Improving TB-Related Knowledge and Behavior with Sembuh TB App towards Indonesia TB Elimination

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ABSTRACT

Introduction

Along with the rapid development in technology, a handful of mobile interventions are now introduced to improve outcomes in TB medication. Sembuh TB app is an Android app, designed to increase medication adherence for tuberculosis patients in Indonesia. This report has an objective to analyse the influence of Sembuh TB app in improving TB-related knowledge and behaviour among TB patients, as well as reaching 2022 target for 90% treatment success rate.

Methods

Two methods were conducted in order to reach the study objective. First method involved initial interview with stakeholders. Meanwhile in the final method or demonstration project, feedbacks received from stake holders interview were evaluated and applied to the TB patients as subjects using the app.

Results

In initial interview, total sample of 69 individuals were gathered. The interviews demonstrated that the app indeed has strong potential to be used by and have desired effects on TB patients. It also pointed to the importance of target segmentation for mobile apps; apps are more suitable to younger generations than to older generations. Meanwhile, a total of 45 users were recruited to participate in the demonstration project. There were 10 active users (22%) at the end of the three-month period of the project and they performed better than app dropouts across four proxies of app effectiveness indicators.

Conclusion

This study succeeded in identifying specific features to be improved and, more importantly, proving the potential of the Sembuh TB App in improving TB-related knowledge and behaviour if the app can be used properly and continuously.

Keywords: android app, TB app, DOT

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INTRODUCTION

Global efforts to combat TB have saved an estimated 53 million lives since 2000 and reduced the TB mortality rate by 37%. However, progress in many countries has stalled, global targets are off-track and persistent gaps remain in TB care and prevention. As a result, TB still kills more people than any other infectious disease. Indonesia is currently the country with the third highest TB burden in the world, contributing to 8% of TB cases in the world. [1,2]

A survey revealed that Indonesia has its TB notification rate dropped significantly despite the doubled number of TB prevalence increased in 2014. According to Global Tuberculosis Report 2019, there were 570,289 cases notified. The consistent number throughout the decade from 2008 also indicates that there is an extensive gap to be addressed, and there is yet to be a significant attempt to identify new cases in Indonesia. [3]

The challenge in Indonesia is represented by the fact that out of the 1,020,000 patients affected by TB, only 330,729 are detected. In 2018, about 281,000 were "missed" by TB services, meaning that they were either not diagnosed/treated or not recorded/accounted in the official system. Other challenges are found in the areas of inefficiency, behavioral problems surrounding TB and Indonesia's overall infrastructure deficiency to support TB treatment. [1-3]

Treatment strict compliance towards medication also serve as a main challenge towards combating TB.

Indonesia has 5.4% of its TB cases lost to follow-up by 2017. The consequence of this issue is a significant increase in the amount of multiple drugs resistance TB cases, along with its treatment success rate that remains under 50%. [1]

In Indonesia, TB treatment requires Direct Obeservation in Therapy (DOT) that involves the relatives of patients and encourages them to provide the antituberculosis drugs directly to the patients and watching them swallow the medications. In 2018, it was reported that the treatment success rate for new and relapse cases registered reached 85%. Nevertheless, the validity of treatment outcome data was not always ascertained. On the other hand, in some high TB burden countries, the completeness of outcome reporting was low. Therefore, there is a clear need for additional strategies to support patients in accurately receiving the full cycle of TB medication and alleviating the national TB burden altogether. [2-4]

A study published in the Journal of Medical Internet Research in 2015 showcased that 58% of surveyed US mobile phone users have downloaded at least one mHealth app onto their device. For health care systems, significant interest exists among users for communicating with doctors and using apps to seek healthcare-related services. [5-7] Indonesia is increasingly seeing smartphone as the primary means of internet access. According to the market research company, eMarketer, the estimation of smartphone users in Indonesia have reached 74.9 million and is showing a 16%

increase per year. [8-10] The country's robust economic growth over the past decade (approximately 5% per year) and its young and large population indicate that the smartphone penetration growth should grow rapidly as the middle class expands swiftly. [11]

Along with the rapid development in technology, a handful of mobile interventions are now introduced to improve outcomes in TB medication. Interventions such as mobile text messaging services (SMS), apps, and other solutions including biometric tools, have the potential to promote adherence to tuberculosis treatment.

