Patient perspectives and willingness to accept incentives for tuberculosis diagnostic evaluation in Uganda.

Jillian Kadota (✉ jillian.kadota@ucsf.edu)

University of California San Francisco <https://orcid.org/0000-0003-4568-8681>

Sarah Nabwire

Uganda Tuberculosis Implementation Research Consortium

Talemwa Nalugwa

Uganda Tuberculosis Implementation Research Consortium

Justin S. White

Philip R. Lee Institute for Health Policy Studies, University of California San Francisco

Adithya Cattamanchi

Division of Pulmonary and Critical Care Medicine, University of California San Francisco

Achilles Katamba

Makerere University College of Health Sciences

Priya B. Shete

Division of Pulmonary and Critical Care Medicine, University of California San Francisco

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Abstract

Background Novel strategies are urgently needed to reduce gaps in the tuberculosis (TB) cascade of care. While patient centered interventions like cash transfers are increasingly recognized as a crucial approach for improving TB outcomes, data to support acceptable incentive intervention design that maximizes their utility are limited. We assessed attitudes and perceptions as well as willingness-to-accept (WTA) varying incentive structures for completing TB diagnostic evaluation among patients in Uganda.

Methods We surveyed 177 adult patients undergoing TB evaluation at 10 community health centers in Uganda between September 2018 and March 2019. We collected household sociodemographic information and assessed attitudes and perceptions of incentives. We conducted a willingness-to-accept experiment assessing willingness to complete TB diagnostic evaluation in exchange for incentives ranging in value from 500 Ugandan Shillings (USh) to 25,000USh (~\$0.15-6.75USD). We compared associations between willingness-to-accept and patient characteristics using ordered logistic regression.

Results Participants' willingness to return to the health center to complete TB diagnostic evaluation increased proportionally with incentive amount. The median participant had a WTA amount between 2,000 and 5,000 USh. Cash (52%) and transportation vouchers (34%) were the most popular incentive types. Half of respondents preferred unconditional incentives, but for a multi-day evaluation 84% preferred conditioning the incentive upon clinic return. In multivariate models we found the pairwise difference between the third income quartile and the reference (lowest) income quartile (aOR=2.38, 95%CI: 1.20-4.69; p=0.01), younger age, and difficulty returning to the health center to be significantly associated with willingness to accept higher incentive thresholds.

Conclusions In Uganda, incentives such as cash transfers or transportation vouchers are an acceptable intervention for facilitating adherence to TB diagnostic evaluation. Household income is associated with preferred incentive structure and amount, especially for those at the cusp of the poverty threshold, who are more likely to prefer unconditional and higher valued incentives. Targeted and context-specific socioeconomic supports for at-risk patients are needed to optimize outcomes.

Background

Tuberculosis (TB) has become the leading infectious killer in the world (1). With only 7 million of an estimated 10 million new cases of active TB reported in 2018 (1), novel strategies are urgently needed to reduce gaps in TB case detection and linkage to care, particularly during the diagnostic evaluation process (2, 3). Patient-centered barriers to accessing TB diagnostic evaluation are increasingly recognized as a major factor contributing to pre-treatment loss to follow-up. Indeed, the high costs TB patients incur while attempting to seek care are often "catastrophic," amounting to > 20% median household income (4, 5), and are driven by inefficiencies in the care-seeking pathway including several visits to multiple providers before obtaining a TB diagnostic test and initiating treatment if positive (6, 7). Additional barriers include fear of stigma and social isolation, geographic barriers to accessing health

care centers, fear of income loss, and food insecurity (8–12). These barriers seem insurmountable for many patients already suffering from poverty.

In recognition of the need to overcome such patient-centered barriers to care, economic incentives such as cash transfers or in-kind incentives are increasingly being used to improve uptake of health services and outcomes in a variety of public health programs for infectious disease prevention and treatment. For example, cash transfers improved diagnostic testing and use of artemisinin combination therapies among malaria positive patients in Kenya (13, 14) and have been shown to increase demand for HIV services throughout sub-Saharan Africa and beyond (15–19). Data supporting the use of incentives in TB prevention and care, however, remain sparse. Some evidence indicates that monetary incentives can be a useful tool for improving patient retention in TB care in hard-to-reach populations (20). Three recent systematic reviews summarizing evidence from trials in predominantly low- to medium-incidence countries indicate that financial incentives may improve a variety of TB treatment outcomes including treatment completion (21–23).

