Assessing the scope for use of mobile based solution to improve maternal and child health in Bangladesh: A case study

Mafruha Alam[1],Tahmina Khanam[2], and Rubayat Khan[3]

Abstract— Patient data collection and emergency health service is the primary challenge in developing countries. Risk assessment of pregnant mother and healthcare based on priority is almost impossible in present health service of Bangladesh. A pilot study was done in three urban slums of Dhaka where BRAC health workers were provided with mobiles. A smart algorithm was incorporated in the mobiles. The mobile solution came up with useful findings. The health workers now could send data directly to central MIS system which reduced previous time lag. A secure web page contained all the patient data which was accessible by BRAC Personnel from anywhere any time. An automated risk assessing decision tree categorized the patients depending on their risk levels for timely treatment. The mobile solution proposed a pro-active, cost-effective platform for rapid health service for pregnant mothers and neonates with reduced manpower.

Key words: m-Health, pregnant mother, health worker,

automated risk assessment

I. Introduction

The concept of using mobile in public health care is very recent and sometimes termed as m-Health. m-Health has the capacity to dramatically expand access to communications and to transmit voice and data at the precise time it is needed, which can empower health workers to make improved diagnosis and provide citizens with access to health care where it is needed most [1]. According to World Health Report 2006 there is a shortage of health workers worldwide where Bangladesh, India and Indonesia observe the greatest shortage among South -East Asia [2]. The uneven distribution of health workers also impede essential health service to people from most disease burdened areas. Shortage of health workers, lack of data on health information gives mobile technology experts to intervene with greater ease in communication with doctors, enhanced skill of health workers and maintaining health data.

Maternal mortality is one of the biggest health care concerns in Bangladesh – with a current maternal mortality rate (MMR) of 570 per 100,000 live births [3]. Bangladesh's 2007 Demographic and Health Survey reported that only 13 percent of all deliveries in Bangladesh are attended by a skilled birth attendant with 21,000 dying annually of pregnancy and childbirth-related causes [4] .One important reason why many pregnant mothers succumb to death or preventable miscarriages is that it is expensive for government or non-government health organizations to track pregnant mothers to assess their level of risk and prioritize its limited resources for targeted intervention.

Current BRAC urban- MNCH:

BRAC the largest NGO had established the Manoshi project in 2007 to benefit maternal, neonatal and child health in Bangladesh. By the end of 2007, the Manoshi programme had been rapidly expanded to all urban slums in Dhaka and now reaches around 1.5 million slum dwellers [5]. The BRAC Manoshi-MNCH (Maternal, Neonatal and Child Health) programme runs through a complex chain starting from Shasthoshebikas/volunteers (SS) who go door-to-door and identify pregnant women (if any), sell medicines and get incentives if they refer risky patient to BRAC's medical center. Each SS covers 200 households (population of 1,000) approximately. Shasthya Karmis (SK), or Health Workers are ground level workers and the most important link in the chain. They have ~10 SS under them, therefore having a coverage area of 2,000 households (10,000 population). They have extensive data collection duties, and have at least SSC level education (10 years of schooling). They also have some medical training, and gather basic household data (35 per day) as well as visit each pregnant woman, recent mother and children (8-10 women, children of 0-5 age per day) under their supervision regularly to record data cards, provide health advice, and refer in case of emergencies. Three SKs are managed by a Programme organizer (PO), who has a variety of duties including data collection, SK monitoring and data verification, crisis management, referring complicated cases and ensuring follow up etc. All the POs and SKs in a Branch

Manuscript received April 1, 2010. This work was supported by AFF.

[1] Mafruha Alam is working as a Research Associate with D.Net (Development Research Network).email:mafruha@dnet.org.bd.

