The Global Use of Mobile Based Applications in Tuberculosis (TB) Care: A Systematic Review Protocol

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Protocol

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Abstract

Background: Tuberculosis remains one of the world's deadliest communicable diseases despite being preventable and curable. The use of mobile phones has increased worldwide over the past decade and this has created opportunities to use mobile phones as intervention tools in health care including in promoting prevention, treatment and adherence monitoring and evaluation. However, the potential of information and communication technologies (ICTs) to fight TB remains largely untapped. Many countries are still researching further on how to use eHealth and mHealth effectively in the fight against TB. This systematic review protocol seeks to explore the mobile based applications that are being used in TB care globally and will provide crucial information to inform programming for the national TB programme, bringing the focus on interventions that really influence improving TB outcomes.

Methods: A systematic review will be conducted through online searches using comprehensive Medical Subject Headings (MeSH) terms in various combinations. Information sources will include the Cochrane Central Register of Controlled Trials, Medline, Google Scholar and PubMed. The review will be done by 2 reviewers who will resolve discrepancies through consensus. Narrative data synthesis will be done.

Discussion: Analysis of the selected studies will provide information on the use of the mobile applications in TB care globally. Conclusions will be based on the best available scientific evidence. The results will provide crucial information to inform programming for the national TB programme, bringing the focus on interventions that really influence improving TB outcomes. This will result in the effective use of resources by channelling them where there is the greatest impact in terms of reducing morbidity and mortality due to TB in Zimbabwe.

Systematic review protocol registration: PROSPERO CRD42020154793

Background

Tuberculosis (TB) is an infectious disease caused by the bacillus *Mycobacterium tuberculosis*. Although the bacteria usually affect the lungs, they can also attack any part of the body such as the kidney, spine, and brain [1]. Tuberculosis that affects the lungs is referred to as pulmonary TB whilst TB affecting other parts of the body is known as extra pulmonary TB. Pulmonary TB is spread by droplet infection when an infected sputum positive infected person sneezes or coughs. The symptoms of TB infection include a cough that lasts 3 weeks or longer, pain in the chest, coughing up blood or sputum (mucus from deep inside the lungs), weakness or fatigue, weight loss, loss of appetite, chills, fever and night sweats [2, 3]

According to the World Health Organisation (WHO) sputum smear microscopy is the widely used methods to diagnose Tuberculosis worldwide. However, this method only detects half the number of TB cases and does not detect drug resistance. On the other hand, the use of the rapid test Xpert which provides results within 2 hours has been on the increase since 2010. This test detects TB and Rifampicin resistance. Currently this test is being recommended by WHO as the initial diagnostic test for all people with signs and symptoms of TB [1]. Tuberculosis is treatable and curable, with active drug susceptible TB

treated with a standard 6-month course of 4 antimicrobial medicines. However, adherence is always an issue during treatment and patients require lots of support in terms of information and monitoring [1].

According to the Global TB Report 2018, TB is still one of the top ten causes of death and is now the leading cause from a single infectious agent, ahead of HIV and AIDS [4].In addition, an estimated 9.6 million people developed TB and 1.5 million died from the disease in 2014 [2.3].Tuberculosis is a leading killer of people living with HIV resulting in a third of all HIV-related deaths globally [1].People with HIV are 19 times more likely to develop active TB disease than people without [1].This is because the combination of HIV and TB is deadly, with each speeding the others progression. In 2018 approximately 251 000 people died of HIV associated TB and 862 000 new cases of TB among HIV positive people were recorded, with 72% of these living in Africa. In 2015 TB was ranked alongside HIV as a leading cause of death [1, 2, 3]. It is estimated that worldwide about 10 million people developed TB in 2017. The majority of these were men (5.8 million) followed by women [3.2] and the remaining 1 million were children. Africa had the largest burden of TB with 281 cases per 100 000 population compared with a global average of 133 cases per 100 000 population [1].

