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Microbiology

NOVEL SMART PHONE APPLICATION FOR PROMOTING ADHERENCE TO ANTIRETROVIRAL THERAPY (ART) IN INDIAN SETTING

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ABSTRACT **INTRODUCTION:** The availability of free antiretroviral therapy (ART) has transformed HIV infection into a chronic manageable disease. However, poor adherence still remains a major challenge. With improved affordability and connectivity, mobile phone based adherence promoting intervention can reach geographically remote and culturally diverse group population. The objective of this study was to develop a user friendly mobile application (app) for the people living with HIV and AIDS (PLHIV) in Indian setting.

METHODOLOGY AND RESULTS: An Android OS based smart phone app was developed following peer review and feedback received from patients. It permit user to set reminders for clinic visit and timely consumption of antiretroviral therapy. The function includes adherence calculator, track your investigations, HIV awareness tool etc.

CONCLUSION: This free to download novel smart phone app can serve as an important "make in India" digital health initiative to reach remotely located PLHIV and supplement ART management workforce.

KEYWORDS : Adherence, antiretroviral therapy, mobile app, smart phone

INTRODUCTION

The human immuno-deficiency virus (HIV) infection started gathering global attention in the year 1981-82, when Centre for Disease Control (CDC), Atlanta reported occurrence of unusual cases of cancers (Kaposi's sarcoma) and *Pneumocystis jerovicii* pneumonia among homosexuals (1). Within few years of its discovery, HIV crossed all geographic and socio-cultural barriers and India reported its first HIV seropositive case in 1986. As on date, we have the third largest number of people living with HIV and acquired immuno deficiency syndrome (AIDS) (2).

The availability of anti-HIV medications also known as antiretroviral therapy (ART) has changed the face of HIV epidemic. With introduction of free ART in the National AIDS Control Program, the AIDS related deaths has declined by 57% since 2007 (3). However, poor compliance to anti-HIV medication is a major hurdle to the overall success of free ART program in India (4, 5). Suboptimal adherence in an individual contributes to development of resistance and early treatment failure (6-8). This further leads to deterioration of overall health requiring prolong hospitalization and switch to costly second-line regimen. Thus there is a need for a cost effective public outreach strategy to improve adherence to ART.

With over one billion subscriber, mobile phones are ubiquitous among Indians (9). Mobile phone based health care intervention can reach geographically remote and culturally diverse group of people in India. Prior study carried out in rural Uganda reported improved adherence following short text message (SMS) based reminders for timely consumption of ART medications (10). However in case of SMS based interventions, timing and content of the message are controlled by the health care provider. Timing of SMS is difficult in case of high pill burden patients as seen in cases of HIV TB co-infection. Also it is challenging to collect patient level adherence data based on SMS based intervention (11). A mobile phone application (app) based reminder can circumvent hurdles presented by SMS without compromising the benefits of wide coverage. Therefore, the primary objective of this study was to develop a user friendly ART medications reminder app for the people living with HIV/AIDS from India. Also till, definite cure is available, prevention of HIV is important to limit its spread. Therefore, the secondary objective was to include health education dimension, which can help in creating awareness about prevention of disease.

METHODOLOGY

A total of five each a) patients consuming ART, b) HIV counsellors and c) HIV/AIDS treating physicians were interviewed to ascertain their expectations from an app to promote adherence to ART. Android platform based smart phone app was developed in collaboration with IT expert, based on the suggestions of patients, physicians and counsellors. In order to have wider acceptance among people covered by National AIDS Control Program, treatment recommendations of National AIDS Control Organization (NACO) were followed.

RESULTS

Novel mobile app for timely ART consumption

Based on the expectations of the HIV counsellors, treating physicians and common needs of patients, an Android OS based mobile app was developed. The App was named "HIV SATHI", an acronym for "Self-care App for Treating HIV Infection" **(Figure -1)**. The app is password protected to maintain confidentiality. Following registration, a user can choose the type, dose and frequency of his ART regimen from the pre installed options to set reminders. The ART regimen included are the standard first and second line options as prescribed by NACO (12). To have an unbiased view, the app uses generic names of all the drugs. The app permits user to set alarms for timely consumption of antiretroviral medications as per his or her convenience. The user is prompted by audio-visual alarm to check a "medicine taken" icon, indicative of timely consumption of pills. If the user fails to respond to the medication alarm, a "missed pill" event is recorded. Cumulative record of missed pill events over past six month can be visualized in this module. Thus, the app helps to keep a track of adherence rate of an individual. In addition to ART, other routine drugs such as nutritional supplements, anti-hypertensive, oral hypoglycaemic agents, *etc* can be added to the medication reminder module. Apart from medications, facility to add reminder for monthly clinic visit and pending investigations are provided in this app.

