

**Real-Time Bio-Surveillance Program:
Field Experiences from Tamil Nadu**

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Introduction

In India, there were outbreaks of major diseases in the past. One of the major outbreaks, which occurred in 1996, was dengue hemorrhagic fever/dengue shock syndrome (Dar et al., 1999). Also in the month of November 2009, there was a fever like disease outbreak: chikungunya, recorded in the southern part of rural Tamil Nadu, India (The Hindu, 2010). This went unnoticed, due to the lag in reporting by paper-based system. Some times, number of diseases is being undetected due to lack of rapid communication system for spatial and temporal analysis to detect their occurrence well in advance. The Directorate of National Vector Borne Disease Control Programme in India has regularly been publishing the status on State-wise disease outbreak such as dengue fever and chikungunya on their website. But, it was not on real time basis, as the data are being collected through paper-based system (DNVBDCP, 2009).

Similarly, health workers in India working in Primary Health Centre (PHC) and Health Sub Centres (HSC) carry to the field 20 registers weighing almost ten kg to aid in documentation of health information. The village health nurses (VHN) along with sector health nurses (SHN) meet on a weekly basis to assess their work and report the consolidated weekly health record statistics gathered from the field at the PHC level and send it to the Deputy Director of Health Services (DDHS) at the district level. They in turn will prepare a location and week wise disease monthly count details and share it to the Directorate of Public Health and Preventive Medicine at State level (DPHPM) (NIC, 2010). It takes one month for DDHS to communicate the disease count details to the directorate located at state level. Hence, it is very clear that the present health information reporting system is entirely paper-based and does not permit to get real time information. This is really a time consuming process and is not effective in detecting the disease outbreak well in advance. Real Time Bio-surveillance Program (RTBP) provides the ability to detect and monitor a wide variety of health events, involving multiple kinds of disease, including communicable and non-communicable, as well as reportable and non-reportable ones, following the general recommendation for disease surveillance systems (WHO, 2004). Implementation of RTBP essentially means to make available right information in the correct form to right place, at right time.

According to Telecom Regulatory Authority of India, the number of mobile phone users increased to 525.15 million, which is an alarming growth rate in India as compared to previous years (TRAI, 2009). It is because of available inexpensive technology and instruments. Therefore the project was designed in appropriate manner with the goal of collecting patient information real-time through mobile phone that would help the health officials to identify the cases affected with particular serious disease before it spreads to other people or regions.

This pilot project was jointly formulated by LIRNEasia, Sri Lanka and Indian Institute of Technology Madras's Rural

Technology and Business Incubator (IITM's RTBI), India with the financial support from International Development Research Centre (IDRC), Canada. Thiruppathur block of Sivaganga district located in southern rural area of Tamil Nadu has been chosen and pilot testing is done since July 2008. Based on the experiences gained so far from this pilot project, this paper has been designed to emphasize lessons learnt in terms of benefits and drawbacks, so as to take the improved technology to other regions and efficient scaling-up.

Methodology

This paper specifically highlights the experiences of 25 health workers from selected PHCs in a district of Tamil Nadu. DDHS selected Thiruppathur block of Sivaganga district in Tamil Nadu, India for pilot testing of the project. Sivaganga district is one of the most economically backward districts located in southern part of rural Tamil Nadu, which has 47 PHCs and 275 HSCs. Rural health care systems in this district is decentralized and the smallest component is HSC and this covers the population of 3000-5000. The HSC is staffed by one VHN covering from 10 to 15 km² and the PHC covers a population level of 20,000 and staffed by mainly paramedical health staff as well as medical doctors. The project area comprised of four PHCs (Nerkuppai, Thirukostiyur, Keelasevalpatty and Sevanipatty) and 25 HSCs covering a range of distance from 10 to 25 km with a rural population of about 68092. Twenty-four health workers spreading over 24 HSCs were selected and the remaining one VHN was not included, as she did not attend the technology-training workshop. One SHN was also inducted, as she was very much interested in mobile phone data entry.

