

Full Length Research Paper

Use of mobile phone: Communication barriers in maternal and neonatal emergencies in rural Bangladesh

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Toll free mobile phone intervention was tested in one sub district of Bangladesh. Prior to implementation, we conducted a formative research to explore perceived advantages and disadvantages of mobile phone communication for maternal and neonatal complication management. We conducted in-depth interviews among twelve community skilled birth attendants and fourteen mothers along with their husbands. All husbands were supportive in their wives' accessibility to their phone, but wives revealed disparity in access to husbands' phone. The advantages identified were reduced cost of consultation and transportation to appointments with skilled providers, time saving during emergencies and controlling barriers to pregnant women's mobility. Other direct benefit was consultation with health professionals to increase confidence of community based skilled birth attendants (CSBAs) in handling emergencies. Respondents sensed that determining the management without examining patient might affect the appropriateness in providing treatment, when the communication mode is only phone. Mothers and their husbands who communicated through mobile phone with providers for their health issue noted some other barriers: irritability from the provider's side and switched off phones. Mobile phone access pathway should be explained to pregnant women, their husbands and service providers from the beginning of an intervention. The well designed e-health solutions based on evidence of formative research may have larger impact on quality of care in Bangladesh.

Key words: Maternal and neonatal emergencies, mobile phone, barriers, rural Bangladesh.

INTRODUCTION

Universal access to reproductive health and rights was designated as a developmental goal at the 1994 International Conference on Population and Development (ICPD) (UNFPA, 1995). This universal access is essential to achieve the millennium development goals for maternal and neonatal health (MDGs 4 and 5), which are to reduce maternal and neonatal mortality to one-third of current levels by 2015.

In a country like Bangladesh, it would be difficult to achieve the MDGs 4 and 5 by 2015 without effective

strategies for the improvement of maternal and newborn survival. Despite numerous initiatives in the public sector in Bangladesh, great inequities remain, particularly in the rural areas (National Institute of Population Research and Training [NIPORT], 2007). In the World health Organization (WHO) country cooperation strategy 2008 to 2013, Bangladesh reported that Bangladesh continues to face a chronic shortage of and imbalance in the health work force skill mix and deployment for maternal and neo-natal health (WHO, 2008).

The Bangladesh maternal mortality and health care survey (BMMS) estimated maternal mortality rate (MMR) as 194/100,000 live birth (NIPORT, 2010). Important contributing factors for the MMR includes more than 80% of home deliveries with untrained birth attendants

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(NIPORT, 2007), delays in recognition of maternal complications (Ronsmans and Graham, 2006) and limited referral linkages and transportation for emergency obstetric care (Chowdhury, 2008; Campbell and Graham, 2006). Previous studies (Syed et al., 2008) about care seeking behavior around childbirth have documented that delayed access to care can contribute to poor birth outcomes. This study has documented lack of knowledge of maternal and newborn danger signs contributed to delayed access to care. In addition, lack of understanding about the need for immediate care from qualified providers and financial and transport barriers also caused delay in access to care (Molesworth, 2006). Therefore, health interventions also need to formulate strategies to address such delays at the family and community levels.

Some authors recommended telephonic advice as a possible solution to the low income countries to address the gaps in health care (Yoon and Kim, 2008). Mobile phones are now widely available to encourage compliance in chronic disease like asthma in Lothian and Kent cities of United Kingdom (Pinnock et al., 2006). So far, the maternal health projects mainly focus text messages to pregnant women, recalling women with risk factors to visit antenatal clinic or referring women who suffer from maternal morbidity (Noordam et al., 2011). However, in healthcare counseling, some patients may prefer direct communication either through face to face to contact or discussion over phone rather than using SMS messages which often lack of individual "tailoring" (Kaplan, 2006).

Projects in Mali, Uganda, Malawi, Sierra Leone and Ghana equipped the TBAs and /or midwives with 'walkie talkie'. This communication system enabled the less educated providers to contact supervisors and ambulances in difficult situations and noted a significant reduction in maternal deaths and an increase in supervised births (Lungu and Ratsma, 2007; Musoke 1999, 2002; Matthews and Walley, 2005; Samai and Sengeh, 1997). However other argued (Krasovec, 2004) that access to communication tools is not the only solution mode for decreasing maternal deaths in isolated areas. The tight timeframe in which a woman requires emergency obstetric care (due to e.g. severe bleeding) implies that quality services need to be accessible at short notice and supported by effective infrastructure management (Musoke, 2002).

Emergency services departments in Gambia provided TBAs and outreach workers with mobile phones to refer pregnancy complications. A project in Madhya Pradesh, India offered pregnant women a health telephone helpline, complimentary ambulance system, and drivers equipped with mobile phones (Tamrat and Kachnowski, 2011). Although there was no impact evaluation but qualitative evidence from pilot programs in similar locations demonstrated that 24 h obstetric mobile-phone-based helplines reduced delays associated with decision

and identifying appropriate health (Tamrat and Kachnowski, 2011). However, researchers of the interventions in Uganda and the Gambia reported that unreliable emergency transport, coupled with poor quality of services at health facilities, compromised the health outcomes (Tamrat and Kachnowski, 2011).

