel comfortable; taking into account that that might turn out to be a mostly oral language that people are not used to use in written form
9. Opt-in approach	For ethical, cost and communication strategy reasons, a system that works with clients who have opted in (they choose to subscribe to a communication platform) is to be preferred over a system that works with bulk messages to an unknown database of clients
10. Piloting	Implementing pilot activities for learning and assessment purposes is an important step in any mHealth intervention

Available literature identifies a number of areas where mobile communication technology, usually as part of a broader set of interventions, can make a difference in favour of MNH. A literature review identified several relevant scientific studies in Asia offering evidence for service utilization gains, However, for sub-Saharan Africa literature found was limited to:

(i) a considerable amount of grey (not peer-reviewed) literature on mHealth initiatives such as those relating to improved health service delivery and reduced maternal deaths in Rwanda (Mugume, 2010), improved quality of care, provider–client communication and emergency referral in Senegal (Netsquared, undated), and improved access to maternal health services in Kenya (Changamka, undated); and

(ii) two scientific (intervention) studies under way in Zanzibar/Tanzania and Ghana that as yet have to report on findings:

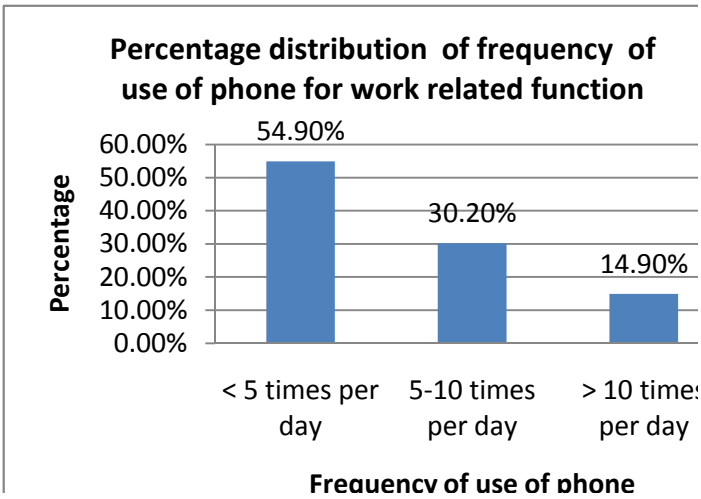
The first (Wired Mothers, Zanzibar (Lund, undated; Wired Mothers, undated)) focuses on assessing the effect of mobile communication interventions on pregnant women's use of health care, skilled attendance at delivery, and neonatal morbidity and mortality, as well as on the health system response to obstetric emergencies.

The second (MoTeCH, Ghana (Mechael and the Dodowa Research Center, 2009; MoTeCH, undated; Grameen Foundation and Motech, 2011)) focuses on mobilizing supply and demand of services, to improve health outcomes, especially regarding MNH – for example, improved ANC access, skilled attendance of deliveries, postnatal care (PNC), essential home practices and immunization.

mHealth for maternal and newborn health in Sierra Leone

Telecommunication services in Sierra Leone include landline (fixed) telephone services, mobile phone services and internet services, among others. Sierra Leone Telecommunications (Sierratel) is the main provider of landlines for both national and international services in the Western Area. Mobile phone communication is provided by four main companies, Airtel (ex-Zain), Africell, Sierratel and Comium, who offer mobile network services in the entire country. The coverage of mobile phone networks is not uniformly distributed, as some populated sites have connectivity, while others do not. In some areas mobile phone connectivity is available only at certain spots, so those who want to call or receive calls must go to and stand at that location. Prepaid mobile phone cards can be purchased throughout the country. Sierratel, Airtel, Comium, Ipitel and a host of others provide email and internet facilities. So-called 'telecentres' and internet cafes are also available in most main towns in the country (personal observation).

Figure 1.2 Frequency of work-related mobile phone use among MNH workers in four districts, Sierra Leone 2011 *(Source: Jalloh, 2011)*



With less than 21 mobile phone subscriptions per 100 population, Sierra Leone's cellular penetration is still relatively low compared to other West African countries (WHO, 2010b). Sierra Leone's National Telecommunications Commission (NatCom) has no data on mobile phone coverage[2] readily available for public use, although a verbal communication mentioned a geographical coverage of 80 percent (personal communication with NatCom, July 2011).

However, mobile phone use is expanding rapidly in Sierra Leone, and the related communication technology is being taken on board by businesses and public services. The stakeholder workshop mentioned earlier produced anecdotal evidence that health managers and health workers in many of the country's 13 districts already use mobile phones for health-related purposes, especially for emergencies and referrals but also for other domains; see Annex 1 for details.

[2] Mobile network coverage: geographical area covered by a provider's cellular service, per mobile network provider and for all combined

This was also confirmed by a 2011 survey (Jalloh, 2011) among 200 government health workers in Western Area, Bombali, Moyamba and Kenema districts. It showed that virtually all used a mobile phone for work-related purposes; which in 90 percent of the cases were personal (not duty) phones on which the health workers spent around 10,000 to 20,000 Leones per week (roughly US$2–4 at current exchange rates). Airtel is the most frequently used mobile network service provider, with 63 percent of health workers interviewed using this network, which gives an indication of geographical and subscriber network coverage. The frequency of work-related mobile phone use was as represented in Figure 1.2. The communication modes mostly used are voice calls and text messages, with only 2 percent using internet/e-mail. The phone is mostly used for giving or asking advice from a professional or friend, giving information about reproductive health issues or calling for an emergency or follow-up of a referral.

The mobile phone is less frequently used for organization and coordination issues, which provides an opportunity. The health workers interviewed expressed that if the use of the phone were free to them, they would use it more to remind clients about appointments, ask and give advice and information to clients and find out about referred patients.

The health workers considered the greatest impact of mobile phones on maternal and neonatal health to be in the areas of emergencies, advice and information, which might indicate that they might need more sensitization and training on appointment reminders. Common constraints mentioned were the availability of a phone, the problems of charging the phone (in areas without electricity or other power source) and the limited network coverage in some areas. These constraints can be partially addressed through provision of phones and solar phone chargers, combined with lobbying and advocacy for improvement of network coverage (Jalloh, 2011).

To date, the Sierra Leonean government has not embarked on developing a mHealth policy. At the same time, public, private and donor funds are being used to invest in mHealth infrastructure (equipment, software, other), and capacity is being built across medical professional groups. While mHealth initiatives are ongoing, no formal evaluations have taken place nor have there been any relevant publications. While a lack of technical expertise or knowledge on applications is not perceived as a barrier to implementing mHealth initiatives, a lack of a policy framework, high perceived cost, a perceived lack of demand for mHealth and a lack of infrastructure are considered barriers (WHO, 2010b).

Meanwhile, supported by the World Health Organization (WHO), the national MoHS has embarked on a process to integrate mHealth into relevant strategic plans but initially intends to generate more evidence of effective interventions. The current report presents the results of a study that constitutes the first national-level MoHS mHealth initiative focusing on MNH, which is one of the MoHS's priority areas.

This Phase 1 study entails a feasibility study including situation analysis, qualitative baseline and pilot-testing of selected applications. In view of the above-mentioned service gaps for maternal health, the study focused on benefits and challenges related to both provider-initiated as well as client-initiated communication, to ultimately improve service uptake, service delivery and health outcomes.

1.2 Justification

Sierra Leone ranks among the countries with the highest rate of morbidity and mortality among pregnant women and children under five years of age. There are a number of reasons for these high rates, including issues related to poor knowledge of sexual and reproductive health (SRHR) and a weak health system.

The above referred literature shows promising potential for improving service coverage through the use of mobile phones. The coverage of mobile phone usage in the country is increasing. There is now (partial) geographic mobile phone coverage in all 13 districts and most of the 149 administrative chiefdoms in the country. While a number of District Health Management Teams (DHMTs) make limited use of mobile phones to coordinate delivery of health care, their approach and scope are different. It is, therefore, not yet clear how best to use the mobile phone to improve health care delivery in Sierra Leone. This study will, therefore, assess the feasibility of introducing and operating selected mobile communication technologies for improved provider-initiated communication on MNH.

Focus
Based on the literature review, the situation analysis presented and the stakeholder consultation, the focus of the study was on improving (i) service quality, (ii) service utilization, (iii) referral systems, and (iv) emergency responses, through the following mHealth applications and related interventions:

a) **Improving awareness** of pregnant women, their families and related community on MNH issues and available services, in order to improve service uptake (advance first ANC visit, increase average number of ANC visits, facility delivery by skilled attendant, PNC) and emergency preparedness, e.g. birth preparedness, danger signs, referral system, transport issues. Communication technologies/applications explored would be:
   - establishing two-way communication between clients/community members and knowledgeable staff via a toll-free 'Mother & Baby' information hotline *(not* for emergencies)

b) **Improving monitoring** of pregnant women by health workers (to improve all four mentioned focus areas), via:
   - provider-initiated, 'personalized'/tailored communication to individual women known to be pregnant, to encourage first or follow-up use of relevant services; and
   - improving general coordination (see below)

c) **Improving point-of-care and emergency service quality**, by facilitating communication and exchange of information and advice among health workers, via:
   - improving general coordination (see below)

d) **Improving general coordination** among various cadres and levels of health workers and managers, through one or more different types of 'closed' mobile networks for staff and addressing barriers to realizing its full potential.

Initially, a second awareness-raising application (text messaging) had been identified; however, this idea was later abandoned – see Methodology section.

The Phase 1 study entails a feasibility study including preliminary situation analysis, baseline and pilot-testing of selected applications with a focus on improving MNH using mobile communication technology.

1.3 Study objectives

Overall goal of the research:
To assess the feasibility of introducing and operating selected mobile communication technologies for improved communication on maternal and newborn health, in a fragile health system in resource-poor settings.

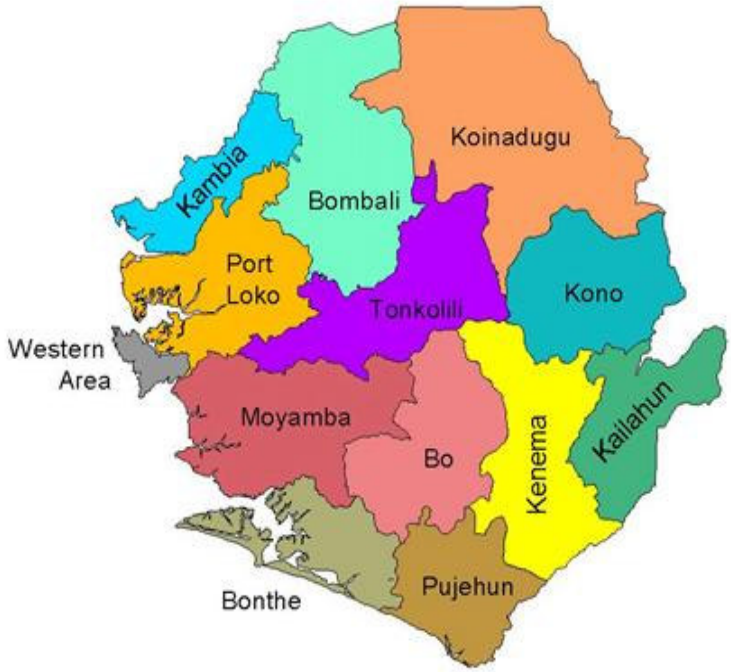
Specific objectives of the research:

1. To assess mobile communication behaviour and perspectives of public health workers and their managers;
2. To explore mobile communication behaviour and perspectives of health service users;
3. To assess the logistical, technical and financial aspects of mobile network providers and related services, including the testing of selected mHealth interventions;
4. To assess risks and preconditions associated with the integration of mobile phone technologies into the health system in low resource settings.

