







RESEARCH ARTICLE

# Acceptability of video observed treatment vs. directly observed treatment for tuberculosis: a comparative analysis between South and Central India [version 1; peer review: 1 approved with reservations]

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## Abstract

### Background

Directly Observed Treatment (DOT) is a requirement in the management of Tuberculosis (TB) globally. With the transition from alternate day treatment to daily treatment in India, monitoring treatment adherence through DOT is a logistic challenge. The pervasiveness of mobile phones in India provides a unique opportunity to address this challenge remotely. This study was designed to compare the acceptability of mobile phones for antitubercular treatment (ATT) support in two distinct regions of India.

### Methodology

This was a cross-sectional exploratory study that enrolled 351 patients with TB, of whom 185 were from Bangalore, South India, and 166 from Ujjain, Central India. Trained research assistants administered a pretested questionnaire comprising demographics, phone usage patterns, and acceptability of mobile phone technology to support treatment adherence to TB medicines.

### Results

The mean age of the 351 participants was 32±13.6 years of whom 140 (40%) were women. Of the participants, 259 (74%) were urban, 221 (63%) had >4 years of education. A significantly greater number of participants were newly diagnosed with TB and were in the intensive phase of treatment. Overall, 218 (62%) preferred vDOT over DOT.

## Open Peer Review

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There was an overall difference in preference between the two sites which is explained by differences in socio-economic variables.

### Conclusion

Mobile phone adherence support is acceptable to patients on Antitubercular treatment ATT with minor variations in design based on demographic and cultural differences. In India, the preference for voice calls over text messages/SMS while designing mHealth interventions cannot be ignored. Of importance is the preference for DOT over vDOT in central India, unlike South India. However, in time, the expanding use of mobile technology supplemented with counseling, could overcome the barriers of privacy and stigma and promote the transition from in-person DOT to vDOT or mobile phone adherence monitoring and support for ATT in India.

### Keywords

DOT, mHealth, Treatment adherence, Tuberculosis, video-based intervention

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## Introduction

The End TB Strategy of the World Health Organization envisions a world free of tuberculosis (TB) related deaths, disease and suffering by the year 2035<sup>1</sup>. The World Health Organization (WHO) adopted DOTS - Directly Observed Treatment, Shortcourse - as a principal component of its global TB control strategy in 1994 based on the success of the directly observed therapy (DOT) in increasing treatment completion rates and preventing drug resistance.<sup>2</sup> It involves the active monitoring and record keeping of each and every dose of medicine by an 'observer' who is acceptable to both the patient as well as the health system<sup>3</sup>.

India contributes to a quarter<sup>4,5</sup> of the 10 million people around the globe<sup>4</sup> with Tuberculosis (TB). DOTS appeared to be the ideal solution that addressed the key drawbacks that were identified by the evaluation of the National Tuberculosis Control Programme. It focused on fostering political will for TB control, reliance on quality sputum examination for diagnosis, uninterrupted supply of antitubercular drugs, Directly Observed Treatment Short - course (DOTS) and, a regular monitoring system<sup>6</sup>.

DOTS is one of the tenets of the RNTCP (Revised National Tuberculosis Control Programme), which became operational in 1997. In the RNTCP, DOT centres serve as a link between the programme and the beneficiaries on a local level<sup>7</sup>. DOTS has undoubtedly resulted in encouraging progress in India's TB case management since it was adopted by the RNTCP. Despite this, there are still obstacles to be overcome to achieve the RNTCP's goals<sup>8</sup>.

In Indian literature on nonadherence to ATT, most studies indicate that patients who are put on the program do not go for follow-up. Some of the major problems associated with DOT include the resource intensive nature on a health system level and the large variations in its rigor in different settings. DOTS faced specific obstacles such as a need for medications to be taken in the clinic, limited privacy, potential stigma, and fewer chances of being able to speak with clinicians., length of treatment, drug related side - effects and pill burden. The large geographic distances demand long travel times and challenging logistics, as the timing of the home-based DOT has to be adjusted to suit both the patient's and the health worker's schedules. Some patients have reported that daily home visits compromise confidentiality, and they are perceived as humiliating and stigmatizing<sup>9-14</sup>.

