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ORIGINAL RESEARCH ARTICLE

Cost-Effectiveness of Using Conditional Economic Incentives to Improve Pre-exposure Prophylaxis Adherence Among Male Sex Workers

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Abstract

Introduction Conditional economic incentives can improve medication-taking behaviors among populations at risk of contracting human immunodeficiency virus (HIV). However, there are no data on the cost-effectiveness of incentive programs for improving pre-exposure prophylaxis (PrEP) adherence among male sex workers (MSWs) who have one of the highest HIV acquisition rates. Our objective was to assess the cost-effectiveness of incentive programs to improve adherence to pre-exposure prophylaxis (PrEP) among male sex workers

Methods We conducted an economic evaluation of the PrEP Seguro randomized pilot trial in Mexico (ClinicalTrials.gov: NCT03674983). Among $n = 110$ MSWs, those randomized to the intervention received tiered incentives based on PrEP drug levels in scalp hair measured at three clinic visits over 6 months. The intervention led to a 28.7% increase in scalp hair PrEP concentration, consistent with increased adherence ($p = 0.05$). Here we use a micro-costing approach from the health system perspective to calculate costs. Quality-adjusted life years (QALYs) were estimated from the number of HIV infections averted through sufficient PrEP adherence (tenofovir concentration > 0.011 ng/mg corresponding to greater than or equal to three weekly doses). Incremental cost-effectiveness ratios (ICERs) estimated the cost/QALY gained owing to the intervention.

Results The mean cost per patient was US $165.53 and $179.55 among standard care and incentive patients, respectively. Over 6 months of follow-up, 62% of standard care patients and 78% of incentive recipients were PrEP adherent. After the program, the lifetime average QALYs gained per infection avoided were 9.17 (minimum, maximum: 7.5, 10.8) and 9.84 (minimum, maximum: 8.05, 11.6) among standard care and incentive patients, respectively. The 6-month ICER was US $20.92/QALY gained by the intervention, which was highly cost-effective at a willingness-to-pay of US $8655 (Mexico's 2020 per capita gross domestic product (GDP)).

Discussion Using behavioral economics approaches for enhancing adherence to HIV prevention may offer health and fiscal benefits through reduced HIV incidence. Fully powered implementation trials can determine future cost-effectiveness of scaling up incentives for PrEP adherence among high-risk populations.

1 Introduction

The human immunodeficiency virus (HIV) epidemic in Latin America and much of the Caribbean is concentrated among key populations. In these regions, HIV disproportionally affects gay and bisexual men, transgender women, and other men who have sex with men (MSM) [1]. In Mexico specifically, the statistics are staggering; HIV prevalence estimates are 0.2% in the general population, 17.4% among MSM [1], and 32.0% among male sex workers [1–3]. This elevated prevalence is driven by various factors, including high rates of stigma, discrimination, and barriers to healthcare access [4]. Socioeconomic factors, such as poverty and limited access to healthcare services, further exacerbate the risk of HIV infection and hinder consistent use of preventive measures such as pre-exposure prophylaxis (PrEP) [5].

In this context, adherence to PrEP has proven to be a significant challenge for MSW, who often face unique obstacles such as unstable housing, stigma, and high-risk behaviors associated with their work [6]. Traditional strategies to improve PrEP adherence have had limited success, particularly in resource-constrained settings [7]. This situation highlights the need for innovative approaches to enhance adherence and, consequently, reduce HIV transmission rates.

Extended author information available on the last page of the article

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Key Points for Decision Makers

Conditional economic incentives significantly improved adherence to PrEP among male sex workers in Mexico, resulting in better health outcomes and proving to be highly cost-effective compared with standard care.

The program's cost-effectiveness was demonstrated at an additional US $20.92 per QALY gained, which is well below Mexico's willingness-to-pay threshold, highlighting the financial feasibility of such interventions.

Research is necessary to evaluate the cost-effectiveness results of conditional economic incentives beyond 6 months in male sex workers, including logistical barriers.

