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Assessment of mobile health technology for maternal and child health services in rural Upper West Region of Ghana

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ABSTRACT

Objectives: This study assessed the perspectives of women and health workers on the feasibility of using mobile health technology (mHealth) for the provision of maternal and child health services in rural settings of the Upper West Region of Ghana.

Study design: The study used a mixed-design approach of quantitative and qualitative methods.

Methods: Interviewer-administered questionnaires, focus group discussions (FGDs), and key informant interviews (KIIs) were employed. Participants included pregnant women, lactating mothers, and health workers from three rural districts.

Results: A total of 489 interviews were conducted, consisting of 290 pregnant women and 199 lactating mothers, with an average age of 26.9 years. Some level of formal education had been received by 67.1% of participants. The mHealth intervention was implemented in the study districts via mobile phones in the form of SMS voice messages, text messages, and phone call reminders. Our results show that participants who received follow-up call reminders and messages (10.2%) from health providers about their health expressed general satisfaction and high optimism toward receiving future follow-ups via their mobile phones. The high acceptability level was also demonstrated in the FGDs and KIIs. Overall, our findings showed that this mHealth intervention was an acceptable and feasible solution to the challenges of access to healthcare services seen in rural areas. Despite the high acceptability level, participants also highlighted barriers, such as limited or erratic power supply and poor mobile network connectivity, which need to be addressed.

Conclusions: mHealth interventions targeting health providers and rural women have the potential to reduce barriers to equitable access to maternal and child healthcare services in these settings. These findings are of clear public health importance and are relevant to policy-makers in this area of service delivery and use; however, policy-makers and program implementers should be cautious of the challenges involved in the scale-up of such an intervention.

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Introduction

Globally, every year, nearly half a million women and newborns needlessly die as a result of complications during pregnancy, childbirth, and the postnatal period.[1] Maternal mortality continues to be a major problem among women of reproductive age (15–49 years) in Ghana, as in many other Sub-Saharan African (SSA) countries, where 1 in 16 women is likely to die as a consequence of pregnancy and childbirth.[2,3] Over 99% of maternal deaths that occur in developing countries among poor and rural women are avoidable.[3]

In SAA, the maternal mortality ratio (MMR) is far higher among rural women (640 per 100,000 live births) compared to their urban counterparts (447 deaths per 100,000 live births).[4] In Ghana, MMR is about 380 maternal deaths per 100,000 live births,[3] which is much higher than global averages of 216 deaths per 100,000 live births.[3] Also, children in low- and middle-income countries (LMICs), including Ghana, are five times more prone to death during and after birth than their counterparts in developed countries.[3] In most developing countries, such as Ghana, access to healthcare services in rural areas is more limited than in urban areas.[5] These issues are more prominent in the Upper West Region (UWR) of Ghana, where there are insufficient doctors, nurses, and other health service providers[6]

According to Feroz et al.,[7] only 52% of pregnant women in LMICs, such as Ghana, obtain the World Health Organization recommendation of a minimum of four antenatal consultations and adequate postnatal care. Neonatal mortality problems in the UWR of Ghana are said to be on the rise because of inaccessible roads and skilled health professionals present before, during, and after delivery.[6]

The rapid development of information and communication technologies in resource-limited settings provides access to high-quality health information and, in general, requires less staff and specialized health professionals to overcome most of the access challenges.[8,9] Also, the ability of mobile phones to reach a wide audience on at relatively low cost makes it an attractive innovation for developing countries.[9,10] This study assessed Savana Signatures and Global Affairs of Canada Technology for Maternal and Child Health (T4MCH) in selected districts in the UWR of Ghana to understand the enablers and barriers for using the technology to provide and use healthcare services.

Methods

Study design

The study used a mixed-design approach of quantitative and qualitative methods, with interviewer-administered questionnaires, focus group discussions (FGDs), and key informant interviews (KIIs).