Despite these studies, critical gaps persist in the existing evidence base for the use and impact of incentives to improve TB outcomes. First, most of the available reviewed evidence comes from trials in well-resourced, low to medium TB incidence settings, highlighting the need for research focusing on how incentives might be utilized to improve TB outcomes in lower-resourced, high-burden settings. Second, the majority of studies focused on the effect of incentive-based interventions on treatment outcomes and adherence for patients already diagnosed initiated on therapy (21). There is little evidence to date for their use in targeting pre-treatment loss to follow-up, the most substantial gap in the patient cascade of care (2, 3, 24). Finally, there has been very limited research on how best to design and implement context-specific incentive interventions that feasibly and sustainably improve TB outcomes (25). Indeed, the few published trials done to assess the utility of cash transfers on TB treatment adherence were terminated early due to lack of fidelity of implementation, suggesting that how best to design and implement these interventions is still unknown (22). Despite being called to provide socioeconomic supports for TB patients, national TB programs are without guidance on how to identify incentive structures best suited to their context, including the amount and type of incentive, timing of distribution, conditionality, and linkage to TB prevention and care programs (25). Overall, these gaps point to the need for formative research to inform the design and implementation of incentives to facilitate patient adherence to diagnostic evaluation in low-resourced, high-burden settings. We sought to assess the acceptability and likelihood of patient incentives in supporting completion of TB diagnostic evaluation in Uganda.

Methods

Study setting and population

Between September 2018 and March 2019, we enrolled participants at 10 community health centers in peri-urban and rural Uganda. Level IV health centers are one of the lowest levels of the health system where TB diagnostic services are provided by the Uganda National TB and Leprosy Control Program

(NTLP). We included community health centers if they used standard (multi-day) sputum smear microscopy and/or GeneXpert MTB/RIF (Cepheid, Sunnyvale USA) testing as the primary method of TB diagnosis. We excluded health centers that demonstrated low volume of TB testing and diagnosis: 1) performing sputum based TB diagnostic evaluation on < 150 patients per year, or 2) diagnosing < 15 smear positive TB cases per year (26).

Eligible participants included adults ≥ 18 years old undergoing first-time evaluation for TB at participating community health centers. We excluded participants if they 1) had sputum collected for monitoring response to anti-TB therapy; 2) had sputum collected as part of active, community-based case finding (*e.g.*, contact tracing, community outreach campaign); 3) had a documented prior history of TB treatment (*e.g.*, reason for Xpert testing or TB treatment marked as treatment failure, relapse, or treatment after loss to follow-up); 4) were referred to a study health center for TB treatment after a diagnosis was established elsewhere; 5) were started on treatment for presumed extra-pulmonary TB only; or 6) had been given a clinical diagnosis of TB. We surveyed consecutive eligible participants who presented on randomly chosen days to enrolled community health centers and who were able to provide informed consent. Trained laboratory staff identified potential participants when they submitted sputum for TB microbiologic testing and referred them to study staff for eligibility assessment and informed consent.

The study was approved by the University of California San Francisco Committee on Human Research, the Makerere University School of Medicine Research Ethics Committee, and the Uganda National Council for Science and Technology.

Study procedures

Patient Barriers Survey

Trained study staff surveyed participants in their native language (Luganda or English) using a standardized tool to understand 1) specific barriers to TB diagnostic evaluation, and 2) attitudes and perceptions of incentives as a way to overcome those barriers (Supplement). We collected survey data on individual- and household-level demographics and socioeconomic status (SES), including household and personal income and health care utilization metrics such as distance and travel time to the health center. The survey tool included an assessment of barriers such as costs, inconvenience, potential job loss for missed work, school or childcare obligations, or lack of transportation related to clinic visits for TB diagnostic evaluation or treatment initiation. We also collected data on the acceptability of incentives by the participant and their community, as well as preferences regarding the type (cash, transportation voucher, food basket), frequency, and conditionality (unconditional or conditional upon health center return) of incentives that would facilitate TB diagnostic evaluation (27).

Willingness-to-accept experiment

Embedded within the Patient Barriers Survey was a hypothetical choice experiment used to gauge participants' willingness to accept (WTA) varying intensities (*i.e.*, amounts) of incentives to facilitate