In the developing world there is a huge spread of mobile phone networks and WHO is increasingly prioritizing strategies through integrating the mobile phone networks. According to the International Telecommunications Union (Barclay, 2009), there are more than 3.3 billion mobile subscriptions worldwide; 68% of those subscriptions are in developing countries and even people living on USD 1 per day increasingly have access to mobile phones (Lund et al., 2010). Mobile phones are increasingly being used to communicate and exchange information (Mechael, 2009).

In recent years, Bangladesh made a revolution in telecommunication systems particularly in use of mobile phones. The number of mobile phone subscribers has increased from 19 million in 2006 to more than 80 million in 2010, or 52.5% of the total population (available at <http://uk.reuters.com/>, 2009) indicating the potential for further growth. The commercial and nonprofit sectors can work together "to enable the poor, especially the poorest, to create a world without poverty" (Grameen Foundation, 2008).

In Bangladesh, there was a shift in development from 1946 to 2003; Grameen telephone through its micro credit program distributed mobile telephones with solar-based battery rechargers to women living in rural villages. Although at that period, Bangladesh was one of the lowest subscribers for mobile phone (less than one telephone subscription per 100 persons); nevertheless access to such mobile communication was a revolution for local villagers. This provides them the direct access to agricultural commodity pricing and in addition, transfer of funds, access to medical services, contact with distant family members in family emergencies and medical situations etc. (available at www.telecommons.com/villagephone/finalreport.pdf).

Qualcomm, the large telecommunications company, initiated the partnership with Grameen in 2006 to provide phones to poor people. This partnership aimed to test the feasibility for scaling up the successful Village Phone program to Indonesia. In this program, village phone operators (VPOs) started the businesses in rural villages where telecommunications services did not exist. The VPOs were able to repay their loans with this earning as well as to earn profits. In July 2008, Grameen Foundation, Qualcomm's Wireless reach initiative, launched Indonesia's first village phone program, reaching up to 500,000 poor Indonesians who did not have access to telecommunications services (Altman et al., 2012).

An integrated maternal and neonatal health (MNH) intervention in a rural area of Bangladesh focusing on

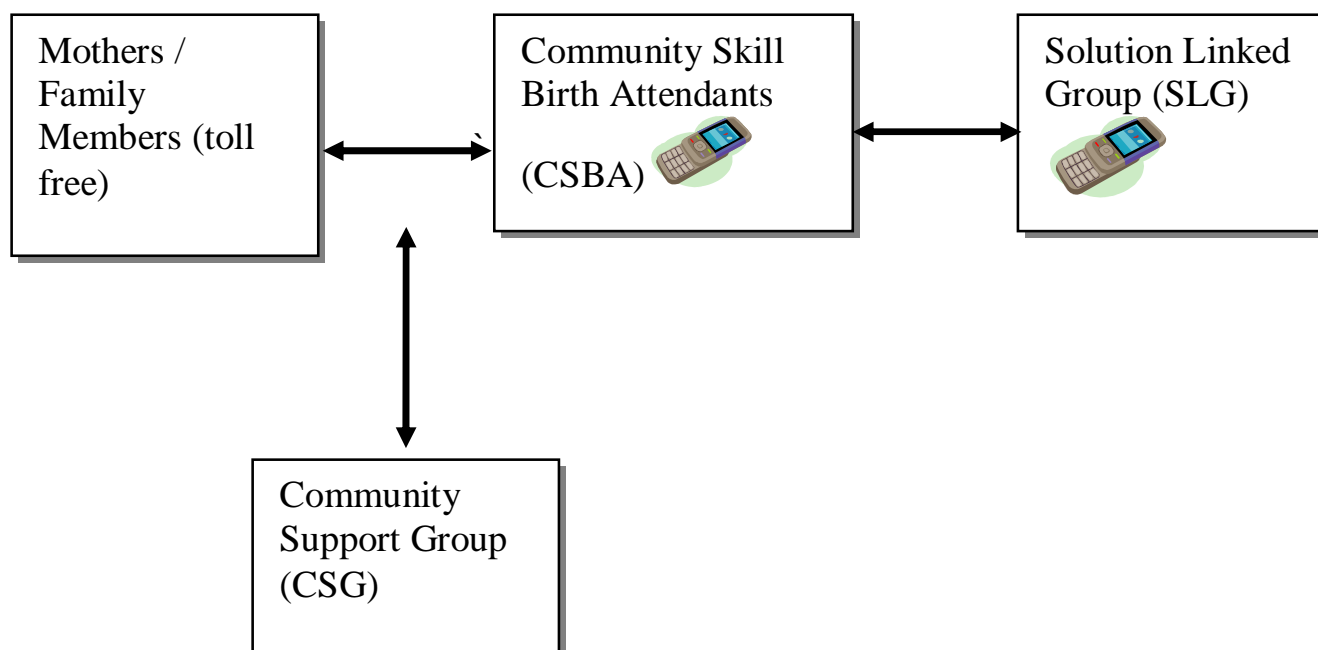


Figure 1. Mobile phone access pathway.

health system strengthening, training of community skilled birth attendants, demand side financing, formation of community support groups etc is currently being implemented. The MNH interventions could also be benefited through integrating information and communication technology with these interventions. Thus, a mobile telephone intervention was developed and tested in Shahjadpur, a sub district of Bangladesh. The effect of this large interventional study will be measured through baseline and end line surveys.

