Acceptability of A Digital Adherence Tool Among Tuberculosis Patients and Tuberculosis Care Providers in Kilimanjaro Region, Tanzania

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Abstract

Background: The WHO has recommended digital adherence tools (DAT) as a promising intervention to improve anti-TB drug adherence. However, the acceptability of DAT in resource-limited settings is not adequately studied

Objective: In this study, we investigated the acceptability of DAT among tuberculosis patients and TB care providers in Kilimanjaro, Tanzania

Methods: We conducted a convergent parallel mixed method study among TB patients and TB care providers participating in our two-armed cluster randomised trial (Remind TB). The trial aimed to investigate whether the evriMED pillbox with reminder cues and adherence feedback effectively improves adherence to anti-TB treatment among TB patients in Kilimanjaro Region in Tanzania. We conducted exit and in-depth interviews among participants, as well as in-depth interviews among TB care providers from the intervention arm. We conducted a descriptive analysis of quantitative data from exit interviews using Stata version 15. Translated transcript and memos were organised using NVivo software version 12. We employed inductive and deductive thematic framework analysis, guided by Sekhon's theoretical framework of acceptability (TFA)

Results: Out of 280 enrolled, 100(41%) were interviewed during exit interviews, and eighteen participants and fifteen TB care providers were in-depth interviewed. The findings showed that the digital adherence tool (DAT) was highly accepted, with 83% expressing satisfaction and 98% reporting positive experiences with its use. Seventy-eight (78%) understood how the intervention works, and 92% successfully used the pill box. Good perceived effectiveness was reported by 84% who noticed improved adherence, and many preferred continuing receiving reminder SMS, indicating high levels of self-efficacy. Ethical concerns were minimal, as 85% did not worry about remote monitoring. However, some participants felt burdened by the use of DAT of which 9% faced difficulties keeping the device at home, 12% were not pleased with receiving daily reminder SMS and 30% reported challenges related to internet connectivity. TB care providers accepted the intervention due to its perceived impact on treatment outcomes and behavior change in adherence counseling and they demonstrated high level of intervention coherence.

Conclusions: Digital adherence tools (DAT) are highly acceptable in Tanzania. However, some barriers, such as TB-related stigma and internet connectivity, may limit acceptance.

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Abstract

Background**:** The WHO has recommended digital adherence tools (DATs) as a promising intervention to improve anti-TB drug adherence. However, the acceptability of DATs in resource-

limited settings is not adequately studied.

Objective: In this study, we investigated the acceptability of DAT among tuberculosis patients and TB care providers in Kilimanjaro, Tanzania.

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Conclusions: DATs are highly acceptable in Tanzania. However, some barriers, such as TB-related stigma and internet connectivity, may limit acceptance.

Key words: Acceptability; digital adherence tool; Medication reminder monitors; Tuberculosis patients; adherence; TB care provider.

Introduction

Tuberculosis (TB) is a significant public health problem and the second leading infectious killer after COVID-19 [1]. The World Health Organization has set a target in its ‘end TB strategy’ to reduce TB deaths by 75% in 2025 and 90% in 2030[2]. Tanzania is among the 30 countries with high tuberculosis (TB) burden and is estimated to have had a TB incidence of 208 per 100,000 population

and 1.3% of MDR-TB cases in 2021[1]. In 2020, Tanzania reported that about 26,800 people died from TB [3]. Tuberculosis is a curable disease if adequate treatment is implemented [4]. However, treatment adherence is a major challenge that hinders tuberculosis treatment efforts [5]. Insufficient adherence to TB medication is contributed by multiple factors such as the social context, the health system, economic factors, patient-related factors (forgetfulness, low knowledge), health service accessibility and drug-related factors such as drug side effects.[6], [7]

The World Health Organization (WHO) has recommended digital adherence tools (DATs) that include short message service (SMS) texts, medication event monitoring devices (MEMS), and video observed treatment (VOT) as promising interventions for improving TB adherence [8]. Digital adherence tools can remind patients to take their medication, offer dose information, alert healthcare practitioners to risky behaviour patterns, and allow healthcare practitioners to intervene when treatment is interrupted [9]. Furthermore, digital devices give baseline information for healthcare providers during adherence counselling, patient motivation, replacement of interrupted medication, and scheduling clinic visits [8].