completion of TB diagnostic evaluation. WTA and willingness-to-pay experiments are a well-established cost-benefit evaluation tool in the economics literature commonly used for ascribing demand for a product or service (28, 29). In WTA experiments, respondents are asked to accept or reject a monetary incentive amount that subsequently increases or decreases in value depending on the participant's response (29). We adapted these tools by developing closed-ended, hypothetical choice questions assessing acceptability of various incentive values ranging from 500 – 25,000 Ugandan Shillings (USh), prefaced with an introductory script: "*We are exploring whether giving patients a cash incentive when they return to the clinic would make it easier to return.*" Following this script, the interviewer randomly alternated between two starting values in order to avoid anchoring (30), either asking: "Would you/could you return for 2,000 Ugandan Shillings?" or "Would you/could you return for 10,000 Ugandan Shillings?". The initial question would be followed by another question either increasing the offered amount if the participant declined the first value, or reducing the offered amount if the participant accepted (Fig. 1), thus reaching the lowest value of an incentive that the participant deemed sufficient to facilitate their return to the health center. The design of the willingness-to-accept experiment (Supplement) followed the structure of similar experiments that have been conducted for other public health conditions (31, 32).

At the time of data collection, US\$1.00 was equivalent to 3,745 USh, implying an incentive range from US\$0.13 to US\$6.68. We selected the lower and upper limits of the WTA experiment (500 USh to 25,000 USh) based on previous studies documenting the direct and indirect costs of health center visits for this population (6) and stakeholder assessment of programmatic feasibility at scale.

Statistical analysis

We carried out descriptive analyses reporting collected demographic and socioeconomic participant data as medians and interquartile ranges (IQRs) for continuous variables and proportions and 95% confidence intervals (95% CIs) for categorical variables. We resolved missing survey data included household income ($n = 27$; 17%) and participant rating of ease of returning to the health center the following day ($n = 6$; 4%) using multiple imputation (MI). We implemented this approach by fitting a statistical model to the observed data to estimate values for the missing data, which was repeated 100 times in order to account for statistical uncertainty in the imputed estimates. Parameter estimates from the multiple imputed datasets were pooled to provide a single estimate in data analysis (33). We assumed our data were missing at random and chose to impute by fully conditional specification (multiple imputation by chained equations) (34, 35). Our imputation model included all variables in our final multivariable analysis model as well as those potentially predictive of the missing values (36). These variables included age, sex, marital status, educational level and community health center location.

We used ordered logistic regression (37) with robust standard errors to account for clustering by health center to assess acceptability of incentives across participant demographic and socioeconomic characteristics of interest. In keeping with this method, we assumed that the relationship between each pair of outcome groups is the same (the proportional odds assumption). This allowed for us to assume that the probabilities for each of the categories of the ordered outcome are cumulative and compares the probability that an individual gives a response in a category or higher compared to lower categories (37).

We established five ranked categories for our outcome of interest: (a) 500 USh, (b) 2,000 USh, (c) 5,000 USh, (d) 10,000 USh, and 25,000 USh.

Participant socioeconomic characteristics incorporated in the ordered logistic regression model included income, described by household income quartiles. We also considered health system characteristics including whether the community health center the patient attended was classified as either urban or rural by the Uganda Ministry of Health (38). Additional factors considered for the ordered logistic regression model were participant characteristics selected based on *a priori* hypotheses of causal relationships with our outcome of interest, or which were significant at $p < 0.20$ in bivariate analyses. These included sex, age, marital status, and difficulty in returning to the health center the following day. The assumption of proportional odds for the final multivariable model was assessed using a likelihood ratio test.

We conducted additional analyses exploring associations between participant socioeconomic and demographic characteristics (*e.g.*, age, sex, income quartile) or health center characteristics (*e.g.*, urban or rural community health center location) and 1) barriers to daily, weekly and monthly community health center visits; and 2) perceptions of incentive acceptability and preferences for conditionality. Bivariate analyses were carried out using Pearson's Chi-square (χ^2) test of association between independent variables and outcomes of interest. All analyses were conducted using Stata (v14.2, StataCorp LP, College Station, TX).

Results

Study sample characteristics

We enrolled 177 consecutive adults being evaluated for pulmonary TB at enrolled health centers on randomly selected days of the week to participate in the study. Of the 177 enrolled participants, 161 completed the full survey and their data were included and analyzed. Of the 16 participants not included in the study, nine started the survey but stopped before completion, and seven participants were not asked willingness-to-accept experiment questions. Of the 161 participants whose data were included in the analysis, 88 (55%) were female and the median age was 38 years (IQR: 28-48). The majority accessed care at a rural health center ($n=110$, 68%) and were informally employed ($n=132$, 82%). The median household income reported was 150,000 USh/month (IQR: 70,000-300,000); Table 1), which is consistent with prior income estimates for this population (6, 39).

