Assessing the scope for use of mobile based solution to improve maternal and child health in Bangladesh: A case study on efficiency of community health workers, automated risk assessment of patients and web based data collection (Working Paper for ICTD 2010 London Conference)

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Abstract

Patient data collection and emergency health service is the primary challenge in developing countries. It is now for a while that m-health has been introduced to improvise the public health system in many countries. Maternal mortality is one of the biggest concerns in Bangladesh. Tracking the pregnant mothers, assessment of their level of risk and prioritizing health care for them becomes almost impossible and also expensive by the existing health care system in Bangladesh. 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. Such a model was introduced to BRAC health workers (Shashthya Karmi) in 3 different urban slums of Dhaka on a pilot phase. A smart algorithm was formed which was incorporated into the mobiles of the health workers who visited the pregnant women on their predefined schedule. Information collected from pregnant women on their physical condition was sent to the MIS system of BRAC head office as soon as the health workers pressed the "send" button of their mobiles at the end of each interview.

The intervention, which lasted for 6 months, came up with some excellent findings. The mobile solution reduced time lag for data collection and transfer to the head office. BRAC personnel could log into a secure web page to see patient information anywhere anytime. An automated risk assessing decision tree categorized the patients depending on their risk levels for remote consultation with a doctor. Monitoring health workers activities became easier. The mobile solution showed the promise to lessen human resource and establish a pro-active, cost-effective platform for rapid health service for pregnant mothers and neonates.

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Key words: mHealth, pregnant mother, health worker, automated risk assessment

I. Introduction

With the advent of modern technology mobile phones have become a necessary tool for communication nowadays. In some developing countries this wireless communication became even handier for data collection and remote health service. The conception of using mobile in public health care is very recent and sometimes termed as mHealth. mHealth has the capacity to dramatically expand access to communications and to transmit voice and data at the precise time it is needed, which will empower health workers to make improved diagnoses and provide citizens with access to health care where it is needed most. (Unicef & Vodafone)

According to World Health Report 2006 there is a shortage of health workers worldwide where Bangladesh, India and Indonesia observes the greatest shortage among South -East Asia (reference). The uneven distribution of health workers also impedes essential health service to people from most disease burdened areas. A statistics shows that almost 37% health workers live in the region of Americas (Canada and United States) which covers only 10% of the global burden of diseases and spend more than 50 % of the world's financial resources of health (ibid). A very different picture is observed in African region known for 24% of the global burden of disease with only 3% health workers and having access to only 1% of the world's financial resources (ibid). 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 (WHO reports). Eighty percent of maternal deaths in Bangladesh happen in rural areas where there is a significant scarcity of skilled birth attendants [1]. Most women die of hemorrhage, followed by anemia [2, 3], hypertensive disorders, eclampsia, obstructed labor and abortion. 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.

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 (http://www.brac.net/index.php?nid=162). The BRAC Manoshi-MNCH 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, providing information and advice to patients, referring complicated cases and ensuring follow up, organizing community information events, etc. All the POs and SKs in a Branch 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 huts. CMWs have paramedic training, and provide their skilled care during delivery. Their activities are supervised by the Programme Organizer 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.

The complex health system of BRAC Manoshi delays data transfer to the MIS system , sometimes which takes about one month. Risky patient prioritizing is not always possible due to delayed data collection. Moreover each 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. 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 a mobile-based data collection software and sent data immediately after each patient's interview to the central MIS system. A secured webpage viewed the patient data to BRAC personnel. The module also gave the scope for patient prioritizing based on an automated risk assessment algorithm.

II. Review of literature

Innovations with mobile application to strengthen health service and data collection have been introduced in many countries around the globe.

