



PUBLIC HEALTH - IT INNOVATIVE INTERFACE IN TUBERCULOSIS TREATMENT

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ABSTRACT

Background-The integration of Information Technology (IT) into Public health can help develop technical and managerial interventions to provide optimum solutions to public health problems. A team comprising of doctors, engineers, designers, pharmacist and healthcare entrepreneur deliberated to evolve solutions to enhance adherence and monitoring in tuberculosis treatment. The proposed IT solution addressed three key factors for non-adherence - Access to medication, awareness and monitoring. This paper explores the feasibility and acceptability of the smart pill box developed for easier access.

Objectives 1. To develop a smart pill box for drug distribution and to test its acceptability. 2. To validate the case of facilitation of drug dispensing for the beneficiaries.

Methods - A pilot study was conducted at three different clinics wherein 60 adult CAT1 tuberculosis patients operated the pill box. A feedback regarding its utility and ease of operation was taken thereafter. 7 key informant interviews and a focus group discussion were conducted to further evaluate the feasibility and appropriateness of this technology.

Results - Out of 60 patients, 30 operated the pill box independently, 16 and 14 required repeated instructions and a demonstration respectively. Content analysis of interview transcripts and FGD revealed that problems such as unsuitability of time and place of drug delivery could be overcome with the use of this technology.

Conclusion - This innovation has all the potential to be a breakthrough in facilitating AKT dispensing and improving adherence.

KEYWORDS : Information Technology, Tuberculosis, Adherence

Introduction

India accounts for a quarter of the world's annual incidence of tuberculosis (TB). TB has taken a toll on millions of lives in India. It kills around 4,80,000 people every year and more than 1,400 people every day.^[1] Over 10 million patients have been treated under the Revised National Tuberculosis Control Programme (RNTCP) over the last decade.^[1] Despite these efforts, the slow decline in the incidence of TB, high mortality rate and emergence of drug resistant tuberculosis pose a serious threat to curbing the spread of the disease.

India being the TB capital of the world, contributes to 50 percent of the global relapse cases. Nearly 2.2 lakhs of patients go into relapse every year.^[1] One of the leading causes of relapse being non-adherence to the treatment protocol by TB patients.^[2,3] The key causes of non-adherence are - side effects of the medication, place and time of drug delivery being unsuitable, loss of daily wages, long waiting hours, migration, travel costs, temporary relief due to medication and undernutrition.^[4,5]

We proposed a multi - pronged approach to improve medication adherence and treatment monitoring. The solution addressed the three key factors for non-adherence-

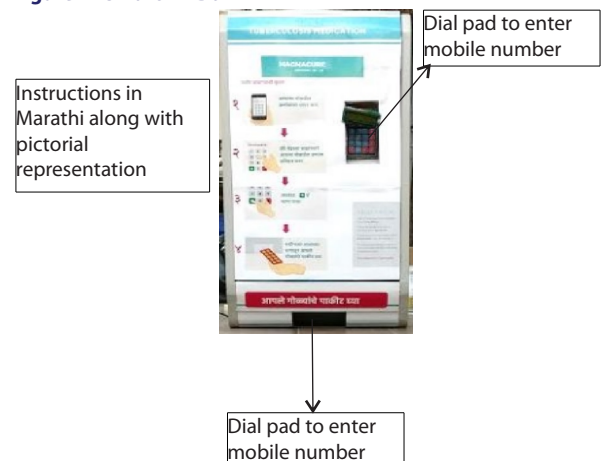
1. Access to medication - Smart IT enabled pill - box
2. Disease Awareness - Automated voice messaging to provide TB education and counselling
3. Motivation and Monitoring - use appropriate incentives and monitoring mechanism to improve adherence and validate reporting.

This proposed solution was the winner of the Healthcare Hackathon organized by Indian Institute of Technology (IIT) Bombay in March 2017. This paper explores the feasibility and acceptability of the smart pill box.

The implementation team combined the expertise of a bio - medical engineer, public health professionals, and a healthcare entrepreneur to design and develop the proposed solution to enhance medication adherence among TB patients. The feasibility testing of the proposed treatment adherence solution was undertaken in phases. In this paper, Phase 1 - the usability and acceptance testing for the IT enabled smart pill box has been discussed.

Access to TB medication was simplified by using a smart pill box to dispense medication. This technology enabled solution would decrease the time for patients to access their pills, reduce waiting hours and also reduce the burden on the Directly Observed Treatment Shortcourse (DOTS) provider. The prototype model developed could dispense TB medication for up to 30 patients a day. The patient identification would either be through a unique bar code printed on the patient enrolment card, Aadhar ID, ATM like medication card, or biometric system.