While DOTS has been credited with saving 7.75 million lives between 1997 and 2017, the prolonged duration of Antitubercular Treatment (ATT) unfortunately leads to suboptimal adherence whether directly observed and self-administered<sup>15</sup>. Annually, 25% of the patients with TB in India do not complete treatment. Suboptimal adherence as well as discontinuing treatment could result in resistance to ATT involving single or multiple drugs<sup>16</sup>. Drug resistance comes with its own challenges of longer treatment durations, higher rates of mortality and morbidity and economic impacts<sup>17</sup>.

Based on WHO guidelines with newer evidence against the efficacy of alternate day ATT<sup>18</sup>, currently, the fixed dose, daily dosing of ATT under the National Tuberculosis Elimination Programme (NTEP) has provided scope for patients to have a family DOT provider. This strategy has many advantages when compared to facility-based DOT - for the patient this would mean saved time, travel costs and prevention of loss of wages<sup>19</sup>, for the healthcare system it requires less manpower, money and time<sup>20</sup>.

Since the advent of mobile phones and its widespread coverage in India (the total mobile telephone subscriber base stood at 1166.02 million in September 2021)<sup>21</sup>, remote DOT has become a possibility, allowing health systems to free up resources, patient time, and maintain patient follow-up and adherence at a lower cost. The epidemic landscape of TB and the low cost of mobile technology provides sufficient appeal to explore the potential of the technology for TB in India<sup>22</sup>.

New technological advancements have attempted to make treatment and adherence support more person-centered in an attempt to overcome these obstacles. Video observed treatment (vDOT) is a variation of DOT in which dose administration is monitored by real-time (synchronous) or recorded (asynchronous) video upload<sup>23</sup>.

vDOT adoption has been proven to be acceptable and feasible in programmatic settings in a number of countries<sup>24-28</sup>. These studies showed that vDOT was feasible and resulted in high treatment adherence even in resource-limited setting<sup>27,29</sup>. vDOT has shown to be helpful in the management of patients with drug - resistant strains of TB, who have poorer treatment outcomes and need more frequent monitoring.<sup>27,28</sup>. In the studies wherein in-person DOT was compared against vDOT performed in real time, treatment completion and mortality rates were not statistically different<sup>26,28</sup>. Based on the evidence from these studies, the WHO recommended video observed therapy could replace DOT if video communication technology is readily available and can be configured and controlled by practitioners and patients<sup>30</sup>.

With technology becoming increasingly available in resource-constrained areas, vDOT has been suggested as a way to improve patient-specific treatment options and increase flexibility. But it has not been formally tested in India despite ideal setting for such an intervention. Prior to implementing an RCT, we planned to explore patient preferences for vDOT versus DOT. Therefore, this cross-sectional survey was done at two sites in India with the objective to assess and compare the acceptability of mobile phone technology in the management of TB in two sites in India - Central India with South India

## Methods

### Study sites

Two districts were selected from the country, Bangalore Urban, Karnataka, South India and Ujjain, Madhya Pradesh, Central India. Madhya Pradesh (MP) has a population of 70 million of whom 20% are tribal and a literacy rate of 69% while Karnataka

has a population of 60 million of whom 7% are tribal and a literacy rate of 75%<sup>31</sup>. The mobile subscriber base in both states nearly equals their population<sup>32</sup>. The TB notification rate in MP is 167 and in Karnataka it is 123 per 100,000 population<sup>33</sup>.

Participants enrolled and received treatment either through the RNTCP or through private providers. In Bangalore, patients were enrolled at St. John's Medical College Hospital, a 1250 – bedded private tertiary level healthcare and teaching facility. The hospital also has a DOTS centre, established through a public-private partnership. Patients with TB are free to avail treatment through the DOT centre, at no cost or through the hospital's pharmacy, for a cost. The public health-care system through which participants were enrolled comprised urban health centres that cater to the general health needs of the population of the city and implement all public health programs including the RNTCP.