Study setting

The study was conducted in three T4MCH intervention districts (Wa West, Wa East, and Jirapa) of the Savana Signatures in the UWR of Ghana, which is one of the poorest and least developed regions.[8] The region has six hospitals and over 53,000 individuals per doctor.[9] In addition, only 45.3% of women in this region give birth in a health facility (the second lowest in the country) compared with over 83% in the Greater Accra Region, the national capital.[9] The intervention districts are the hard-to-reach districts in the UWR in terms of access to health facilities, as a result of inadequate roads and poor infrastructure, combined with local customs. Lack of health information further influences the limited utilization of maternal and child health services in these underserved settings. To strengthen the health system to improve access to maternal and child health services, Savana Signatures implemented the T4MCH intervention through an interactive platform for health providers to share health information and provide health education.

Study participants and sampling

The target population were women of childbearing age (15–49 years). The main criteria for inclusion of households were the presence of (i) a pregnant woman; (ii) a lactating mother with a child aged 0–12 months; (iii) a mother who lived in the study area during pregnancy; or (iv) a mother who gave birth within the study area. A simple random sampling method was used to select households within each cluster/community. This sampling method allowed every member of the population being studied an equal chance of being selected. Overall, a total of 489 interviews were completed, comprising of 290 lactating mothers and 199 pregnant women.

The qualitative study was comprised of FGDs and KIIs. The FGDs included 39 participants: 21 pregnant women and 18 lactating mothers. Additionally, we conducted 10 KIIs, which included healthcare managers, health policy-makers or implementers, doctors, nurses, and midwives from health facilities in the study districts, to complement the focus groups. Table 1 provides a detailed summary of all interview types and respondents.

Data processing and analysis

The quantitative data collected was checked and screened for completeness and accuracy on a daily basis. Data were coded, doubly entered, and analyzed using the Statistical Package for Social Science software for Windows, version 20. Descriptive statistics including frequencies and cross-tabulations were run to generate output on all variables. The FGDs and the KIIs were analyzed separately to manage the extensive data set.

For the qualitative data, audio recordings were transcribed verbatim in English by two experts. The transcripts were shared and read through thoroughly, independently, and repeatedly by the study team members to ensure completeness and accuracy of the transcriptions and also to obtain a sense of the data as a whole. Data were analyzed thematically, and views and important quotes from the themes were presented as results for the study. To ensure the internal consistency and reliability, the quantitative data were used to triangulate with the qualitative results to strengthen the study.

Table 1 – Type of interviews and respondents.

Interview type	No. of interviews	Respondents
Focus group discussion	6 in total (Wa West [2], Wa East [2], Jirapa [2])	Each of the three areas had one group of lactating mothers and one group of pregnant women
Key informant interviews	10 in total (Wa West [2], Wa East [2], Jirapa [6])	With (Community Health Nurses) CHNs, nurses, doctors, health directors, and public health officers.
Survey	290 in total (Wa West [93], Wa East [101], Jirapa [96])	Pregnant women
	199 in total (Wa West [84], Wa East [42], Jirapa [73])	Lactating mothers

Results

Characteristics of respondents

A total of 489 interviews were conducted. Respondents consisted of 290 pregnant women and 199 lactating mothers as detailed in Table 2.

The ages of respondents ranged from 16 to 45 years. The average age of women was 26.9 years. The ages of their children ranged from 28 days to 12 months, with a mean age of 4.7 months. Most of the women (408 [83.4%]) were currently married and 29 (5.9%) were single/never married. A considerable proportion (66.3%) belonged to the Dagao ethnic group. Most (57.9%) were Christians. Over fifty percent (52.4%) of the women were multiparous, and 24.5% were primigravid. In total, 67.1% had some level of education and 32.9% had no formal education. Among the respondents, most (381 [78%]) were workers, but not on a salary, while 49 (10%) were not involved in any kind of work.

Knowledge on T4MCH intervention

Of the 489 women who were interviewed in this study, less than one-third (107 [21.9%]) had a fair knowledge of the mHealth intervention that had been implemented by Savanna Signatures in their districts. The major sources of information were from durbars, health education sessions, health providers, and others.