Figure 1 - Smart Pill Box



The pill box would be capable of dispensing both intensive phase and continuous phase pills. The pill box would connect to the RNTCP database to check for any changes in medication prior to dispensing the medication.

Further in case of default, the DOTS provider would be informed and pills would not be dispensed even if the patient attempted to collect them.

Material and Methods

Study settings and participants

60 participants were recruited in the pilot study from three clinics with the assistance of PATH, a Non-Governmental Organization that works for tuberculosis patients especially in the urban slums. To be eligible for the study, the patients had to be 18 years or older, on Anti Koch's Treatment - Category 1 (CAT 1 AKT), with access to a mobile phone. Two trial locations suggested by PATH were chosen based on patient flow and diversity. The third location was the DOTS centre at Govandi, with one of the highest numbers of TB patients in Mumbai. The trial participants were chosen to ensure that the user acceptance testing was done in a representative sample, consisting of patients from both the genders and across the various age groups for adult CAT 1 TB patients. Informed consent was taken both from the patients and the treating physicians.

Procedure

The pill box dispensed medicines on entering a 10-digit mobile number on the dial pad and pressing the '#' button at the end. It had instructions regarding the operation in Hindi and Marathi along with pictures describing the same. The participants were required to read the instructions and pictorial illustrations and try to operate the device on their own. A team member was present for any kind of assistance required by the participants. For the purpose of the pilot study, the pill box dispensed nutrient supplements approved by the respective physicians. Those participants who could not understand the instructions on the pill box, were explained the same and asked to retry operating the device. If the participant failed the second time, a demonstration was provided by the team member assisting the participant.

The participants were further asked a set of 10 questions to assess properties like ease of use and acceptability of the technology. A Focus group discussion (FGD) with patients and their family members was also conducted. Key informant interviews were conducted with stakeholders including physicians and DOTS providers. The data so obtained was analysed inductively to reveal themes and subthemes.

Results

60 patients under CAT 1 AKT ranging in age from 20 years to 65 years were enrolled in this pilot study from three different locations. Of the 60 participants 38 were males and 22 were females. The findings from the key informant interviews and focus group discussion are discussed under the following headings-

Challenges in adherence

One of the major cause of non - adherence stated by participants was side effects of the drugs. As a participant stated

"I have been taking these medicines from last 3 months, and the doctor says will have to continue for another 3-4 months. But taking these medicines is not easy, I always have a feeling of vomiting. It was more in the beginning..it has decreased now."

(46 year old female)

Some patients admitted that there was lack of support from caregivers which led them to stop taking AKT

"I took TB medicines earlier but stopped after 2 months...I have to start it again due to cough. My earlier employer fired me when I told him that I have TB."

(32 year old male)

"I have seen a neighbour who had TB and when people came to know about it, they stopped coming to his house. So I have not told anyone, even my family members... that I am taking TB medicines..so I cannot ask anyone from family to collect these medicines. This is why I come to this centre even though it is little far from my area"

(48 year old male)

A few patients attributed the inconvenience faced at DOTS centre as a cause of non-adherence. Inconvenience in the form of long queues, loss of wages for the day, limited clinic time of the DOTS Centre were some of the reasons quoted.

"The day I have to take the medicines from centre my day gets wasted..I have to take leave from work and the employer cuts my pay for that day. Even though I try to come early to the centre, so that I take medicines and go to work...most of the times the health worker comes by 9-9.30 and starts distributing medicines by 10. I cannot finish it before 10.30...after that going back to work is only possible by 11. My work starts at 9.I work as a cleaner in a private office. How would they accept me at work so late?"

(30 year old male)

The health care providers also added that patients stopped taking medicines due to temporary relief from symptoms after starting AKT.

Out of 60 patients enrolled in the trial, 30 patients operated the pill box independently, 16 required repeated instructions and 14 required a demonstration.

Table 1 – Smart Pill Box Feedback

Properties	Yes	No
Display and instructions easy to understand	35	25
Machine easy to use	27	33
Faster than current system	38	22
Use device without supervision	30	30

The interviews and FGD revealed the following points:-
Usefulness of the smart pill box

The patients reiterated that the pill box was quick to deliver the medications. This would in turn lessen their door-to-pill time and prevent loss of wages.