Digital adherence tools (DATs) have proven feasible in high- and low-resource settings [9]–[11]. Also, studies conducted in Tanzania among people living with HIV, in Uganda and China among patients with drug-susceptible TB and in South Africa among MDR-TB patients have shown these devices to have a relatively high acceptability [12]–[15]. However, the literature indicates that the wide implementation of DAT in China has shown challenges, in which 11.3% refused to use DAT at enrolment, and 8.2% refused to use DAT during treatment [16]. Another study in Vietnam has shown that participants could not use the pillbox as required because they could not carry it into their workplace [17]. More evidence of DAT's acceptability is needed to inform its large-scale implementation in resource-limited settings.

Investigating implementation research outcomes, such as acceptability, feasibility, sustainability, and adoption, is essential in identifying implementation bottlenecks that may hamper intervention effectiveness in a real-world setting [18]. In addition, when a healthcare intervention is not considered acceptable, it may affect healthcare providers' perception and treatment delivery [19]. In this study, we aimed to investigate the acceptability of DAT among patients and TB care providers for improving adherence to anti-TB drugs among TB patients in Kilimanjaro.

Methodology

Study design

We conducted a convergent parallel mixed methods study among TB patients and TB care providers,

which was embedded in our cluster randomized trial (REMIND-TB). The study was approved by the Kilimanjaro Christian Medical College Research Ethics and Review Committee (CRERC) with approval No.1157 dated 10 December 2018) and the National Health Research Ethics Sub-Committee (NatHREC) with Ref. NIMR/HQ/R.8a/Vol.IX/2992, dated 14 January 2019. We registered the trial at the Pan African Clinical Trials Registry under PACTR201811755733759.

The Remind-TB trial

From 2019 to 2021, we conducted a two-armed cluster randomised trial to investigate whether the evriMED pillbox with reminder cues and adherence feedback effectively improves adherence to anti-TB treatment among TB patients in Kilimanjaro Region in Tanzania. Study sites were randomised into 12 clusters, six intervention and six control arms. The inclusion criteria for the trial were patients' diagnosis with presumptive sensitive TB aged 18-65; attending care at any of the TB centres in Kilimanjaro region, Tanzania; willing to use an evriMED pillbox; able to read and understand SMS; able to understand and willing to sign informed consent. Exclusion criteria were admitted participants and those who previously participated in similar studies. We provided participants in the intervention arm with an evriMED 1000 pill box for their medication storage and intake. In the control arm, participants followed the standard of care procedures. In both arms, we followed participants for six months of treatment. In the evriMED arm, participants received a reminder SMS every day thirty minutes before their set time of taking medication. Detailed information about the REMIND-TB trial and the DAT can be found elsewhere [20].

Digital adherence tool (evriMED pill box)

The evriMED1000 is a type of tablet dispenser with a SIM card produced by Wisepill, based in South Africa. The pillbox records the opening of the box and stores these so-called medication events on a chip, along with the date and time whenever it opens. This information is transmitted to a centralized server when one opens the device. Additionally, the evriMED1000 delivers a daily heartbeat event that includes information about the device's identification, battery life, and signal quality. If the pillbox is not opened on a particular day, any pending events will be transmitted during the next heartbeat.

The evriMED1000 sends a reminder SMS to an individual's mobile phone 30 minutes before intake time. If the individual does not take the medication within 1 hour of the intake period, a second reminder SMS is generated and sent. The patient does not require internet connectivity to get reminder SMS. The Wisepill pillbox use a Global Roaming SIM chip that will connect the best available mobile network in the area. These devices are designed to work in low network resource

settings.

As the trial was an implementation study, TB care providers took full responsibility for participant care within their regular duties. They had to explain and demonstrate the use of the evriMED device to patients, provide medication through the device, and discuss adherence reports generated by the device during follow-up clinics. Participants were trained on device usage upon enrollment and were required to stay with it for the entire six-month treatment period. Any challenges related to device functionality or misunderstandings were addressed through ongoing discussions between patients and care providers during follow-up visits.