In Ujjain, the participants were enrolled through two private tertiary hospitals, district tuberculosis hospital, two government civil hospitals, one government polyclinic, private tertiary hospitals and district tuberculosis hospitals. These hospitals and clinics deliver TB care services through their respective DOT centres. Government civil hospital and polyclinic only run DOTS service (with no TB care facility). Additionally home visits were also done to contact study participants

Patients who were seriously ill or those who did not understand the purpose of the study were excluded.

### Study design

This was a cross-sectional exploratory study that enrolled 351 patients with TB through consecutive sampling between February 2016 and December 2017. Of those enrolled, 185 were from Bangalore Urban and 166 from Ujjain.

After informed consent, trained research assistants administered a questionnaire that comprised demographic variables, phone ownership and usage patterns, acceptability of mobile phones in the management of TB, preferred components of mobile phone support and suggestions for newer applications.

### Data analysis

Data was managed and analysed using IBM SPSS version 24. The frequencies, means, medians and standard deviations were derived. The outcome variables assessed were preference for voice calls vs. SMS for adherence support and preference for video DOT vs. DOT for treatment monitoring. Bivariate associations were assessed between demographics, clinical details, phone usage and preference-based variables using Chi Square tests and unadjusted risk ratios. Variables with associations with the outcome, a p-value  $\leq 0.20$  were included in a logistic regression model. A p value of  $< 0.05$  was considered significant.

### Ethics statement

Data from two independent studies was combined for this study. Institutional Ethical Clearance was obtained from St. John's Medical College, Bangalore (IEC no 342/2016) and

RD Gardi Medical College, Ujjain (IEC no 68/2016) for each study. Written informed consent was obtained from all study participants after adequate explanation and providing them with a 'Patient Information Sheet' prior to administering the questionnaire.

## Results

### Demographics

Of the 351 participants, 185 were from Bangalore and 166 from Ujjain. The median age of the participants was 32 (25 – 45.5) years, most were married (69%) and resided in an urban locality (74%). Over two-thirds had  $>4$  years of formal schooling (63%), 38% were literate in English and most were newly diagnosed cases (78%) of pulmonary tuberculosis (60%). On comparing the socio-demographic characteristics between the two sites, the study participants differed significantly with respect to place of residence, education, employment status, category of treatment and site of infection. (*Table 1*)

### Mobile phone description and usage

Overall, 281 (80%) participants used mobile phones, of whom 42% (119) owned a smart phone. Of all those who used mobile phones, 51 (18%) participants shared their mobile phones with their family. A higher proportion of participants from Ujjain had access to a smartphone, and were familiar with using functions such as SMS, the alarm and camera, as compared to those from Bangalore. The educated and employed participants were four times [Adjusted OR=3.937(2.028-6.802) and 3.703 (2.028-6.802), respectively] as likely as the non-educated and unemployed participants to use a mobile phone. Participants who were younger [3.8 (2.1-6.9)], educated [5.295 (3.005-9.329)], and employed [3.469 (1.973-6.098)] were more likely to use mobile phones. The associations remained statistically significant even when introduced onto a logistic regression model(*Table 2 & Table 3*).

### vDOT vs. DOT

Among all the participants, 218 (62.1%) preferred vDOT over DOT. Of those who preferred vDOT, 112 (51%) felt that it saved time and money, 17 (8%) felt it avoid missing their doses, while 28 (13%) believed that it would avoid repeated visits to the DOT centre. Of those who preferred DOT over vDOT, 70 (53%) did not know how to record videos; nine (7%) considered that the care and support by visiting the health care professional was better and eight (6%) were afraid that their videos could be leaked to the public. Of the 218 participants that preferred vDOT, 142 (77%) were from the Bangalore and 76 (46%) from Ujjain. Those who were from Ujjain, did not receive any formal education and did not have access to a mobile phone were more likely to prefer DOT over vDOT and these associations remained statistically significant even after being introduced into a logistic regression model. (*Table 4*)

## Discussion

Despite the availability of effective treatment and advances in public health, the elimination of TB remains a challenge that demands a multifaceted approach. In the backdrop of the COVID – 19 pandemic the hard-won gains of the TB programmes

**Table 1. Comparison of demographic and clinical characteristics between participants from Bangalore and Ujjain (n=351).**