2Methodology

The study was mainly qualitative, exploratory in nature (with a small quantitative component connected to a small 'intervention' in the form of piloting several communication applications) and was implemented in two sites, Kenema district and Western Area. The research table in Annex 1 offers a summary overview of research questions, research methods, data collection tools and research participants, in relation to each other and the study objectives.

Figure 2.1 Map of Sierra Leone with districts
Study site: Western Area and Kenema



Description of study area
The study was conducted in two out of the 13 districts in Sierra Leone, Kenema district and the Western Area. Kenema district is one of the three districts in the eastern region of Sierra Leone. The 2004 National Population Census put the population of Kenema district at 497,948, with a projected population of 606,894 for 2011. It occupies a total surface area of 6053 km^2 and comprises of 16 chiefdoms. The district headquarters is Kenema town. The district has 121 functioning PHUs and two hospitals. Access to some of the health facilities in the district is difficult due to the poor road network, especially during the rainy season. The district enjoys a forested environment and rich, fertile land. Trading, mining (gold and diamonds) and farming (coffee, cocoa and rice) are the main economic activities, while unemployment is high and literacy levels are low. The main ethnic groups in the district are Mende and Temne. The main religious affiliations are Christian and Muslim.

The other study district, the Western Area, is situated in the western region of Sierra Leone and hosts the capital city, Freetown, which is the largest city in the country. It is divided into rural and urban areas. Freetown is the hub of the nation's administrative, financial, educational, communications, cultural and economic centre, as well as its main port. The 2004 National Population Census estimated the population in the Western Area as 947,122 and projected it to reach 1,214,928 for 2011. The Western Area is a region with much potential, from rain forests to white sandy beaches, hills and valleys. The land area covers approximately 557 km^2. Although the main road network remains satisfactory, the road quality in most areas has been in a poor physical condition owing to nearly two decades of neglected maintenance. The principle economic activities in the Western Area are small-scale agriculture, fishing, petty trading, industry and business enterprises such as small-scale farming, fishing, salt manufacturing, poultry and animal husbandry. The Western Area has 135 health facilities of which 60 percent are public, 20 percent are private for profit and 20 percent are faith-based.

Research methods included semi-structured interviews, in-depth interviews, focus group discussions, literature review, a mini-survey, and observation.

Testing of applications
As part of the research, the following relatively small interventions were introduced for communication between clients and health workers:

1. A toll-free *Bellehwoman & Pikin* (pregnant woman and baby) information line, which can be reached from any phone (Western Area only);
2. Health worker-initiated client monitoring through mobile phones (Western Area and Kenema district).

Bellehwoman & Pikin information line: the free information line (mobile number) was set up in coordination with mobile network provider Airtel and could be reached from any phone during a period of four weeks. Calls were taken by rotating staff from the national MoHS Reproductive Health department and focused on pregnancy, child birth and postnatal and neonatal care and health. The free information line was promoted through radio slots in the *lingua franca* Krio, through the national radio station Sierra Leone Broadcasting Corporation (SLBC). This implied that, besides English, queries would only be handled in Krio and not the other main languages; this was agreed upon during this pilot phase for reasons of logistics and cost.

Health worker-initiated client monitoring: in each of the two study districts, a health facility was identified that had a high dropout rate from antenatal and postnatal visits (King Harman Road Government Hospital in Western Area and Sembeima MCHP in Kenema district). They were each provided with three mobile phones with top-up cards of the three most common mobile network providers (Airtel, Comium and Africel). The phones were meant and used to inform and remind clients, including defaulters, about clinic appointments (with a focus on antenatal and postnatal visits), medication and the importance of delivering in a health facility.

> Note: initially two additional applications had been included.
>
> (i) A second awareness-raising application had been identified, whereby pregnant women during their first ANC visit would be asked to agree to receive regular text messages on healthy pregnancy-related issues as well as appointment reminders, in line with their progressing pregnancy. However, when the research team became aware of the issue of illiteracy in relation to mobile phone use (as addressed in the next chapter), this idea was abandoned.
>
> (ii) One or more 'closed' mobile networks for staff were going to be introduced; this was abandoned, as it turned out to be too ambitious in terms of effort, time and funding.

Research participants involved were:

- health workers, health managers and community key informants from the districts;
- health service clients (actual and potential) and male, female and young community members from the districts;
- pregnant women targeted with communication initiatives, and staff involved in operating these systems, from the two districts;
- users of the information line and staff involved in operating it;
- staff that used mobile communication networks and staff involved in operating these networks;
- key informants (health managers and experts) at national level.

Selection of research participants
In the two selected districts, semi-structured interviews (SSI) were held with 18 health workers of different cadres, who were identified after discussion at

DHMT level.

Sixteen female (potential and actual) clients, eight from each district, were interviewed, some at the health facility where they had just received services (exit interview), others in the community, selected with help from community leaders and other key informants. Care was taken that women were not pushed into participation by chiefs or other community leaders with power. (The clients' health records were not accessed in any way.)

The nine focus group discussions (FGDs) were held at mostly the same villages as the SSI interviews. The respondents for the various FGDs with community members from that district were selected from the community where the selected facility was situated. The PHU staff and community leaders assisted in the recruitment, which was carried out by the data collectors.

Community key informant interviews were conducted in each district at community, facility and district level, as well as at national level, and the participants were purposively selected at each level. Recruitment at national level was carried out with support from the principle investigator and at district and community level by the data collectors.

The mini-survey was implemented among pregnant women targeted with communication initiatives, and among users of the information line. The professional staff operating the information line asked all clients if they wanted to participate in the survey, after which a number were selected for interviews. Clients needed to give their permission to be contacted by researchers.

Observation was used regarding the testing of new and promising communication technology for use among health workers and between these and clients and community members. Facility staff and managers asked if clients wanted to participate in the interviews and then asked for appropriate contact details. The data collectors then approached the relevant clients.

Sampling
The selection of the two districts was purposive – Western Area (where the capital city is located) and provincial district Kenema with a relatively high mobile phone coverage. The research wanted to learn from using work-related mobile phones and opted to concentrate the feasibility study in those districts with sufficient mobile phone coverage. The idea is that coverage is expanding in other districts, so that when the interventions are ready for scaling up in districts that currently have low coverage, the technology will be able to support them. There is also the expectation that perceptions of issues investigated will differ between areas closer to the capital and districts much further away. The criteria for selection are:

- mobile phones for work-related purposes have been introduced;
- high mobile phone network coverage and use;
- referral services and maternal and neonatal health services are available; and
- geographical, social and cultural diversity.

In each of the two selected districts, the specific study sites were selected in coordination with the DHMT, taking into account maximum variation criteria; health workers that were interviewed for data collection were selected accordingly.

Health service clients were selected randomly as they left the facility after receiving services (actual clients); and purposefully in the communities (potential clients).

Male, female and young community members were purposefully selected within communities: younger women and men between 15 and 24 years of age, and women and men between 25 and 40. Criteria were:

- men, women and youth from low and lower-middle social strata;
- people able to talk freely among each other; and
- mixed youth groups, as girls and boys feel free to talk among themselves.

Respondents at national level were key MoHS staff, and staff of mobile phone companies and other relevant organizations.

Data collectors' training and instruments
Data collectors were carefully recruited and trained in applying the protocol.

Instruments for interviews, FGDs and the mini-survey were developed, field-tested and adapted, although data collectors later felt that more adaptations (for example, making the more structured parts of the instruments looser) would have been beneficial.

Data processing and analysis
While the idea was to record and transcribe the interviews and FGDs, this did not happen due to logistical challenges during the field work. Therefore, notes in English were taken during the interviews and FGDs in local languages and the English-language reports written soon thereafter. These reports were checked before coding and analysis. Analysis was based on a 'grounded theory approach' (Glaser and Strauss, 1967), whereby codes were not pre-constructed but inductively derived from the data during a participatory data analysis workshop. Text fragments with the same code were then literally cut from the reports, collected onto large sheets and further analyzed for subdivision (further coding) using the study objectives and topic guides as reference, before being pasted onto the sheet.

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

- Oversight for finalizing and field-testing the data collection instruments and the training of data collectors rested with experienced senior researchers from the MoHS, the University of Sierra Leone and KIT.
- For the most part, enumerators with previous experience in collecting field data and the right language skills were recruited and trained in collecting the various types of data, the importance of respectful attitudes etc. They were supervised during fieldwork, when quality assurance procedures were also applied (checking reports, keeping field notes etc.).
- Draft data collection instruments were only finalized after field-testing.
- Interviews and FGD notes were transferred to a report as soon as possible after the session.
- Data validity was judged via triangulation, comparing various respondent groups and data collection instruments. Participants in the data analysis and validation workshop consisted of data collectors, MOHS staff, KIT expert facilitators and experienced senior university staff. Social scientists, gender specialist and MoHS staff with a medical background presented various perspectives for analysis and validation.

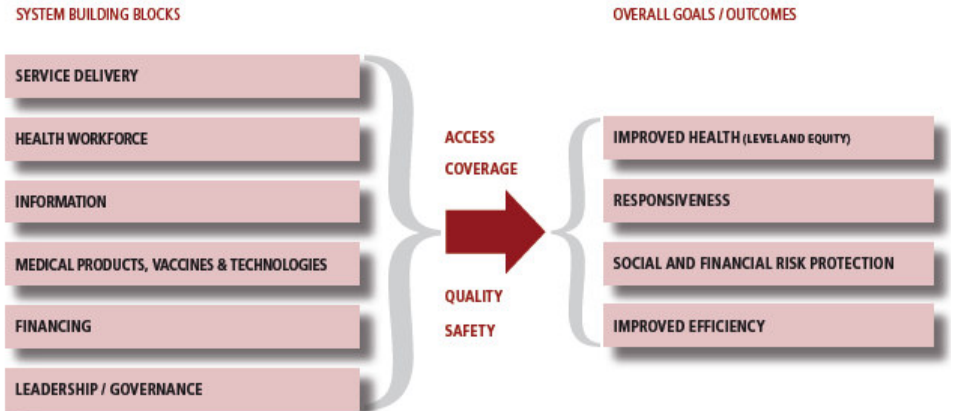
Conceptual frameworks
For the research protocol as well as the analysis and reporting on the study findings we were inspired by various conceptual models:

a) the *Three Delays model* for maternal mortality (Thaddeus and Maine, 1994), as presented in Figure 1.1;
b) the *mhealth domains framework*, as presented in Table 1.2; and
c) the WHO health system framework (WHO, 2007), as shown in Figure 2.2, below.