Mixed Method Study on Acceptability of DAT

Study procedures

Enrolled participants from the intervention arm of the REMIND-TB trial who completed six months of treatment were called for a phone interview. One inclusion criterion for this study was that participants had to be randomized into the intervention arm, while we excluded all participants randomized into the control arm. The other in- and exclusion criteria were the same as in the trial. In addition, we purposively selected 18 TB patients for an in-depth interview. Considering that this was an implementation study in which all the activities were carried out by TB care providers, we purposively selected 15 TB care providers to understand the acceptability pattern of evriMED. We aimed at a heterogenic sample for both patients and healthcare workers by considering patients with good and bad adherence as well as diverse professional experiences among TB care providers. We obtained written informed consent from all individuals who participated in the acceptability study. After completing the follow-up of all participants in the REMIND-TB trial, we purposively selected TB treatment centres with their respective care providers in each cluster, who were called for an in-depth interview. Interviews were done by trained research assistants using a topic guide in the Swahili language. Audio recordings of the interviews were transcribed and translated by experienced research assistants.

The theoretical framework of acceptability (TFA)

The TFA is a theoretical framework that helps to evaluate the intervention acceptability based on the lived or perceived experiences of individuals who deliver or receive an intervention [19]. The TFA has seven constructs that can evaluate acceptability before, during, and after implementation performance [19]. In this study, we used TFA to investigate the acceptability of DATs among TB patients and TB care providers. We believe that this theoretical framework is the best to use for this study due to its robustness in integrating the comprehensive concept of acceptability derived from

diverse theories in health psychology and behavior change. To our knowledge, this inherent strength makes TFA the best theory of acceptability when compared to other theories. In addition to that, several studies have employed this theory to evaluate the acceptability of healthcare interventions [15], [21]–[23].

Table 1: Constructs and description of the theoretical framework of acceptability (TFA)

Constructs	Description
Affective Attitude	How an individual feels about the intervention
Burden	The perceived amount of effort that was required to participate in the intervention
Ethicality	The extent to which the intervention has a good fit with an individual's value system
Intervention Coherence	The extent to which the participant understands the intervention and how it works
Opportunity Costs	The extent to which benefits, profits, or values were given up to engage in the intervention.
Perceived Effectiveness	The extent to which the intervention is perceived to have achieved its intended purpose
Self-efficacy	The participant's confidence that they can perform the behaviour(s) required to participate in the intervention

Data collection tools

Exit survey

We conducted an exit survey after a participant completed the treatment. The survey was done by phone by trained research assistants. We did the survey using a semi-structured questionnaire that we developed using the seven constructs of the acceptability framework (affective attitude, perceived burden, ethicality, perceived effectiveness, intervention coherence, self-efficacy, and opportunity cost).

In-depth interviews

We conducted in-depth interviews with patients and TB care providers from the intervention clusters. Patients and TB care providers were interviewed at their respective health facilities at the agreed time. All interviews were conducted by two experienced researchers led by the first author (AM). We used different topic guides for in-depth interviews with patients and care provider, respectively. We used the Sekhon framework for acceptability to define the guide. Questions mainly focused on the seven constructs of TFA. The questionnaires were adapted if new topics came up during interviews.

Data analyses

To answer the objective regarding the acceptability of evriMED among TB patients and TB care providers, we conducted a descriptive analysis of the exit survey responses using STATA version 15. The results of the exit survey provided an overview of the frequency and percentages of each element of acceptability. In addition, we further analysed the qualitative responses of participants and TB care providers inductively and deductively using thematic framework analyses. Three researchers independently read the transcripts (AM, MS, RM). We developed memos and subthemes inductively based on the narratives and deductively by adopting pre-identified themes from the theoretical framework constructs. We uploaded transcripts and memos in NVivo for coding and data organization. Narratives from the transcripts were then coded based on the pre-defined sub-themes.

Results

Description of participants

We enrolled a total of 280 participants in the intervention arm. Twenty-one (7.5%) died before study completion, and 14(5%) were excluded due to either being transferred to other regions or lost to follow-up. Of the 245(87.5%) participants who completed treatment, 145(59 %) were not interviewed because their phone number was unreachable. We interviewed 100 (41%) patients. Details of the demographic characteristics of TB participants is shown below in the tables 2.