	Total (n=351)	Bangalore (N=185)	Ujjain (N=166)	P-value
<b>Age(years)</b>				
Median (IQR) (n=348)	32 (25-45.5)	32 (26-45)	32.5 (24-50)	0.252
<b>Sex</b>				
Male (n=351)	211 (60%)	114 (62%)	97 (58%)	0.543
<b>Marital status</b>				
Married (n=351)	241 (69%)	123 (66%)	118 (71%)	0.354
<b>Residence</b>				
Rural (n=351)	92 (26%)	64 (34%)	28 (17%)	<0.001
<b>Formally educated*</b>				
Educated (n=351)	221 (63%)	145 (78%)	76 (46%)	<0.001
<b>Literate in English</b> (n=351)	135 (38%)	69 (37%)	66 (40%)	0.636
<b>Employment status</b>				
Employed (n=351)	189 (54%)	109 (59%)	80 (48%)	0.044
<b>Type of patient</b>				
New case (n=351)	273 (78%)	159 (86%)	114 (69%)	<0.001
<b>Type of TB</b>				
Pulmonary TB (n=351)	210 (60%)	98 (53%)	112 (68%)	0.006

**Table 2. Usage of mobile phones and its association with demographic and clinical characteristics (n=351).** LR Model p value <0.001 [Forward Stepwise (Conditional) method]; Nagelkerke R square: 0.264 (step 3); -2 Log likelihood: 286.649 (step 3).

n=351	Mobile use: No (n=70)	Mobile use: Yes (n=281)	p value	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
<b>Site</b>					
Bangalore	34 (18%)	151 (82%)			
Ujjain	36 (22%)	130 (78%)	0.439	0.813 (0.481-1.373)	
<b>Gender</b>					
Male	36 (17%)	175 (83%)			
Female	34 (24%)	106 (76%)	0.097	0.641 (0.379-1.086)	

n=351	Mobile use: No (n=70)	Mobile use: Yes (n=281)	p value	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
<b>Education</b>					
No formal	48 (37%)	82 (63%)			
Educated	22 (10%)	199 (90%)	<0.001	5.295 (3.005-9.329)	3.937 (2.118-7.299)
<b>Employment status</b>					
Unemployed	49 (30%)	113 (70%)			
Employed	21 (11%)	168 (89%)	<0.001	3.469 (1.973-6.098)	3.703 (2.028-6.802)
<b>Age (years)</b>					
≥32	54 (29%)	133 (71%)			
<32	16 (10%)	148 (90%)	<0.001	3.759 (2.049-6.896)	2.654 (1.359-5.185)
<b>Literacy in English</b>					
Yes	31 (23%)	104 (77%)			
No	39 (18%)	177 (82%)	0.263	1.353 (0.641-2.298)	
<b>Sputum</b>					
Negative	29 (17%)	145 (83%)			
Positive	41 (23%)	136 (77%)	0.128	0.663 (0.390-1.127)	

**Table 3. Comparison of mobile phone usage characteristics between the two sites (n=351).**

	Bangalore	Ujjain	p value
<b>Model - Smartphone (n=318)</b>	83 (44.1%)	114 (68.7%)	0.005
<b>SMS use (n=351)</b>	49 (30%)	56 (33.9%)	0.358
<b>Alarm use (n=319)</b>	73 (38.8%)	79 (47.6%)	0.886
<b>Camera knowledge (n=318)</b>	91 (48.4%)	98 (59%)	0.953

**Table 4. Preferred treatment observation technique and its association with demographic, clinical and mobile phone usage characteristics (n=351).** LR Model p value <0.001 [Forward Stepwise (Conditional) method]; Nagelkerke R square: 0.378 (step 4); -2 Log likelihood: 351.638 (step 4).