Whereas the Three Delays model is content-focused (on MNH) and summarizes supply-side and demand-side factors influencing maternal mortality, the WHO framework concentrates in more detail on the supply-side (health system)

factors in terms of 'building blocks' and 'outcomes/goals', while also including intermediary factors such as access, coverage and quality. This is useful for the purpose of this study (and is also used for Sierra Leone's National Health Sector Strategic Plan).

Figure 2.2 The WHO Health System Framework (WHO, 2007)



Study limitations

The study had the following limitations:

- Data were collected from the two districts with high mobile phone coverage and so cannot be taken as representative for the current situation in all districts.
- As for qualitative research in general, data quality depends very much on the ability of the interviewers and FGD facilitators (who were thoroughly trained), as well as on the willingness and openness of respondents to collaborate (for whom a safe environment was created and sensitivity used during the interview or FGD).
- The data collected touched on a number of structural issues, such as the recently launched FHCI, gender issues and others. These would deserve being addressed in more depth; however, that was clearly outside the scope of this study.

3Findings

This chapter presents the findings emanating from the data collection as described in the methodology section. After introducing respondent characteristics, findings will be presented regarding (i) communication among health staff, and (ii) communication between health staff and clients. The final sections will summarize generic issues regarding perceived benefits, management and operational issues and barriers.

As stipulated in the methodology section, several (mobile) communication applications have been tested. However, due to organizational constraints the testing phase started later than planned and the data collection among health workers and clients regarding their experiences with the applications could not be processed in a timely manner for inclusion in this report. They will be presented in a second edition of this report (or as an annex) as soon as possible.

3.1 Participant characteristics

Research participants included a total of 85 community members, 45 district health workers and managers, four national-level health managers and two experts.

The community members were 47 women and 38 men, across SSIs, FGDs and key informant interviews. Age groups below and over 30 were both included in substantial numbers. Among female clients and FGD participants, virtually nobody had education exceeding secondary school; half had (some) primary school education or less. Slightly more participants from Kenema district were included than from Western Area.

Sixteen female clients were interviewed; they had an average of 2.8 children (range 0–6) and lived an average 1.9 miles (3.0 kilometres; range 0.1–8.0 miles) from the nearest health facility. Those who made one or more ANC visit during the last (or current) pregnancy had their first visit on average at 3.2 months (range 1–8). We were not able to establish a reliable figure for the average number of ANC visits.

District-level health staff involved in the research consisted of 36 women and nine men. More female and lower-level female staff were included as respondents as they are the ones that may be using mobile phones and are sometimes the only staff available at health post level. 'Health staff' for the purpose of this study also included non-formal health staff such as community health workers (CHWs), traditional birth attendants (TBAs) and health volunteers. The large majority were over 30 years of age. Participants were equally distributed across both study districts, Kenema and Western Area.

Annex 3 provides a summary of the research participants' background characteristics.

3.2 Communication among health workers

Introduction

This section examines the actual and potential role of mobile communication among health workers. Over the past years, several DHMTs in Sierra Leone opted to introduce a 'closed user group', whereby a bulk contract for voice calls and text messaging (and potentially other features) is established with a mobile network provider for a limited number of phones that can only be used to communicate with other phones in the group. This improves free-of-charge communication options among health staff, fixes costs per month and prevents non-work-related use.

Such closed user groups have been established in both study sites. The MoHS confirmed that all 121 health facilities in Kenema district and all 99 facilities in Western Area are included in the group, as well as relevant management offices and staff, and would operate a facility phone. However, only three of the 18 health workers that participated in the SSIs said they had access to a facility mobile phone, and several indicated that the facility phone was either not operational or not accessible.

> *"The phone is with, or is in the care of, the CHO. If he is not around we may not be able to use the phone. (…) In such instances we may need to use our personal phone to make the work easier for us. (…) [But] there are times that we don't have money at that moment to buy [top-up] cards for our phones."*
>
> – Female health worker, Western Area

Phone possession among health workers is addressed in the next section (3.3).

Current use, future perspectives

Health workers indicated a variety of ways in which mobile communication is currently used for work-related purposes. The inventory of these ways as mentioned by the 18 SSI participants is shown in Box 3.1.

Box 3.1 Inventory of current use of health worker to health worker mobile communication (N=18)

( ) = number of times mentioned (multiple responses possible)

- Receive/provide information on meetings, workshops, appointments (10)
- Referrals, emergency referrals, call ambulance, announce arrival at facility (9)
- Supply chain management: ask for/monitor supply delivery, coordinate NID logistics, coordinate pick-up of stock (9)
- Consultation/exchange of advice with colleagues about diagnosis, case management, other (9)
- Consultations with and providing information to supervisor/boss (7)
- HMIS: call to read out weekly or monthly reports, and receive feedback; or for supervisor to get clarification on reports (5)
- Call staff to facility for emergency (2)
- Share disease surveillance data (1)
- Supervision (1)

Mobile phones are easy ways to communicate about pending meetings and workshops. They are also used for referrals in general and emergencies in particular, whereby emergency obstetric care was mentioned several times. A female health worker from Western Area stated:

> *"When there is a case of difficult delivery, such as a retained placenta, the staff on duty uses the phone to call for the ambulance. We use our personal phone to follow up on the patient during the journey from the facility to the point of referral."*

During national immunization days, phones are used to communicate about logistics and stock replenishment. More in general, supply chain management is facilitated via mobile communication – health staff use it to enquire about the availability of drugs, request drugs and other supplies, and to fast-track the delivery of supplies to the facility.

Colleagues phone each other or their supervisor for consultations and advice on diagnosis, case management and other issues.

> *"I also use [the phone] to ask advice of how to handle a case that I am not too familiar with. Like a pregnant woman came, unable to breathe well, so I called my boss on the phone because she was not around and explained the case to her; she gave me advice as to how to go about it."*
>
> – Female health worker, Kenema

> *"There are some of our colleagues who are relatively new in the profession. They sometimes call us for advice from their facilities when they encounter difficulties. We also call our colleagues and even supervisors in Freetown when we need advice."*
>
> – Female health worker, Western Area

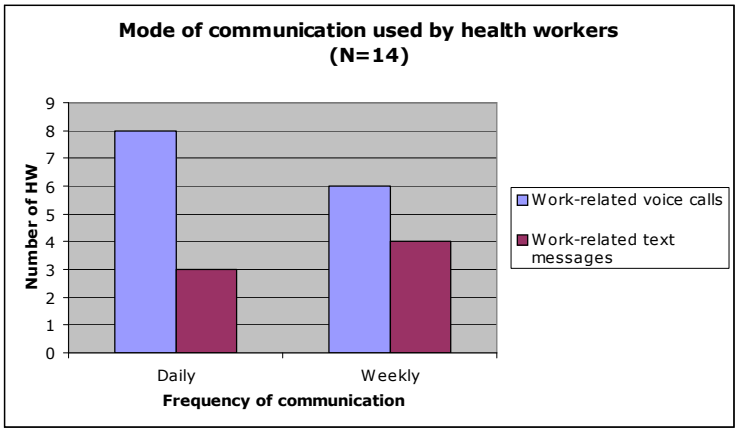
Health managers encourage this way of seeking support. According to one health manager from Western Area: *"If someone has a problem, the person can explain or read the diagnosis, and we can suggest treatment."* A female health manager from Kenema indicated she uses the phone for supervision and thus cuts down on travel costs, since the supervisor would otherwise need to make a visit to the PHU to find out what is happening at the health facility:

> *"If I have not heard from the in-charge of a particular PHU for over three days, I will call the in-charge to find out what was wrong."*

Also, time and cost can be saved by submitting reports by reading out weekly or monthly reports over the phone rather than by travelling to the district offices.

> *"Every Friday we call the M&E officers and read out the information on drugs, ANC attendance and pattern of diseases from our books."*
>
> – Female health worker, Western Area

Figure 3.1 Mode of communication used by health workers



Mode of communication
Health workers are generally of the opinion that between voice calls and text messages, calls are the preferred mode of communication. *"Calls are the most effective because I get an instant response."*

> – Male health manager, Western Area

This is also illustrated by the interviews (see Figure 3.1) – nearly all health workers use their mobile phone for work-related calls on a daily or weekly basis; but only half use it for text messaging.

Specific barriers
While general barriers and challenges to mobile phone communication are addressed elsewhere, some are specific for communication among health workers. Specifically, some illiterate TBAs cannot make appropriate use of the phones independently. This was mentioned by a TBA from Western Area, who acknowledged that *"because I am an illiterate, I will always need somebody who is enlightened to make calls for me."*

In addition, mobile phones can sometimes be a nuisance to health workers; a female health worker (Western Area) noted that whenever you receive a phone call, "*you are sure to be disturbed from whatever you are doing.*" A related, more serious challenge, according to some, is the risk that the use of health worker-initiated calls as well as an increase in calls received may lead to health workers being overwhelmed by the added workload.

A major challenge reported by several respondents is that the duty (closed user group) phones are not operational everywhere and that access to use them is limited. For example, one male health manager noted that in Western Area, *"among the 120 phones that are out there, I will hardly get up to 50 to respond when I call."*

3.3 Communication between health workers and clients

This section deals with health worker–client communication, regardless of whether this is initiated by health workers or by clients.

Introduction

The majority of the 18 health workers interviewed possess one or more mobile phones which are used (for private and work purposes) by all for voice calls and by most for text messages; the camera function is used very seldom. Only one health worker reported not using the mobile phone for work purposes. The health workers who reported work-related mobile communication mostly use their personal phone, with some also having access to a facility-owned phone.

One-third of the 16 female clients interviewed own a phone; another third do not own a phone but have access to a close relative's phone; while the final third reported not having access to and thus not using a mobile phone. Importantly, *all* clients that depend on a relative's phone indicated that they needed to ask permission to use the phone, from their husband, son-in-law, brother or other family member. Virtually none of the clients had ever used a mobile phone for health-related calls; several indicated that they did not see the need for this.

Box 3.2 Inventory of (a) current use and (b) future perspectives of health worker-to-client and client-to-health worker mobile communication

a + b = number of times mentioned

- Follow-up of clients (3+6)
- Allow clients to make enquires in advance of (maybe) coming to the clinic; or check the need to come (4+2)
- Appointments and related reminders (3+2)
- Treatment reminders (2+0)
- Referral (2+0)
- Sensitizing men (2+0)
- Encouraging clients to go to the clinic (0+2)

Current use, future perspectives

Health workers use mobile phones to communicate with clients for various reasons. Most health workers used mobile phones to follow up on clients – for example, after initiating treatment or during and after pregnancy.

Some health workers use their mobile phones to agree on appointments with clients or to give reminders.

> *"I give my phone number to pregnant women who visit the facility for ANC, especially when they are almost due to be put to bed* [deliver]*. In case of emergency they can call me, since the facility doesn't open late at night. I also call clients to monitor the progress of her pregnancy, and make follow-up on patients after treatment.*
>
> – Female health worker, Western Area

> *"After every delivery we request for the phone numbers of the mothers and if we do not see them in few hours for postnatal care we communicate with them to follow-up."*
>
> – Female health worker, Kenema

In most Sierra Leonean cultures, the husband is often the one deciding about his wife's medical care; he decides whether the pregnant wife should go to a health facility for ANC or delivery. Some women would, therefore, want to see that health workers sensitize their husbands, so that they realize *"how to treat us well during and after pregnancy"* (female client, Kenema).

