

UNIVERSITI TEKNOLOGI MARA

**GAMIFIED-REALITY-VIDEO-
OBSERVED-THERAPY (GRVOTS)
MOBILE APPS DEVELOPMENT AND
ITS IMPACT ON TUBERCULOSIS
TREATMENT ADHERENCE AMONG
WORKING AGE POPULATION**

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ABSTRACT

The success rate of tuberculosis (TB) treatment in Malaysia remains below the recommended World Health Organization target of 90% despite implementing Directly Observed Therapy Short Course (DOTS), a physical drug monitoring system, since 1994. With increasing numbers of patients with TB in Malaysia defaulting on treatment, exploring another method to improve TB treatment adherence is vital. Using gamification and real-time elements via video-observed therapies in mobile apps is one such method expected to induce motivation toward TB treatment adherence. The objectives of the study were to document the process of designing, developing, and validating the gamification, motivation, and real-time elements in the Gamified Real-time Video Observed Therapies (GRVOTS) mobile app, to assess the usability evaluation of the GRVOTS mobile apps and to determine the impact of Gamified Real-time Video Observed Therapy (GRVOTS) mobile apps on patient medication adherence and motivation. This study was conducted in two phases. Phase one is the development and validation phase. A modified nominal group technique via a panel of 11 experts was used to validate the presence of the gamification and motivation elements inside the app, which were assessed based on the percentage of agreement among the experts, followed by the usability study done on 65 numbers of patients and 11 supervisors. In phase two, the impact of the GRVOTS mobile apps was tested in a single-arm intervention study involving 71 patients. The analysis was done using the percentage of agreement among the experts for the modified NGT, the independent t-test for the usability study, and RM ANOVA for the single-arm arm intervention study at three-time intervals. The GRVOTS mobile app, which patients, supervisors, and administrators can use, was successfully developed. For validation purposes, the gamification and motivation features of the app were validated as they achieved a total mean percentage of agreement of 97.95% (SD 2.51%), which was significantly higher than the minimum agreement score of 70% ($P < .001$). The mean usability score was 74.73 (SD 14.64), indicating that GRVOTS is a usable mobile app that can be used to replace the currently employed Physical Direct Observed Therapy Short Course (DOTS). The single-arm intervention study showed a significantly higher treatment adherence score of 90.87% than the standard score of 80%, with a mean difference of 10.87 (95% CI: 7.29, 14.46; $p < 0.001$). The participants' medication adherence scores, as evaluated by MyMAAT, and their intrinsic motivation scores, measured by IMI scores, significantly improved across three-time intervals before (T0), after 1 month (T1) and after 2 months (T2) of GRVOTS mobile apps usage. . The IMI Interest domain exhibited the highest mean difference of 19.76 (95% CI: 16.37, 21.15; $p < 0.001$), while MyMAAT scores displayed the lowest mean difference, with an increase of only 5.38 (95% CI: 2.67, 8.10; $p < 0.001$) from T0 to T2. In conclusion: A validated GRVOTS mobile app that contains gamification and motivation elements is usable as a user-friendly tool for DOTS monitoring. These mobile apps also can encourage and enhance motivation and medication adherence among TB patients.

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CHAPTER ONE

INTRODUCTION

1.1 Research Background

Over 10 million people have been reported to develop Tuberculosis (TB) each year globally (WHO, 2020). In Malaysia, from 2010 to 2015, TB cases increased from a notification rate of 68.4 cases to 79.6 cases per 100,000 population (MOH, 2016b). In addition, according to a model projection by (Ismail, 2017) the observed and projected TB incidence cases in Malaysia from 1990 will reach up to 300,000 in 2030.

In Malaysia, Direct Observed Therapy Short Course (DOTS) has been implemented since 1994 and resulted in a treatment success rate for TB from 76% in 2013 to 81% in 2017(NSPTB 2015-2020); however, it has remained below the recommended WHO target, which is 90%. In addition, we can see an increase in the prevalence of TB treatment default in Malaysia, which ranged from 4.0% (2010) to 4.8% (2015) and increased to 5.6% in the latest study (Liew et al., 2015). The increasing number of TB cases indicates that issues and challenges still need to be tackled and addressed at all levels.

The increasing number of Tuberculosis cases has become the primary concern, as it can lead to the country's loss, as patients with incomplete treatment will amplify the total cost of TB treatment to be 4-5 times more than an average cost of RM 901.63 per patient (Fun, 2016). Additionally, TB patients' poor adherence to their treatment and medication can worsen their TB situation and pave the way to increasing multidrug resistance (MDR) (Gugssa Boru, Shimels, & Bilal, 2017). Furthermore, the compliance rate of DOTS among the working-age population was only 91% in 2013, below the national goal of 93-100% (MOH, 2012).

Looking deeper into TB defaulter characteristics, most of them are in the working-age population. Patients from urban areas also have higher odds of 1.2 for unsuccessful treatment than rural patients (Liew et al., 2015; Tok et al., 2020). In addition, according to one qualitative study by (Mohd Shariff, Shah, & Kamaludin,