Variables	Preferred DOT	Preferred vDOT	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
<b>Site (n=351)</b>				
Bangalore	43 (23%)	142 (77%)		
Ujjain	90 (54%)	76 (46%)	0.256 (0.162-0.404)	0.289 (0.166-0.502)
<b>Sex (n=351)</b>				
Male	74 (35%)	137 (65%)		
Female	59 (42%)	81 (58%)	0.742 (0.478-1.150)	

Variables	Preferred DOT	Preferred vDOT	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
<b>Age (n=351)</b>				
<32 years	39 (24%)	125 (76%)		
≥32 years	94 (50%)	93 (50%)	0.309 (0.195-0.489)	
<b>Marital status (n=351)</b>				
Married	105 (44%)	136 (56%)		
Single	28 (26%)	82 (74%)	2.261 (1.373-3.724)	
<b>Residence (n=351)</b>				
Rural	43 (47%)	49 (53%)		
Urban	90 (35%)	169 (65%)	1.648 (1.017-2.671)	
<b>Formally educated (n=351)</b>				
No formal education	87 (67%)	43 (33%)		
Educated	46 (21%)	175 (79%)	7.697 (4.721-12.549)	3.134 (1.751-5.617)
<b>Employment status (n=351)</b>				
Not gainfully employed	65 (40%)	97 (60%)		
Gainfully employed	68 (36%)	121 (64%)	1.192 (0.774-1.837)	
<b>Literate in English (n=351)</b>				
Others	78 (36%)	138 (64%)		
English	55 (41%)	80 (59%)	0.822 (0.529-1.278)	
<b>Access to phone (n=351)</b>				
No	49 (70%)	21 (30%)		
Yes	84 (30%)	197 (70%)	5.472 (3.090-9.690)	3.246 (1.644-6.410)
<b>Model (n=318)</b>				
Smartphone	105 (52.5%)	92 (76%)		
Basic phone	95 (47.5%)	29 (24%)	0.348 (0.211-0.575)	
<b>Camera use(n=318)</b>				
No	59 (29.6%)	73 (59.8%)		
Yes	149 (70.4%)	49 (40.2%)	3.535 (2.203-5.672)	

worldwide have been impeded and reaching the ambitious SDGs seem near impossible<sup>34</sup>. The prolonged duration of treatment accompanied by the multi-drug regimen often proves as a barrier to cure<sup>19</sup>. DOTS, therefore evolved as a necessity, implemented based on early research surrounding adherence to ATT. Given the switch from alternate day treatment to daily treatment, DOTS poses a logistic challenge to the National Tuberculosis Elimination Programme (NTEP)<sup>35</sup>. This switch has created a need for additional adherence support systems within the NTEP and an opportunity to harness mobile technology as a tool for treatment adherence. Therefore, mobile applications such as the 99DOT and video DOT have found their way into the recent guidelines for TB control globally.

However, there is limited evidence regarding the acceptability and the feasibility of such applications, especially in low-middle income countries, where both the burden of TB and the need for treatment support is high. Further, the regional and demographic diversity within countries, is expected to influence the acceptability of the technology for healthcare<sup>32</sup>. We therefore, decided to explore and compare the acceptability of mobile phone adherence support for ATT between South and Central India focusing largely on video DOT.

#### Mobile phone-based communication

Mobile phone adherence support was acceptable to most participants in our study. Education and phone ownership along

with a need to ensure treatment success influences acceptability. Feasible mobile phone support in HIV infection has the potential to improve adherence. Evidence that such support among developing countries, like India, is effective is ambiguous at best<sup>36–38</sup>.

However, negating the effectiveness of a potentially useful tool for adherence support in TB, given its overwhelming acceptability is farfetched without contextual evidence in the Indian setting. While DOTS has brought us a long way in terms of improving rates of treatment adherence, a one-size fits all approach cannot be used for patient support and adherence monitoring<sup>2</sup>. Successful interventions vary contextually based on content, components, instructiveness, duration or the time point at which the intervention was initiated during treatment<sup>19</sup>.

### Preferred mode of communication

A global survey on eHealth reported that SMS reminders were preferred over voice calls<sup>22</sup>, contrary to our study where only 1/4<sup>th</sup> of the patients at both sites preferred SMS over voice calls. Respondents <32 years of age, employed and literate preferred text messages over voice calls. Other studies in the Indian context also reflect a preference for voice calls over SMS and an association of this preference with English literacy. Studies also indicate that difficulty in articulation of textual material in an SMS make them less popular even amongst the literate<sup>39</sup>.