Some health workers do this already, sensitizing men about the health of their pregnant wives and the risks associated with pregnancy, to ensure that husbands permit their wives to seek prompt care and treatment. In fact, men

are sometimes seen as beneficiaries of improved communication between health workers and pregnant women:

> *"This will benefit the men indirectly; it will make the men become less worried about their wives' pregnancy. They will be confident that their wives will deliver safely since they are in constant touch with their health worker which is the first step of being health and having a healthy baby."*
>
> – Female community FGD participant, Western Area

One male community key informant from Kenema confirmed this:

> *"The benefit the men and the community as a whole get is that their wives and children would be treated well and problems of complications that pregnant women envisage during pregnancy will be solved."*

A female community key informant (Western Area) concurred, hinting at issues regarding female–male communication:

> "*Yes, the men will be interested because many pregnant women do not share health information with their husbands, for example men will be interested in knowing when their wives will put to bed* [ready to deliver] *so that they can prepare financially for it."*
>
> – Female community key informant, Western Area

From their side, female clients also have their reasons to get in touch with health workers – for example, to ascertain the location of the health worker, especially over the weekend and at night when the facility is not open. Also, they call to enquire about pregnancy tests and know the time for immunization, and when they are ready to deliver. In addition, clients call for the ambulance during emergencies, especially when they are about to deliver. A Western Area female health worker in Western Area said:

> "*Some call to enquire whether we are at the facility or at home, they may want to see us, as it will save them time and energy*".

Furthermore, clients indicated that they expect health workers to express concern for them and other clients by calling them to find out about their health and the outcome of their treatment:

> *"If I leave the hospital feeling very ill, I expect the health worker to call and find out how I feel. I expect the same to be done when my child is not well."*
>
> – Female client, Kenema

> *"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."*
>
> – Another female client, Kenema

Mode of communication and literacy

The study also attempted to determine the preferred mode of communication between health workers and clients. Almost all respondents, clients as well as health workers, preferred the use of voice communication to text messages. The main reason given for this was the high level of illiteracy in Sierra Leone, making it impossible for most people to read text messages.

> *"I don't like text messages. I will prefer voice call because there may be issues to clarify and there is provision to interrupt during conversation and the response will be given instantly.*

> *The disadvantage with text is that most people are illiterate and cannot read and write. Some people don't even know how to use the phone."*
>
> – Female community key informant, Western Area

> *"I do not receive text messages because I do not know how to read. I can only receive calls. I cannot even make the call myself. My brother usually helps me out."*
>
> – Female Kenema client

> *"I do not know whether I do receive text messages or even picture messages because both my son-in-law and I do not know how to read or view to see we have in the phone."*
>
> – Another female client, Kenema

One health worker had the same concern:

> "*There is the issue of illiteracy to consider. Can they be in the position to use it correctly? Can they be able to install and save numbers on the phone and select them correctly?"*
>
> – Male health manager, Western Area

The other reason for preferring voice calls was that it helps the health worker to interact better with the client. Some health workers mentioned that clients feel happier with voice calls, especially when they hear the voice of a health worker whom they are already familiar with. Some health workers mentioned that through talking to the client, they can ascertain the level of severity of the client's health condition. Other health workers also mentioned that, unlike voice messages, text messages may not be seen or acted upon immediately.

> *"Clients and health workers would prefer voice calls, because most of the clients cannot access text messages, they are mostly illiterate. I also think that many of those who can read do not know how to use this application. Another problem is that a text message is not read immediately on receipt. The time lapse can cost a life*."
>
> – Female health worker, Kenema

Quick evaluation of intervention: free information line

Research participants were asked what they thought of a future free-of-charge information line. Several were positive about the advantages of such a line:

> *"This line…will be very useful especially when there is a woman in critical labour condition. If such a woman delivers a baby out of the hospital then this line will be useful to get advice [so] as to take the woman to [the] hospital or to advise the doctor or nurse to see her at home."*
>
> – Male community key informant, Western Area

The same key informant also mentioned that the information can be useful for women who are not attending ANC and for men.

Similar but a bit different was the approach by a male focus group, where it was mentioned that:

> "*It is good for the health centre to have a special line to receive emergency call because some people are living far away from the health centre.*"
>
> – Male community members' focus group, Kenema

Regarding the *Bellehwoman & Pikin* information line put in place, data were collected regarding the number and duration of calls and the issues/topics/questions discussed. Interviews were also held with selected

clients who had used the information line, about their experiences with the information line. However, these data unfortunately could not be processed and made available in time for the current report; once available they will be reported on and included in a second edition of (or annex to) this report.

Quick evaluation of intervention: health worker-initiated client monitoring
Each call and relevant related information was recorded in a ledger. Interviews were held with both providers and clients regarding their experiences with the information line. However, these data unfortunately could not be processed and made available in time for the current report; once available they will be reported on and included in a second edition of (or annex to) this report.

Topics suitable for discussing over the phone
While discussing the current use and future perspectives of mobile communication with clients and health workers, it became evident that some issues are addressed more easily over the phone than others. Table 3.1 summarizes these issues for both groups of research participants.

The table shows that most of the respondents find it easy to communicate via mobile phone about most issues that are related to sexual and reproductive health – including family planning, pregnancy, ANC, delivery and child health. As some participants put it:

> *"It will be very helpful to receive information on family planning especially for teenagers who do not have the opportunity of discussing such issues. Even the shy ones can be informed via the mobile phone with people around her not knowing what she said or what was being said to her. This will prevent teenage pregnancy."*
>
> – Female community key informant, Western Area

> *"For now I would like them to discuss what should be done to position my baby properly as I approach the last month of pregnancy. I will not find anything difficult on the phone, but I expect the speaker to be mild."*
>
> – Female client, Kenema

Meanwhile, other topics are specifically deemed uncomfortable by both groups: STIs, HIV and test results in general. For other topics there are no strong indications.

> *"Well for the test result it is difficult to communicate via phone especially for HIV. Also there are some clients who do not want other people to know that they are pregnant especially in the early stages."*
>
> – Female health worker, Western Area

> *"Some people will not be comfortable talking about 'Growth'* [fibroid] *because people in the community will gossip about her inability to conceive a child. 'Okobo'* [impotency] *should not be discussed via mobile phone."*
>
> – Male community key informant, Western Area

Table 3.1 Addressing topics over the phone: frequency a topic was mentioned as 'comfortable' or 'not comfortable' to be addressed over the phone (x = one participant)
(Source: Semi-structured interviews with clients (N=16) and health workers (N=18))

Topics	Comfortable		Not comfortable		'Conclusion' for both groups (clients, HWs)
	Clients	Health workers	Clients	Health workers	
Sexual and reproductive health					
▪ **STIs in general**	x		xxxx	xx	Both uncomfortable
▪ **HIV, AIDS**		x	xxxx	xxxxx	Both uncomfortable
▪ **Family planning**	xx	xx		x	Both comfortable
▪ ***Okobo* (impotency)**				x	unclear
▪ **Pregnancy**	xxxx	xx	xx	x	Both comfortable
▪ **Abortion**				x	unclear
▪ **Antenatal care (ANC)**	xxxx	xx	x		Both comfortable
▪ **Treatment for high blood pressure**		x			unclear
▪ **Emergency obstetric care**			x		unclear
▪ **Delivery**	xx	xx			Both comfortable
▪ **Breastfeeding**		x			unclear
▪ **Child health, nutrition, immunization, first aid for baby**	xx	xx		x (immun.)	Both comfortable
General					
▪ **Health information in general**		xxxx			HW comfortable
▪ **Health conditions**	x				unclear
▪ **(New) services**	x				unclear
▪ **Drugs, medical supplies**	xxx				Clients comfortable
▪ **Test results (general)**			xx	x	Clients uncomfortable
▪ **Malaria**		x			unclear
▪ **Typhoid**	x				unclear
▪ **Infections (general)**	x		x		unclear

One female client mentioned:

> *"The issue of HIV/AIDS and abortion, I find these were very difficult to discuss on a phone with a health worker for fear of scandal."*
>
> – Female client, Kenema

Some respondents mentioned specific issues that should, or should not, be discussed with women and men, and that certain issues should be discussed separately, although others believed there should be no difference. Several women suggested that health workers should specifically address issues such as unprotected sex, STIs and HIV with men, as "*they need it more than women*" (female client, Western Area).

Sensitivities: confidentiality, privacy, gender issues
Provider–client communication can give rise to concerns around confidentiality and privacy, as well as gender issues. The data indicate that some female clients prefer to talk to female health workers, while other female clients would much rather talk to male health workers because they think men are better at keeping secrets than women. A male community key informant from Western Area stated:

> "*I have observed women patients in hospital who label some female nurses as gossips. They prefer talking to the male nurses*".

The location of the conversation was another concern. A health manager said:

> *"It is ethical to maintain privacy and confidentiality, therefore matters discussed must be kept between the two people in the conversation. Persons speaking and those answering the phone call must ensure that nobody is eavesdropping."*
>
> – Male health manager, Kenema district

Clients who do not own a phone often have access to their relatives' or other people's phones and might have to call in the presence of these relatives, or – if they are illiterate – even have to ask these to dial for them. Similarly, clients who own a phone sometimes are asked to share it with others. In addition to the practically 'unavoidable' breach of privacy due to this type of phone sharing, some female clients mentioned that their husbands sometimes check their phones. Another client stated:

> *"My husband is jealous a lot, so he checks my phone all the time for other numbers of people he says are my boyfriends."*
>
> – Female client, Kenema district

However, other women do not allow their husbands to do this. Mobile phone communication can also cause marital trouble in a different way. A female community key informant (Western Area) stated that family planning would be difficult to discuss on the phone:

> *"I think all health topics/issues can be discussed via phones except family planning – some women did not get the consent of their husbands to become clients, and the use of a phone might cause problems from the husband."*

A male key informant from a community stressed the need for trust when asking to use other people's phones to call or be called. He also mentioned the risk of misinterpretation or distortion of messages. Several health workers also worried about this; a Kenema female health worker stated:

> *"It is not easy to call a woman who does not have a phone because some information must be kept private and confidential. The only option is to leave a message to the [other person's] number that is available, for the client to report to you on a given time. (…) When necessary, I call one of the few people with phones to reach my clients. I remain very cautious of the message I give, bearing in mind that privacy and confidentiality needs to be maintained."*

3.4 Other mobile applications

Few health workers mentioned the future option of collecting and sending/uploading data via mobile phone, which they saw as beneficial. However, for the time being phones are only being used to communicate epidemiological data verbally.

3.5 Perceived benefits

The previous sections offered an overview of a wide range of current use and future perspectives regarding mobile communication. At a higher level, we were interested to find out how different participant groups perceived the short/medium- and longer-term benefits of increased use of mobile communication for health. Based on the answers obtained, we produced Table 3.2 below, in which we have grouped the mentioned benefits according to short/medium-term and long-term.

Short- and medium-term benefits for clients

The perceived benefits for clients, as already implied by the previous sections, involve improved health awareness, better health worker–client communication, more responsive services in general, and especially in

emergency situations and regarding MNH, and avoiding transportation challenges.