In the initial stage of the pilot project, after getting the consent letter from the Health Secretary, Department of Health and Family Welfare, Tamil Nadu, a project orientation programme for 25 health workers working in the jurisdiction of Thiruppathur block was conducted to create awareness about pilot project's goals and objectives. One mini survey was carried out among these 25 health workers, who are

willing to participate in this pilot project, to understand their background and characteristics followed by a two-day technology-training workshop organized in May 2009. In this workshop they were trained in mobile phone data entry by adopting standard operating procedures of m-HealthSurvey application which is developed by IITM's RTBI for RTBP involves three basic steps: (1) install and configure the application; (2) submission of data; (3) transmitting the patient data using General Packet Radio Service (GPRS), which is a wireless data service deployed as a standard feature in a many mobile phones. The GPRS transmits patient data over the mobile operator's network to an Internet gateway, further to which it goes to a central database for storage and analysis

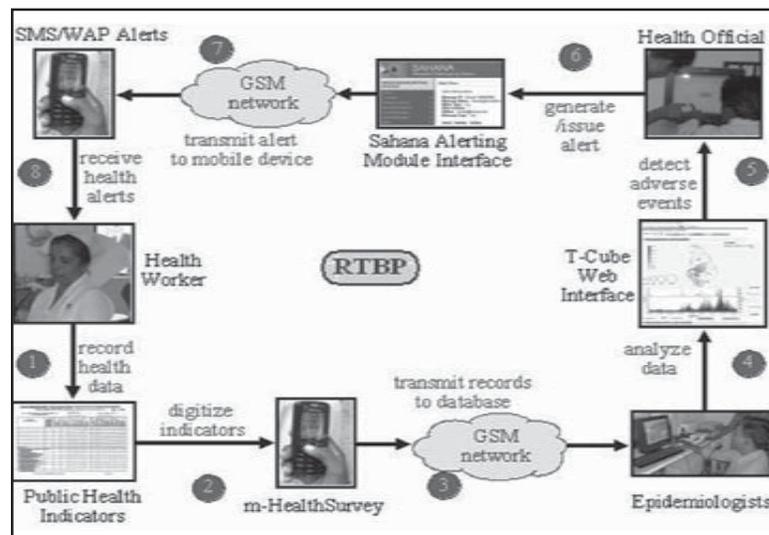


Figure 1: Data Collection Method and Information Flow

(Nuwan *et al.*, 2009). Submission of data is done on the mobile phone using an installed java-based application (Kannan and Sheebha, 2009).

The Fig. 1 depicts the data collection method and information flow. The health workers participating in RTBP project were given free mobile phones with GPRS connectivity

from the project. From June 2009, they started entering health data (patients' location, age, gender and disease/syndrome) and entered data were stored on back end database. A RTBP staff was stationed in the field to monitor them and to give timely trouble-shooting support. At regular intervals, their feedbacks were collected, deliberated and most appropriate ones incorporated in m-HealthSurvey application.

Findings

Demographic Characteristics of Health Workers

Table 1 summarizes the health workers' demographic characteristics. All the health workers were female with higher number of health workers belong to the age group between 41 and 50. Most of the health workers (68 %) had studied up to the 10th standard and only 28 per cent had studied up to the 12th standard. They all had attended various short terms training courses on reproductive child health, HIV/AIDS etc from the reputed organization called Gandhigram Rural Institute of Health and Family Welfare, Tamil Nadu. A

Table 1
Distribution of Demographic Characteristics of Healthcare Workers

Demographic Characteristics	n = 25n (%)
<i>Age Group (years)</i>	
30 to 40	7(28)
41 to 50	14(56)
51 to 60	4(16)
<i>Educational Qualifications</i>	
10 th Std	17(68)
12 th Std	7(28)
Graduation	1(4)
<i>Years of Service</i>	
0 to 5	4(16)
6 to 10	3(12)
11 to 15	3(12)
16 to 25	15(60)
Total	25 (100)

majority (60%) had been working as health workers for the last 16 to 25 years in their respective centers and was well integrated to their village community.