Table 2: Demographic characteristic and treatment outcome of participants

Sex		Values, N=245	Percentage (%)
	Male	207	73.9
	Female	73	26.1
Inclusion clusters			
	Moshi rural DH	21	7.5
	Moshi rural HC	115	41
	Moshi urban DC	3	1.1
	Moshi urban HC	42	15
	Same Mwanga	49	17.5
	Kibong’oto	50	17.9
Age			
	<20	2	0.7

	20-29	50	17.9
	30-29	57	20.4
	40-49	89	31.8
	50-59	52	18.6
	60+	30	10.7
Education level			
	None	9	3.2
	Primary	213	76.1
	Secondary	56	20
	Tertiary	2	0.7
Marital Status			
	Married	155	55.4
	Single	79	28.2
	Separated or divorced	35	12.5
	widowed	11	3.9
Treatment outcome			
	Cured/completed treatment	245	87.5
	Transferred and lost	14	5
	Dead	21	7.5

In addition, we further in-depth interviewed eighteen patients and fifteen TB care providers (DOTs), and we reached data saturation from these interviews. Among the eighteen patients, 12(66.6%) were male and 6(33.3%) were female. Detailed demographic characteristic are shown in table 3. Of the fifteen TB care providers that were interviewed, 3(20%) were male, and 12(80%) were female, of whom 4 (26.6%) were clinicians, 1(6%) was a pharmacist, 4 (26.6%) were medical attendants and 6(40%) were registered nurses.

Table 3: Demographic and adherence characteristics of in-depth interview with individuals diagnosed with TB

No	Sex	Age	education	Marital status	Participants adherence as shown by DAT
1	Female	30	Secondary	Married	10%
2	Male	40	Primary	Married	24%
3	Male	58	Primary	married	21%
4	Male	55	Primary	Married	38%
5	Female	53	Primary	Single	99%
6	Male	48	Primary	Married	99%
7	Male	56	Primary	Married	21%
8	Female	38	Primary	Single	0%
9	Female	49	Primary	Married	100%
10	Male	63	Secondary	Married	100%
11	Female	45	Primary	Separated	68%
12	Male	52	Primary	Married	90%
14	Male	59	Primary	Married	99%
14	Male	41	Primary	Married	99%
15	Female	45	Primary	Divorced	41%
16	Male	52	Primary	Married	93%
17	Male	40	Primary	Married	96%
18	Male	60	Secondary	Married	98%

Patients' and TB care providers' acceptability of DAT

Table summarizing quantitative survey findings can be found in Multimedia Appendix 1

Affective attitude

Many participants described positive views concerning the use of the intervention. In the exit interview,98 out of 100 participants (98%) indicated their general experience with the pill box was either good or very good. Eighty-three percent (83%) reported that the intervention was satisfactory, and 85(85%) had either a good or very good attitude toward the content of the reminder SMS. Of 20 people who saw their adherence graph, 18(90%) had a good or very good attitude toward graphs.

In the in-depth interviews, participants expressed positive opinions about the appearance and attractiveness of the pill boxes. They were particularly impressed with the white colour of the pill box. TB care providers and patients acknowledged the appropriateness of the pill box's size, stating that it allowed for hygienic medication storage. However, some TB care providers suggested increasing the pill box size to accommodate patients' cards. Furthermore, some participants appreciated the pill box's size as it matched the size of TB drug blisters. Additionally, participants with co-morbidities (TB-HIV) found the large size of the pill box advantageous for storing drugs for other diseases. This is illustrated in some quotes:

"From my point of view, the device is good. Even from looking at it. Even the colour itself is not bad." [Patient, 42 years old Male]

"…. it reminds him. Even though he doesn't have his phone, it helps him think he should take medication. The second thing I see is that drugs stay safe. Thirdly, it helped patients to be alert. They were swallowing the medicine on time, and if they forgot, it reminded them." [TB DOT, Registered nurse]

Participants and TB care providers highlighted the benefits they experienced from using the intervention, particularly regarding medication reminders and storage. TB care providers expressed satisfaction with attending to patients utilizing the intervention as it enabled them to monitor progress through adherence reports. However, a few participants expressed negative sentiments. One participant suggested that having pill boxes in different colours would be more attractive, as the white colour could quickly get dirty. Another participant felt the pill box size was too large to carry and recommended reducing it by half, as mentioned by some participants:

"It alerted us that why this guy/patient has this problem. Let us call him and sit to talk with him about what the problem is. [TB DOT, Medical attendant]

"The first advantage is to be reminded. You understand me. It reminds you. I have been reminded many times because I also like to sleep; if I do not go out, I always like to sleep at home. Also, drug storage." [Patient,30 years old female]

"It's good, but when it's new. If it is new, it is very attractive. Now, it shows it has been used. It is clean, but not attractive anymore." [Patient,56 years old Male]

"I don't know... the size should be reduced to half! I see it is big." [Patient,30 years old Female]

Perceived burden

We examined the perceived effort involved in using the intervention. During the exit interview, it was found that some participants faced challenges when using the intervention. Specifically, 10 (10%) of respondents mentioned experiencing TB-related stigma, 12(12%) expressed discomfort

with receiving daily SMS reminders, 7(7%) found it challenging to use the device, 9(9%) encountered difficulties keeping it at home, and 3(3%) reported issues with charging the device. Additionally, 30 (30%) reported experiencing challenges with mobile network.