Short- and medium-term benefits for health staff

The general perception of most of the health workers interviewed was that the mobile phone has improved access to emergency care. This improved, speedy referral may be very useful to ensure lifesaving information and support. Generally, most health workers said that mobile phones make their work more efficient.

> "*It saves my energy and even that of the client. Otherwise I will walk to see the clients or the client walk to see me. It also saves my time because communication is quick and prompt."*
>
> *– Female health worker, Western Area*

Other perceived short- and medium-term benefits include improvements in diagnosis and case management; strengthened surveillance; better supply chain management and HMIS. Also, mobile communication improves working relationships among different cadres of health workers in different facilities. Another female health worker from Western Area said:

> "*It has made the work easier for us, ask for advice, purchase drugs and get help which otherwise would have cost us money, energy and time. For example, for less than five minutes we can call and get help."*

One of the health workers interviewed held the view that although mobile phones are beneficial, some patients may lie about their health on the phone – a practice that will be detrimental to the patient:

> *"It is beneficial, but most of them will tell lies on the phone, so it is better you talk to them face to face".*
>
> – Female health worker, Western Area

Long-tem benefits to health workers and clients

The study also attempted to determine the benefits of health worker-initiated mobile phone calls to clients. Most health workers said that health worker-initiated calls help to reduce both child and maternal mortality. As one health worker put it:

> *"It has reduced maternal mortality rate by giving emergency response especially in the case of calling for an ambulance for referrals".*
>
> – Male health worker, Kenema

The study also reveals that mobile phones can be used to encourage clients to visit the health facility and are, therefore, useful for increasing immunization coverage, by reminding clients about their next visits. They can also be used to provide health promotion messages and help with follow-up with pregnant women that are in the later stages of pregnancy. Some men interviewed also reported that use of mobile phones can benefit the entire community by helping in the management of complicated cases.

> "*The benefit the men and the community as a whole get is that their wives and children would be treated well and problems of complications that pregnant women envisage during pregnancy will be solved".*
>
> – Male community key informant, Kenema

Table 3.2 Inventory of perceived benefits of expanded mobile communication for health
(Source: Semi-structured interviews with clients (N=16) and health workers (N=18))

Benefits	Health staff		Clients	
Strategic short/medium-term benefits for clients	F	M	F	M
Improve health awareness; address doubts, queries		x	x	
Easier contact health worker–client	x			
More responsive (emergency) services, better attention	xx	xx		
Improved MNH services: - monitoring pregnant women who live far away - nurse can explain pregnancy issues to the woman - pregnancy/delivery/PNC emergencies better handled; safer delivery - men less worried	xxx		xxxxxxx	x
Reduce transportation problems (re. drug supply, ambulance, advice from colleague); saves time and (opportunity) cost		x		
Saves time and energy (less need to go to clinic)			x	
Strategic short/medium-term benefits for health workers, service delivery				
Work will become easier, more efficient	xxx	x		
Improve diagnosis, case management, quality (via consultation)	xx	xx		
Improve expertise via consultation with colleagues	xx			
Improve client follow-up, treatment support		x		
Improve (emergency) referral	xx			
Improve disease surveillance system	x			
Avoid transportation logistics, time	x	x		
Improve supply chain management	xxx	xx		
Creates more cordial relationship between health worker colleagues, and between these and DHMT		x		
Improve HMIS, M&E	x			
Strengthen community involvement		x		
Longer-term benefits for community, society				
Reduce mortality	xxx			
Reduce maternal mortality; save women's lives; safer delivery	xxx	x	x	
Reduce disease conditions	x			
Improve service coverage	x			

3.6 Management and operational issues and challenges

Introduction

This section presents the findings regarding managerial and operational issues in relation to mobile communication for health, including current mHealth initiatives, phone access, coverage, cost, battery charging and sustainability; as well as issues related to working with mobile network providers. These issues represent an important part of the challenges and barriers health staff and clients face; some of the more specific communication-related barriers are addressed in Section 3.2 (Specific barriers) and in Section 3.3 (Sensitivities).

Current mHealth initiatives

In the introduction it was stated that several health districts started mHealth initiatives a few years ago (see Annex 1). As part of the data collection for this study, health staff were asked whether they knew of any such initiatives in their district, to which three-quarters responded positively. From among these, the summary of answers regarding the (pre-categorized) type of programme is presented in Figure 3.2. It shows that 'communication with colleagues' is the main rationale, followed by 'information line' and 'HMIS'. With the exception of the information line (the actual meaning of which we did not explore), this is broadly in line with the findings from the interviews in general.

Figure 3.2 Current mHealth programmes in two study districts

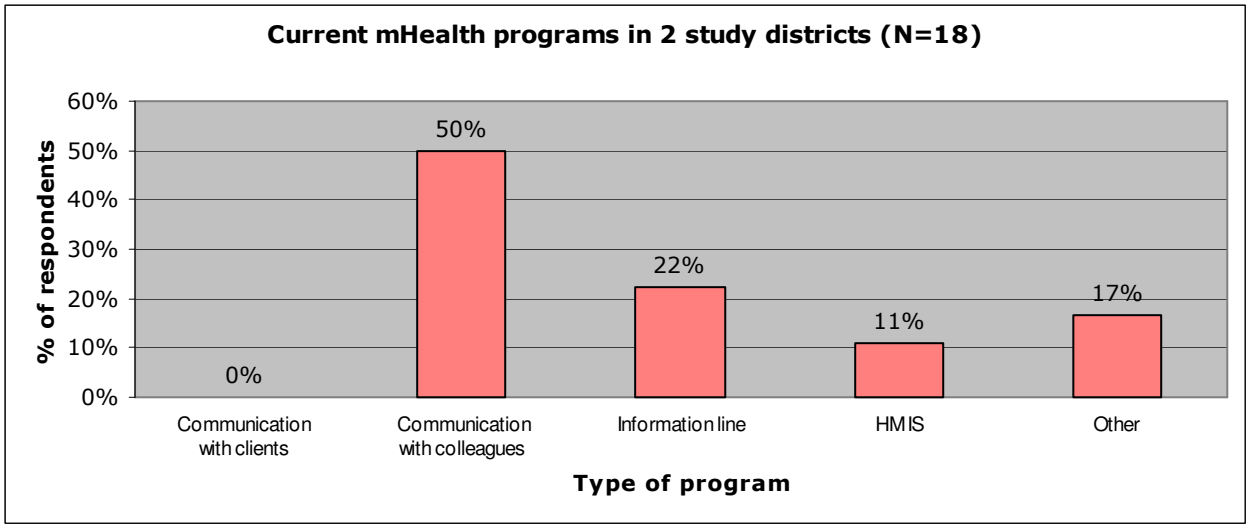
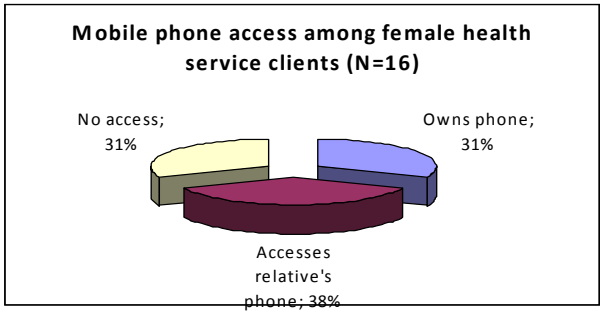


Figure 3.3 Mobile phone access among female health service clients



Access to phones

As noted earlier, in both study sites, Western Area and Kenema district, closed user groups have been established; there is no national-level policy to this effect, but such initiatives are seen as the responsibility and prerogative of the DHMTs (who then have to negotiate with mobile network providers themselves), as was confirmed by interviews with national-level health

managers. At the same time, one of these managers who believed mobile communication can assist in improving health outcomes saw it as a problem that the use of mobile phones is optional.

Meanwhile, the MHoS confirmed that all 121 health facilities in Kenema district and all 99 facilities in Western Area are included in the closed user group. A major challenge, however, reported earlier and by several respondents, is that these duty phones are not operational everywhere and that staff to whom the phone was not assigned only have limited access.

In terms of private possession and use of phones, in Section 3.2 we reported that only very few health workers do not possess private phones and that almost all use their phones for health-related calls. On the other hand, two-thirds of clients do not own a phone, and only half of these can access a relative's phone after asking permission – see Figure 3.3. Again others are said to ask their neighbours to allow them to use their mobile phones. The same neighbours serve as contacts for incoming phone calls. Virtually none of the clients had ever used a mobile phone for health-related calls.

Figure 3.4 Perception of mobile network coverage

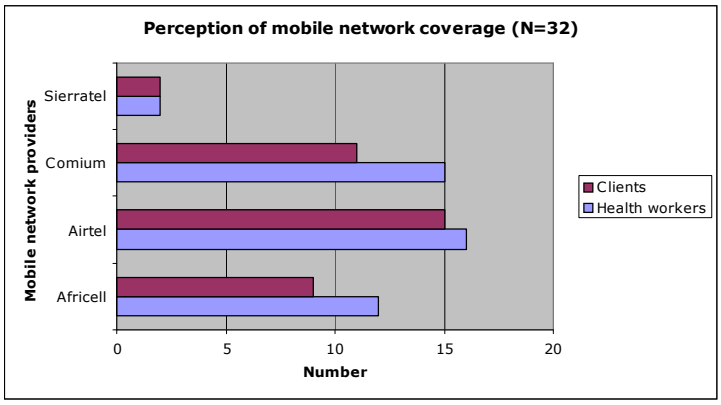
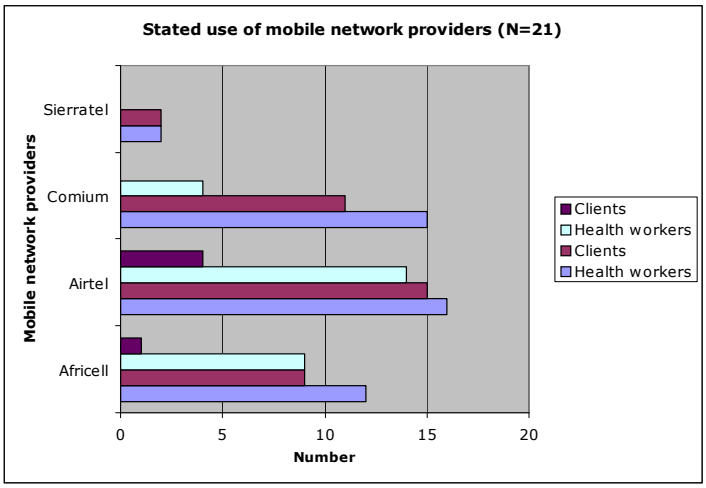


Figure 3.5 Stated use of mobile network providers



Coverage

Geographical coverage varies widely among the various providers. For the respondents, Airtel is the mobile network provider seen as most available; Comium was second, and Africell came third, with Sierratel in last place. Actual usage is highest for Airtel, with Africell second; participant responses indicate Comium and Sierratel usage is minimal and even completely absent in some parts of the study areas.

Respondents highlighted the problems they face with the availability of the network in their localities. Limited or unreliable geographical coverage in their respective communities was identified as a serious problem, a view expressed by clients as well as health workers.