When taken as prescribed, daily oral PrEP is highly effective for reducing the risk of HIV acquisition [8]. Oral PrEP has also shown to be cost-effective in settings where HIV incidence is greater than 3 per 100 person-years or when PrEP uptake is high among people at substantial risk [9]. Despite the demonstrated effectiveness and cost-effectiveness of PrEP for HIV prevention, male sex workers (MSWs) continue to face multiple barriers to sufficient PrEP adherence. These barriers stem from high medication costs [7], stigma [4], behavioral risk factors such as frequent drug and alcohol use [6], irregular daily routines [10], and reduced access to health services [4]. Poverty can lead MSWs to engage in higher risk sexual behaviors, engaging in condomless sex for a price premium. Poverty also limits access to HIV prevention services owing to lack of funds for transportation or clinic fees [5, 11]. Recent 2023 findings from the 3-year implementation PrEP (ImPrEP) demonstration project among 9509 participants in Latin America found that same-day oral PrEP was feasible for MSM in Mexico and elsewhere, but that socioeconomic health determinants (e.g., lower education and being of non-white race) led to decreased PrEP adherence during study follow-up [12].

Behavioral economics provide a framework for understanding and designing interventions to overcome behavioral biases that can undermine adoption and adherence to positive health behavior's [13]. Conditional economic incentives (CEIs) have emerged as one behavioral economics-based tool that aims to improve health outcomes by offering tangible rewards contingent upon demonstration of positive health behaviors [14]. Previous studies have demonstrated the effectiveness of CEIs for improving adherence to antiretroviral therapy among people living with HIV [15]. However, there is a gap in literature regarding the use of CEIs to improve PrEP adherence, specifically among MSW in Mexico. Our study aims to fill this gap by evaluating the cost-effectiveness of CEI as a policy intervention to enhance PrEP adherence among MSW in Mexico City.

Providing conditional economic incentives, which can include both monetary (i.e., cash and supermarket vouchers) incentives and non-monetary rewards (e.g., trophies, capital goods, and social recognition etc.), may be particularly pertinent for people who have recently initiated PrEP and may find the new behavior of pill-taking difficult [16]. Conditional incentives have increased uptake of HIV prevention behaviors in multiple contexts, including HIV testing for adolescents [17] and voluntary medical male circumcision among middle-aged males [18]. In our recently completed PrEP Seguro randomized pilot trial, administering tiered economic incentives in the form of supermarket vouchers conditional on objectively measured PrEP adherence led to a statistically significant 28.7% increase in scalp hair PrEP concentration, consistent with sufficient weekly adherence over 6-months [19]. These effectiveness findings align with stated preferences of MSWs, who are highly willing to accept a CEI-based intervention for PrEP adherence if offered along with fixed payments [20]. Though evidence shows incentives for PrEP adherence are effective and acceptable among male sex workers, we do not yet know if CEI-based programs are cost-effective for health systems with limited resources.

This analysis builds on our effectiveness findings from the PrEP Seguro randomized pilot trial to estimate the incremental cost-effectiveness of providing conditional economic incentives to increase PrEP adherence among one of the populations at highest risk for HIV acquisition in Latin America. We hypothesize that administering incentives conditional on PrEP concentration levels in scalp hair will be more costly but be more cost-effective in the short term compared with providing clinic-based HIV prevention services without incentives. By contextualizing this study within the broader HIV epidemic in Mexico City and the existing literature on CEIs, we aim to highlight the importance of exploring innovative policy interventions to address the persistent challenge of PrEP adherence among MSWs.

2 Methods

2.1 Design and Implementation of the PrEP Seguro Trial

We conducted a randomized pilot study to evaluate the effectiveness of using conditional economic incentives

