Technology and its role in supporting Tuberculosis treatment adherence

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Systematic Review

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Abstract

Compliance with TB treatment has now become a problem that must be handled seriously because the high non-adherence rate will give a bad contribution to the success of TB treatment, including MDR-TB and also morbidity and mortality. Many innovations have been made to improve TB treatment adherence, one of which is using mobile-based technology. This article aims to explore the effectiveness of the technology used to improve treatment adherence in TB patients: types, ways of working, advantages, and limitations of each application. This is a systematic review through searching 3 databases, namely Scopus, WoS, and Science Direct. Some of the advantages in applying technology to improve TB treatment adherence are easy to use if you understand how to operate tools/applications are cost-effective because they reduce transportation costs in reaching remote areas or in conditions of transportation difficulties such as after a disaster, the use of this technology provides patient satisfaction in treatment and facilitates the involvement of the family/support system in the treatment of patients. Several things must be considered (limitations) of the technology to be used, including experts, patient knowledge and skills, economic condition, electricity availability, and whether the technology used will not increase the burden on patients related to the stigma of TB disease. We can conclude that the use of technology is indeed very good in supporting the improvement of TB treatment adherence, but the selection of this application must pay attention to the characteristics of the population as well as the advantages and limitations of each application.

Introduction

Tuberculosis (TB) is an infectious disease that causes the most deaths with a single infectious cause, can affect anyone. Until now, a quarter of the world's population has been infected with this disease, of which 44% came from Southeast Asia (WHO, 2020). Globally, the target of achieving TB treatment has not been achieved yet (WHO, 2020)(Byonanebye *et al.*, 2021), with a high rate of non-adherence to treatment in TB patients, will greatly affect the increase in the number of MDR-TB (Multi Drugs Resistant). The factors that influence the level of adherence of TB patients in treatment are lack of knowledge, economic factors, stigma, lack of social support, drug side effects, long duration of treatment. (Gebreweld *et al.*, 2018), disbelief that medicine can heal (Azizi, Karimy, and Salahshour, 2018), difficult access to treatment facilities (Ruru *et al.*, 2018) and lack of family support as supervisors to help monitor patients taking medication (Chen *et al.*, 2020).

Compliance with taking medication for TB patients can be improved through the presence of a drug-taking supervisor (DTS). DTS can come from family members, closest relatives, or health workers who are committed and have time to supervise patients during the treatment period, but DTS also have limitations, namely: busyness, boredom and the number of people willing to become PMOs is decreasing. To overcome this, technology has been developed that aims to improve patient compliance with taking drugs and to keep patients continuing treatment according to the established program. Most of these smartphone-based applications have been tested directly in the community with varying effectiveness (Wang *et al.*, 2019)(Iribarren *et al.*, 2021). The use of this technology is not only aimed at patients but

also at health workers who serve TB patients (Patel *et al.*, 2020). The applications developed are diverse and have their respective approaches so that each application has its advantages and disadvantages (Byonanebye *et al.*, 2021). A lot of research has been done to measure the effectiveness of each application, therefore this article will discuss it as a whole.

Objective

Explore the effectiveness of the technology used to improve treatment adherence in TB patients: types, ways of working, advantages, and limitations of each application.

Method

This article is a systematic literature review that focuses on the use of technology in improving treatment adherence in TB patients. The method used is Literature Review. The journals taken are international reputable journals with appropriate themes. The databases used in this literature search are Scopus, Web of Science, and Science Direct. In the article search, the author uses the keywords: Technology, Tuberculosis, Adherence. After conducting a literature search in 3 databases with the keywords above, the selected articles are published in the last 3 years (2019, 2020, and 2021) and full research articles (not literature reviews). The researcher will then make a selection based on the title, then based on the abstract, and finally the full-text selection. The results of the selection will be used as articles to be reviewed. The data were analyzed descriptively by the research objectives that have been set.

Result

The use of technology to monitor TB treatment adherence is not a very new thing, but many innovations have been developed to make this technology increasingly able to answer the need to improve TB patient treatment adherence. The table below is a summary of the applications that have been evaluated through research.

Table 1

Application to improve TB treatment adherence
(advantages and limitations)

No	Name of Application	Ways of working	Advantages	Limitations
1.	VDOT (video directly observed treatment) (Dos Santos <i>et al.</i> , 2019), (Sekandi <i>et al.</i> , 2020), (Nguyen <i>et al.</i> , 2021), (Do <i>et al.</i> , 2019), (Kumar <i>et al.</i> , 2019)	Monitor daily TB drug intake in patients via video. Patients send videos if they take drugs through the application and will be checked by officers.	Easier and cheaper, save time in implementation. Increase patient satisfaction and compliance.	<ul style="list-style-type: none"> • Requires professional skills to check daily drug intake • Patients must be able to use their mobile phones to make videos and send them • Need to consider the language used in the application so that it is easily understood by patients
2.	Digital medication monitor and SMS (Musiimenta <i>et al.</i> , 2019), (Zaidi and Wells, 2021),	The machine will record when the medicine container (pillbox) is opened and sends a reminder message to take medicine to patients and drug-taking companions	Easy, inexpensive, motivating patients, and effective in increasing patient adherence to TB treatment	<ul style="list-style-type: none"> • Messages are not sent if the HP is out of power or the connection is interrupted. • Patients will forget to take their medicine if the SMS is not read • There is a concern that other people will know if he has TB if he reads SMS