The objective of this large study is to assess the use of mobile phones in increasing communication about maternal and neonatal complications and increase in health care utilization from skilled providers. The sub district is divided into two equal halves based on the number of unions (lowest administrative unit in a sub district). One half is serving as intervention and other as control. In the intervention unions the community based skilled birth attendants (CSBAs) are provided with mobile phone and the mothers with requisite information on mobile communication in their needs.

Mothers / family members are eligible to call free of charge in maternal and neonatal concerns and emergencies to a single designated CSBA's number from any call operators. The CSBAs receive calls from the mothers and provide advice. They in turn, seek advice from appropriate specialists about conditions for which they are unable to provide first hand advice by calling the solution linked group (SLG) and making referrals if necessary. All the CSBAs calls are also free of charge. A community support group (CSG) is formed at the local

level to provide support to the mothers and family members for the timely accessing of the mobile phone (Figure 1).

Before initiating the implementation of the intervention, formative research was undertaken and is the subject of this paper. This formative research aimed to understand the usual communication pathway of mothers for their maternal and newborn health issues. This research also explored mother's accessibility to mobile communication, CSBA's, mothers and their husband's perceptions of the advantages and disadvantages of mobile phone communication for the first stage rapid management of maternal and neonatal complications. The formative research findings helped in finalizing the requisite information for mothers as well CSBAs and SLG on mobile communication in mother's need.

MATERIALS AND METHODS

Study setting

We conducted semi-structured in-depth interviews among the mothers, their husbands and CSBAs in Shahjadpur sub district of Sirajganj district. Shahjadpur is situated to the north-west of Dhaka on the Jamuna River. This is mainly agricultural economy with a large number of cottage-based weaving factories. The sub-district has about 600,000 population. There is one 50 bed primary public health care centre, several private clinics that offer cesarean section and approximately 62 CSBAs (in public and private employment), that is, 1 per 10,000 population.

In Shahjadpur, a baseline survey was conducted in 2009 as part of an integrated maternal and neonatal health project. Based on

this baseline survey's result about the use of skilled attendant at delivery, the 14 unions of the selected sub district were divided into high, medium and low performing areas. Seven unions from these three categories were randomly selected for intervention area and similarly the remaining seven were selected for the control area of the larger mobile phone study. The formative research was conducted among the seven intervention unions.

Study population

The respondents for this formative research were pregnant women, recently delivered women (in the three months prior to interview), their husbands, and CSBAs in the seven intervention unions. The study was conducted between January to February, 2010. The respondents were purposively selected with an intention to cover all seven intervention unions.

Data collection

The in-depth interview comprised of 14 mothers (7 pregnant women and 7 delivered women) along with their husbands. Pregnant women and new mothers were interviewed at their homes. Husbands were interviewed at home or in their workplace. Each interview lasted for 45 to 60 min. Twelve CSBAs were included from the intervention unions for in-depth interviews. An equal number of CSBAs were selected from the public and NGO health sectors. One husband declined to participate; no reasons were given for this decline. Therefore, a total of 14 mothers and 13 husbands were interviewed. The mothers were selected from different income groups - low income (monthly income less than 100 dollars), medium income (in between 100 to 200 dollar) and high income (equal or more than 200 dollars) purposively.

For the formative research, the socioeconomic status was crudely assessed by income rather than using standardized items. Additionally, the 'hard to reach' locations were defined based on the distance between the villages and sub district health complex. Commonly, the villages which are situated 10 and 25 km away from the sub district health complex have poor road infrastructure and some villages have no options for communication other than boat.

One field research officer (FRO), with a background in anthropology and previous work experience in qualitative method was recruited for data-collection. Intensive training was provided through classroom lecture and practical visit to the field site. The classroom lecture was basically on the guideline and mock in-depth interviews. Separate guidelines were used for in-depth interviews of mothers, husbands and CSBAs. The guidelines were developed based on the theoretical framework described below. The guideline included a small number of open ended questions to generate discussion which was followed by probing questions seeking explicit details. We collected information on the communication process between mothers and providers, with a particular focus on mobile phone communication, their perception on this communication for maternal and neonatal health care and suggestions to improve this communication pathway.

The interviews also explored CSBAs' willingness to communicate with the solution linked group (SLG) to receive advice in maternal and neonatal care and suggestions to improve this communication. The guideline also focused on the availability and accessibility of mobile phone for health care communication purpose by women, their existing use of mobile phone for maternal and neonatal health problems, factors that facilitate or hinder the use of mobile phone and their willingness for future use of such communication.