Despite efforts by the DHMTs in both study areas to improve communication links between health workers via closed user groups, not all phones are in operation for various reasons including network coverage and quality issues. According to a women's focus group in Kenema, in some places people have to travel one and a half miles to find coverage, and even that is unreliable. A female health worker from Western Area noted that, in certain cases, "*the network is bad, and it is difficult to make calls to certain areas.*" Coverage is

particularly difficult in the rural areas, as observed by another female health worker from Western Area:

> *"…we have been trying to call the CHO, but we could not reach him because his phone was off."*

Cost of phones

Of the clients who stated they did not own a phone, several indicated they could not afford to buy one or to operate one. Health workers, almost all of whom have a phone, mostly operate under the pre-paid system via top-up cards to replenish phone credit. Many expressed concerns about the cost and availability of top-up cards; those who indicated how much they spent for work-related phone use on a weekly basis mostly indicated amounts in the range of 4,000 to 8,000 Leones. For several health workers, having to pay for work-related phone use was a burden:

> *"There are no direct benefits to the health worker because I have to pay the cost of top-up cards when I communicate with clients."*
>
> – Male health worker, Kenema

> *"The more calls you make the more credit you will have to buy … it is a great sacrifice."*
>
> – Female health worker, Western Area

A male health worker from Kenema possessed a duty phone but ran out of duty credit:

> *"The phones provided by the DHMT and the International Rescue Committee do not have credit now. We are now using our personal phones to call, and we are not compensated."*

In addition, top-up cards are not always easily available, and some people would have to travel long distances to purchase them. Other costs incurred relate to battery charging – the health workers stated that they have to pay commercial centres to get their batteries charged.

> *"Because we do not have a generator in this facility, we always pay 1,000 Leones anytime we charge the phone, and this is done frequently."*
>
> – Female health worker, Western Area

Even so, health workers also indicated that they are willing to use their personal phones for work-related communication when necessary. As one male health manager from Kenema district indicated:

> *"We are willing to use our own phones for work related purposes because it will make our work easier. It will cut down on the incidents of closing the facility to travel to headquarters just to submit a report".*

Finally, both battery charging and cost of top-up credit also pose barriers for clients, according to one health worker (Western Area):

> *"People…are poor and are unwilling to pay for top-up cards or even pay for charging their batteries."*

To address the issue of the cost of top-up cards, some suggested that the government should provide health workers with top-up cards or arrange for proceeds from the sale of drugs to be used to purchase top-up cards.

Battery charging

Many respondents reported that they experienced problems with battery charging, especially in areas where sources of electricity are scarce. In some instances, health workers said they pay up to 2,000 Leones to get their phones

charged. Others cited the lack of availability of fuel to run their generators as a problem.

Apart from the cost involved in getting batteries charged, both the health workers and the clients reported that they sometimes have to cover long distances to benefit from this service.

In addition, people run the risk of damaging their batteries or losing their original batteries. This was emphasized by the health workers' focus groups in both Kenema and Western Area:

> *"Repair of my phone is a problem and if the batteries get damaged, it is difficult for us to have an original battery."*
>
> – Health worker focus group, Kenema

> *"Sometimes batteries are changed or stolen at the tele-centre when sent to charge".*
>
> – Health worker focus group, Western Area

Sustainability

Several health workers expressed their fears about the sustainability of the current closed user group system and appealed that the services be continued to consolidate the achievements that have been realized since its inception. A female health worker (Western Area) pleaded: *"It is for it to be effective and not just stop when we would have got used to it."*

Suggestions and conditions

Throughout the interviews and FGDs, research participants referred to various things to be put in place to ensure that identified barriers are addressed and that a mobile communication system generates the benefits it is expected to.

In general, to facilitate communication, community members suggested establishing key 'health communication posts' and "*each post should be close to the pregnant women or somebody close to that individual*" (male key informant, Western Area), whereby women with young children or someone close to them should have free access to the communication post.

Another community key informant stated that key community contact persons (such as the Chairman, Secretary General, mammy queens and other female traditional leaders should be identified in different areas of the communities so that clients and their representatives can have easy access to making health-related calls, especially for referral. Also, the idea of a special number of information lines came up. In a men's FGD it was suggested that:

> *"It is good for the health centre to have a special line to receive emergency call because some people are living far away from the health centre…and a specific number that anybody can call for emergency."*
>
> – Men's focus group, Kenema

Faced with MNH issues but also a lack of phone access in communities, some respondents suggested that the government should provide mobile phones, including top-up cards, to pregnant and lactating women so they can be in touch with health workers. The idea of a toll-free information line also surfaced: it was suggested that nurses who deal directly with pregnancy and childbirth are the right persons to answer the calls of clients, who could use a free health hotline.

Several of the national-level informants suggested that all health facilities in the country (and not only a few districts where the DHMT adopted the closed user group approach) should embark on this strategy, and that an inter-sectoral mHealth forum be created with participation from several ministries.

Another expert at the same level found that the use of mobile phones for collecting and submitting data should be coordinated, as currently "it is not well organized."

To deal with illiteracy and the difficulty of using text messages, one national-level expert suggested putting in place a voice-response system using various local dialects.

To address the issue of health workers paying for top-up cards from their own pockets, some suggested that the government should provide health workers with top-up cards or arrange for proceeds from the sale of drugs to be used to purchase top-up cards.

In view of battery recharge problems, using a solar recharging system was suggested by some as the solution.

Some clients and community members were not too happy with how health workers use the mobile communication system and suggested supervision and training:

> *"Sometimes they do not respond to your calls. Staff should be monitored and educated on the use of mobile phones for work-related purposes."*
>
> – Female client, Western Area

Working with mobile network providers

From our interactions with the four mobile network providers in Sierra Leone, such as during the February 2011 stakeholder workshop and subsequent discussions and the one interview, we learned that in Sierra Leone it is hard to obtain reliable data regarding geographical coverage, number of mobile subscribers and tariff structure from any of the providers who deemed such information confidential and classified, with an eye to the competitiveness of the mobile market.

While NatCom has no data on mobile phone coverage readily available for public use, as noted earlier, it estimated the geographical coverage of all providers combined at 80 percent.

Regarding establishing a partnership with one or more mobile network operators in a country, working with a single provider may have advantages (co-funding, 'free' technical support, access to client database?), but also has disadvantages that should be considered, such as (i) reduced options of technology and applications, as other operators may offer additional options; (ii) reduced coverage of mHealth services: the operator's market share in a particular region may be small, thus unless the platform offers inter-operability most people with mobile phones will not be able to use the services.

On the other hand, unless a programme has major goals over multiple years and is funded accordingly, it may not be cost-effective to establish working agreements/contracts with all available mobile network operators in view of the expected time and budget this requires.

4Discussion and conclusions

The current feasibility study is a preparatory step for a more in-depth and rigorous NET-RC Phase 2 intervention research project that would start later in 2011. Even so, Phase 1 has been quite ambitious in scope, as evidenced by the findings presented in the previous chapter.

It is, however, important to keep in mind that the Phase 1 efforts are preliminary efforts and that discussion of findings should at this stage not lead to far-reaching, final conclusions. This chapter will discuss the findings with a view towards generating insights and inputs for the Phase 2 study; which of course may also be useful to others engaged in designing and preparing mHealth-type interventions and research.

This chapter will focus on the four specific research objectives as a structuring principle:

1. To assess mobile communication behaviour and perspectives of public health workers and their managers;
2. To explore mobile communication behaviour and perspectives of health service users;
3. To assess the logistical, technical and financial aspects of mobile network providers and related services, including the testing of selected mHealth interventions;
4. To assess risks and preconditions associated with the integration of mobile phone technologies into the health system in low resource settings.

Where applicable, the following conceptual models presented earlier will be used:

- the Three Delays model for maternal mortality (Thaddeus and Maine, 1994);
- the mHealth domains framework; and
- the WHO health system framework (WHO, 2007).

4.1 Mobile communication for health: behaviour and perspectives

Health workers

The results show that work-related use of mobile communication for health is already very common among health workers, and health managers are encouraging this and putting in place mobile communication strategies. The top-five reasons given by health workers for using the phone were as follows: general coordination; (emergency) referrals; supply chain management; consultation with colleagues on diagnosis and case management; and consultations with supervisors. Communication with clients (other than 'about' clients) was mentioned less prominently.

Surprisingly, even when both study sites (Kenema district and Western Area) had been chosen partly in view of the existing closed user groups for mobile communication, set up by their respective DHMTs, the large majority of health workers who participated in the study use their own personal phones for work-related calls. They spend substantial amounts of their own money on work-related calls on a weekly basis, which is an indicator that mobile communication has become an indispensable part of the daily work. Indeed, health workers clearly expressed that mobile communication "*makes our work easier*". Still, having to pay out of their own pocket, to some, constitutes a disincentive to some.

The closed user groups seem less than fully operational, partly due to the limited geographical coverage of the mobile network in the district and partly due to the fact that the phone rests with one person and therefore is accessible

to others only when that person is around. Whether they *really have* access did not become clear.

The preferred mode of communication is voice calls, although half of the health workers also use text messaging.

Barriers identified relate partly to external factors (those that cannot be solved by the health system), such as geographical coverage of the mobile network; but also to factors that can be considered as 'internal' (which can be addressed by the health system). Internal factors mentioned were poor access to battery charging facilities (where solar power has been mentioned as a solution), poor access to a duty phone (closed user group phone facilities) and poor access to/payment of top-up cards (which could be dealt with via controlled distribution of top-up cards or by improving the operations of the closed user group). In addition to these, low literacy rates of low-level community health volunteers such as TBAs were mentioned as a factor.

Health service clients and other community members
Only one-third of clients interviewed owns a mobile phone; others either need to seek permission from family members to use their phone or have no access at all. Very few have ever used a phone for health-related purposes, yet many see potential benefits of mobile communication.

Maternal and newborn health is consistently mentioned as the most important area that would benefit from mHealth strategies – and not only for communication between women and a health worker (ambulance staff included), but also in terms of husbands receiving information and guidance that makes them care better for their wives and 'worry less' about the pregnancy. These are indications that mobile communication is seen as having the potential to influence knowledge and attitudes, and may change the way in which women and men communicate.

In addition to the benefits of communicating with staff working at health facilities, community members also were positive about the potential of a 'toll-free information line'; although some used this term to indicate that they feel calls to health facilities should be free of charge.

Client–health worker interaction
Unlike in many other African countries where mobile communication has also seen a rapid increase over the past years, in Sierra Leone text messaging has not yet gained much popularity. This is in part due to illiteracy, but probably also related to the preference for using local languages (many of which are only used verbally, not in writing); and to the perception that text messaging is not 'direct' enough to be useful.

The issue of cost deserves attention in relation to client–health worker interaction, as intensifying this could increase the cost to health workers, who currently pay mostly from their own pockets, while many community members may not be able to afford the cost involved. A toll-free information line is one step but is no solution when a client feels the need to contact a specific health facility or health worker.