Experiences with the Health Workers during the Technology-training Workshop

During this workshop, it was observed that most of the health workers had ever used Short Messaging Services (SMS) and some of them were totally illiterate in handling mobile phone even for voice interaction. In the workshop, most of the health workers shared with us that they would seek help from their children or young relative or neighbours when they use mobile phone for voice. This technology-training workshop was their first experiences using mobile keypad for entering text. At the end of two-day workshop, all the health workers had become aquatinted and showed interest in learning to enter data for project purpose and eventually were able to collect the health data independently. During the workshop, it was noted that some of the health workers learnt very quickly and started helping others. They also gave a lot of suggestions to improve the m-HealthSurvey application and report generation page on the backend database. There was initially some resistance to getting involved and complying with the proposed technology intervention. However, we also observed in this workshop that all the health workers who attended the training were familiar with the project objectives and other details, as we had already conducted an initial awareness meeting with them.

Experiences with Health Workers during Submission of Health Data

As soon as the technology-training workshop was over, the health workers were requested to submit health data up to 30th May 2009 through their mobile phone, this was to acclimatize them to the usage of application. The official launch of data collection began from June 1, 2009. The health workers were continuously monitored and given trouble-shooting support by the staff stationed in the field. The data started

coming in from day one to our backend database and it was found that there were erroneous spelling mistakes mainly on disease/syndromatic information. The project team initiated analysis on the data by week-wise and disease-wise to understand the patient inflow status with respect to their health sub centers. To know the mobile phone expertise level of health workers after four months from the technology-training workshop, one small mock exercise was done. The study revealed that the time taken to submit health data per patient by a health worker through mobile phone was two minutes for all the health workers affiliated to four PHCs' except Nerkuppai PHC. However, the health workers working under the jurisdiction of Nerkuppai PHC were unable to enter data on their mobile phone and the training session was not taken seriously. It was also found that they had not been actively involved in mobile phone data entry since the launch when compared to other health-workers from the remaining PHCs. The possible reason could be that those health-workers presumably had a perceived fear in entering data which will further be seen and reported to their higher officials and might result in unnecessary administrative problems to them in future. This claim was later checked with DDHS office and the DDHS denied and stated this excuse framed by the concerned health-workers.

After observing this fact, each health workers of this group was met individually and explained the purpose and objective of the project and assurance was given to them that this was only for testing purpose and this pilot testing would never affect their official activity. Healthworkers were convinced and assured of regular data entry. The field staff was advised to make regular periodical field visits to the respective HSCs attached to Nerkuppai PHC and build good rapport and continuous motivation.

Experiences with Paramedical Staff and Medical Officers (MO) at PHC Level

During one of the visits to PHCs, it was observed that there were more patients' inflow in the PHC when compared to

HSC and maintenance of registry information was an arduous task. Hence it was thought upon to collect those data also through a web based data entry (Internet method) as they had computer with Internet connectivity. But considering the constraints faced at PHC in respect of human resource availability for doing this activity and also frequent failure of internet connectivity, the web based data entry task was dropped and switched over to mobile phone data entry at PHC level. The DDHS requested to appoint field assistants to enter data through mobile phone at the respective PHC level. The field assistants recruited by the project reported to PHC on daily basis from October 2009 and the patients' information was taken from the following registers and the same was entered over RTBP mobile phone application. This was one of the important steps that we had adopted during the pilot phase.

- Out Patient Diagnosis (OPD) register contains OPD Number, Date & Time of visit, Village name, Name of the Patient, Age and Sex. The person who is assistant for staff health nurse before the patient meets with MO for check-up usually enters this information.
- Nominal Register contains Diagnosis (Disease/Syndrome), Symptoms, Sign and prescription details. This information is actually collected in this register while the patients are meeting with MO.