The training also focused on spot-training on qualitative methods during pre-testing the guidelines. The guidelines were revised in response to the local practice and context after pre-testing. The pre-

testing of guidelines was conducted in order to understand whether the content of the guidelines was feasible in the context of Bangladesh, whether these could generate the relevant discussions and the approach of asking questions was clear to the targeted population. We pre tested the guidelines among mothers who were not the actual participants of the formative research but had the similar characteristics to the mothers expected to include in the formative research. We selected those mothers from Shahjadpur sub district from the control area of the larger project. After pre-testing, the guidelines were modified in terms of language and contents for asking selected sensitive questions.

The research was conducted after receiving IRB approval from International Centre for Diarrheal Disease Research, Bangladesh (ICDDR, B). Written consent was obtained from each participant after explaining the purpose of the study, information to be collected and risk and benefit for participating in the research. A tape recorder was used to record the interview with participant's permission.

Theoretical framework

The ICT4HC (Lwin et al., 2008) model was based on the value-of-ICTs-to-education model (United Nations Development Programme, 2005). This model, suggests that an ICT, such as mobile phones, can act as a producer of opportunity, increasing their capacity and potential; enabler of social ties by strengthening communication links within the medical hierarchy, and with the patient and generate knowledge that would allow critical information to be shared and used effectively. The ICT4HC model addresses the presence of inter-related barriers that could hinder the translation of benefits into sustainable development goals. The obstacles of infrastructural, economic, technological, and socio-cultural factors have been repeatedly noted in existing ICT4H studies. In the context of the present study, all these factors have been taken into consideration on which in-depth information has been collected.

Data analysis

Transcripts were prepared in Bangla from the tape-recorded in-depth interviews. We conducted initial coding based on the several prior themes identified at the beginning of our research, for example, communication process, use of mobile phone, views of mobile communication in maternal health and recommendation for mobile communication. These prior themes were determined on the basis of the intervention aims and activities. We reviewed the transcripts for emergent sub-themes which helped us to further explore the prior themes. The sub-theme coding was determined by consensus following discussion between the research officer and investigators.

The process of coding continued until we reach the point of saturation that means there were no new code emerging and then we developed a code list. After completion of a code list, we developed a matrix by using the codes from the sub themes to read the whole dataset simply. We compiled each sub theme by respondent category. In this matrix, we included key words or shortened quotations. This process helped in searching for patterns, associations, and explanations in the data. When possible, we triangulated responses from different groups of respondents along with the subthemes.

RESULTS

Respondent's profile

The majority (8 out of 14 respondents) of the women

Table 1. Background characteristics of selected mothers at seven interventions union.

Characteristics	Mothers n= 14
Age (In years)	
< 20	2
20-25	8
>25	4
Education	
No formal education	4
Primary to secondary	10
Pregnancy status	
Recently delivered	7
Pregnant	7
Residency (Distance from the health complex)	
< 5 km	8
10 km	5
25 km	1
Monthly family income	
<\$100	4
\$100-200	6
>\$200	4

were between 20 to 25 years, two were below 20 years of age while four were in their early thirties. Most of the interviewees were Muslim. Only four of them had no formal education and the remaining 10 women had education from primary to secondary level (Grade 5 to 10). Eight women were residing in unions which have a <5 km distance from the sub district health complex, 5 women had this distance up to 10 km and 1 lived 25 km away from the health complex. Most women were living in a family who had a monthly income between \$100 to 200, for four women this was >\$200 and for another four women it was <\$100 (Table 1).

Communication process for care seeking

Of the fourteen mothers included in the in-depth interviews, seven mothers communicated with the CSBAs for their health related issues. The main purposes of their communication were routine check up and conduction of delivery, some mothers were found to visit the hospital simultaneously to know their babies' position and condition. Mothers addressed the CSBAs as either '*Chachi*' or '*Khala*' (aunt) which is customary to call a birth attendant in Bangladesh. The CSBAs mentioned maternal and neonatal complications as reasons for communication by mothers, in addition to the routine check up and general advice. Commonly, the mothers

preferred the traditional birth attendants (TBA) for conducting routine deliveries, however, if any complication arose during delivery the communication usually occurred face-to-face between the family members and CSBA "If there is any problem, then they ran to me as a crazy person" -CSBA

Overall CSBAs reported that face to face interaction was the most common form of communication. However, after repeated questioning the CSBAs mentioned about occasional mobile communication by mothers but it was not the norm. The mothers also communicated with providers other than CSBAs like MBBS doctor (Bachelor of Medicine and Bachelor of Surgery), health assistants, village doctors, and TBA for maternal health related issues. The mothers who had an income more than \$ 200 generally went either to the health facility or to the MBBS doctor while others had contacted the CSBAs. The families of this income group (\geq \$ 200) were not aware of the CSBAs, although one mentioned having been introduced to the CSBAs in a community orientation session organized by the local public health sector.

Access to mobile phone

It was found that most of the husbands are mobile phone subscribers but not all women have their own mobile phone. In the high income group, most of the women

have easy access to mobile communication either through their own phone or from others, for example other family members, neighbors or from shops where they can buy mobile service. Poor accessibility of mobile services was observed mostly among the women in low income group (<\$100). In this group, commonly the husbands who were the owner of mobile phone took it to his work place and that prevented their wives from accessing the services, especially when the husbands were away from home and till they returned at end of the day.