The following views are from participants on how Savanna Signatures activities are promoted in their districts:

Table 2 – Characteristics of respondents (n [%]).

Characteristics of respondents	Total sample (N = 489)	Pregnant women (*n* = 290)	Lactating mothers (*n* = 199)
Age in years			
≤20	83 (16.9)	48 (16.6)	35 (17.6)
21–35	326 (66.7)	199 (68.6)	127 (63.8)
≥36	80 (16.4)	43 (14.8)	37 (18.6)
Marital status			
Single/never married	29 (5.9)	16 (5.5)	13 (6.5)
Married	408 (83.4)	239 (82.4)	169 (84.9)
Separated	2 (0.4)	1 (0.3)	1 (0.5)
Living together/cohabiting	49 (10.0)	34 (11.7)	15 (7.5)
Widow	1 (0.2)	0	1 (0.5)
Mothers level of education			
No formal Education	161 (32.9)	104 (31.9)	57 (28.6)
Primary	102 (20.9)	53 (18.3)	49 (24.60
(Junior High School)JHS/vocational	116 (23.7)	68 (23.4)	48 (24.1)
Middle school certificate	2 (0.4)	1 (0.3)	1 (0.5)
(Senior High School)SHS	48 (9.8)	28 (9.7)	20 (10.1)
Tertiary	54 (11.0)	36 (12.4)	18 (9.1)
Other	6 (1.2)	0	6 (3.0)
Religion			
Christian	283 (57.9)	173 (60)	110 (55.3)
Muslim	175 (35.8)	99 (34)	76 (38.2)
Traditionalist	31 (6.3)	18 (6)	13 (6.5)
Ethnicity			
Dagao	324 (66.3)	193 (67)	131 (65.8)
Waala	130 (26.6)	72 (25)	58 (29.1)
Sisaala	13 (2.7)	11 (3.0)	2 (1.0)
Other	22 (4.5)	14 (5.0)	8 (4.0)
Occupation			
Trader	85 (17.4)	48 (16.6)	37 (18.6)
Artisan	129 (26.4)	78 (26.9)	51 (25.6)
Farmer	167 (34.2)	97 (33.4)	70 (35.2)
Salary worker	59 (12.1)	34 (11.7)	25 (12.6)
Unemployed	49 (10.0)	33 (11.4)	16 (8.0)

Table 3 – Contact with healthcare provider via mobile phone according to districts (n [%]).

Contact	Wa West District		Wa East District		Jirapa District		Total
	Pregnant women	Lactating mothers	Pregnant women	Lactating mothers	Pregnant women	Lactating mothers	
Yes	6 (1.2)	8 (1.6)	5 (1.0)	2 (0.4)	19 (3.9)	10 (2.0)	50 (10.2)
No	87 (17.8)	73 (14.9)	95 (19.4)	39 (7.9)	77 (15.7)	59 (12.1)	430 (87.9)
No response	1 (0.2)	2 (0.4)	2 (0.4)	0 (0)	3 (0.6)	1 (0.2)	9 (1.8)
Total	**94**	**83**	**102**	**41**	**99**	**70**	**489 (100)**

The other time we were having a durbar on health promotion activities, they talked about some of the things Savanna Signatures will be doing for the women. (FGD—Pregnant women—Wa East).

People in the communities are getting to know about the existence of Savanna Signatures through the durbars we normally hold to educate them (KII—Health worker—Jirapa).

When I went for antenatal care, a midwife took my phone number and told me Savanna or something like that told them to collect them to call us later… (FGD—Pregnant woman—Wa West).

Communication between health workers and clients via mobile phone

Some pregnant women and breastfeeding mothers indicated getting mobile call reminders from healthcare providers as a follow-up on their health, although there was some variation in the number of respondents contacted across the three districts (see Table 3).