[2]Tahmina khanam is a Teacher at University of Dhaka and is currently doing research with Click Diagnostics Inc.email: maya@clickdiagnostics.com

[3]Rubayat khan is working with Click Diagnostics Inc. email: rubayat@clickdiagnostics.com)

are supervised by a Branch Manager (BM), who is the in-charge for their respective branch. At the end of each month, the cards from all SKs are brought in for data entry into a MIS system, from which reports can be generated. Head Office can therefore access the information only after it gets into the system, which can take up to a month from the collection of the data. The lowest level of physical infrastructure under the Manoshi Programme is the Delivery Centers (*Birthing Huts*), each of which covers 2,000 households (population of 10,000). Two Urban Birth Attendants (UBAs) and one Community Midwife (CMW) work at the birthing hut. CMWs have paramedic training, and provide their skilled care during delivery. Their activities are supervised by the PO and coordinated by the SK. There are MBBS doctors at the regional office level, each of which covers approximately 3 branches. These doctors get called by phone (from SKs or their supervisors) to deal with complicated situations, and are required to visit the patients. Their time is not utilized optimally due to extensive traveling required before they can see a patient and give them medical advice.

Risky patient prioritizing is not always possible due to delayed data collection. Moreover doctor and patient ratio is too high to ensure emergency health care for patients. A model in which community health-workers use ICT to gather real-time information about pregnant women and send to a specialist can help to address this gap and help health organizations take precautionary measures about risky cases of pregnancies.

Scope for intervention

Click Diagnostics proposed a simple and yet powerful mechanism for data collection, which would address most, if not all, of the bottlenecks faced by the Manoshi programme. In this paper the intervention of the Click module in BRAC Manoshi project is described where each health worker (SK) possessed mobile-based data collection software and sent data immediately after each patient's interview to the central MIS system. A secured web page viewed the patient data to BRAC personnel. The module also gave the scope for patient prioritizing based on an automated risk assessment algorithm.

II. METHODOLOGY

The project was divided into three components: development of the module (sophisticated algorithms, mobile module, web module, automated risk categorization, M& E Framework), training of the health workers with the new application, intervention and finally evaluation of the intervention.

Development of Sophisticated algorithms

Sophisticated algorithm with built-in decision tree was developed to collect data in a simple one-by-one question format according to BRAC existing automation card for:

- Pregnant women and mothers at all levels – ANC, delivery, PNC, etc.
- Neonates, Infants and children from 0 to 5 years of age

Development of mobile module

Mobile module was developed on a Nokia 3110c mobile phone (Cost~$90), with capability for:

- Complete Bangla interface
- Secure log-in
- Flexible decision tree
- Range/type validation and cross-validation of data
- Photo capture from within software
- Voice records within software to record open ended data
- Dynamic update of questionnaire algorithm through GPRS internet at any time without need for physical update
- Off line data collection and storage for synchronization later (when internet is available)
- Ability to view work schedule from within the application
- Ability to view doctors' feedback for each patient in real time, and in Bangla

Development of Web module:

Web module with the following features was developed:

- Secure login
- User management system for different personnel with different administrative privileges
- Real time update of new incoming data
- Simple interface to view patient data, pictures and hear voice records from within the same page
- Transcribe voice records in respective text fields
- Write doctor feedback in a box which is automatically transliterated into Bangla, and can be sent to a SK's phone at the click of a button
- A reporting tool to see daily reports of data inflow and characteristics

Development of Automated Risk Categorization Algorithm

To categorize the risk level of pregnant women and recent mothers an automated risk categorization algorithm was developed.

Monitoring & Evaluation Framework

The overall areas for evaluation of the project were:

1. **Efficiency:** To test whether the Shashthya karmis (SK) could efficiently collect data from pregnant women and enter in the Click module; whether total time for reporting process and service delivery was reduced; whether referrals became more efficient due

to automated risk assessment and work scheduling; whether management could track and monitor the SK's work more effectively.

2. **Cost Benefit Analysis:** To assess the changes in costs brought about by the new system.
3. **Usability:** To test whether SKs, their supervisors, managers and top BRAC Health management found the solution easy to learn and use.
4. **Value Addition:** To test whether real-time data about patients and automatic risk assessments could be used to make interventions to address high-risk patients, hence potentially leading to reduction in emergencies and eventually deaths, and whether additional services can be enabled using the new system.