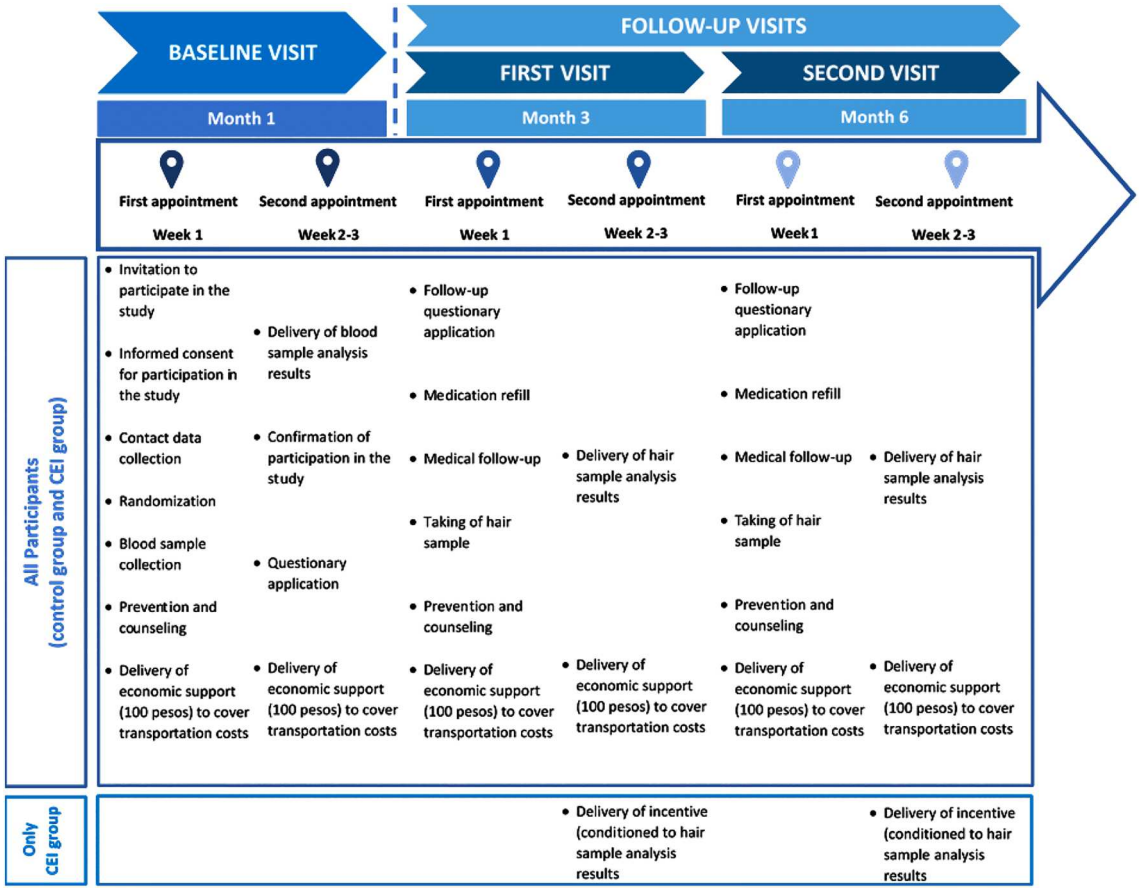

Fig. 1 Study design of the PrEP Seguro randomized pilot trial

(CEIs) to increase adherence to free PrEP among male sex workers (MSWs) in Mexico City (ClinicalTrials.gov identifier: NCT03674983). Detailed explanation of the trial design and findings are available elsewhere [19]. Eligible participants were male, aged 18 years or older, HIV-negative within the past month, and reported engaging in penetrative sex with at least four male partners and exchanging sex for money, drugs, or gifts on four or more occasions in the past month. They also needed to be part of the ImPrEP project (more details elsewhere [19]), able to provide contact information, willing to give blood and hair samples, and capable of providing informed consent. Participants were recruited by research and clinical staff at Clínica Condesa during scheduled care visits and through community outreach at known sex work locations in Mexico City such as La Alameda Central, Zona Rosa, and Metro Hidalgo. Male sex workers recruited in these venues were first enrolled in the ImPrEP program before being invited to join the PrEP Seguro study. Clínica Condesa is a primary, outpatient care center for people living with HIV and the largest provider of antiretroviral treatment in Mexico. The clinic also offers screening for sexually transmitted infections and general HIV prevention and care in Mexico City. The trial enrolled 110 male sex workers who were then randomly assigned to receive standard HIV prevention care alone or standard HIV prevention services with conditional incentives. PrEP adherence was assessed on the basis of tenofovir/emtricitabine (TDF/FTC) concentrations in scalp hair samples collected at the first study visit following randomization (baseline), as well as at the 3- and 6-month visits post randomization (Fig. 1). Hair samples were collected at each of the three primary study visits (baseline, 3-month, and 6-month visits). Owing to the coronavirus disease-2019 (COVID-19) pandemic, there were at times delays in processing and analyzing these samples, with the results taking approximately 3 months to become available. As a result, the incentives for participants in the intervention group were delivered at the subsequent visit after the test results were received. Despite these delays, all participants—both in the intervention and standard care groups—attended the same number of study visits.