Type of information communicated to them by healthcare providers

For the respondents who had received a follow-up mobile call reminder (10.2%), the main reasons for communication were checking on health condition and as a reminder of the next visit to the heath facility (46.6%), discussion of antenatal care (23.3%), and discussion of facilities available to give birth (10.5%). These issues are further verified by women in the FGDs.

….oooh! yes, they have been calling me; they called to find out about my condition and to remind me of my next visit (FGD—Pregnant woman—Wa West).

Anytime it was getting to my antenatal visit, they called to remind me. Whenever they called, they ask about my health and also the need to get a blood donor (FGD—Lactating mother—Wa West).

When I went to deliver, one of the midwives took my mobile number and always called me to find out how I was doing with my baby (FGD—Lactating mother—Jirapa).

Perception on follow-up call reminders

For the 10.2% of the women who received follow-up call reminders, discussions were on issues such as home visits, family planning, dangerous practices after delivery, early postnatal care, newborn care, when to visit the health facility, information on danger signs, and reminders about gestation birth date, the need for delivery in a facility, and others. All the women who had previous contact with health providers see the follow-up reminders as important and helpful. They also expressed satisfaction in the information they received from health providers as indicated in Table 4. These sentiments are also affirmed by the FGD participants in the quotes below:

They have been calling me to ask about my pregnancy. I always feel very happy and relieved whenever they call to ask about my health (FGD—Pregnant woman—Wa West).

I felt privileged to be called by a midwife to find out about my health and my baby … (FGD—Lactating mother—Jirapa).

…. sometimes we have health problems but because of the distance to the health facility we are not able to go…. Now that they are going to be contacting us through phones, it is good (FGD—Pregnant women and lactating mothers—all districts).

Some of us don't have the money to go to the hospital for health care on every problem …. now that the nurses can reach us on phone and can also get them on their phones to discuss about our health…. it's a good thing (FGD—Pregnant women and lactating mothers—all districts).

The anticipated future benefits of mHealth were expressed by several participants as demonstrated in the following statements:

This will let us get solution to our health problems at our homes without necessarily spending time travelling to the health facility all the time (FGD—Pregnant women—Jirapa).

…yes, this will help us to get information on our health and children from the midwives… It's really a good innovation (FGD—Pregnant women—all districts).

Table 4 – Level of satisfaction with information from health workers.

Level of satisfaction	*n* (%)
Very satisfied	25 (50)
Satisfied	24 (48)
Partially satisfied	1 (2.0)
Total	**50 (100)**

Presumed reasons for not being contacted

We wanted to know from the women who did not get follow-up mobile reminders (89.8%) as to why they think they were not contacted. They gave varied reasons such as not owning a mobile phone (3.2%), having no mobile network coverage (1.8%), follow-up call reminders not usually being done by health providers (21.5%), and other reasons (2.5%). The majority (54.2%) had no any idea why they were not being contacted by health providers.

The midwives told us when they were collecting our phone contacts that not all of us will be contacted by them…that the contact we depend on individual problems or need… (FGD—Pregnant women and lactating mothers—all districts).

Acceptability

All the women who received follow-up mobile calls (100%) and the majority (98.2%) of those who did not receive follow-up calls expressed high optimism toward receiving future follow-up mobile reminders from health workers.

Some of the participants equally expressed high acceptability levels as demonstrated in the sentiments below:

… follow-up phone reminders by health providers will make us to be in constant contact with the nurses for information on our health without being physically present at the health facility. I think this way will definitely reduce pressure of always having to travel to the health facility for certain information which we can equally sit at our homes comfortably and get from the nurses (FGD—Pregnant women and lactating mothers—all districts).

While women recognized follow-up mobile calls as a valuable reminder on their health, some women additionally spoke of it as a way of building trust between themselves and their partners.

Sometimes when we tell our husbands what the nurses told us, they think we are lying to them… but with the follow-up call reminders, they will now be convinced that we really visit the hospital that is why the midwives are calling us. This will help build trust between us and our partners (FGD—Pregnant women and lactating mothers—all districts).

If they involve our partners in the follow-ups, it will enable us to always get the needed assistance to help us visit the health facility when it is required of us to do that (FGD—Lactating mothers—all districts).