In India, a project called TeleDoc was launched in 15 villages of Haryana where village health workers provided with hand held mobile phone devices communicated with doctors who used a web application to help diagnose and prescribe for patients (Reference). Accurate information on health status and health workers are still hard to get because of lack of data (World health report , 2006). Data collection software (like Episurveyor) has made interventions in the m-health platform for faster and high quality, lower cost analysis (source: Episurveyor).Community Health Information Tracking System (CHITS) was launched in Phillipines in 2004 where the open source programme allowed the communiy healthworkers to send SMS messages (which penetrated most of Phillipines) to report injuries and receive training on health surveillance via their mobile phones (Source : CHITS). The CHITS project also contained web-based system for the graphic presentation of injury data used by decision makers (ibid).In developing countries paper-based surveys exist which are costly and lacks data accuracy. A mobile health data collection and record access tool, also known as Epihandy helped to mitigate these issues in rural areas of eastern Uganda where data was collected on breastfeeding and child anthropometry (reference:unf). Results comparing Epihandy to data collected through similar paper based health surveys found greatly reduced data entry errors, increased cost efficiency and general user acceptance by the new technology (ibid). Another pilot project by Cell PREVEN in Peru on line database, easy access to data from anywhere in the world, secure web connectivity, email ,voice mails

and text messages to alert key personnel (Cell-preven).

III. Methodology

The project was divided into few 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 algorithms 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
- Offline 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 were 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 SKs 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.

Piloting the module Sample size & Duration

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 to use the Click module. From each branch one branch manager and one PO were also trained as the supervisors of SK work, so that they can assist in troubleshooting.
The SKs sent patient data to BRAC center from October2009 to January 7,2010.

Training

The SKs, Pos and BMs were given training to Click module in 2 successive sessions and each session was 6 hours in duration. The first session was covered the use of mobile phones in collecting patient information around 3 to 4 hours and exercise of maternal module for 2 hours. The second session was same as the previous one with child module.

Results:

Efficiency:

The Click module was more efficient from BRAC's existing automation system in several areas. The duration of patient interview was significantly reduced because Click module could be used while the patients are working, because of simple format, and easy multiple-choice entry. The collection of data and reporting was in real time means no time laps due to manual entry in the branch offices because data directly goes to the server from SKs mobile phones. Click system could completely eliminate the problems of incomplete data.

Usability:

SKs were trained easily in the mobile module. Even the oldest SKs (aged 40 years), could easily pick up the technical skill relatively quickly, and was the most sincere in sending data. The data collection was also easier than current automation system due to a simple step-by-step process with multiple choice answers and voice record. Click system could generate automated schedule for SKs, which was completely manual at BRAC. Adding new set of question with no additional cost was another use of the Click module. Click system was much more user friendly for doctors as well. However, one person

would need to type in all the open-ended responses, which might add a little cost and cause some inconvenience.

Acceptability:

The response from SKs in using mobile technology was not considered as a challenge. The Click mobile solution was acceptable for both BRAC personnel and patients. But 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:

Cost for the existing automation card system and Click module was compared. After deducting the cost for BRAC personnels (who did not play a role in the intervention) and printing cards and adding up the cost for technology ,Click module showed reduced cost than the automation card system.

IV. 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, 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. The limited project duration disallowed the testing of all features of the mobile-based system, because some crucial features were developed near the concluding stages of the pilot. For example, automated risk assessment and work scheduling could be launched in the last month of the pilot. Also, tracking improvements in health indicators 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.

Conclusion & Recommendations:

Overall, the mobile telemedicine platform was well accepted and run quite successfully. The personnel involved in implementing the mobile-based system from BRAC reported being convinced that this system should replace the current systems. Both the SKs and their supervisors (POs and BMs) 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 healthcare 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.
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:

- Transfer data directly from rural site to any branch or head office, which is not possible through a card-based automation. Eliminate logistical hassles of bringing cards back to branch for data entry.
- 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.
- Predict complications using automated risk categorization and take precautions to ensure that the patient reaches a health facility on time, or gets the required care.
- Monitor SK work automatically/manually and remotely, without needing to follow their trails.

If such a system is designed for rural areas, or if the piloted system is rolled out to include all Manoshi branches, it should consider the following changes to the system structure and design:

- The questionnaire must be redesigned to take advantage of real time data, asking which questions would ensure better understanding of patient condition and hence enable delivery of better care.
- 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.

References
Appendix