Patient barriers to community health center visits for TB care

Participants who indicated that they would be unable to return for either daily, weekly, or monthly health center-based TB care most frequently reported lack of transportation as their largest barrier (for daily medication adherence: $n=84$ (62%); weekly: $n=15$; 58%; monthly: $n=2$; 67%; Table 2). Although 155 (96%)

participants indicated that they would be able to return to the health center the following day to retrieve their test results if needed, 40% (n=62) stated that it would be difficult to do so.

Self-reported barriers to health center visits among participants who indicated they would be unable to return for health center-based TB care differed by income quartile. Participants in the lower income quartiles indicated transportation difficulties as their main challenge to health center visits compared to those in higher income quartiles, who cited a mixture of concerns including transportation, inconvenience, and possible job loss ($p=0.02$) (Table 2). Participants in rural locations noted a lack of transportation as their main barrier to return to community health centers (urban: 37%; rural: 73%), whereas those in urban locations were more likely to indicate inconvenience (urban: 29%; rural: 18%) or possible job loss (urban: 24%; rural: 4%) as their primary concern ($p<0.001$). Barriers to community health center visits varied slightly by sex ($p=0.07$), but did not vary by other sociodemographic characteristics such as age (results not shown).

Participant attitudes and perceptions regarding incentives

We evaluated attitudes and perceptions regarding incentives among participants and their communities (n=161) (Table 3). Seventeen participants (11%) had received some form of incentive before, mostly in the form of cash or food as a part of a study-based program to support health outcomes. Participants almost unanimously agreed that incentives were acceptable to themselves and for those within their communities. Receipt of cash, transportation vouchers, or food was reported as acceptable among participants and their communities (cash: n=160, 99%; transportation vouchers: n=159, 99%; food: n=156, 97%). When asked to compare types of potential incentives, the majority of participants preferred cash (n=84; 52%) or transportation vouchers (n=54; 34%) to facilitate return to community health center to complete diagnostic evaluation. While the preferred type of incentive did not vary by income quartile, age, occupation and health center location, women were more likely to choose transportation vouchers (n=48; 55%) compared to men, who instead preferred cash (n=31; 43%; $p=0.04$).

Preference for incentive conditionality

We assessed participant preference for conditionality of incentives within the context of both single and multi-day TB evaluations to assess whether providing the incentive either before or after the patient completed diagnostic testing would be most helpful in finishing diagnostic evaluation and initiating treatment. For hypothetical single-day evaluation scenarios, where testing and treatment initiation could be completed in the same day, participants in the second and highest income quartiles preferred an incentive conditioned upon completion of diagnostic testing (n=24, 71% and n=17, 65%, respectively). In contrast, participants in the lowest and third income quartiles preferred unconditional incentives provided

at the beginning of the diagnostic process, and the receipt of which was not dependent on completion of testing (n=12, 33% and n=14, 39%, respectively; $p<0.01$). For hypothetical multi-day evaluation scenarios, the proportion of participants who preferred conditional incentives provided only after completion of diagnostic evaluation was high overall but varied slightly by income quartile (overall: n=134, 84%; Table 3). We also assessed preference for conditionality based on participants' report of whether it would be easy or difficult to return the next day to receive their test results and initiate treatment. In the context of multi-day evaluations, almost all participants (n=57; 95%) who indicated return to the health center would be difficult agreed that conditioning incentive receipt upon return would be helpful in finishing their evaluation; however, only 37% (n=22) felt that conditionality would be helpful for same-day evaluations. Preference for incentive conditionality did not differ by age, sex or health center location.

Willingness to accept incentives for TB testing

Participants' willingness to accept varying amounts of an incentive to return to clinic are shown in Figure 3. Forty (40) participants (25%) accepted 500 USh, 69 participants (43%) accepted 2,000 USh or less, 112 (70%) accepted 5,000 USh, and the remainder (n=49; 30%) required 10,000 USh or more to facilitate TB diagnostic evaluation (Figure 3). Participants' willingness to accept different amounts of incentives varied by income quartile, particularly for mid-range incentive values of 2,000 USh ($p=0.06$) and 5,000 USh ($p=0.02$). Specifically, participants in the third income quartile were less likely than other income quartiles to accept these mid-range amounts (Table 4).

Bivariate ordered logistic regression analyses revealed that participants who reported that it would be difficult to return the next day to the health center were more likely to require higher incentive amounts compared to those who responded that return would be easy (OR=2.12; 95% CI: 1.48-3.05). Older participants were less likely to require higher incentive amounts to complete TB diagnostic evaluation compared to their younger counterparts (OR=0.55; 95% CI: 0.32-0.94) (Table 5). No significant associations were found for sex (OR=0.98; 95% CI: 0.50-1.96), marital status (OR=1.31; 95% CI: 0.77-2.22), or community health center location (OR=0.64; 95% CI: 0.22-1.86) and accepted amount of hypothetical incentives.