Sembuh TB app is an Android app, designed to increase medication adherence for tuberculosis patients in Indonesia. The earlier version of the app was originally developed in Japan, then later localized to fit the Indonesian context. The app has several features that are integrated into a single, accessible, free app, with an aim to improve the well-being of TB patients. This report has an objective to analyse the influence of Sembuh TB app in improving TB-related knowledge and behaviour among TB patients, as well as reaching 2022 target for 90% treatment success rate.

MATERIALS AND METHODS
"Sembuh" is an Indonesian term of *"Cured"*. Sembuh TB app has five features ready to be implemented to the users, such as:

- **Alarm:** This feature allows patients to manage their medication schedule by setting up the time when alarm will ring on daily basis with a pop-up message "Minum Obat". It is first set when patients sign up to the app, and later the alarm time can be changed from the menu.
- **Calendar:** Calendar tracks patients' record in taking the medication. Everyday patients are expected to click "Sudah Minum Obat" ("Already took the medication") as soon as they take the medicine, and the app will mark the respective days with green dots, allowing patients as app users to understand that they do not miss any medication in any days in the past. If patients do not click the button, late medication notifications will be sent a day after, assuming patient does not take medication for that day. Calendar also enables patients to set a reminder for the hospital visit, and specify what kind of tests they are supposed to take: sputum smear, blood test, or chest X-ray. For the hospital visit purpose, reminder messages will be delivered automatically one day before the visit to reduce the chance of patient negligence on hospital visit.
- **Educational video:** In this feature, patients are able to access TB-related educational videos using this app. The topics of the videos are varied, ranges from the information about TB, the urgency of taking medicine on a daily basis, the risk of dropout from treatment, to suggested food and nutrition intake of TB patients. In addition to that, when patients

install the app, a tutorial video describing how the app can be used will be also displayed.
- **Supporter message:** This feature manages supporters and supporting messages received by patients. Supporters can send motivational messages once they are invited by each patient and install the app. This function is expected to give a supportive environment for patients to face their challenges during medication.
- **E-consultation:** An online consultation service provided by PT. MeetDoctor is also included in this version of app. Patients can submit any questions or concerns related to TB, and a general practitioner (GP) will respond to those questions within 24 hours in working days, during working hours only. This GP had been trained and supervised by a team from Department of Pulmonology from Persahabatan Hospital, which enables them to answer any questions in trustable and professional manner.

Two methods were conducted in order to reach the study objective. First method involved initial interview with stakeholders. Meanwhile in the final method or demonstration project, feedbacks received from stake holders interview were evaluated and applied to the TB patients as subjects using the app.

I. **Methods of Initial Interview**
As the initial activity of the two-year project, We conducted a round of initial interviews in Jakarta in January 2016 to capture feedback to the mobile app and understand general challenges in TB treatment.

The healthcare providers interviewed belong to five different facilities in the Jakarta and greater Jakarta area including two puskesmas and three hospitals.

II. **Methods of Demonstration Project**
As the culmination of the two-year initiative, we conducted a demonstration project of the Sembuh TB mobile app among 45 TB or MDR-TB patients at three hospitals in the greater Jakarta area. Despite technical challenges with the app, the project demonstrated that the app utilization was moderately good compared to industry average and the app effectiveness was demonstrated in the four outcome areas, i.e. the domains of knowledge, medication adherence, body weight, and timeliness of hospital visits, comparing app users and dropouts.

The demonstration project was designed based on the logic that information disseminated from the app leads to knowledge, which in turn triggers behavior change. Following this logic, data was purposively collected to understand app utilization (outputs) and app effectiveness (outcomes), as well as feedback from user experience.