Experiences with Staff at DDHS

In the beginning stage of the project, it was found that there was lack of rapport building among RTBP Project staff with DDHS officials. In view of this, it was suggested that the staff who are working in the field on behalf of IITM's RTBI to meet DDHS officials at Sivaganga fortnightly in order to have constant rapport building, as for desired results to be achieved we need utmost cooperation from the DDHS office. It was mentioned in one of the meetings with DDHS, the Health Inspector from the respective PHC while submitting the cumulative records on a weekly basis to DDHS uses a standard format and DDHS will further consolidate all the

information collected from each PHC/HSC and submit it to Directorate of Public Health and Preventive Medicine (DPHPM) on a monthly basis. The DDHS suggested that in order to show the advantage of RTBP, a cost benefit analysis can be worked out (present paper based reporting cost vs. RTBP cost) and the cost could be associated with reporting, analysis and notification system to health workers and health officials.

m-HealthSurvey Certification Exercise

In the month of October 2009, an m-HealthSurvey certification exercise was conducted with the active participation of 23 health workers (two health workers did not take part due to prior commitments) to assess and certify them in operating the m-HealthSurvey mobile phone software used for digitizing and submitting patient records. Prior to the start of this exercise, a four-page document titled "Standard Operating Procedures" in Tamil version through our field staff circulated to the same to all the health workers. A well-structured questionnaire consisting of the following, i) installation and configuration of m-HealthSurvey; ii) data entry submission and iii) standard operating procedures were introduced.

The install and configure m-HealthSurvey exercise was to judge their ability to install and configure the m-HealthSurvey application on their own. In the data entry submission exercise, they were asked to enter only the mandatory fields: case date/time, location (village name), symptoms, gender and age group. In some cases they were requested to submit the disease and their signs as well as determine using "unknown" or "other" options for the disease. The exercise was timed and evaluation of their performance was based on how much they could accomplish within the stipulated time frame. Total time in minutes from starting time to end time for Part I and II exercises was computed. The number of records entered by them in the part II exercise was stored in the back end database. In the part III, three general questions related to standard operating procedures were asked to choose the correct answers for each

question. After completing the three exercises, each part was given points/marks as per marking scheme and finally the health workers were evaluated towards the certification. It was decided that if a health worker scored above 70 points, she is a certified as m-HealthSurvey user and if a health worker scores above 95 points, then she is awarded with potential m-HealthSurvey certificate.

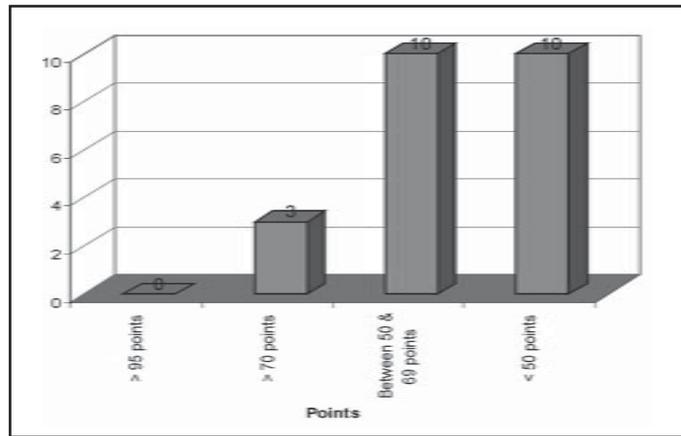


Figure 2: Points Scored by Health Workers in the Certification Exercise

The certification exercise (Fig. 2) revealed that only three of the 23 health workers who participated in this exercise scored above 70 points, while the remaining 20 were below the expected level. It was also observed that standard operating procedures for data entry were not fully understood by some of the health workers. The results of this exercise was very much helpful to design refresher training schedule for the health workers. It was decided collectively that individual performance of the low scoring candidates should be provided targeted attention in order to improve their skill and knowledge of using mobile phone for data submission. The reason for poor performance might be due to their middle age factor and also majority of them did not use the mobile phone for any other purpose prior to this RTBP pilot project's technology training workshop. The results from this exercise

stimulated the project staff to further motivate and train the health workers to become a familiar and certified m-HealthSurvey user in future.