In-depth interviews revealed a few aspects that participants and care providers were experiencing in using the intervention. Few participants expressed challenges in travelling with the pill box. TB care providers mentioned that the intervention increased their workload as it required extensive discussions with patients about various aspects of adherence. Moreover, mobile network-related issues caused delays in the system's signal transmission when the pillbox was opened, leading to poor adherence reports for some patients and incorrect SMS notifications. Some participants suggested that the system should not send reminder SMS to treatment supporters, as the device occasionally failed to detect events due to network problems. This can be seen from the following quotes:

*"I did not feel comfortable going with it because others would suspect me [of being sick]." [Patient,*56 years old male]

"…. But the time was insufficient according to the working environment. So, once you get a patient in this environment, it is a bit of a challenge to sit with them. You must be brief because the time is insufficient, and you might need to work in the OPD wards simultaneously. So, if you sit with that patient for a long time, you will cause a jam in another unit." [TB DOT, medical attendant]

"If the network is fine, the adherence is good. But, if he goes to a place without a network, the device is not communicating even if he has taken the medicine," [TB DOT, medical attendant*]*

Ethicality

Many participants and care providers described the intervention as fitting well with their value system. Exit interviews with participants revealed that 85 out of 100 (85%) did not worry about being monitored remotely, and 77(77%) said they did not experience any form of stigma. Similar findings were observed in the in-depth interviews. Many participants considered the pill box morally acceptable and appreciated how it helped maintain their confidentiality. TB care providers also found the content of the reminder SMS to be beneficial for their patients, as illustrated in the quotes below:

"I saw the benefits of hiding the secret of my illness. The device is acceptable for my side. I do not know for others." [Patient,56 years old male]

"...It is morally right to use the device." [Patient,42 years old Male]

"I think the SMS contents were fine." [TB DOT, medical attendant]

Furthermore, participants emphasized that the pill box and text messages aligned with their social

values within their families. They highlighted that the intervention facilitated ongoing support from their families throughout the medication period, as described by the following participants:

"…. even my wife told me: 'The time to take the medicine is near. Go and take the medicine.' Even if the hours have not arrived, she remembers" [Patient,42 years old Male]

"*They supported me well. For example, giving me milk food. Even, sometimes, when they do cleaning, they wipe the device."* [Patient, 48 years old female]

Intervention coherence

Most participants and TB care providers claimed to understand the intervention and how it works. The findings from the exit interview revealed that 78(78%) of respondents indicated they understood the intervention, 92(92%) mentioned they could use the intervention without any challenge, and 84(84%) could charge the device without problems. However, only 20 out of 100 participants (20%) were shown their adherence graph during counselling sessions with care providers.

Similar findings emerged during the in-depth interviews, where many participants and TB care providers effectively communicated the purpose of the intervention and its operational processes. During the interview, we asked healthcare providers to show how they had informed participants about intervention objectives and how it worked. The in-depth interviews revealed that healthcare workers understood the intervention's objectives and were adept at conveying this information to their patients. Furthermore, participants and care providers were able to explain how different components of the pillbox such as the alarm, lights, charging system and reminder system, communicate with the server. However, the interviews revealed that most participants did not remember the name of the pill box. Instead, they used to call it by their local name, 'kiboksi', which means 'the box'. This is demonstrated in the following quotes:

"It reminds you to swallow the medicine, so when you open it, it indicates someone has opened the device and swallowed it. When you do not open it, it means you have not swallowed it. So, you will be sent a reminder message." [TB DOT, Registered nurse]

"*This device, first, is the one we use to store medicine. Second, when you open this device, it turns on the lights and gives an alarm. Once you have taken out the medicine inside and used the one you need, the other ones you must put back in. When you put them back inside the device, you close this device. If you close it properly, the lights turn off. One thing I have noticed is that it gets to the point where you open it, and then the lights turn on and off. The moment it turns on and off, it does not show the indicator again."* [Patient, 63-year-old male**]**

"*Honestly, the graph has never been shown to me"* [Patient, 30-year-old female].