RESULTS

The results of this report were divided per method. Data gathered from initial interview were used for target users segmentation, whilst informations obtained from demonstration project were analyzed to produce app utilization rate.

I.   Results of Initial Interview

The interviews covered a total sample of 69 individuals including 37 patients, 13 family members, and 19 healthcare providers. Apart from target segmentation, the interviews demonstrated that the app indeed has strong potential to be used by and have desired effects on TB patients. One of the important findings from the interviews was that, while the majority of the respondents thought the app would be useful, 15 people (mostly those 51 years and above) did not show interest in it, mostly because they found the app to be too complicated for elders. This points to the importance of target segmentation for mobile apps; apps are more suitable to younger generations than to older generations who aren't familiar with smartphones.

Over 30 ideas were made by the interview respondents regarding modifications and new features to the app and educational videos. The project team converted this "wish list" into an "action list" taking into account priorities expressed by respondents, technical difficulty, and potential impact on the user experience.

II.   Results of Demonstration Project

A total of 45 users were recruited to participate in the demonstration project, with almost a half representing Goenawan Lung Hospital and the rest belonging to Persahabatan and Cempaka Putih Islamic Hospitals. Of the 45 users, 33 were normal TB patients and 12 suffered from MDR-TB. While best effort was made to interview all 45 users at the end of the 3-month period, We were unable to interview several patients as some stopped their medication and did not come to hospital anymore, deceased, and few were not willing to participate. In the end we successfully conducted 37 interviews.

Out of the 45 users, many stopped using the app in their first and second months for various reasons, leaving the remaining 10 active users (22%) at the end of the three-month period.

The 10 participants who actively used the app for three months performed better than app dropouts across four proxies of app effectiveness indicators. Percentage of each indicator of nondropouts patients versus dropouts patients can be seen as below:

1.   Increased TB-related knowledge: 90% vs. 26%
2.   Medication adherence: 100% vs. 83%
3.   Weight gain: 70% vs. 40%
4.   Timeliness of hospital visits: 74% vs. 34%

DISCUSSION

Sembuh TB is a mobile application that has been thought to fit the population in middle income countries with young ages as average. This app utilizes its five main features, such as alarm for reminding daily medication, calendar for tracking medication compliance, education videos, supporter messages, as well as free online consultation. After doing initial interview to 69 samples, 21.7% of subjects did not show interest. Those subjects were suggested to be elders and hence, further specification regarding age group inclusion was conducted in the next step of study. Reflecting from initial interview by prioritizing suggestions from respondents and technical difficulty, several revisions of actions were to each feature.

In the final study, 37 out of 45 participants were interviewed and after period of 3 months, 22% of participants remained. Despite this number could be considered small, this percentage is slightly higher when compared with the mHealth industry average, which score was released by Flurry, Yahoo analytical companies in 2016. Technical challenges, such as error in the application and unstable internet connection have contributed to why some participants decided to stop using the application. Some participants also thought that accessing and clicking the application everyday as burden. These patients felt that they did not require extra support to comply with the TB treatment and can manage their medication independently.[11-13]

Delving further into the challenges of the app, interviewees were asked why they did not use certain features at all. Indeed, a staggering 70% of the users never accessed the e-consultation service, while 57% and 51% did not access the supporter message and educational videos, respectively. While various reasons were given for their non-use, this was one of the important findings from the demonstration project: some features that required hundreds of hours of technical development were simply not catering to users' needs and preferences. Therefore, one of the key recommendations points to eliminating such features so that the overall app can be less complex overall and lighter in size, which in turn contributes to alleviating technical errors. However, out of these three features, educational video could be considered as highly important as it is the only resourceful outlet for patients to gain TB-related knowledge. Therefore, despite the fact that it was only accessed by nearly half the patients, we further conducted analysis on this feature to see if patients specifically benefitted from this feature or not.