Several clients expressed the expectation that health workers get and keep in touch with them and even to encourage them to visit the clinic. This seems like using the mobile communication potential in a quite 'passive' way on the client's side, while considerably increasing the health worker's workload, although fewer clinic visits could partly compensate for this. Indeed, some health workers think that mobile communication may lead to an increased workload and being "*disturbed from whatever you are doing*". This is cause for consideration if a system is foreseen whereby clients also become part of health workers' mobile communication network, and communication initiatives

are possible and expected from both sides. On the other hand, some health workers expressed the concern that clients who actually need to come to the clinic may not come if they can get in touch by phone. These are potential developments to explore further.

Confidentiality and privacy were issues that raised concern among community members as well as health workers. These concerns are mainly related to whether the health worker a female client communicates with is male or female, the location of the (mobile telephone) conversation, the use of relatives' or other people's phones (phone sharing) and the contents of the conversation. While some health workers clearly showed they are aware of the need to maintain confidentiality, they indicated that this is not always easy, as phones are shared among several family members and even neighbours. Also, gender aspects again play a role, since husbands may not be aware that their wives are using certain health services.

Regarding the contents of conversations, both clients and health workers clearly indicated that not all topics can be discussed over the phone. While many have no problem discussing sexual and reproductive health issues in general, HIV and other STIs are off-limits for many. At the same time, there is disagreement within and between the groups of health workers and clients regarding whether pregnancy issues are suitable for discussion over the phone; but then, different people may have different issues in mind (for example, pregnancy test result versus ANC visit follow-up).

Benefits of mobile communication ('rationale for mHealth')
Regarding benefits to clients of strengthening mobile communication (demand side), both clients and health workers have similar views, focusing on maternal and newborn health (information, emergency response), emergency services in general, and improved health information and awareness.

With respect to benefits for health workers and service delivery (supply side), health workers substantiated the rationale for investing in mHealth through a range of improvements, with an emphasis on efficiency and making work easier, improved supply chain management, improved (emergency) referral, and better diagnosis and case management.

More than clients, health workers also mentioned structural benefits for communities in terms of health outcomes: safer delivery and reduced maternal mortality and mortality in general.

Conclusion
The first two specific research objectives could be adequately fulfilled.

Health workers, clients and other community members alike see much potential in using mobile communication across various mHealth domains, to improve information, service delivery, access, quality, efficiency, responsiveness and, ultimately, health outcomes (cf. WHO health system framework). It is not difficult to see how this could influence the Three Delays, although the evidence generated over the past two decades regarding the challenges in reducing maternal mortality implies that there probably is little 'low-hanging fruit' although there is evidence that community-based initiatives can contribute to avoiding Delays.

Some of the issues to be considered when designing and planning for expanding mobile communication strategies and/or mHealth research include the following:

- for health workers, making the available closed user groups more operational and phones accessible (and/or controlled distribution of top-up cards when feasible)

- considering whether other districts should initiate similar closed user groups (and measuring impact via baseline/end line research)
- using text messaging is suitable for communication among health workers and probably could be exploited much more; the same applies to data collection and submission options
- meanwhile, in view of illiteracy rates, in the short term text messaging does not seem a promising mode of communication with clients, and alternatives (to complement regular voice calls) could be explored – such as toll-free information lines, voice-response systems, voice mail messages, picture messages. Consideration of local languages will then be a must
- battery charging alternatives (solar power chargers)
- how to take advantage of information by phone to engage men more in SRHR issues, while taking into account whether the female partner is in favour of this
- whether clients who do not have a phone could nominate a person they trust to receive phone calls on their behalf
- how to avoid that clients, who actually should make a clinic visit, use the phone as an excuse not to come to the clinic.

4.2 Mobile network operators

All four mobile network providers participated in the February 2011 stakeholder workshop that started Phase 1 implementation. However, communicating with and receiving relevant information from these mobile operators regarding coverage data, subscribers and tariffs has been challenging, while also regulator NatCom so far has not shared relevant information (although an important report seems to be in the pipeline).

It is unlikely that any of the operators would be interested in improving their geographical network coverage based on the public health sector's needs and mHealth plans alone, as these are too small-scale to offer substantial business benefits. Still, if closed user groups and other strategies were implemented countrywide and if DHMTs worked together to negotiate contracts, they would gain substantial cost reductions.

In terms of relatively small mHealth initiatives under Phase 2, it is probably not cost-effective to negotiate contracts with each of the four providers. It would be worthwhile, however, to negotiate for clients across all networks to have access (via a special 'short code') to any (toll-free) line to be launched.

Regarding mHealth applications, in the end only two of the foreseen four applications were implemented, of which for one (the information line) a contract was established with one of the mobile network operators. However, evaluation and data processing for both applications have not yet been completed and will be shared at a later stage.

Conclusion: this specific research objective could be fulfilled only partially, and more work is needed leading up to and during Phase 2.

4.3 Health system aspects

In Section 4.1 we mentioned that it is not too difficult to relate the perceived benefits of expanded mobile communication to several of the components of the health system framework presented earlier (WHO, 2007). Here we aim to have a closer look at how the research findings can be interpreted in terms of how aspects of mHealth technology and interventions interact with the six health system building blocks. This is because, while mobile communication is perceived as potentially beneficial in a number of ways, there may also be strains and demands on the health system for which health policymakers and managers may need to prepare.

Service delivery – an improved information flow to and communication with clients has the potential of increasing service demand in clinics but also generating demand for new over-the-phone services. On the other hand, there may be 'efficiency gains' in terms of clients no longer attending the clinic if issues can be addressed over the phone, and there is the risk that clients who actually would need to be seen at the clinic avoid this, thinking a phone encounter with health staff is sufficient.

Health workforce – the previous point implies that mHealth strategies may lead to an increase in health workers' workload; this may be (partially) compensated for by efficiency gains. But the availability of mobile communication will lead to new demands on health workers' skills and routines, and there may be a need to develop a kind of 'protocol' for how health workers should deal with mobile communication with clients. Such a protocol could address confidentiality, hours of the day health workers can (and cannot) be reached, and interference of phone consultations with clinic work – in addition to 'hardware and software' issues regarding access to phones, cost, battery charging and others. In addition, mHealth applications could be used to strengthen in-service learning by health workers (mLearning).

Information – This is a key potential of mobile applications in various modes: voice call, automated or personalized voice mail, text message, picture message, voice-response system, information line, data collection and submission/sharing, automated remote monitoring of clients etc. For data collection and sharing, standards and systems would need to be put in place. Regarding information exchange among health workers, text messaging strategies could be developed and health workers trained in using these actively or passively. Any substantial information flow to and possibly from clients would also require standards and systems.

Technologies – The above interplay between health system building blocks and mHealth strategies require thinking through a number of aspects of which several surfaced during our data collection. These aspects include but are not limited to: choice of technology (hardware and software), mode of communication (voice, text, other), choice of applications (information to clients, exchange among health staff, data collection/sharing, other), literacy, language, confidentiality, inter-operability, cost to clients, cost to the health system, payment methods, battery charging etc. (see also Table 1.3.). Regarding cost to clients: many clients do not possess a mobile phone and indicated they would not be able to sustain the associate cost. Those that do have (access to) a phone may mostly use it to be passive communicators (whereby others initiate), rather than initiating communication themselves. However, to realize the potential of mHealth for clients, they need to be able to initiate communication and information queries. This implies that adequate mechanisms should be considered to make services affordable and thus accessible to poor clients. Otherwise, the financial barriers may be too big for poorer clients and community members to benefit from new technologies, and then the 'information and service gap' between those who can afford to access these and those who cannot will widen rather than reduce.

Financing – With the 'Splash' system, mobile money transfer has recently been introduced in Sierra Leone. There are similar but different applications available, such as vouchers that can be transferred to eligible clients (for example, pregnant women) accessing a phone and which then entitles clients to certain services for a reduced fee or free of charge, in designated clinics and other outlets.

Governance – The decision to embark on mHealth strategies rests with each DHMT separately, in consultation (or after approval of) the local council. Yet

there seems a potential for easy gains if more than a few districts would embark on similar mHealth strategies and negotiate the systems and related tariffs with one or more of the mobile network operators of choice. Other governance-related aspects needed to be addressed include a regulatory framework (that would (also) address ethical issues), public–private partnerships, affordability, sustainability and others.

Conclusion

The number of dimensions of interaction between mHealth strategic and health sector aspects is potentially large, and most have thus far not received major consideration.

The set-up, focus and time span of the Phase 1 activities, however, did not allow for an in-depth review of all (potential) health systems aspects. It will, therefore, be important to more profoundly address and research the above issues in the framework of the NET-RC Phase 2 intervention study.

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Annex 1 – Overview of current mHealth initiatives in public health sector, Sierra Leone 2011

Source: Stakeholder workshop, Freetown, 16 February 2011; categorized in line with typology of mHealth interventions as per research protocol

Description of mHealth activity	Where	When	Benefits	Challenges
Education and awareness **Client calling health worker for advice (HIV)**	Most or all districts	From 2008; some districts from 2010		Mobile hardware and infrastructure-related ▪ Some areas have poor coverage (only 60–65% mobile phone coverage nationwide) ▪ Calls can be made only at certain calling spots ▪ Low access to battery recharging facilities Mobile cost-related ▪ Cost of mobile ▪ Cost of airtime recharge; no provision for recharging Other ▪ Client may not have access to phone ▪ Absence of husband to make decision ▪ No fuel for ambulance
Point of care support - **Staff advising staff** - **Staff getting advice from DHMT**			• Improve case management • Improve quality of services	
Client monitoring - **Health workers contact client for HIV drugs and other concerns** - **Call patients for their TB medication**			• Improve compliance • Improve relationship between client and provider • Improve client satisfaction	
Emergency responses - **Calling ambulances for obstetric emergencies. Both community and PHU staff have telephone number of ambulance drivers and can call** - **Instructions on how to handle emergencies**			• Timely referral; reduce delays from PHU to hospital • Create provider awareness • Improve management of emergencies • Decreases maternal deaths	
Disease surveillance **Transmit surveillance information (district to national)**			• Timely reporting • More accurate and complete data • Prompt response	
HMIS - Data transfer			• Improve data quality • Timely reporting	
HRM - Supervision			• Save time for supervision	
General coordination **Information sharing among health workers:** - **DHMT asking for information** - **Information on meetings, workshops, supervision** - **To requisition drugs, supplies**			• Reduce stock-out • Better coordination	

Annex 2 – Feasibility study research table; comparing planned and actual implementation

General criteria: districts need to have mobile phone coverage; participants need to have access to a mobile phone in the family.