During discussion with the husbands, it seemed that there was no gender differential in using mobile phone from the husbands' sides. Almost all husbands were found to be supportive in their wives' access to their mobile. They agreed that mobile communication for maternal and neonatal health has the potential to indirectly improve maternal and neonatal health status through providing rapid advice and help in making rapid decisions during the emergency state of mothers. However, wives interviewed showed different views and disparities in accessing mobile phone in contrast to those ideas expressed by their husbands. The following quotes were from the same family,

"When the delivery date will be nearer, then maybe I shall keep my mobile with my wife. For any emergency she will call the health worker" – Husband

"No, I cannot use the mobile phone. My husband goes to work at 7 am and comes back at 8 pm. If I want to use other's phone it needs money. The mothers who need to spend money for phone call should be toll free, please make this" - Wife

CSBAs informed that husband's ownership over the mobile is the main cause for poor accessibility of mothers to mobile services. Some of the CSBAs also stated that some husbands do not allow their wives to use their mobile phone.

Advantages of mobile phone communication

Four main advantages to mobile phone communications were identified by respondents. Those were, reduce cost of consultation, no need of transportation to appointments with skilled providers, time saving during emergencies, and overcoming barriers of a pregnant women's mobility. Most of the CSBAs mentioned that the use of mobile phone might reduce the risk of complications and death during childbirth because it might help in reducing the response time to obstetric emergencies. Restricted mobility and accessibility of maternal services is a major problem in hard to reach areas as mentioned by the mothers of those areas. In such areas, use of mobile phones was considered as an important advantage especially in extreme cases,

"Mother or baby could be saved if treatment is given half an hour before or they could die if it is given half an hour after. If you have communication through mobile, they can at least make the preparation for the hospital beforehand" – CSBA of hard to reach area
"With the baby in our belly we cannot walk properly, even though we have to go to the providers. We would be benefited if the government would provide us a mobile phone or transport" - Mother of hard to reach area

Mothers who have a long way to reach the sub district health complex reported that the direct cost of transportation contributed a substantial proportion of expenditure on health care. They perceived that mobile communication is a cost saving measure to access health services. In many instances, CSBAs and mothers discussed that mobile communication can help in serving the beneficiaries when only advice is needed and where there is no need to have face to face consultation. Different perspective was identified among mothers in relation to the cost of mobile phone communication with the health providers.

"If I want to visit an MBBS doctor for any health related issue, I need 200 taka. Whereas, to take health related advice using the phone, I need only two taka to contact and 10 more taka for good words. And after that, if I request the doctor to visit me, the doctor will also come to visit me." –mother.

The other direct benefit commonly mentioned was consultation between SLG and CSBAs. The consultation with health professionals has always been a benefit as it increases the confidence of the CSBAs in handling the emergencies and enables them to make decision.

"We feel more confident when mobile phones facilitate the access to the guidance of SLG during the moment when higher level information is required"- CSBA.

Maintaining confidentiality would be an added advantage to this toll free communication, as one mother noted, "We have disease but do not want to talk about it face to face. When we will talk over phone then you cannot see me and I am also not seeing you, then there would be no problem to discuss".

One CSBA also said that such communication is a mean of privacy; a mother can express herself more to the CSBAs over phone on her maternal and neonatal problem.

Identification of barriers to mobile phone communication

Most of the mothers and their husbands were concerned about the risk of not interacting directly with the providers.