The health workers sentiments were also in accordance with these assertions.

I think the mobile phone reminders will really help. It will be very comfortable and amazing for a woman to sit at home and get a signal to educate her on her pregnancy, baby or on herself. It is very good. It will also reduce the number of visits to health facilities. It will also create an avenue for nurses to bring the partners of the women on board the discussions (KII—Health worker—Jirapa).

Despite the high expectations of both women and health-care providers of mHealth being the way to go in the future, they also expressed their views on potential challenges health providers and women are likely to encounter in its scale-up. Their views on the challenges they envisage are demonstrated in the following statements:

Our major problem is about the network connectivity. The network is so bad that in some places people have to climb trees or high objects in some communities to call or receive calls… (KII—Health worker—Jirapa).

Some of us don't have electricity in our communities. Charging phones will be a challenge to us. Anytime the nurses want to call us, and the phone is off they can't reach us (FGD—Pregnant women and lactating mothers—all districts).

Not all of us have mobile phones…so in this case what are we going to do…and even those who have, some of us can't always buy the airtime (FGD—Pregnant women and lactating mothers—all districts).

Several health providers also expressed similar sentiments:

…again, looking at Wa East in particular, sometimes the network coverage is a challenge. You know people are at places which are very difficult to access, what I am saying here is that yes somebody comes to you to give her number to you, may be one or two weeks, one month, you are not able to reach the person, is there a way that we could trace to that particular person locality and then find out how we can bring them on board? (KII—Health providers—Wa East).

Those villages without electricity, the charging of the phone will be a problem. They may have the phone, but they may not get the power to maintain the phone. That's one of the challenges that we may have in these communities (KII—Health workers—all districts).

Related to the above challenges are potential isolated challenges expressed in the following quotes by several participants across the districts:

…so, by introducing technology in maternal and child health, our bigger challenge has to do with the mothers' ability to afford the phones. You want them to go and buy phones, after buying phone you have to put in the credit, so these are some of the challenges I think these mothers are likely to face (KII—Health worker—Jirapa).

Some of us don't have proper phones. You know we don't have money to buy phones. It is not only the phones that we do not have, but also money to buy credits to make calls so introducing something like this without the supply of these things will be a problem to some of us (KII—Health provider—Jirapa).

…you see, even though we don't have phones, our husbands have. The problem is that some of them will not allow us to touch their phone or give their numbers to the midwives to contact us through it (FGD—Pregnant women—Wa East).

Participants expressed similar views on personal challenges that providers might face.

The midwives who have been calling us would also need credit to enable them to be calling us…so I believe they need to be given phone credits to help to be contacting us (FGD—Pregnant women and lactating mothers—Wa West).

Related to individual mobile phone ownership is a technical skill to use the phone.

…actually, the technology compliance of even our own health workers as in handling the laptop or computers or mobile phones is an issue. They are not generally conversant with the laptop or the information and communication technology services. You know some people don't have the technical know-how to use the phone (KII—Health provider—Wa East).

Some of the women cannot even read simple text messages … there is still a problem (KII -Health workers - all districts).

They said they will give us text messages, but some of us cannot read… (FGD—Pregnant women and lactating mothers—Jirapa).

The other issue is skills. You know some of the people don't have the know-how to use the phone… (KIIs—Health workers—all districts).

Discussion

The effective implementation of mHealth interventions is critical in addressing equity challenges, particularly in rural and hard-to-reach settings. This study assessed the perspectives of pregnant women, lactating mothers, and health professionals on an mHealth intervention in selected districts in the UWR of Ghana. Overall, our findings showed that the mHealth intervention was acceptable and feasible. Participants believe that the innovation is good and if successfully scaled-up and sustained, could address some of the equity challenges in accessing healthcare services in the region. Scale-up and sustainability are the critical next steps to improving mHealth.[10]