Therefore, mHealth communication in low and middle-income countries (LMICs) is likely more acceptable and effective if designed to incorporate the preference for voice calls. Pictorial messages and designing digital interfaces are other options available to populations with low literacy<sup>40</sup>. It is postulated that text messages in regional languages that use local scripts are further likely to enhance acceptability<sup>41</sup>.

Age influences mobile phone usability, studies have indicated that performance time, as well as, errors while using mobile applications increase with age. Further, older users find menu navigation more challenging than younger users<sup>42</sup>. In the current study, the participants who were less than 32 years of age were 70 times less likely to prefer conventional DOT over vDOT. Age related decline in cognition, working and verbal memory, spatial and psychomotor ability, sensory perceptions including vision, and self-efficacy contribute to the challenge<sup>43,44</sup>. Additionally, the technological inexperience of populations could also contribute to the challenges faced in navigating the mobile phone to access a SMS. On the contrary, receiving a voice call involves a simple, single action of tapping or pressing a button on the phone<sup>43,45</sup>.

### Personalisation: frequency and content of reminders

At both study sites, respondents preferred medication reminders early in morning, in time for their medications. However, some of those who were employed, as well as those who were literate welcomed reminders any time in the day to minimise forgetfulness and ensure adherence. Various studies have explored reminders delivered at varied timings with varied content for supporting adherence<sup>46</sup>. Some have used prefixed timings and contents of reminders while others have used prefixed

content with timings based on the participants' preference. However, a systematic review showed no significant difference in adherence between daily and less frequent text messaging for treatment adherence in chronic disease<sup>46</sup>.

### Video DOT (vDOT) as an alternative to DOT

vDOT is (i) synchronous when the patients connect with their healthcare provider real-time using video technology on their computer or mobile phone, or (ii) asynchronous, wherein the patient can upload a video of themselves taking their medication using a mobile application, which the healthcare provider can view anytime remotely<sup>47</sup>. vDOT has the potential to overcome barriers to in-person DOT such as repeated visits to the healthcare provider (based on the dosing schedule) and issues with confidentiality or disease disclosure<sup>48–50</sup>. On the contrary, challenges with internet connectivity<sup>48</sup>, theft or losing phones<sup>49</sup> and difficulties in confirming the medications swallowed are barriers to vDOT<sup>22</sup>. Asynchronous offline video recording has provided a solution to poor internet connectivity. Artificial intelligence could help identify the individual as well as match the shape and size of the pills swallowed to those prescribed<sup>51</sup>. However, Artificial Intelligence (AI) will require clearly visible pills in the video. Further, given that shape and size of ATT is not unique, the potential for substitution remains a cause for concern.

Most of the respondents in Ujjain preferred DOT over vDOT when compared to Bangalore where vDOT was the preferred option. On further analysis, majority of the respondents in Bangalore were aged below thirty – two years, employed and used smartphones, when compared to respondents at Ujjain. Even though most of the respondents at Ujjain owned a basic personal mobile phone, they preferred in-person DOT as there was low penetration of smart phone usage and difficulty in using mobile camera. Thus, factors like type of phone used, the literacy and employment status of the respondents at Ujjain probably contributed to this preference.

This cultural and demographic diversity within India is a challenge mHealth interventions and have to be taken into consideration while designing the intervention.

Concerns about videos being made public via social media, illness being revealed to family members, unknown people viewing their videos and the discomfort of recording themselves with the required clarity were the main reasons for preferring in-person DOT. Adequate training, counseling and assurance of privacy and confidentiality prior to initiating treatment will likely play a significant role in the acceptance of vDOT.

### Comparison of 99DOT with vDOT

Given that DOTS require patients to visit healthcare providers as per their dosing schedule, alternatives for DOTS in the form of peer support, community-based DOT and mobile phone adherence support interventions have been explored<sup>52</sup>. The 99DOT is one such alternative to DOT that aims to ensure 99% ATT adherence. The 99DOT has three components (i) a text message reminder (ii) a missed call that the patient makes to a toll-free number that is revealed when the pill is popped from



its blister, and (iii) counselling support<sup>53</sup>. However, absence of visual evidence of the patient having consumed the medication is a limitation to 99DOT. Additionally, discrepancies between mobile numbers registered in 99DOT and those that patients actually use interferes with 99DOT<sup>54</sup>. vDOT has the potential to overcome these limitations by providing visual evidence and the ability to use vDOT applications using a smart phone. However, unlike vDOT, 99DOT can be administered via basic mobile phone models as well.