Objectives	Main research questions	Research methods	Data collection tools	Research participants
1. To assess mobile communication behaviour and perspectives of public health workers and their managers	1.1 Profile – phone possession, type, network, coverage, costs, battery charging, …	Semi-structured interviews (SSIs) 1 (NB – part on 1.1 more structures/ closed; part on 1.2-1.5 more open)	SSI guide 1 – HWs	20 health workers (HWs) from various levels; 10 from each of 2 districts, from among the following: - 2 TBA, 2 CHW-RCH, 2 MCHP/CHP, 2 CHC staff - 4 hospital staff incl. ANC, staff involved in emergency referral of obstetrics cases ACTUAL: 18 interviews
		In-depth interviews (IDIs) 1	IDI guide 1 – HMs (address self and HWs)	10 health managers (HMs); 5 from each of same 2 districts: - 3 in-charges - 2 DHMT staff ACTUAL: 11 interviews
		Key informant interviews (KIIs) 1	KII guide 1 – district KI	6 key informants; 3 from each of same 2 districts, from among the following: - Health Management Committee representatives e.g. local councillor - local CBO/NGO staff - Chiefs ACTUAL: 11 interviews
		Focus Group Discussion (FGD) 1	FGD topic guide 1 – HWs	2 groups of sub-district level HWs, 1 from each of 2 districts; 8–10 people in one group; e.g. MCHAs who mostly deal with MNH clients (use meeting/ training opportunities) ACTUAL: 2 FGD
	1.2 Behaviour and expectations – use (work/private), work use (purpose), use (format), paying for cost, security, asking/giving advice from/to colleagues, communication with clients …	Literature review	Literature review guide	
		Semi-structured interviews 1	SSI guide 1 – HWs	20 HWs – see above
		In-depth interviews 1	IDI guide 1 – HMs (address self and HWs)	8 HMs – see above
		Key informant int. 1	KII guide 1 – district KI	6 KIs – see above
		FGD 1	FGD topic guide 1 – HWs	2 groups – see above
	1.3 View on technology-related benefits and challenges	Same as 1.2		

	1.4 General: view on health-related benefits and challenges (actual, potential)	Same as 1.2		
	1.5 Specific: view on MNH-related benefits and challenges (actual, potential, selected applications)	Same as 1.2		
2. To explore mobile communication behaviour of health service users	2.1 Profile – phone possession, access, type, network, coverage, cost structure, costs, airtime charging, battery charging, …	Semi-structured interviews 2+3	SSI guide 2 – actual clients	8 actual health service clients; 4 from each of same 2 districts as above: - 4 women clients (health service user) ACTUAL: 16 client interviews (actual+potential mixed)
			SSI guide 3 – potential clients	8 potential health service clients; 4 from each of same 2 districts as above: - 4 women who are pregnant, identified in community (not facility), who had not more than 1 ANC visit in their last pregnancy and/or did not deliver in the health facility ACTUAL: 16 client interviews (actual+potential mixed)
		Focus group discussion 2+3+4	FGD 2 topic guide – adult female community members	2 groups of female community members, 1 from each of 2 districts; 8–12 people in one group ACTUAL: 2 FGD Women
			FGD 3 topic guide – adult male community members	2 groups of male community members; 1 from each of 2 districts; 8–12 people in one group ACTUAL: 2 FGD Men
			FGD 4 topic guide – young community members	2 groups of young community members; 1 from each of 2 districts; 8–12 people in one group ACTUAL: 3 FGD Youth
		Key informant interviews 2	KII guide 2 – community KIs	4 Key informants, 2 from each of the 2 districts from which FGD members derived, e.g. chiefs, other ACTUAL: 11 interviews
	2.2 Behaviour and expectations – use (purpose – personal, work, public services etc.), use (format), language, literacy?, paying for cost, security, …	Literature review	Literature review guide	
		Semi-structured interviews 2+3	SSI guide 2 – actual clients	8 actual clients – see above
			SSI guide 3 – potential clients	8 potential clients – see above
		Focus group 2+3+4 discussions	FGD 2 topic guide – adult female community members	2 groups of female community members – see above
			FGD 3 topic guide – adult male community members	2 groups of male community members – see above

			FGD 4 topic guide – young community members	2 groups of young community members – see above
		Key informant interviews 2	KII 2 guide – community KIs	4 KIs – see above
	2.3 View on technology-related benefits and challenges	Same as 2.2		
	2.4 General: view on health-related benefits and challenges (actual, potential), acceptability/ feasibility to use phone for health purposes, confidentiality worries, …	Same as 2.2		
	2.5 Specific: view on MNH-related benefits and challenges (actual, potential, selected applications); view on what kind of MNH-questions clients would like/want/dare to ask	Same as 2.2		
3. To assess the logistical, technical and financial aspects of mobile network providers and related services, including the testing of selected mHealth interventions	3.1 Experience and views on key aspects e.g. coverage current/future, reliability, cost per unit, cost packages, reverse billing, corporate social responsibility policy and funding, technological monopoly, inter-operability, ICT regulatory framework and policies e.g. consumer rights and unsolicited messaging, …	Literature review	Literature review guide	
		Key informant interviews 3+4	KII guide 3 – national health managers and policymakers	5 health managers and policymakers – national level ACTUAL: 4 interviews
			KII guide 4 – experts	8 key informants: - 2 health system experts - 2 health communication experts - 1 ICT for health expert - 2 telecom experts from telecom companies - 1 telecom expert not working for a telecom company ACTUAL: 2 interviews
	Application 1 (testing) – Channelling of one-way communication messages to women who have subscribed to these during their first ANC visit ACTUAL: Cancelled	Mini-survey 1	MS questionnaire 1	20 pregnant women who were targeted with messages, 10 per each of 2 districts
		Key informant interviews 5	KII guide 5 – KII involved in testing mHealth application 1	4 staff involved in operationalizing the system (ANC nurses, health managers, system operators, experts), 2 per each of 2 districts
		Observation 1	Observation checklist 1 (prep, process, implementation, effect, issues, …)	2 people closely involved in developing and putting the application into operation 1

	Application 2 (testing) – Establishing two-way communication between clients/community members and knowledgeable staff via a toll-free 'Mother & Baby' information hotline (*not* for emergencies) ACTUAL: Implemented in 1 district only	Mini-survey 2	MS questionnaire 2	20 users of the hotline, 10 per each of 2 districts ACTUAL: Pending
		Key informant interviews 5	KII guide 5 – KII involved in testing mHealth application 2	4 staff involved in operationalizing the hotline system (hotline responsive staff, health managers, system operators, experts), 2 per each of 2 districts ACTUAL: Pending
		Observation 1	Observation checklist 1 (prep, process, implementation, effect, issues, …)	2 people closely involved in developing and putting the application into operation 2 ACTUAL: Pending
	Application 3 (testing) – Provider-initiated, 'personalized' communication to individual women known to be pregnant, to encourage first or follow-up use of relevant services ACTUAL: Implemented	Mini-survey 3	MS questionnaire 3	20 pregnant women who were targeted with communication initiatives, 10 per each of 2 districts ACTUAL: Pending
		Key informant interviews 5	KII guide 5 – KII involved in testing mHealth application 3	4 staff involved in operationalizing the system, 2 per each of 2 districts ACTUAL: Pending
		Observation 1	Observation checklist 1 (prep, process, implementation, effect, issues, …)	2 people closely involved in developing and putting the application into operation 3 ACTUAL: Pending
	Application 4a (existent application e.g. closed user group; evaluate) – One or more 'closed' mobile networks for staff and addressing barriers to realizing its full potential ACTUAL: cancelled as separate data collection; addressed as part of regular interviews	Mini-survey 4	MS questionnaire 4	20 health staff (HW, managers), users of the mobile communication system 1, 10 per each of 2 districts
		Key informant interviews 5	KII guide 5 – KII involved in testing mHealth application 4a	4 staff involved in operationalizing the system, 2 per each of 2 districts
	Application 4b (new application e.g. Push To Talk; testing) – One or more 'closed' mobile networks for staff and addressing barriers to realizing its full potential ACTUAL: Cancelled	Mini-survey 4	MS questionnaire 4	20 health staff (HW, managers), users of the mobile communication system 2, 10 per each of 2 districts
		Key informant interviews 5	KII guide 5 – KII involved in testing mHealth application 4b	4 staff involved in operationalizing the system, 2 per each of 2 districts
		Observation 1	Observation checklist 1 (prep, process, implementation, effect…)	2 people closely involved in developing and putting the application into operation 4b
4. To assess risks and	4.1 Key aspects of health systems (e.g. 6 WHO building blocks) in Sierra Leone	Literature review	Literature review guide	
		Semi-structured	SSI guide 1	20 health workers in 2 districts – see above

preconditions associated with the integration of mobile phone technologies into the health system in low resource settings	context, that are relevant for general mHealth initiatives e.g. preconditions, risks, feasibility, sustainability, technology (choice/risk of monopoly, accessibility, usability, compatibility, appropriateness, affordability, functionality, development), cost, scaling up, data collection and handling, regulatory framework, partnerships/PPP, customer care, ethics e.g. informed consent and confidentiality, M&E, …)	interviews 1		
		In-depth interviews 1	IDI guide 1	6 HMs – see above (district level)
		Key informant interviews 3+4	KII guide 3 – national health managers and policy makers	5 health managers and policymakers – see above
			KII guide 4 – experts	6 key informant experts (same as or from among the 8 mentioned under 3.1): 2 health system experts 2 mHealth/health communication experts 1 ICT for health expert 1 telecom expert
	4.2 …and same as 4.1, specified for the chosen focus of mHealth applications and related interventions (see objectives/focus)	Same as 4.1		

Annex 3 – Background characteristics of research participants

Characteristics	Community members							Health staff												Experts	
		Community members (FGD)				Key informants - community	Total community members	Health workers (SSI)						Health workers (FGD)						Key informants - health managers		Total health staff	Key informants - experts	Total
	Female clients (SSI)	Adult women	Adult men	Young people	Total			SECHN	CHO	MCH Aide	CHW /TBA	Other	Total	SECHN	CHO	MCH Aide	CHW /TBA	Volun-teer	Other	Total	District	National			
Sex																								
Women	16	16	0	12	28	3	47	1	0	7	5	1	14	2	0	1	0	6	5	14	8	0	36	0	83
Men	0	0	18	12	30	8	38	0	0	0	3	1	4	0	1	0	0	0	1	2	3	4	13	2	53
Age																									
≤30	nd	8	5	24	37	0	nd	1	0	1	0	0	2	0	0	0	0	5	0	5	3	nd	na	nd	nd
>30	nd	8	13	0	21	11	nd	0	0	6	8	2	16	2	1	1	0	1	6	11	8	nd	nd	nd	nd
Education																									
primary or less	11	10	5	14	29	nd	nd						nd							nd	nd	nd	nd	nd	nd
(some) secondary	5	6	13	9	28	nd	nd						nd							nd	nd	nd	nd	nd	nd
more than secondary	0	0	0	1	1	nd	nd						nd							nd	nd	nd	nd	nd	nd
Study site																									
Western Area district	8	7	8	8	23	5	36	1	0	5	3	2	11	0	1	1	0	0	6	8	5	0	24		60
Kenema district	8	9	10	16	35	6	49	0	0	2	5	0	7	2	0	0	0	0	6	8	6	0	21		70
National	0				0	0	0						0							0	0	4	4	2	6
Total	**16**	**16**	**18**	**24**	**58**	**11**	**85**	**1**	**0**	**7**	**8**	**2**	**18**	**2**	**1**	**1**	**0**	**6**	**6**	**16**	**11**	**4**	**49**	**2**	**136**

*	Staff positions not specified
nd	no data
CHC	Community health centre
CHO	Community health officer
CHW/TBA	Community health worker/Traditional birth attendant

FGD	Focus group discussion
MCH Aide	Mother and child health aide
SECHN	State-enrolled community health nurse
SSI	Semi-structured interview