Individuals randomized to the intervention condition received economic incentives based on level of PrEP

adherence measured at each of the three study visits. Participants with TDF/FTC concentrations of at least 0.043 (ng/mg), consistent with taking five to seven pills per week, received an incentive of ~ US $20. Those with concentrations between 0.011 (ng/mg) and 0.042 (ng/mg), indicating taking three to four pills per week, received an incentive of ~ US $10. Participants with concentration levels below 0.011 (ng/mg), consistent with taking two or fewer pills per week, received no incentive [15].

2.2 Collection of Cost Data

We used a direct-measure microcosting approach to estimate the costs associated with providing healthcare resources to study participants. Microcosting is a detailed and granular costing method that involves identifying and valuing all the individual components of a healthcare intervention. In this study, cost information was collected from May 2019 to August 2020 from the healthcare provider's perspective (Clínica Especializada Condesa). This involved a thorough review of administrative records and interviews with key informants such as clinic managers and healthcare staff.

We identified all relevant resources used in delivering the intervention and standard care. Direct medical costs included the cost of the PrEP medication (tenofovir) and the resources associated with routine scheduled HIV care visits. For each scheduled visit, we recorded the cost of infectious disease tests, such as tests for gonorrhoea, chlamydia, syphilis, and other clinically indicated infections.

We also considered the cost of healthcare personnel time, including physician consultations and counseling services. This was estimated on the basis of the average salaries of providers and social workers at the clinic (Clínica Especializada Condesa). For each identified resource, we obtained the unit costs from the clinic's financial records. For example, the cost of PrEP was based on the actual purchase price paid by the clinic, which could differ from market prices owing to bulk purchasing agreements or subsidies.

To facilitate comparison and ensure consistency, we adjusted all base unit costs to reflect a common year and currency. The costs were first standardized to 2020 values using Mexico's 2020 consumer price index (CPI) to account for inflation. After adjusting for inflation, all costs were converted from Mexican pesos to US dollars (US $) using the 2020 World Bank official exchange rate (local currency units (LCU) per US $, period average) [21]. This process ensured that the cost estimates were presented in a standardized currency, making them comparable to international studies [21]. The mean cost of tenofovir was US $104. This cost estimate in our study reflects the procurement cost paid by the specific clinic participating in the trial, which may differ from retail prices owing to bulk purchasing agreements or subsidies. Online Table A2 shows the unit costs of the material and human resources involved in care and intervention delivery during the trial.

2.3 Quality-Adjusted Life Years

We estimated the number of quality-adjusted life years (QALYs) for each enrolled participant at 6-months based on the number of HIV infections averted owing to being sufficiently highly adherent to PrEP. First, we defined sufficient adherence using a dichotomous variable derived from hair analysis results. A TDF/FTC hair sample concentration below 0.011 ng/mg (equivalent to taking three to four pills per week) was classified as nonadherent (0) and a concentration of at least 0.011 ng/mg (equivalent to taking at least three pills per week) was classified as adherent (1) [22]. Among participants randomized to receive standard care without incentives, 62% of male sex workers were categorized as adherent at the end of the 6-month follow up period. Among participants randomized to the incentive condition, 78% were adherent after 6 months. Next, for both trial arms, we calculated the number of prevented HIV infections owing to sufficient PrEP adherence over the 6-month trial. We assumed an incidence rate of five new HIV cases per 100 person-years [3] and a PrEP effectiveness of 96% [23]. At each measurement timepoint (baseline, 3-month visit, and 6-month visit), we calculated the infections avoided by each adherent patient as:

$$\text{No. infections avoided} = \text{New HIV cases per month} \times \text{PrEP effectiveness.}$$

For the first visit, we estimated 0.3936 infections avoided = (0.41 new HIV cases per month) (0.96). Similarly, for the 3-month and 6-month visit, we estimated 1.2 infections avoided = (1.25 new HIV cases per 3-month) (0.96). Next, to estimate the total infections avoided over the whole 6-month period, we summed the infections avoided for each visit. Last, to calculate the QALYs gained per averted infection, we used a lower limit of 4.45 QALYs [24] and an upper limit of 6.43 QALYs [25]. We calculated the mean number of QALYs gained by each program based on these ranges. More details about QALY estimation are summarized in Online Table A2.