The boundary partners were: Shasthya Karmi (SK), Branch Manager (BM), patients and BRAC management as per the outcome methodology. The evaluation team conducted Focus Group Discussion (FGD) and interviews with Branch managers (BM), Shasthya Karmis (SKs) Programme Officers (POs) and BRAC health team before and after the pilot. The evaluation team visited the urban slum areas where they followed the SK s during scheduled visits to patients and also interviewed patients about the service. The evaluation team also visited the birthing huts, observed emergency patients and talked with CMW in charge.

Piloting the module

Sample size & Duration:

The study covered 3 sites of BRAC Manoshi program in Dhaka (Urban Slums): Kunipara, Mohammodpur and Badda. From the 3 centers 9 SKs were selected purposively who were trained in 2 successive sessions to use the Click module. From each branch one branch manager and one Programme organizer (PO) were also trained as the supervisors of SK incase of assisting in troubleshooting. The SKs sent patient data to BRAC center from October2009 to January 7, 2010.

III. Results

Efficiency:

Shashthya Karmis (SK) were efficiently collecting data from pregnant women and entering them in Click module, ease in data collection observed. Interviews by Click module required less time than existing automation system. Click module reduced the time of interview from 30 minutes (by automation) to 4-6 minutes. Time lag between data collection and entry in central MIS system had also reduced. By automation card procedure it took about one month to entry data in database whereas by click module data could be entered within a second after being collected at patient's home. However, the SK s could not always send data immediately after the interviews due to delay in server. They waited till the end of the day and sent saved data depending on availability of the server. All the data sent by the Click module were complete. The mobile software was designed in such a way that there was no scope of sending incomplete data to the system. The algorithm set in the mobile software allowed the SK s to send data only when it was complete. Automated risk assessment and work scheduling begun at the end of the study. The referral system had not been generated according to the plan. The BRAC health team could not track and monitor the SK 's work from BRAC centre more effectively due to lack of access to internet. The BM s who were in charge of the branches could not monitor SK 's work as they did not have access to internet at respective branches.

Usability:

The SK s during interview admitted that they were relieved to collect data by Click's simple step-by-step process with multiple choice answers and voice record. Satisfaction observed among the SK s with the convenience of automated work scheduling by click module.

Acceptability:

The response from SKs in using mobile technology was not considered as a challenge. The Click mobile solution was acceptable for both Branch managers and Shasthya Karmis. Patients could not perceive any difference between BRAC's current system and Click system because additional services like doctor feedback could not be tested.

Cost benefit analysis

In the existing automation card system, there was no scope for adding new questions. Any changes brought to automation card would require reprint of cards. But click module required no additional cost for adding new set of questions. Click module required no data entry operators. The CBA roll out model for 1 year showed that number of programme officers who monitor the Shasthya Karmis could be reduced as Branch managers should be able to track Shasthya Karmis from the branch offices. The roll out model for click module could save up to 3.9% in total after calculating depreciation cost, printing cost of automation card and calculating reduced human resources.

Value addition

Click module could address high risk patients at the end of the pilot. But emergency service to high risk patients was not enabled during this phase. Patients visits based on prioritization by Shshthya karmis (SK) was not possible during this phase.

IV. Discussion

In BRAC's current automation card system, every SK has to fill out the automation card and then report the findings of the

card in a small card which is ultimately sent to the central MIS system via Programme officers (PO) and Branch managers(BM). At the beginning of the use of the card the error rate was very high, it also delayed the data collection process. Branch managers have to go physically to BRAC Head office to convey all the data gathered by the Shasthya Karmi (SK) which is time consuming and costly. It becomes more costly when data are found incomplete or there is some error in the information of the patient. The Click module simplified the chain of data process and prescribed a cost effective model with lesser but skilled human resource. SKs successfully sent data directly after each interview. The rate of errors between the existing automation card and click module could not be compared as there was no tracking number for the automation card. Click system ensured complete data entry by a smart algorithm.