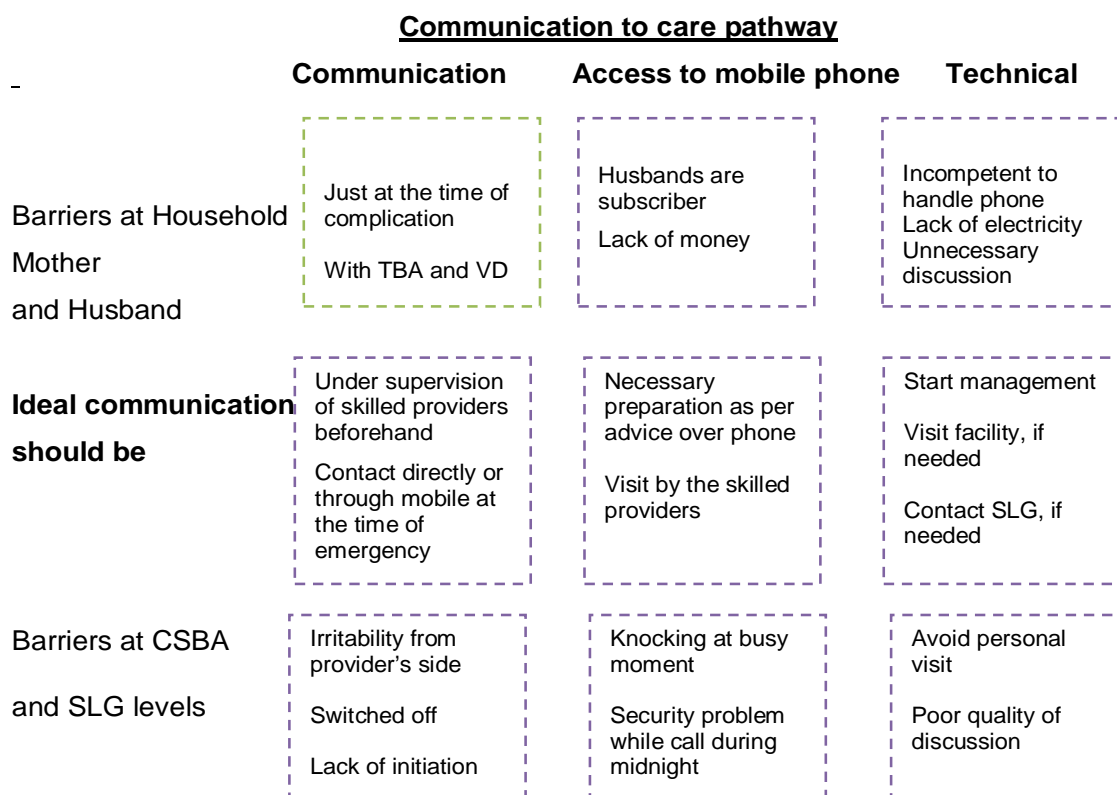


Figure 2. Communication pathway: A path of ideal behavior in maternal complication management and barriers at different levels.

They sensed that mobile communication for health service support is the alternate indirect mean of services which has some disadvantages; absence of physical examination and then determining the care needed might affect the appropriateness in curative treatments. Many of the CSBAs also stated that their involvement and responsibility would not be ended at mobile communication (Figure 2). They said that they understand their responsibilities when they examine the patient to see the dilatation of the cervix and for any complication which is unmanageable by them, they can seek advice from the expert group. One of the CSBA felt that many of them might ignore their responsibility to visit the mothers in person once mobile communication is well established.

On the other hand, the mothers and their husbands who had already communicated with providers for some health issues using mobile phone noted some other barriers. These includes irritability from the provider's side, sometimes the mobile phone found switched off so that the family could not contact her anymore, and fear of the mobile network problem especially in case of an emergency. Irritability from the provider's side was the most common and uppermost barrier for accessing health services using mobile phone. As one mother

stated:

“Her mobile is switched off or there is no charge in her mobile, in this case the mobile communication would be dangerous for me at the state of emergency.”

CSBAs from their perspective also stressed on many other barriers. Long time taken to reach the point of discussion from the mother's side would be a hindrance for effective discussion over phone. Calling the CSBAs at a busy moment and calling at midnight were considered disturbances to CSBAs. While most of the women considered mobile communication positive on the contrary the women also mentioned that unnecessary discussion from mother's side may incur extra cost. The cost of mobile communication for maternal and newborn health care depends on the length of discussion over phone which could be avoidable. Overall, the results showed that mobile communication is a mean of cost saving in order to receive the first stage maternal health management. However, two husbands of the low income group found that mobile communication contribute a substantial proportion of expenditure over their poor earning:

“We earn 500 taka in week and think that we will spend 300 taka on rice, 200 taka on vegetable and then can spend the week nicely. In between this, if we have to carry the cost of a mobile phone and have to spend twenty taka for it, then this twenty taka is our deficit, it is a loss.”

Technical incompetency of mothers to handle a mobile phone is often a determining factor to the access of mothers to mobile services. Difficult geographic access in many rural communities is another barrier for action by CSBA's, even after a mobile call CSBA's are unable to reach the pregnant women during their need. Poor access to electric power was also mentioned as a barrier in charging a phone, hence again limiting a mother's access to mobile phone use.

Solution to barriers

The results of the study revealed that toll free communication would be a welcomed measure of economy for the mothers and thus aid in the use of rapid control measure for maternal complications. Gender inequality in accessing the mobile phone would also be reduced by toll free communication. As mentioned by a mother lack of money and inability to approach her husband to use his mobile phone would lead the woman to turn to toll free communication. However, a few respondents felt that there was a possibility to take advantage or misuse the toll free communication.

Some women and their husbands suggested that integration of mobile technology to the nearby health infrastructure would create better responses to their health needs. For instance, if there is a provision of toll free mobile communication located in the health facility at village level there would be better communication and response to mothers by the local health professionals. One husband expressed a strong opinion about provider's commitment to maternal and neonatal health support in this mobile linkage pathway,

“Always the mobile phone should be kept open, they should be aware about the problems of the mobile set”.

An integrated approach to mobile phone availability and access would reduce a woman's reliance on her husband's mobile phone and would have the potential to improve communication for maternal and neonatal health problems,

“If we could have a meeting with the village head and then select a particular person with whom a mobile phone will be kept which could be easily accessible to mothers and thus would help the mothers during their need”. –mother.

“If there is a community specific centre from where the pregnant women and mothers can reach the network and they can communicate through mobile during their emergency.”- mother.

CSBA's suggested strategies to create awareness among the mothers as well as to develop their skills to use mobile phones. Husbands should be included in the awareness efforts to eliminate social biases and CSBA's must also make efforts to monitor mother's condition physically simultaneously providing advice over phone.