Perceived difficulty in returning to the health center (aOR=2.53, 95% CI: 1.59-4.02) and age (aOR=0.44, 95% CI: 0.22-0.91) remained significant associations in our multivariable analysis (Table 5). The pairwise difference between the third income quartile and the reference income quartile class (aOR=2.38, 95% CI: 1.20-4.69) was associated with willingness to accept higher incentive thresholds ($p=0.01$). The association between income and level of incentive needed to complete diagnostic evaluation trended towards statistical significance in our final multivariate model, indicating that participants in higher

income categories were more willing to complete TB diagnostic evaluation for higher incentive amounts compared to those in the lower income categories ($p=0.08$).

Discussion

Our results demonstrate that patients view incentives as an acceptable public health intervention for improving adherence to TB diagnostic evaluation in a high-burden, low-resource setting. The vast majority of participants expressed that incentives were socially and culturally acceptable to both themselves and their communities, including cash transfers, transportation vouchers, and food rations (99%; 99%; and 97%, respectively). Even though all incentive types were universally acceptable in this setting, participants clearly preferred cash or transportation vouchers over food for TB diagnostic evaluation (52%; 34%; and 9%, respectively). Thus, even in a setting with high rates of impoverishment (median household income $< \$1.90/\text{day}$) (39), participants expressed clear preferences for how incentives would be structured, and these preferences could translate into differential responses to incentives and diagnostic outcomes. In this context, acceptability of incentives did not differ based on income or other demographic characteristics of our participants. Our results demonstrate that incentives for TB diagnostic evaluation are acceptable to recipients and their communities, as has been shown in other public health contexts (40–42).

The strong preference reported for cash transfers or transportation vouchers as the type of incentive most likely to facilitate completing TB diagnostic evaluation is consistent with the most frequently stated barrier to TB prevention and care for patients: high transportation costs and lost wages. Transportation costs are a known driver of patients costs in accessing TB care in Uganda and worldwide (4, 6, 43), and a pervasive structural barrier for vulnerable patients seeking services for a variety of other healthcare needs in sub-Saharan Africa (44–55). Participants in higher income categories more frequently reported a mixture of barriers to return to the health center including possible job loss or inconvenience, which correspond to more recently described barriers to care reflected by high indirect costs of TB prevention and care services (4, 6, 43). Our findings also suggest that heterogeneity in preference for different incentive structures may be driven by a difference in the relative importance of barriers to completing TB diagnostic evaluation for participants. For example, males indicated a preference for cash (42%) compared to females, who preferred transportation vouchers (55%; $p = 0.04$) suggesting that men and women in these communities may view the use of cash and vouchers differently based on local gender dynamics.

We found that willingness to return to the clinic increases proportionally with incentive amount, such that 25% of participants would return for an incentive of 500 USH, and 100% would return for 25,000 USH. If, as our WTA experiment found, the provision of a modest cash incentive of 5,000 USH could motivate up to 70% of patients who otherwise would not return to clinic to complete their diagnostic evaluation, completion of recommended testing in this context could be increased from a baseline of 56% (26) to over 80%. This change would substantially reduce patient attrition in the TB cascade of care. Further, the median participant had a WTA between 2,000 and 5,000 USH (US\$0.53–1.34): an incentive range that

may be acceptable to National TB Programmes and reasonable to implement at scale. Combined, these findings could have significant program and policy implications for reducing pre-treatment loss to follow up among presumptive TB patients.

Our results demonstrate a non-linear relationship between income and willingness to accept incentives for returning to a clinic to receive TB test results, suggesting that incentives may drive behavior differently among participants with different income or socioeconomic status. Study participants on the extreme ends of income (*i.e.*, bottom and highest quartiles) settled on acceptable incentive values less than those in the second and third income quartiles. The majority of participants in the lowest income quartile agreed to an incentive valued at $\leq 5,000$ US\$, which corresponds to the amount required to directly offset the cost of one-way transport for a health center visit (6). Seventy-five percent (75%) of participants in the highest income quartile were also willing to return to the clinic for diagnostic evaluation for $\leq 5,000$ US\$, less than 5% of their weekly income. This, along with results from our assessment of conditionality across income indicating that participants in the highest income quartiles preferred conditional incentives provided after completion of diagnostic evaluation, may suggest that they were aware of the ability of incentives to increase motivation and adherence (56). In contrast, participants in the lowest income quartile preferred unconditional incentives provided immediately, suggesting that these participants were not willing to accept uncertain payment and valued the incentives as funds to pay for or offset costs of care, and may operate by directly alleviating poverty. Research on the various mechanisms by which incentives alter behavior and health outcomes is an ongoing area of research for behavioral economists and public health experts (57). One meta-analysis of behavioral economics influenced financial incentives for health promotion showed that while incentives typically increased the odds of eliciting behavior change, different demographic and socioeconomic characteristics of targeted populations predicted the success of different incentive structures (58).