The SK s gradually became skilled and built their expertise in collecting data by mobile software. They were skilled enough to train other SK s to handle the mobile software. Monitoring the work of SK s include continuous supervision in the field which is very laborious. By proposed Click module Branch managers at the branch should have been able to track down the work of SK. Unfortunately in this pilot project, BRAC server did not support Branch offices with server connectivity. During the intervention, any BRAC personnel could access the web page with proper ID and password and see the patient data anytime during the day. Each patient's data viewed all the information of the patient as well as information of the SK. An important aspect of the intervention was patient prioritizing which was achieved in this pilot. The web page gradually improvised during the intervention and was able to categorize patients based on their risk at the end of the intervention. The patients were categorized from Risk level 1 to 3 with 3 being extremely risky and requiring intensive care. Unfortunately due to the very short length of the project other services like giving text message to SKs based on their patient's risk level was not possible. The web page also had the option of a space for medical advisor's to put advice on individual patient's web information. Like the text message service, the doctor's panel was yet to be recruited and kept this medical service inactive for this pilot.

The pilot study did not make significant changes in terms of cost benefit analysis. But when the cost for this mobile intervention was compared with that of automation card system for one year in a roll out model, click module had huge impact in terms of economic and efficient use of resources.

In developing countries, trust is an integrated word with health. Any health care provider has to ensure trust to community people. When Shasthya Karmis(SK) approached the community with mobile applications and took their photos there was no voice raised against this method which is also a positive platform for mHealth.

V. LIMITATIONS

BRAC automation card (existing system) and Click module went side by side during the pilot program. Each SK had to fill out the automation card and then fill out Click module through mobile. So, calculation of time duration for each interview through click mobile may not be accurate. The sites and SKs were purposively (as opposed to randomly) selected and might not have been representative of all Manoshi branches. Time constraint was another factor for this pilot. Due to a limited time frame, the technical developments had to be developed simultaneously with the project implementation. Some features of the system were only introduced near the end of the pilot (For example, automated risk assessment and work scheduling could be launched in the last month of the pilot), and hence could not be tested extensively enough. The true value addition of such a system would be in reducing complications, emergencies, and hence deaths and life-threatening conditions. But because data was collected for only a short period, these impacts on the health of pregnant women could not be assessed. Also, tracking improvements in health indicators was not a possibility, partly because the implementation period was too limited to follow patients through their pregnancies. The pilot lasted for a brief period which could not get a convincing picture for cost effectiveness of the intervention. Often, the BRAC infrastructure was not geared towards making real time interventions due to the nature of existing systems. Hence, although the technology was conducive to real time interventions, such interventions were not made during the course of the pilot, and hence its health impacts could not be studied.

VI. CONCLUSION & RECOMMENDATIONS

Overall, the mobile telemedicine platform was well accepted and run quite successfully. Both the Shasthya Karmis(SK) and their supervisors (Programme officers and Branch managers) insisted that the implementation of mobile system would make the system considerably more efficient, pro-active and easier. But the full impact of a mobile-based data management system could not be tested within the parameters of this pilot. However, the system has been developed and tested, and one can easily observe that the system has the potential to radically improve the efficiency and quality of health care provided by BRAC *Manoshi* Project, and make the system more geared towards preventive measures. For such a comprehensive impact to be tested, the system needs to be tailored towards implementing the various new possibilities opened up by real-time data, and needs to be flexible to adopt new strategies during the course of the pilot. For a country like Bangladesh

where the doctors cannot reach the poor in remote places, health worker with the light of mobile can give access to remote diagnosis and timely treatment. It might even be argued that the Click system is even more applicable for the rural MNCH program, because of the solution is not limited by geographical boundaries, and can lead to the following improvements/additions to existing services:

- Treat patients remotely by doctors stationed anywhere; especially video consultation using XVD enabled conferencing systems set up in rural branches. In rural areas, it is even more difficult for doctors to physically visit patients.
- Branches must be assigned exclusively to use the Click system, in order to compare their efficiency, service design, and cost with other branches using existing systems. Branches must also be assigned randomly in order to gain statistical confidence.
- BMs must be able to track work of SKs using a web based reporting/monitoring tool, preferably through their mobile phone. SMS alerts would also be helpful.
- A panel of doctors should be available to look through patient records and provide feedback immediately in complicated or risky cases.
- There should be a mechanism in place to treat patients according to their risk level. The SKs should be informed about the risk level of their patient, and should be trained to provide some basic treatment or advice.
- Patient visits must not be made uniformly, but according to risk levels. In other words, high risk patients should be visited more frequently than low risk patients.

ACKNOWLEDGMENT

Authors thank BRAC automation team for their continuous support during the intervention.

REFERENCES

[1] *m Health for Development*. United Nations foundation & Vodafone Foundation report. Available at:http://www.unfoundation.org/global-issues/technology/mhealth-report.html

[2] *Working together for Health*. WHO publications, 2006 Available at: http://www.who.int/whr/2006/en/

[3] *The State of the World's Children 2008*. Unicef publications 2007.Available at: http://www.unicef.org/sowc08/

[4] *Bangladesh Demographic and Health Survey 2007*. National Institute of Population Research and Training (NIPORT), Mitra and Associates, and Macro International. Dhaka, Bangladesh and Calverton, Maryland, USA: National Institute of Population Research and Training, Mitra and Associates, and Macro International, 2009

[5] Manoshi: Urban- MNCH. Available at: http://www.brac.net/index.php?nid=162

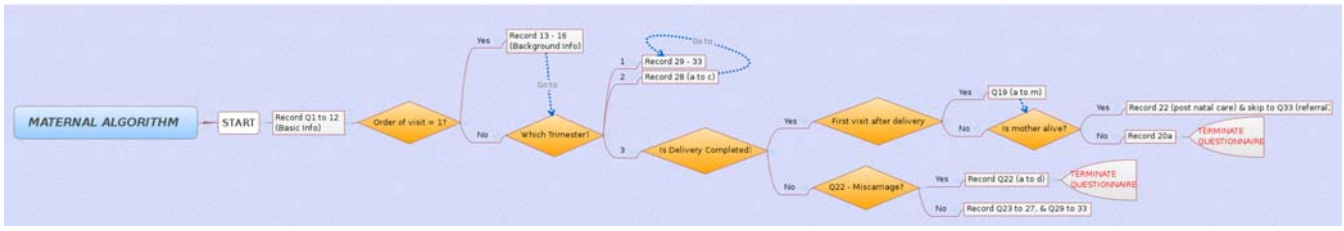

Fig.1.Maternal Module developed for software during the intervention

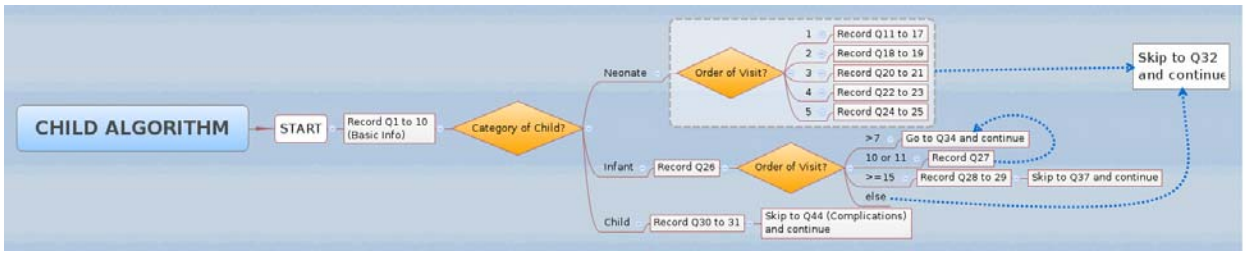

Fig . 2. Child algorithm developed during the intervention

Fig. 3. A secure web page viewed patient data and left a space for doctor's advice

Fig. 3. A secure web page viewed patient data and left a space for doctor's advice