### Methodological issues

The study provides reasonable insight into acceptability of mobile phone applications for adherence support for TB treatment in South and Central India. It also provides a comparison of design considerations for interventions between South and Central India in the light of cultural and demographic differences. However, as we used consecutive sampling from healthcare facilities and did not estimate a sample size, caution in generalising the results is advised. Yet, we were able to capture responses from varied demographic groups i.e., urban and rural India, men and women and those availing care from private providers as well as those receiving ATT through the RNTCP. While we did not capture income (at Ujjain), employment and education status can be considered as a surrogate for economic status of the participants. Although we do not have the details of the participants who declined consent, our sample included 70 participants who do not have mobile phones, thus this does not deter the generalizability of the study results.

### Conclusion

The acceptance of mobile phone applications for healthcare delivery in ATT was compared at two different locations in India. The results indicate that mobile phone adherence support is acceptable to patients on ATT with minor variations in design based on demographic and cultural differences. While it is easier to design a standard intervention, customizing certain features to specific population groups to ensure universal coverage could improve the acceptability of such interventions. Further, as in other studies in the Indian context, the preference for voice calls over text messages/SMS while designing mHealth interventions cannot be ignored. Of importance is the

preference for DOT when compared to vDOT in central India, indicating that a single intervention is not the solution to improving treatment adherence throughout the country. However, in time, the expanding use of mobile technology, supplemented with counselling, could overcome the barriers of privacy and stigma and promote the transition from in-person DOT to vDOT or mobile phone adherence monitoring and support for ATT in India.

### Data availability

Open Science Framework. Acceptability of Video Observed Treatment vs. Directly Observed Treatment for Tuberculosis: A Comparative Analysis between South and Central India. DOI: <https://doi.org/10.17605/OSF.IO/HX936><sup>55</sup>

This project contains the following underlying data:

- Questionnaire used in the study
- Questionnaire data

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0).

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### Authors' contributions

The concept and design of this study were provided by RR, VD, and MP. Data management and analysis were done by JSR, AAK, AD, SSV, and US. The drafting the manuscript was done by RR, JSR, AAK, AD, US and SSV, and the critical review was done by VD and MP.

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# Open Peer Review

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## Version 1

Reviewer Report 04 August 2022

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### Main recommendations:

1. The description of what vDOT is in the discussion section, I found to perhaps fit better in a section in the introduction. The description was super helpful and helped contextualize your study; however, it would be more beneficial to have read about it at the beginning of the paper.
2. I appreciated the sub-headings in the discussion to help organize the various themes that are being studied; however, I wonder if there could be even 2 general headings that are more consistent with the way the results are presented: 1) mobile phone description and usage (under this section: mobile phone based communication, preferred mode of communication, personalization: frequency and content of reminders); 2) vDOT vs DOT (under this section: video DOT (vDOT) as an alternative to DOT, comparison of 99DOT with vDOT). I just found the various subheadings in the discussion relevant, but not organized in a way that helped me understand the two main aims of the study (understanding phone usage and comparing vDOT to DOT).
3. There was only brief mention of COVID-19 and its impact on TB in the discussion section; I would suggest on elaborating on it a bit more or integrating it also into the introduction somehow as a clause for why DOT and vDOT is inherently invaluable.

### Other minor recommendations:

1. There is a double period on either side of the second citation in the introduction.
2. There is an unnecessary period directly following the 4,5 citation.
3. Incorrect grammar in this sentence with period and comma side to side "DOTS faced

specific obstacles such as a need for medications to be taken in the clinic, limited privacy, potential stigma, and fewer chances of being able to speak with clinicians., length of treatment, drug related side - effects and pill burden.”

**Is the work clearly and accurately presented and does it cite the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**

Yes

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**

Partly

***Competing Interests:*** No competing interests were disclosed.

**We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.**

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