In Zimbabwe TB is among the top 10 diseases of public health importance and is a leading cause of death among adults. The country had an estimated TB incident rate of 278 per 100 000 population in 2015 [3]. The treatment success rate of 80% in 2015 (2), is still below the global target of 87%. Main challenges faced by the country in TB control are the emergence of drug resistant TB (DR), high TB death rates, high defaulter rates and non-evaluation of treatment outcomes for TB patients [5, 6].

Several treatment adherence interventions for TB exist to support patients. These include the provision of education and counselling on the disease and treatment ; offering a package of treatment adherence intervention for patients on TB treatment in conjunction with the selection of a suitable treatment administration option; material support to patients (for example food, transport, living allowance, housing or financial bonus); psychological support to patients (for example counselling sessions or peer-group support); communication with patients (for example home visit, SMS or phone call); digital medication monitor (a device to measure time between openings of the pill box and/or send SMS or audio reminders) ; staff education (e.g. education, chart or visual reminder, educational tool and desktop aid for decision-making and reminder). In addition, effective treatment options for each patient may be offered and these include community or home-based treatment, over facility-based treatment or unsupervised treatment; treatment administered by trained lay providers or health-care workers and the use of digital health technology such as SMS or phone calls, medication monitors, and video observed treatment – as a replacement for in-person directly observed treatment – when conditions of technology and operation allow [7].

The World Health Organisation has noted that the potential of information and communication technologies (ICTs) to fight TB remains largely untapped. Many countries are still researching further on how to use eHealth and mHealth effectively in the fight against TB. A lot of work still needs to be done to maximise the impact of these methods for monitoring treatment in people with TB [8].

The use of mobile phones has increased worldwide over the past decade and this has created opportunities to use mobile phones as intervention tools in health care including in promoting prevention, treatment and adherence monitoring and evaluation [9, 10]. The effectiveness of such client centred applications needs to be known as it will improve client care. A systematic review of the effectiveness of such patient centred applications in TB Care is important to inform future programming for the national TB programme, bringing the focus on interventions that really influence improving TB outcomes. This will result in the effective use of resources by channelling them where there is the greatest impact in terms of reducing morbidity and mortality due to TB in Zimbabwe.

The research question seeks to explore the mobile based applications that are being used in TB care globally and the implications of their use. The systematic review aims to summarize the literature on mobile based applications used in TB care globally, with specific objectives to: Determine the types, the scope, the target users and the effectiveness of the mobile TB applications in TB Care globally.

Methods

The new Cochrane guidelines for systematic reviews of Interventions will be followed [12].

A comprehensive online search will be conducted to identify potentially eligible studies. Studies not found in the online domain will not be included. The eligibility criteria for the review will include:

- Peer reviewed and published articles
- Quantitative and qualitative methodologies
- Studies with mobile TB patient applications as interventions
- Studies clearly outlining study outcomes
- Studies written in English (due to limitations in translating capacity)

Data Sources

Electronic databases that will be searched are the Cochrane Central Register of Controlled Trials, Medline, Google Scholar, PubMed The World Health Organisation International Trials Registry platform (Clinicaltrials.gov), mHealth Alliance, mHealth in Low Resource Settings database and the Journal of Telemedicine and e-Health.

Search Strategy and Screening

The search will be performed by 2 reviewers, the first author and another doctoral student who will have co-authorship of the paper. A wide range of medical subject heading (MeSH) terms will be used in various combinations and these include: ‘mobile based applications’, ‘mobile apps’, ‘digital apps’, ‘Tuberculosis Care’, ‘TB Care’ and ‘Tuberculosis’. The first-stage screening of titles and abstracts will identify potentially

eligible studies for original research in which the title and abstract suggest the use of mobile based TB applications to eliminate articles not within the scope of the systematic review. Reasons for excluding potentially eligible studies will be listed. The second stage screening will entail review of full texts if selected studies using pre specified eligibility criteria. Reference lists of full text studies assessed for inclusion will be used to identify more studies. If the two reviewers disagree, discussion and consensus will be employed to reconcile the differences. A Preferred reporting items for systematic reviews and meta analyses (Prisma) flow diagram will be developed at the beginning of the data search.