DISCUSSION

The present study supports the importance of the perceived advantages that would play key role in adopting the mobile communication pathway in maternal health complication management as described by Roger (1983). According to Rogers (1983), the diffusion of an innovation is enhanced when the perceived superiority of an innovation is high compared to existing practice (that is, the relative advantage). Despite an overall positive perception towards mobile phone use by respondents, this formative research has drawn attention to a host of equity related issues to the successful implementation of a mobile phone programme for maternal health.

Women from low socioeconomic status were less likely to have their own phone or access to a phone. Although almost all husbands have a mobile phone but they often did not share the phone with their wives. Globally, a woman is 21% less likely to own a mobile phone than a man and this is highest in South Asia, followed by Sub-Saharan Africa. One of the main reasons for not owning a mobile phone is cost associated to this communication (Noordam et al., 2011).

Gender differentials in mobile communication were reported in the low socio economic group in this formative research. Gender imbalance in the use of mobile phone is also observed by a case study in Uganda. Traditional gender roles limit women's access to mobile phones and thus affect their quality of life (<http://mobileactive.org/contact>, 2009). Our study findings warrant that the later stages of Roger's (1983) diffusion model needs to be emphasized in the larger study. Any factor that limits women's participation in the mobile communication would obstacle the greater adoption and swifter diffusion of this innovation. Roger described that low complexity, easily used, and able to be adopted on a trial basis are qualities associated with greater adoption and swifter diffusion. The participants are aware about perceived advantages of mobile communication pathway and motivated for adoption. However, other conditions are apparent for adoption of such innovation, that are access of women to mobile phone and training for sufficient technical competency of women to operate mobile phone. Noordam et al. (2011) also highlighted

illiteracy as another important obstacle for using the mobile communication. As there are greater health care needs among the poor, there should be actions from the larger social perspective to address the problem of gender inequity in health. Initial adoption of this new way of care seeking behavior would be integrated into women's lifestyle through training of women on technical use of mobile phone and community mobilization. The broader strategy should include respective community initiative to motivate the husbands on the need of mobile contact between their pregnant wives and service providers.

The perception by all types of respondents of a likely reduction of response time for obstetric emergencies and maternal issues through mobile communication was one of the important findings. This is especially effective for women residing in remote villages, having limited access to transport and other skilled provider's services. Many women in this sub district are living in poverty, with poor road infrastructure and transport options. Distance and time taken to travel to health facilities prevents many people, especially the poor rural women from accessing maternal health services because the direct costs of transport contribute a substantial proportion of expenditure on health care (Molesworth, 2006).

The poor pregnant women of Bangladesh may also miss or delay the opportunity to seek care from a skilled provider to avoid the substantial cost for availing the care. Significant impacts have been shown on remote medical monitoring and home healthcare through mobile medical information system (Jen, 2009). In addition, findings from some other studies considered this health care service through mobile communications a cost savings, as transportation is no longer necessary due to telephone access (Mechael, 2009).

Current study findings also revealed that mobile communication was perceived as saving time for seeking advice on basic illness from a skilled provider like CSBAs. This in turn would eliminate the extra load on facility care through preventing the unnecessary visit in person at the facility. The mobile communication may also succeed in providing life saving medication by skilled provider until the poor women could later be attended at the facility level. Nevertheless, this would also facilitate the access of pregnant women to skilled care services whose mobility is restricted just for their pregnancy. This can be explained again by Roger's theory: relevant factors for successful mobile communication pathway in rapid management of maternal complication are participants' predisposition to mobile phone communication and their perceived advantages of this pathway.

Mentioning management techniques that emphasized on maintaining privacy through mobile communication identify the shortcomings of privacy issue in the service delivery of Bangladesh. Thus, such mobile communication can benefit mothers in providing quality services

in terms of 'assuring client's confidentiality' (Gatsinzi 2006) and motivate mothers to use the mobile phone services.

The other important perceived advantages of mobile communication were higher level consultation and guidance to the community level skilled providers. Some strategic importance of information and communication technology was identified in some other studies, for example, in addition to reduction of response time to obstetric emergencies, mobilizing assistance in extreme cases during home deliveries and facilitating the consultation between nurse mid-wives and physicians (Mechael, 2009). Generally, consultation with specialized health professionals by community based providers and mothers usually do not happen in Bangladesh. Therefore, introducing toll free mobile communication would facilitate their access to health management when higher level consultation is deemed necessary. This would again have an impact on decreasing the unnecessary referral cases. Furthermore, CSBAs' perceived benefit on receiving guidance from a specialized group of providers through mobile communications summoned for an important implication by CSBAs in managing difficult deliveries. In Indonesia, a similar intervention revealed some specific perceived benefits which are congruent with our study findings, for example mobile phone cause easy communication with supervisors, possible for coordinated visits thus increased time efficiency and assistance over phone during complication (Chib and Chen, 2011).

The share of medical care expenditure for visiting a health facility or a skilled provider is high as this includes transport cost, provider's fees, medicine and basic management of maternal health issues, and all these can be reduced by mobile communication. The cost of mobile use in medical care expenditures is relatively low but nevertheless the poorer families argued for the small extra cost to be covered through this mobile communication. Similarly, in a literature by Chib and Chen (2011) included the costs, poor mobile phone network in rural areas as constraints in mobile communications. Introducing toll free mobile communication for maternal health in our larger intervention would act as an assistive device for the poor families of Bangladesh.