RTBP Mobile Phone Health Data Analysis

Number of Records: The patients' health data collected through m-HealthSurvey application using mobile phone starting from June 2009 to December 2009 its weekly analysis is graphically presented. The analysis of data on number of patients' (Fig. 3) shows that the total number of records was gradually increasing at an average of 14 per cent over weeks and the total number of records recorded was 36428 as on the last day of December 2009. In the initial weeks (1 to 11), the number of records entered by them was fewer and in the 12th and 13th week since launch it was observed a drastical reduction when compared to previous weeks and this was attributed due to lack of inflow of patients. The reason for poor number of records could also be due to lack of monitoring of the health workers during this period. On observing this trend at our back end database, each health worker was given close monitoring and trouble shooting support. The data collection was also initiated at the PHCs where number of patients'

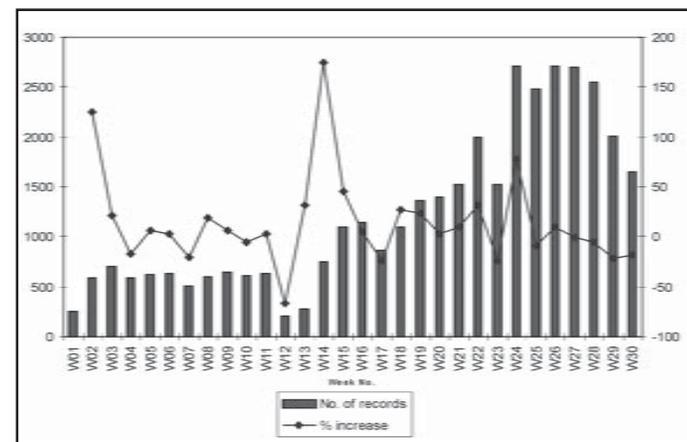


Figure 3: Week wise Numbers of Records and Percentage Increase During Jun '09 to Dec '09

inflow was higher when compared to HSC. In view of this, the number of records did increase tremendously from 14th week onwards. The higher number of records over the weeks might also be due to acquiring knowledge and skill of using mobile phone. The data was analyzed to understand the gender bias among the patient records. It was observed that the highest numbers of patient were female which might be due to the gender factor of the VHN who influenced female patients to visit health care centers.

Real Time (RT) vs Off Time (OT) Data Submission: When a patient is seen on a given day and if his/her data is submitted before the following morning, then that data is treated as Real-Time (RT) whereas if the data is submitted further to that then it is treated as Off Time (OT) data. Based on this classification, the week wise data was analyzed and it is presented in terms of real time vs off time records in the Fig. 4. There was an undulate increase of real time data submission as compared to off time data at the rate of 300 plus per week. Though the off time data submission was less as compared to real time data, there was a pattern of unsteady increase and decrease. The reason for this is that many of them enter data after working hours and even in the weekend when they have time. As a result highest records was found to be entered in the real time,

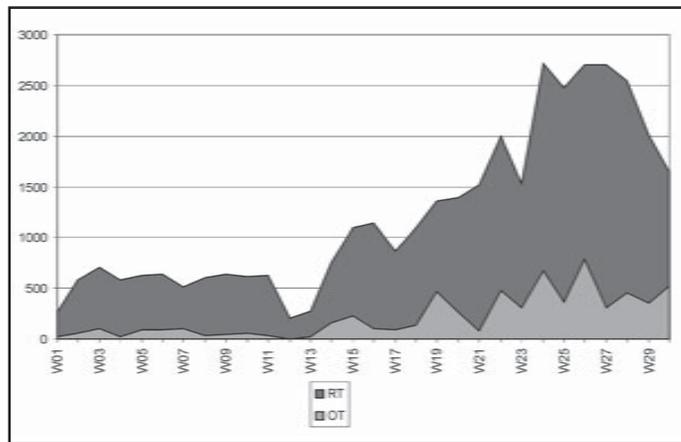


Figure 4: Week wise Real Time (RT) vs Off Time (OT) Records

which is a good sign for the project, and it could be improved further in near future by giving constant monitoring and trouble shooting support. The health workers have found a balance in concentrating both in the mobile phone data entry and paper based reporting systems. This could be one of the reasons for off time data submission.