No	Name of Application	Ways of working	Advantages	Limitations
3.	99 DOTS (Cross <i>et al.</i> , 2019), (Thomas <i>et al.</i> , 2020), (Cattamanchi <i>et al.</i> , 2021), (Patel <i>et al.</i> , 2020)	It is a combination of packaging for TB drugs and cellphones. Patients will find a different phone number every day on the medicine package that the patient must call if they have taken the medicine (free of charge)	Using very simple and inexpensive technology.	<ul style="list-style-type: none"> • The patient must be able to read • Patients can forget • There must be a willingness on the part of the patient to make a phone call, otherwise, the patient may be considered non-adherent to treatment • There is a need for other evaluations to ensure patient compliance • Need a good understanding of the patient to be involved in this program
4.	The Drone Observed Therapy System (DrOTS) (Nouvet <i>et al.</i> , 2019), (Bahrainwala <i>et al.</i> , 2020)	Integrate innovative technology bundles including drones, digital compliance monitoring technology and educational videos to support mobile-based TB control.	<ul style="list-style-type: none"> • Excellent for use in remote areas, allowing remote monitoring and delivery of medical supplies to hard-to-reach areas • Save money for transportation 	<ul style="list-style-type: none"> • Requires high expertise to be able to adopt this technology, both from health workers and from patients.

No	Name of Application	Ways of working	Advantages	Limitations
5.	The Medication Event Reminder Monitor (MERM) (Manyazewal <i>et al.</i> , 2020), (Thomas <i>et al.</i> , 2021), (Drabarek <i>et al.</i> , 2019)	Pillbox that provides warnings (Audio and Visual) when medication should be taken and facilitates remote monitoring of medication adherence.	<ul style="list-style-type: none"> • Audio and visual reminders improve medication adherence • Remote monitoring reduces clinic visit times, making it easier for patients and reducing the workload for Healthcare workers • Labeling of drugs makes it easier for patients to take the right drugs • Facilitate family involvement • Patients feel more cared for by the health system 	<ul style="list-style-type: none"> • Less durable cardboard construction • The large size makes it difficult to move and store it, making it difficult for people who work all day long. • Need to pay attention to stigma and disclosure of the patient's diagnosis if it is known by others (social influence) • Inaccurate use of MERM due to lack of understanding during counseling. • The data recorded by the pillbox does not always accurately reflect usage patterns
6.	EMM (Elektronik Medication Monitor) (Wang <i>et al.</i> , 2020)	The portable plastic box can record every time the box is opened, thus indirectly recording patient compliance with medication	<ul style="list-style-type: none"> • Easy to use and easy to carry 	<ul style="list-style-type: none"> • Data recorded by the tool does not accurately describe patient compliance • There is a need for more detailed guidelines on the use of this tool • patient adherence to TB treatment is low

Discussion

The use of mobile/smartphone-based technology has been shown to provide a significant increase in TB treatment adherence. Based on the results above, it can be seen that there are 6 types of methods to improve patient compliance, namely: VDOT (video directly observed treatment), Digital medication monitor and SMS, 99 DOTS, The Drone Observed Therapy System (DrOTS), The Medication Event

Reminder Monitor (MERM) and EMM (Electronic Medication Monitor), although based on research results show that the effectiveness of each tool is different depending on population characteristics and also local socio-cultural, Some of the advantages in applying technology to improve TB treatment adherence are: easy use if you understand how to operate tools/applications, are cost-effective because they reduce transportation costs in reaching remote areas or in conditions of transportation difficulties such as after a disaster, the use of this technology provides patient satisfaction in treatment and facilitates the involvement of the family/support system in the treatment of patients.

Apart from the benefits, several things must be considered (limitations) of the technology to be used, including whether the tool/application used will require experts with special abilities, the patient's ability to run the application in terms of knowledge, skills, and economically (whether the patient can afford to buy a compatible cellphone/smartphone for the application. Another factor that must be considered is how to respond to the condition if the patient runs out of power/damage to the cellphone, for example by automatically diverting messages to the HP support system (people closest to you)), so that the reminder to take medication will not be interrupted, it is also added how to prepare patients and the support system to really understand the proper use of the application, and the need for a detailed manual on the application manual. menu research suggests that the patient may forget his or her treatment plan if there is no reminder. The last thing to consider is whether the application used will exacerbate TB stigma in the community, related to disclosure of TB status due to reminders that are known by others.

Conclusion

The use of technology is indeed very good in supporting the improvement of TB treatment adherence, but the selection of this application must pay attention to the characteristics of the population as well as the advantages and limitations of each application.

Declarations

Conflict of Interest: I/we certify that there is no actual or potential conflict of interest in relation to this article.

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Figures

Figure 1

Diagram 1 Article Selection Flow (PRISMA 2020)