These poor families stressed more on the toll free telecommunication systems. Some of them felt that they should be entitled to services at one community based network service. This network might help to provide an opportunity for immediate and local responses to health problems especially to people who do not possess any mobile phone. It would be suggestive that an accessible and acceptable infrastructure like Union Council (local government office at village level) can initiate a toll free mobile network. The mobile phones would be situated at the Council office and would be open only for the pregnant women of that locality. This finding seems to

Table 2. Stages of diffusion of innovation and process for the larger study based on the formative research findings.

Stages of behavior change	Awareness, sensitization program and provider's care in the larger study
Awareness of a problem and a need to change	Under supervision of skilled providers beforehand. Contact directly or through mobile at the time of emergency. Necessary preparation as per advice over phone.
Motivation to make change Skill development	Direct introduction to the CSBA in the orientation session. Demonstration on toll free communication.
Initial adoption of the mobile communication pathway	Visit by the CSBA. CSBA advice on facility visit in need. CSBA contact SLG in need. Immediate management through mobile if possible.

Source: Rogers (1983).

have important implications because recently, the Government of Bangladesh is integrating innovative technology in the health infrastructure for the better response to health needs. This made a strong claim about demand side technology integration into the national mother and newborn initiative. Furthermore, this finding repeats the explanation for adoption an innovation in relation to Roger's theory. According to Roger, a feasible infrastructure that would enable people to participate in an innovation would act as a factor for adoption of such a new communication pathway.

The respondents emphasized that mobile communication should be integrated with case assessment and management through visit by the providers. Telecommunication might be an effective process for providing information and advice by a trained healthcare provider at the time of maternal health emergency and hence, may prepare the woman and her family about to happen in the management process of complications. Nonetheless, the inevitable complications during pregnancy and childbirth should be assessed and appropriate treatment should be initiated and provided through visit either by providers or family to providers.

In the current study, practical concerns arose about the implications for professional workload, similar to another study (Pinnock et al., 2006). Providers' attitudes such as inadequate response at maternal emergencies constitutes a major barrier to the telecommunication system and mothers of this study already experienced this through mobile communication for health. Lack of power supply and knowledge for operating a mobile are equally important for the quality health services through mobile phone. These would lead users to be skeptical or feeling uncomfortable with unfamiliar systems. To be more extensive in the adoption process of telecommunication for health issue, this new idea should be placed appropriately within a community. Moreover, it was found that the women included in the in-depth interviews actively looked for maternal services from

different skilled providers, mostly through direct contact. Therefore, it could be concluded that the concept of mobile communication for health purposes may not have been familiar to rural women of Bangladesh.

A short orientation program for health providers as well as women on the condition of mobile use can help for effective communication. Finally, this formative research also documented the inadequate utilization of safe delivery services by rural mothers which is similar to the national findings. Bangladesh has made impressive progress in reducing maternal mortality (NIPORT, 2010). However, the utilization of safe delivery services was low in the country. According to BDHS (2007) and NIPORT (2007) more than 70% delivery are still assisted by unskilled birth attendants. Therefore, toll free mobile phone intervention could potentially make a difference in the access of mothers to skilled providers.

Conclusion

The role of the mobile phone access pathway should be explained to pregnant women, their husbands and participating service delivery personnel from the very beginning of implementation of such an initiative and should be evaluated throughout the course of the programme. The use of mobile technology is taking a leap from simply rendering information to becoming a bridge to providing more timely services. Therefore, success of such initiative will depend not only on the acceptability and accessibility by the mothers and family but also on the willingness and participation of the service providers at community level as well as at referral facility levels.

RECOMMENDATIONS FOR FINALIZING THE LARGER TOLL FREE MOBILE PHONE STUDY

Table 2 shows the areas which need more emphasis

while implementing the larger study. The implementation of the proposed strategies would provide clear evidence on the investment of resources in linkage to the theoretical framework. An increased focus on awareness and sensitization of both community and health care providers should be adopted by the larger studies as charted in Table 2.

Initial benefits of adoption of such an innovation would be shown in systems that track pregnant women through supervision of skilled providers, management initiation over phone and monitor adherence by CSBAs.

In conclusion, we can expect that this well designed e-health solutions based on evidence that emerged from this formative research may have a much larger impact on quality of care in a poor resource settings.

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Abbreviations. **ICPD**, International conference on population and development; **MDGs**, millennium development goals for maternal and neonatal health; **BDHS**, Bangladesh demographic and health survey; **WHO**, World Health Organization; **BMMS**, Bangladesh maternal mortality and health care survey; **MMR**, maternal mortality rate; **MNH**, maternal and neonatal health; **CSBAs**, community based skilled birth attendants; **SLG**, solution linked group; **CSG**, community support group; **FRO**, field research officer; **TBA**, traditional birth attendants; **HA**, health assistants; **VD**, village doctors; **MBBS**, Bachelor of Medicine and Bachelor of Surgery.

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