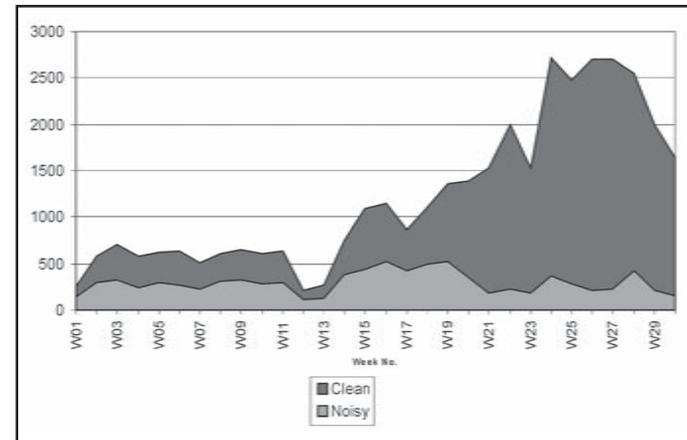


Figure 5: Week wise Clean vs Noisy Records

Clean and Noisy Records: While the highest number of records were entered in the real time basis throughout the period, some of the records were found with erroneous data in terms of incorrect/incomplete words without editing the disease names, symptoms and signs (Fig. 5). The list of diseases with subsequent symptoms and signs given as drop down menu in the m-HealthSurvey application was earlier incomplete and due to this the health workers were sometime hurriedly entered the data if the particular disease name was not available in the application. It was also observed that they seem to be entering data without correcting for spelling and needs to be edited properly. Majority of the health workers had studied in the Tamil medium school only up to 10th standard, which might be one of the possibilities for making noisy records since mobile-based application is entirely in English. This experience was helped the project team to convey

the error status with the health workers to avoid further erroneous data. In order to avoid erroneous data, the project team is now updating with higher number of possible disease names in the drop down menu of the m-HealthSurvey application.

Potential Risks and Benefits of RTBP Project: The experiences gained so far with the active participation of health workers and health officials such as VHNs, SHNs, MOs and DDHS made possible to draw the benefits and drawbacks of RTBP pilot project. This will be really useful for further planning and extrapolation to other areas.

Benefits

- The Health Workers and health officials at HSCs, PHCs and DDHS could concentrate more on other developmental works as the RTBP mobile phone data entry require lesser time for report preparation
- Staff can generate the disease prevalent report on location wise and can notify the health workers at the right time with right forecasting information
- Staff will have more time to do planning, monitoring and re-planning on their own way
- Encourages staff to be more systematic when analyzing the health data
- Sustain the reporting system over period of time through regular use
- Provides data for subsequent evaluation and lessons learning
- Can provide aggregated information for results based management.

Shortcomings

Some of the health workers are entering data in the off time as they are preoccupied with their other routine daily tasks takes much of their time. The error rates like misspelling and without editing the disease names (noisy data) were observed

in the data analysis. This has to be taken into consideration while reviving the m-HealthSurvey in the further study.

Recommendations

Based on the experiences gained from the pilot project, the following recommendations are made.

- The health workers need to be continually trained and monitored in order to enable them to achieve the desired results.
- To further study of ways to simplify data entry on m-HealthSurvey
- DDHS already has a system of health data management and a culture of storing health information in its management systems. It is felt that this system should be compared with RTBP tool in terms of workload and time availability.
- Since the PHC has a dearth of human resource for mobile phone data entry, project needs to evaluate the feasibility of appointing a separate project staff to enter data when the project further expands to other regions.

Conclusions

RTBP researchers conclude the health workers have acquired the ability to enter data through m-HealthSurvey application using mobile phone. However, there are some hurdles that need to be overcome like error rates, which have to be reduced, and simplification of the process of the data entry submission is required to improve real time records counts.

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