"If such a machine becomes available it will be very helpful as I can come to collect my medicines any time after work. I will not have to take leave from work."

(39 year old female)

Health care providers however had mixed views about the technology. It was stated that the pill box would free considerable amount of time which would be useful in counselling the patient. Moreover record keeping would be made easier. However the pill box required the user to be literate and know his/her mobile number which might prove to be a hurdle in implementation.

"This machine can be a good thing in some places, but in slums many people don't even know their own mobile numbers, so they may need someone else to operate such machines for them. I think there should be an arrangement for such situations also."

(DOTS provider)

“As our clinic is located in slums, many patients here are migrants. These people many a times don't have a permanent address neither a permanent mobile number. Most of the women have a slip with their husband's number written on it and give the same whenever asked for contact numbers. It can create confusion if multiple members of same family are under treatment and using one mobile for the entire family.”

(Medical practitioner)

Ease of use of the pill box

When enquired about the ease of use, the following points on feedback of the design was noted.

“Initially I could not find where the buttons were to dial my number. After help, I dialled the number and was told that medicines will get dispensed from the machine. I was unable to find the place from where medicines would come out. The machine works properly but some things are confusing”

(52 year old male)

Many patients opined that a small training session would be beneficial for easy operation.

“At first, I wasn't able to understand how to use this machine. But after it was demonstrated, I got it. Now I can even explain it to others. Most of the people living in this area are uneducated like me, but they are intelligent... if explained once they will be able to use this machine like me.”

(40 year old female)

Factors for mass adoption of pill box

Table 2 – Preferred locations of the pill box

Location	Number
Local railway station	10
ATM centre	6
Nearby medical facility	15
Bus stop	2
Local chemist	19
DOTS Centre	8

Some of the preferred locations for the pill box as suggested by patients were local chemist shop, nearby medical facilities, local railway station, DOTS Centre, ATM centre and bus stops.

“Most of the people in Mumbai travel to work by local trains. If such machines are made available at local stations, they can easily collect their next set of medicines while coming back from work.”

(36 year old male)

“Most of the dropouts are due to side effects or stigma attached to TB. If these TB drugs will get dispensed at public places the confidentiality of patients will get compromised.”

(Medical practitioner)

“When the patients attend the DOTS centre, we also get an opportunity to counsel them about possible side effects, precautions and all Dos & Don'ts . If drug dispensing gets automated, then counselling and monitoring the treatment will become more difficult.”

(DOTS provider)

One of the health care providers suggested to have voice instructions for easy use. Another stakeholder suggested that the system could be linked with E-Nikshay for integrated record keeping and monitoring. Linking the system to Aadhar card number for robust patient identification was also suggested.

Table 3 – Key themes and Primary themes emerging from the study

Key themes	Primary themes
Challenges in Adherence	<ul style="list-style-type: none"> • Side effects • Inconvenience at DOTS Centre • Lack of counselling • No care giver support • Feeling of temporary well being
Usefulness of the smart pill box	<ul style="list-style-type: none"> • Save time • Avoid wage loss • Robust record keeping • Frees time for counselling
Ease of use of the smart pill box	<ul style="list-style-type: none"> • Change location of keypad • Change location of dispensing area • Minimum training • Dynamic mobile numbers
Factors for mass adoption	<ul style="list-style-type: none"> • Location of pill box • Voice instructions • E-Nikshay integration • Pill dispenser logic

Discussion

Many attempts have been made in the past to improve adherence in long term therapies.^[6,7,8] Adherence is imperative in tuberculosis treatment to prevent treatment failure, relapse and emergence of multi drug resistance. Consistent with the findings in previous studies the major causes of non-adherence that emerged in this study included side effects of AKT drugs, temporary relief from symptoms, long waiting hours, loss of wages, lack of support from care givers.^[4,5] As a part of the integrated solution to solving the problem of non-adherence among urban slum dwellers, a smart pill box was devised and tested among 60 patients.

The usefulness and ease of use of the pill box so developed was analysed so as to modify its design and structure before rolling it out on a larger scale. Suggestions about the design were taken into consideration for the revised version of the pill box. The key motive behind the smart pill box is to empower the patients to independently access their pills according to their own convenience.

The integration of IT with public health can provide practical insights for technical and managerial interventions. The smart pill box is a frugal innovation with the potential to be a breakthrough in AKT dispensing. The pill box along with incentives and adequate counselling and monitoring through urine tests can prove to be useful in improving adherence and decreasing mortality and morbidity related to tuberculosis in India.

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