Turning now to the brighter side of the findings, the demonstration project revealed that app usage does indeed seem to contribute to increased knowledge and improved behavior with regards to TB treatment. To measure these changes, data was collected and analyzed in the domains of knowledge, medication adherence, body weight, and timeliness of hospital visits.

Based on the findings from the demonstration project, We recommends the following actions with regards to

improving the app itself: fix technical challenges, build a server-less app, and streamline low usage features.

Server-less app, in general, allows users to run app and service without dependence on servers. It does not require provision and no establishment of contact with any servers. While in the demonstration project it has been observed that unstable communication with server can cause various errors such as late or missing notifications and troubled app usage experience, server-less app, or app with no server at all, has one consequence, that is, the app would not be able to have notification systems automatically. However, it is without doubt to say that push notification is central in the usage of Sembuh TB app, as it enables patients to receive reminder to go to hospitals, take medicine, and receive news about TB in general, i.e. notification about TB day or TB-related events. The app needs to have this effective tool which would send information to patients. That said, if Sembuh TB app wants to be a server-less app, it needs to build an independent, separate notification system in order to the app to keep sending notifications to the users.

Finally, streamlining rarely used features allows the new Sembuh TB app to maximize the use of other features which are highly beneficial, favorited, and widely used by most users. Thus, in the new version the team should focus in enhancing the performance of the main features, and that said, it is important to include these three in the next development of the app:

- Feature 1, **Alarm** & Feature 2, **Calendar**: As getting reminded to take medication and to go to hospital are the top 2 reasons to install the app stated by nearly 80% of all patients, these two features must be maintained well in the app.
- Feature 3, **Educational video**: While only used by nearly half of the total users, educational videos intrigue some patients and are able to shape expected behavior in the treatment, as proved by the result of the active users' performance in demonstration project.

Once the next generation of the app can be developed incorporating the aforementioned suggestions, We recommends the app to be promoted in a multifaceted way so that more patients can access and benefit from the app, thereby contributing to reducing the overall TB burden in the country.

Despite the availability of a number of applications related with TB, such as

- *TB Mobile*: An application that provides TB molecule structures to infer potential targets or search by targets to retrieve compounds known to be active,[14]
- *WHO End TB App*: An application to access all the necessary TB meeting informations,[15]

- *E-counselling App:* An application developed in Phnom Penh that provides online counselling to strengthen TB treatments,[16]
- *LearnTB App:* An application aims to educate Indian clinicians regarding the definition, diagnosis, treatment, management and counselling practices available for TB,[17]
- *E-DETECT TB App:* An application that helps health-care staff to perform active and latent TB screening practice according to the WHO recommendations,[18]

Nevertheless, several TB applications as mentioned only have specific one tool that has already been owned by Sembuh TB App. One application offers function only to health-care workers in TB screening practice. There have not been any application providing more complete features, for both assisting TB patients in terms of medications and engaging health-care staff with patients, as Sembuh TB.

As a final remark, we would like to note that a mobile app like Sembuh TB is not the ultimate tool to fix the challenges in drug compliance faced by TB patients. It is important to position the app as a supportive tool to improve treatment, as there are many other factors contributing to patients' treatment success, i.e. involvement of family members, hospitals, accurate knowledge on TB, side effects, and others. As a supportive tool, the Sembuh TB app holds strong potential to contribute to improving the well-being of TB patients in Indonesia.

CONCLUSION
In conclusion, the project succeeded in identifying specific features to be improved and, more importantly, proving the potential of the Sembuh TB App in improving TB-related knowledge and behavior if the app can be used properly and continuously.

This app hopefully can also answer clear need for additional strategies to support patients in accurately receiving the full cycle of TB medication and alleviating the national TB burden in Indonesia.

As new tool and approach to disease control, usage of Sembuh TB App will be rely on experiences of future users. This experiences will be crucial for further optimization. Even from programmatic point of view, there is not yet clear contribution as monitoring and evaluation tools. But Sembuh TB Apps offer increase of adherence and decrease number of loss to follow up.

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