Perceived effectiveness

Participants and TB care providers expressed that the intervention successfully achieved its intended goal. In the exit interviews, 84 out of 100(84%) of respondents acknowledged that the intervention improved their treatment adherence. Similar findings were observed in the in-depth interviews with both participants and TB care providers. Participants mentioned that the intervention facilitated adherence by providing timely reminders, enabling them to stick to their scheduled intake times. They found the SMS reminders especially helpful when occupied with other activities and prone to forgetting. Furthermore, TB care providers reported that the intervention significantly improved treatment outcomes for patients compared to those who did not use the pill box, as described in the following quotations:

> *"Receiving the message that says 'the time of intake is near'". That has helped me a lot because you are probably far from home. So, you will estimate I have 20 minutes or half an hour to be home".* [Patient, 63 years old Male]
>
> *"I thank God, to be honest, no patients could stop medication or even die"* [TB DOT, Medical attendant]
>
> *"Honestly, I have been successful because many patients have recovered; they didn't get resistance."* [TB DOT, Clinician]

Healthcare providers expressed that the intervention improved their rapport with patients by providing feedback on adherence counselling, fostering a sense of compassion and love. They found the adherence report valuable in effectively monitoring the patients' progress. Moreover, the intervention resulted in positive behavioural changes among TB care providers. Many providers mentioned that the feedback on adherence counselling sessions helped them refine their approach when attending to TB patients, and they gained a better understanding of the significance of adherence in time of medication, which had previously been given less attention, as described in these quotations:

> *"It helps to keep the closeness…among the patients…You even get time to talk to him and discover what's happening with him. Many positive patients have come out completely healed."* [TB DOT, registered nurse]
>
> *"For us care providers, it was helpful because we are not doing one work, but also doing other work. So, once we get the patient's information for reference from the devices, it helps us to know if the patients are in good care compared to those who are not using the devices.* [TB DOT, medical attendant]
>
> *"… in the past, we were giving drugs, but we did not emphasize that if a patient should swallow*

medicine at 8.00 a.m., it should be taken at 8.00 a.m. every day. We used to tell them to take drugs in the morning regardless of the time. For this study, we dispensed and told them to choose whether it was 8 or 9 o'clock. He will choose and should take the drug at the same time every day. And we have seen that it has brought great success." [TB DOT, Clinician]

Opportunity costs

Few participants mentioned that they had to give up something valuable to participate in the study. Exit interview results show that 6(6%) of respondents incurred extra costs while using the intervention. From the in-depth interviews, one participant expressed using more money because he got a reminder when he was away from home and did not want to ruin his intake report. So, he decided to take a quick transport to get home on time. Another participant mentioned working fewer hours than usual to get home early to take medication on time, as mentioned by some participants:

"There was a period when I was receiving messages, but if I went somewhere and became late, I had to take a quick motorcycle." [Patient, 63 years old male]

"That happens once in a while because you may find that you are working somewhere, and then you still have time, but you have to leave early." [Patient, 42 years old Male**]**

Self-efficacy

Many participants and TB care providers said they were confident to engage in the intervention. In the exit interviews with participants, 84(84%) of the respondents said they are comfortable to continue receiving reminder SMS every day. The same was found in the in-depth interviews, in which some of the participants expressed that they preferred the device to be given to many patients and not to a few just for research. Others mentioned that they were confident in explaining the pillbox to their families and relatives. TB care providers expressed that the intervention would be suitable to be adopted in their care and, if possible, include patients suffering from other diseases like HIV, as illustrated in the Quotations:

"For my part, I advise this research project to continue. Not just for research purposes only and end there. It should continue because it is a good thing, and the scope should be expanded to get more people to use this device." [TB DOT, Registered nurse]

"This device is so good to the extent that I liked it and wished I could remain with it." [Patient, 53 years old Male]

Discussion

Principal findings

This study aimed to evaluate the acceptability of DAT (evriMED) among patients and TB care providers to improve adherence to anti-TB drugs in Kilimanjaro. The overall findings of this study indicate high acceptance of DAT among TB patients and care providers. We found that high acceptance of DAT was based on a positive attitude toward using DAT (affective attitude), in which 83 out of 100 participants (83%) were satisfied with the intervention, and 98 (98%) expressed good experiences. Seventy-eight (78%) understood how the intervention works, and 92(92%) could use the pill box, such as opening the device, refilling the pills, and recharging the box (intervention coherence). Eighty-four out of 100 (84%) participants reported improved adherence (perceived effectiveness), and they preferred to continue receiving reminder SMS (self-efficacy). We further found a few participants who reported experiencing difficulties while using DAT. Some participants reported experiencing TB-related stigma, others were not happy being reminded daily 12(12%), and other participants reported experiencing difficulties keeping the device at home 9(9%). Additionally, 30(30%) reported experiencing challenges with mobile network.