Our multivariate analysis found that participants in higher income quartiles were more likely accept TB diagnostic evaluation for higher incentive values compared to those in the lowest quartile (aOR = 2.38, 95% CI: 1.20–4.69). Participants in the 3rd income quartile, whose household incomes fall at or below the World Bank's threshold of \$1.90USD/day (39), were more likely to prefer unconditional incentives and have a higher willingness-to-accept threshold. Preference for relatively higher value incentives may reflect decision-making by individuals at the margin of impoverishment to prevent worsening poverty. If we assume that the effectiveness of financial incentives stems from a solely economic perspective, in which incentives provide income support to offset the potential direct, indirect and/or opportunity costs associated with accessing a health service (59), then the provision of cash or transportation vouchers to those who are already the most impoverished or those at the brink of falling into poverty, for whom such costs would serve as prohibitive or catastrophic, may act as a social protection intervention. Nonetheless, 40% of all study participants reported that it would be difficult to return to the community health center the following day, making them 2.53 times as likely to only accept the highest incentive values compared to those who said it would be easy. This suggests that there are challenges for individuals regardless of relative wealth – and that cash or other forms of incentives could act as an important motivational or protective intervention for improving access to the community health center and TB outcomes overall.

Our study has some important limitations. First, some of our data were incomplete, with 17% of household income, for example, missing, usually because participants were unable to recall this information. We addressed this limitation using multiple imputation. Multiple imputation is a well-known flexible method to achieve improved precision and remedy the biases resulting from missing data which is not missing at random (60). We attempted to minimize this bias by considering a wide range of variables in our imputation model that would be potentially predictive of missingness, in addition to all variables in the substantive analysis. It is also important to recognize that self-reported income is an imperfect and potentially unreliable measure of wealth, particularly in low-resource settings where ownership of assets and property might be a better indication of relative wealth (61). Another potential source of bias in our study was the use of only two starting values that we used for the willingness to accept negotiation period, making it such that only some of the WTA outcomes were possible depending on which amount the participant was initially offered. Finally, as this willingness-to-accept experiment was conducted as subset of larger study, by design we did not have the power to detect meaningful differences between groups. Even so, we were able to describe some important associations between incentive structure, acceptability, and patient social and demographic characteristics.

Conclusions

The use of hypothetical choice experiments such as willingness-to-accept experiments can be a useful tool in designing complex intervention that include patient incentives, such as social protection interventions for public health (32, 62, 63). These social protection interventions are meant to protect patients from serious social and financial risk and are a core component of the World Health Organization's END TB strategy (64), which cites their potential for improving TB outcomes among vulnerable populations (65). Our study is the first to use a willingness-to-accept experiment to identify incentive structures to improve completion of TB diagnostic evaluation and reduce pre-treatment loss to follow-up, the largest gap in the patient cascade of care. Our study shows that despite some differences in the level of acceptable incentive amounts, modest values of cash transfers may be sufficient to facilitate and motivate completion of TB diagnostic testing in this resource-limited setting. These methods can be further leveraged to inform the design and evaluation of other social protection interventions for vulnerable populations. By suggesting characteristics such as incentive type, duration, value, and conditionality that predict successful TB outcomes for specific populations, our study provides a systematic approach to operationalizing social protection interventions as a core pillar of TB prevention and care activities.

Abbreviations

TB

tuberculosis

NTLP

National TB and Leprosy Control Program

SES
socioeconomic status
WTA
willingness-to-accept
USh
Ugandan Shillings
USD
United States Dollar
IQR
interquartile range
CI
confidence interval
MI
Multiple Imputation
OR
odds ratio

Declarations

Ethics approval and consent to participate: The study was approved by the University of California San Francisco Committee on Human Research, the Makerere University School of Medicine Research Ethics Committee, and the Uganda National Council for Science and Technology. All participants provided verbal informed consent to participate in the study.

Consent for publication: Not applicable.