Data Extraction, Management and Synthesis

References will be managed using Zotero or Endnote. The 2 reviewers will independently extract data using an electronic excel form designed by the first author to collate information on selected variables. Data variables are shown in Table 1. The first author will enter the data and the second reviewer will check for errors. Discrepancies will be settled through discussion and consensus. All the data obtained via database searches will be taken as is, no follow-up will be done with authors. Narrative synthesis will be done in accordance with the Cochrane Handbook of Systematic Reviews for Interventions [11].

Table 1
Data Items / Variables

Variable	Definition
Title	Study title in full
Objectives	Set objectives for the study
Research Questions	Research questions for the study clearly articulated
Registration status	Whether study was registered or not, as is required for RCTs
Study design	Clearly state the specific type of study that was carried out
Year study carried out	Dates and year study was carried out
Intervention	Type of intervention used in the study
Time taken to develop intervention	Amount of time devoted to developing the intervention
Mechanism of action	Description of how the intervention operates (method of delivery)
Target audience	State the people targeted by the intervention and how these were selected
Intervention scope	Outline clearly what the intervention can or cannot do
Intervention limitations	Describe shortfalls of the intervention
Challenges faced in conducting the study	Outline any challenges that were faced during the study, with special reference to the accessibility of the intervention in limited resource settings
Study outcomes	Record all study outcomes related to patient care, knowledge, levels of adherence, cure rate, treatment completed, death rate, defaulter rate and loss to follow up
Follow up studies	Note any follow-up studies conducted in response to findings of the reviewed studies
Sustainability of intervention in low resource settings	Outline issues of feasibility of sustainably rolling out the intervention as part of routine patient care and support especially in low resource settings
Funding Sources	List of all sources of funding for the study
Other information	Include any other relevant information

Assessment of Quality of Selected Studies

A standard quality appraisal checklist for randomised controlled trials and qualitative studies adapted from the Critical Appraisal Skills Programme (CASP) will be used to assess the overall quality of the selected studies [12]. Each study will be evaluated by looking at its: Methodological quality- the extent to which the design and conduct of the study are likely to have prevented systematic errors (bias) ;

Precision- a measure of the likelihood of random errors ; External validity- the extent to which the results are generalisable or applicable to a particular target population .

Assessment of Risk of Bias in Selected Studies

The Cochrane Risk of Bias Assessment tool [13] will be used to assess the risk of bias in the selected studies as follows:

- Selection bias: evaluation of the random sequence generation (RCTs) and allocation concealment (RCTs)
- Performance bias: assessing the blinding of study participants and/or investigators (all studies)
- Detection/Outcome bias: Assessment of who was aware of the intervention
- Attrition bias: Assessment of availability of outcome data for all
- Outcome reporting bias: Assessment of the extent to which the data was reported based on the protocol (all studies)

The studies will be scored as having high, low or unclear risk of bias.

Discussion

The results of the systematic review will provide crucial information to inform programming for the national TB programme, bringing the focus on interventions that really influence improving TB outcomes. This will result in the effective use of resources by channelling them where there is the greatest impact in terms of reducing morbidity and mortality due to TB in Zimbabwe.

Abbreviations

AIDS : Acquired immunodeficiency syndrome

CASP : Critical Appraisal Skills Programme

DARE : Database of Abstracts Reviews of Effects

DR : Drug resistant

HIV : Human immunodeficiency virus

TB : Tuberculosis

PRISMA : Preferred reporting items for systematic reviews and meta analyses

Declarations

Ethics approval and consent to participate

Not Applicable

Consent for publication

Not applicable

Availability of data and materials

Data sharing is not applicable in this article as no datasets were generated or analyzed.

Competing interests

The authors declare no competing interests

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Authors' contributions

All the authors contributed in conceiving and design of the protocol. The manuscript has been read and approved by all authors.

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Conflicts of Interest

The authors declare no competing interests

Amendments

All-important protocol amendments will be documented, tracked and dated

Sources of Support

Technical support for the review will be provided by the co-authors. The UKZN Library will provide support to access and search the chosen databases

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