Comparison with Prior Work

Our findings support similar studies reporting on the acceptability of DAT among patients and healthcare providers [12], [13], [15], [24]. The potential benefit of DAT, such as its ability to monitor medication adherence or ease of use, was deemed valuable by patients and TB care providers. A study done in South Africa reported that the acceptability of DAT was highly associated with its ease in use among patients [12]. The real-time medication monitoring reports and feedback on adherence helped patients to understand their health condition and led to improved patient and care provider relationships [12], [24], [25]. In addition, it led to improved care practice and behaviour change among TB care providers. Many healthcare providers reported feeling more accountable for patient follow-up and motivating patients to adhere to the time of medication intake. Feedback on adherence counselling also generates a sense of care among patients, which has an impact on the psychosocial life of patients.

However, participants reported several challenges of DATs, such as incorrectly sending SMS due to internet failure, the large size of the pillbox and the existence of the reminder alarm, which led to fear of disclosure and, consequently, non-use of the device during travelling. Similar challenges have been reported by other studies [14], [26], which, if not well addressed, might contribute significantly to the non-use of DATs and less uptake of DATs [24]. TB care providers reported an increased

workload during the use of DATs. Similar findings were reported in a study done in China, where healthcare providers reported a moderate workload increase during DAT implementation [16]. However, this contradicts a study in India, which reported a decreased healthcare workload [24]. We found that the increased workload by healthcare workers was reported as a major concern in the setting with a shortage of care staff, mainly dispensaries and health centres. Larger facilities like hospitals reported a slight increase in the workload. In addition, some participants, 48(48%) stated that adherence report from the device was not shown nor utilised in their conversations with health workers. The health care provider was likelier to have little knowledge of the value of adherence reports as a tool for counselling. Regular training should be conducted to reinforce their understanding of the intervention for effective scale-up. Fear of TB stigma and unwanted disclosure should be considered for effective intervention scale-up.

Limitations

The study had certain limitations. One significant limitation was that, because of the COVID-19 pandemic, all exit interviews were conducted via phone calls, which posed challenges related to network connectivity and potential interruptions during the questioning process. Mitigation strategies were employed, such as recapping participant responses to ensure accurate information capture. Another limitation is the small sample size of the exit survey compared to the number of enrolled participants. This was influenced by a new public policy implemented in July 2021, where unregistered SIM cards were blocked, making it difficult to reach most participants. Nonetheless, the study found that the participants' characteristics were like those not interviewed. Additionally, the 59% of participants who were not reached due to the change of government policy, were not affected during the medication period. The change of government policy in SIM card registration took place when many of our participants had already completed the treatment follow-up and were waiting for the exit survey. In this case, the change in government policy impacted the exit survey process rather than the intervention itself.

This study has notable strengths that enhance its significance and scope. Firstly, we enrolled participants from all TB-providing facilities in the Kilimanjaro region, offering a comprehensive understanding of acceptability from a broader perspective. Notably, our research pioneers the investigation of the evriMED reminder pillbox's acceptability among TB patients in East Africa, providing valuable insights into acceptance. Additionally, using the Theoretical Framework of Acceptability (TFA) facilitated a robust understanding of acceptability in the evriMED reminder pillbox among TB patients.

Conclusion

Our study demonstrates the positive acceptance of digital adherence tools (evriMED) among patients and TB care providers for improving ant-TB drug adherence. While the potential acceptability of DAT is evident, addressing concerns related to mobile network, participants' preferences regarding the number of reminder SMS and providing adequate training and technical support to healthcare providers are critical for successful implementation. Future research should explore the impact of evriMED on large-scale implementation in different settings.

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Supplementary Files

Multimedia Appendixes

Table summarizing Exit survey findings.
URL: http://asset.jmir.pub/assets/39a50e11da59ab0b23df5285b4962112.pdf