Availability of data and materials: The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: PS, AC, and AK conceived of the study. SN and TN collected the data. JK and PS analyzed the data. JK and PS wrote the first draft of the manuscript and AC, AK, SN, TN, and JS contributed revisions to the manuscript and approved the final submission.

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Tables

Table 1. Patient demographic and socioeconomic characteristics, Uganda 2018 (n=161).

	Overall (n=161)
	N (%) or Median (IQR)
Sex	
Male	73 (45.3)
Female	88 (54.7)
Age	38 (28-48)
Community health center location	
Rural	110 (68.3)
Urban	51 (31.7)
Marital status	
Single	11 (6.8)
Married (Monogomous)	69 (42.9)
Married (Polygomous)	18 (11.2)
Divorced/Separated/Widowed	63 (39.1)
Has children	145 (90.1)
Number of children (n=144)	4 (2-6)
Adults in household	2 (1-3)
Education level	
None	20 (12.4)
Primary	104 (64.6)
Secondary	33 (20.5)
Tertiary	3 (1.9)
Vocational/other	1 (0.6)
Employment status	
Unemployed	17 (10.6)
Informal	132 (82.0)
Formal	9 (5.6)
Student	2 (1.2)
Civil Servant/other	1 (0.6)
Household Income per month (US\$) (n=134) ^{1,2}	150,000 (70,000-300,000)
Personal Income per month (US\$) (n=141) ²	100,000 (50,000-200,000)

1. 16.8% of participants missing information on household income.

2. At the time of data collection US\$1.00 was equivalent to 3,745 US\$.

US\$: Ugandan Shillings

Table 2. Patient perceived barriers to TB medication and community health center visits by income quartile (N = 161).¹

	Overall	Bottom Quartile	2nd Quartile	3rd Quartile	Top Quartile	p- value
	n=161	(n=37)	(n=35)	(n=35)	(n=26)	
N (%)						
Would you return to take free medication:						
Daily (yes)	17 (10.6)	2 (5.4)	6 (17.1)	0 (0.0)	6 (23.1)	0.02
Weekly (yes)	76 (48.4)	18 (50.0)	18 (52.9)	12 (34.3)	14 (53.9)	0.47
Monthly (yes)	151 (96.2)	32 (88.9)	34 (100.0)	34 (97.1)	26 (100.0)	0.13
Barriers to clinic visits						
Transportation	84 (62.2)	25 (75.8)	18 (64.3)	22 (62.9)	6 (35.3)	0.02
Inconvenience	29 (21.5)	8 (24.2)	6 (21.4)	4 (11.4)	4 (23.5)	
Possible job loss	14 (10.4)	0 (0.0)	3 (10.7)	5 (14.3)	5 (29.4)	
Other	8 (6.0)	0 (0.0)	1 (3.6)	4 (11.4)	2 (11.8)	
Will you be able to return tomorrow for test results	155 (96.3)	36 (97.3)	32 (91.4)	34 (94.4)	26 (100.0)	0.40
If yes, will it be easy/difficult to return						
Easy	93 (60.0)	20 (55.6)	22 (68.8)	18 (52.9)	17 (65.4)	0.51
Difficult	62 (40.0)	16 (44.4)	10 (31.3)	16 (47.1)	9 (34.6)	

1. 8% of participants missing information about household income

Table 3. Patient experiences and attitudes towards incentives and medication by income quartile (N = 161).¹