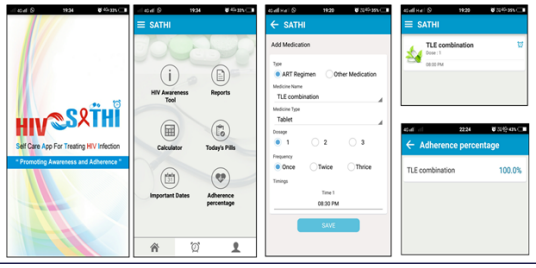

Figure 1. "HIV Sathi" App. The screen shots of "HIV SATHI" ART medication reminder app. On providing the desired ART regimen, frequency and timing; the alarm is activated and monthly adherence percentage record is stored

HIV awareness tool

The HIV awareness module is targeted for general population especially youth, to spread knowledge about HIV and AIDS. It contains health education material pertinent to HIV prevention, diagnosis and treatment in form of frequently asked questions, posters and power point presentations. Information on free NACO sponsored clinics available in the state is included, where free HIV diagnostic and treatment facilities are available. This module also contains list of adverse drug reactions commonly experienced by individuals who are recently initiated on ART.

HIV self management

Understanding and tracking results of the routine investigations is an important aspect of self management of chronic diseases. In this app the user can fill-up results of biochemical and haematological investigations. For ease of interpretation, the out of range values are automatically highlighted. Also one can easily visualize and track the CD4 cell count trend in a graphical format. A dedicated E-mail ID is provided in the app to communicate with team of HIV experts for resolving any personal queries. The calculator section of the app contains body mass index calculator and creatinine clearance calculator. Both these function are frequently used by patients and physicians for routine assessment **(Figure - 2).**

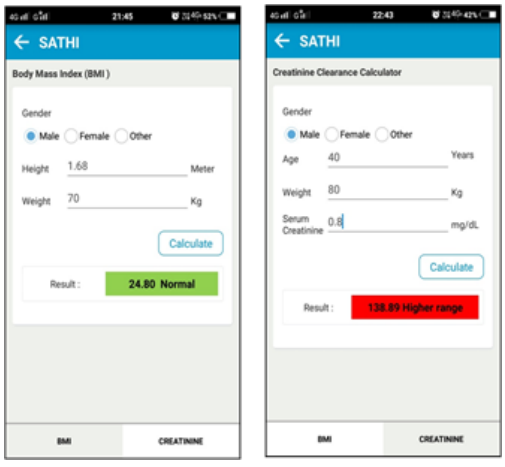

Figure 2. Calculator function: The app also has Body mass index (BMI) calculator and Creatinine clearance rate calculator.

DISCUSSION

Sub optimal adherence to existing first-line ART is an important factor associated with early treatment failure (13). Poor adherence not only accelerates disease progression but also increases the risk of HIV transmission (6). In a resource limited country like India, with third highest burden of HIV infected people, preservation of therapeutic options by periodic counselling to improve adherence is a priority. HIV related stigma and discrimination coupled with adverse doctor patient ratio hinders effective counselling in ART clinics. The drop in the average selling price of smart phones has resulted in exponential increase in number of mobile users in India. Moreover, enhanced accessibility of internet and decrease in the data cost has made digital health initiative an attractive option for health care provider to communicate with patients. World health organization (WHO) recommends mobile phone based adherence support interventions in form of text messages and reminder devices (14). In sub-Saharan Africa encouraging results were reported by use of text message based reminders to improve adherence to ART (15). However, in a randomized controlled trial conducted in Southern India, weekly pictorial and voice message reminders could not demonstrate improvement in the adherence (16). Unlike text message based reminder, App based reminder can be personalized. In this project we developed an app to create awareness to HIV and promote adherence to ART.

The younger generation is at higher risk of acquiring HIV and other sexually transmitted diseases. In this busy world, there is a need to provide concise, authentic and relevant information to the technology savvy youth. John ME et al, have indicated improved self management in youth who have not yet disclosed their HIV status, following a discrete mobile phone based intervention (17). The awareness module of the app is an attempt to engage youth into HIV prevention strategy.

Although numerous apps are available on internet now a day; there is need for a HIV specific app meeting the requirement for Indian population. A systematic review of 272 medication reminder app by Santo et al, reported lack of desirable features in most of them (18). An interventional review has shown moderate quality of evidence of positive impact of mobile apps on health status of patient with chronic diseases such as diabetes, hypertension and asthma (19).

There is need for collaboration between app developers and health care professionals for improving acceptability of mobile phone based interventions in prevention of HIV and other sexually transmitted diseases (20). "HIV Sathi", is an innovative app that not only fulfils the needs of medication reminder app but also helps in self management of disease and creating awareness. Rodrigues et al, have estimated a cost of Rs 79 to Rs 110 per patient per year to facilitate SMS based mobile phone intervention (21). Although inexpensive, such intervention requires fixed expenditure on equipments, software, etc, along with recurrent costs on staff. The "HIV Sathi" app is available free of cost at Google play store and can be downloaded from the link: https://play.google.com/store/apps/details?id=com.alarm.saathi

Limitations of the app

Utilization of various features of the app is restricted to affordability of a smart phone. The app features are currently available in English language only. Multilingual option will increase the clientele usage. As the app will work on offline mode, it won't be possible to upgrade regularly. The alarm function may be missed in case the mobile is switched off or the battery is discharged. Field trial of this app in large population is required to determine its acceptability.

CONCLUSION

The ubiquitous presence of mobile phones in Indian population makes it an efficient channel for health care delivery. This freely available novel smart phone app can serve as important digital health initiative to serve the needs of remotely located HIV infected patients and supplement ART management workforce.

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