There is a large literature base recommending best practices for successful scale-up of mHealth programs in SSA.[11] Recent reviews of studies in SSA using mobile phones, especially in rural settings, to promote behavior change have demonstrated mixed to positive effects of such programs.[12–15] Evidence shows that moving toward a more strategic approach to planning, development, and evaluation of mHealth initiatives will greatly enhance the impact of mHealth and its integration into health systems.[10]

Unique to these findings is that participants' knowledge and awareness about the mobile technology intervention was high. Introducing innovative approaches, such as mHealth, could result in equitable and efficient delivery of and access to health services, leading to good health outcomes for mothers and babies in Ghana. Previous studies have shown that mHealth interventions are effective, especially those that are aimed at changing the behavior of pregnant women and women in the postnatal period. These mHealth interventions were associated with improved utilization of preventive maternal healthcare services, including uptake of recommended antenatal care and postnatal care services.[16] However, there is limited evidence regarding the impact of such interventions on maternal and child health programs in LMICs, such as Ghana,[17] where mHealth programs are still in the pilot stages and awaiting impact, outcomes, and effectiveness assessments.

All participants in the interviews, FGDs, and KIIs expressed general acceptability and feasibility for the mHealth intervention, especially in terms of reduction in the distance and cost of accessing and using healthcare services.[18] This finding corroborates with several findings of other studies in SSA.[19–21]

Another important finding of this study is building trust among partners. Health providers also think it will help women get the support they need from their partners in terms of seeking health care, since their partners will also be involved in the conversation. The importance of male partner support in accessing maternal and newborn care has been extensively documented.[22,23] It has been established that little or non-involvement of male partners in maternity care leads to low utilization of maternity health services.[22]

The important issue of limited or erratic access to power supply, cost of mobile phones, airtime, and network coverage was highlighted in this study. Participants are of the view that if these challenges are not addressed, it would be an obstacle to the provision and access of health services in their settings. Several studies in SSA and LMICs have reported similar challenges.[24,25] Evidence indicates that pilot projects and other interventions in which health innovations are tested on a small scale often show impressive results; however, these results are often not sustainable as a result of the challenges faced by large-scale implementation.[11,24,26] Providing proof of implementation feasibility and laying the groundwork for future large-scale implementation is a first major step toward successful scaling-up, although this does not mean that scaling-up will occur automatically.

Policy implications and conclusions

Implications for the public and policy-makers

Using mobile phones and other wireless devices are an attractive technology for delivering public health interventions and educational messages to rural populations. The active participation in these interventions by rural populations, especially women, will aid successful implementation of these initiatives, leading to improved health outcomes. Such initiatives also have the potential to reduce cost and geographical barriers associated with accessing health care in these settings, resulting in improved health and reduction in morbidity and mortality.

- Health policy-makers and implementers continually face new maternal and child health service problems to solve.
- mHealth interventions may be effective solutions to improve maternal and child health service utilization in deprived rural settings of Ghana.
- The findings of this research show that mHealth strategies have the potential to address maternal and child health service utilization challenges in rural settings of Ghana.

- These findings should inform and guide policy-makers, health professionals, technologists about the potential of mHealth in strengthening the health system.
- Ensuring mHealth intervention scale-up and sustainability requires concerted efforts from policy-makers, program implementers, community-based organizations, and stakeholders in health.

In conclusion, although these findings are of clear public health importance and are relevant to policy-makers in this area of service delivery and use, policy-makers and program implementers should be cautious of the challenges of scale-up. To achieve this will require adequate support from governments, stakeholders, policy-makers, and program implementers.

Author statements

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Ethical approval

This study was reviewed and approved by the Institutional Review Boards of Navrongo Health Research Center. Written informed consent was obtained from each respondent prior to participating.

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Competing interests

The authors declare that they have no competing interests.

Authors' contributions

A.S.L. conceived and designed the study, and all authors reviewed the data collection tools and participated in data collection and analysis. A.S.L. prepared the manuscript. S.I., B.B.A., and E.B. provided critical initial review and final review of the manuscript. All authors read and approved the final manuscript.

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