	Overall	Bottom	2nd	3rd	Highest	p-value
		Quartile	Quartile	Quartile	Quartile	
	n=161	(n=37)	(n=35)	(n=35)	(n=26)	
	N (%)					
Received incentive before	17 (10.6)	5 (13.5)	7 (20.0)	3 (8.3)	0 (0.0)	0.09
Incentive helped	17 (100.0)	5 (100.0)	7 (100.0)	3 (100.0)	-	-
Any negative feelings towards incentives (yes)	9 (5.6)	34 (91.9)	34 (97.1)	33 (91.7)	26 (100.0)	0.37
Cash would be accepted in community (yes)	160 (99.4)	36 (97.3)	35 (100.0)	36 (100.0)	26 (100.0)	0.45
Transportation vouchers would be accepted in community (yes)	158 (98.8)	37 (100.0)	33 (97.1)	36 (100.0)	26 (100.0)	0.40
Food would be accepted in community (yes)	156 (96.9)	36 (97.3)	34 (97.1)	35 (97.2)	25 (96.2)	0.99
Preferred incentive type to return to finish evaluation (self)						
Cash	84 (52.2)	19 (51.4)	19 (54.3)	17 (47.2)	13 (50.0)	0.92
Transportation vouchers	54 (33.5)	13 (35.1)	9 (25.7)	15 (41.7)	8 (30.8)	
Food	15 (9.3)	4 (10.8)	4 (11.4)	2 (5.6)	4 (15.4)	
Insurance	3 (1.9)	0 (0.0)	1 (2.9)	1 (2.8)	1 (3.9)	
Other	5 (3.1)	1 (2.7)	2 (5.7)	1 (2.8)	0 (0.0)	
Preferred incentive type to return to finish evaluation (community)						
Cash	62 (38.5)	14 (37.8)	12 (34.3)	12 (33.3)	12 (46.2)	0.93
Transportation vouchers	73 (45.3)	17 (46.0)	15 (42.9)	18 (50.0)	9 (34.6)	
Food	22 (13.7)	5 (13.5)	6 (17.1)	5 (13.9)	5 (19.2)	
Other	4 (2.5)	1 (2.7)	2 (5.7)	1 (2.8)	0 (0.0)	
Prefer incentive conditional on diagnostic evaluation completion - same-day (yes)	79 (50.0)	12 (33.3)	24 (70.6)	14 (38.9)	17 (65.4)	0.003
Prefer incentive conditional on diagnostic evaluation completion - multi-day (yes)	134 (84.3)	35 (94.6)	24 (70.6)	32 (88.9)	19 (73.1)	0.02
Would take medication if doctor prescribed it for free (yes)	158 (98.1)	37 (100.0)	22 (94.3)	35 (97.2)	26 (100.0)	0.59

1. 16.8% of participants missing information about household income

Table 4. Willingness to accept incentives for receiving TB test results by household income quartile (N=161).¹

	Overall (n=158)	Bottom quartile (n=37)	2 nd quartile (n=35)	3rd quartile (n=35)	Highest (n=25)	p-value
	N (%) or Median (IQR)					
Monthly household Income (US\$) ¹	150,000 (70,000- 300,000)	50,000 (30,000- 50,000)	100,000 (80,000- 150,000)	255,000 (200,000- 300,000)	460,000 (400,000- 550,000)	<0.001
Accepted 500 US\$	40 (24.8)	10 (27.0)	11 (31.4)	4 (11.1)	7 (26.9)	0.20
Accepted ≤2,000 US\$	69 (42.9)	17 (46.0)	18 (51.4)	8 (22.2)	12 (46.2)	0.06
Accepted ≤5,000 US\$	112 (69.6)	30 (81.1)	22 (62.9)	18 (50.0)	20 (76.9)	0.02
Accepted ≤10,000 US\$	145 (90.1)	33 (89.2)	33 (94.3)	30 (83.3)	23 (88.5)	0.54
Accepted ≤25,000 US\$	161 (100.0)	37 (100.0)	35 (100.0)	36 (100.0)	26 (100.0)	-

1. 16.8% of total participants missing information on household income.

2. At the time of data collection US\$1.00 was equivalent to 3,745 US\$

US\$: Ugandan Shillings

Table 5. Factors associated with increased incentive values to return to the health center to complete diagnostic evaluation, based on ordered logistic regression.

	Unadjusted		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age >38 years	0.55 (0.32-0.94)	0.03	0.44 (0.22-0.91)	0.03
Male gender	0.98 (0.50-1.96)	0.97	-	
Urban community health center	0.64 (0.22-1.86)	0.41	0.46 (0.16-1.35)	0.16
Married	1.31 (0.77-2.22)	0.32	-	
Difficult to return to health center	2.12 (1.48-3.05)	<0.001	2.53 (1.59-4.02)	<0.001
Income quartile				
2nd highest	1.06 (0.51-2.21)	0.87	1.13 (0.51-2.47)	0.76
3rd highest	2.34 (1.23-4.45)	0.01	2.38 (1.20-4.69)	0.01
Lowest income quartile	1.00 (0.39-2.63)	0.99	1.15 (0.50-2.65)	0.73

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Figures

Figure 1

Willingness-to-accept survey experiment algorithm. Participants were asked whether they would be willing to accept a randomly assigned starting value of either 2,000 Ugandan Shillings (USh) or 10,000 USh to facilitate return to the health center for completion of diagnostic evaluation. Subsequent offered values would either be increased or decreased, depending on whether the participant declined or accepted the initial or previous offered value. Overall values offered ranged from 500 USh to 25,000 USh.

1. At the time of data collection US\$1.00 was equivalent to 3,745 USh.
 USh: Ugandan Shillings

Figure 2

Percentage of participants willing to accept varying incentives for receiving TB test results, N=161.

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