2.4 Incremental Cost-Effectiveness Ratios

We calculated the incremental cost-effectiveness ratio (ICER) as the additional cost needed to gain one additional QALY, comparing the CEI-based program to standard care. The ICER was calculated by dividing the difference in costs between the intervention and standard care arm (ΔC) by the difference in QALYs for the same comparators (ΔE) (ICER = $\Delta C/\Delta E$). We used Mexico's per capita gross domestic product (GDP) in 2020 (US $8655) as a willingness-to-pay

Table 1 Average cost (US $) per patient, by randomization assignment

Item	Receiving standard care ($n = 61$)				Receiving standard care with CEIs for PrEP adherence ($n = 42$)			
	Mean	Std. dev.	Min.	Max.	Mean	Std. dev.	Min.	Max.
Medicines	104.65	18.72	88.39	118.99	107.21	21.82	90.4	123.66
Visits	4.17	1.95	3.11	6.15	4.27	1.9	3.32	6.12
Tests	52.41	1.2	51.33	53.23	52.15	2.19	49.89	53.23
Incentives*	4.66	0	4.66	4.66	15.92	2.61	13.52	17.4
Total cost per patient	165.53	20.34	148.34	181.73	179.55	23.22	160.5	196.62

Visit costs reflect the sum of the hourly rate for the provider, the counselor, and the psychologist. *Std. dev.* standard deviation, *min.* minimum, *max.* maximum

*Incentive amounts for patients receiving standard of care alone reflect transport reimbursement costs. Incentive amounts for patients receiving standard of care with CEIs reflect transport reimbursement costs plus the cost of the conditional economic incentives

(WTP) threshold for determining cost-effectiveness [26]. Two WTP thresholds were used in this analysis. First, we employed a threshold of US $8500, representing Mexico's per capita GDP in 2020, in line with a commonly used benchmark in health economic evaluations [27]. This threshold assumes that an intervention costing less than the per capita GDP per QALY gained is generally considered cost-effective. However, recognizing the limitations of this approach, particularly in low- and middle-income countries, we also used a more stringent threshold of US $3850, as suggested by Woods et al. [28]. This threshold is based on empirical estimates of the health opportunity costs specific to Mexico, offering a more realistic assessment of the intervention's value given the country's healthcare context.

2.5 Sensitivity Analysis

We conducted a probabilistic sensitivity analysis (PSA), specifying appropriate probability distributions for each key parameter. Costs, including medication, clinical visits, and administrative overhead, were modeled using gamma distributions, reflecting their skewed nature and non-negativity. The effectiveness of the intervention, measured in quality-adjusted life years (QALYs) gained, was modeled using a beta distribution, which is suitable for variables bounded between 0 and 1. We then ran 10,000 Monte Carlo simulations, in which values for each parameter were randomly drawn from their respective distributions. Each simulation generated a potential scenario, allowing us to calculate a distribution of possible outcomes for costs and QALYs for both strategies: standard PrEP care and PrEP + CEI. From these outcomes, an ICER was calculated for each iteration, providing a distribution of ICERs rather than a single point estimate.

The results of these simulations were analyzed to estimate the probability that the PrEP + CEI intervention would be cost-effective at various willingness-to-pay (WTP) thresholds. We constructed cost-effectiveness acceptability curves (CEACs) to visualize the proportion of simulations where the ICER was below given WTP thresholds. This graphical representation helped illustrate the uncertainty around the intervention's cost-effectiveness. The cost-effectiveness analysis and probabilistic sensitivity analysis (PSA) were conducted using R software (version 4.3.1) with the dampack package [29]. This software facilitated the calculation of the incremental cost-effectiveness ratio (ICER) and allowed us to rigorously address uncertainty in key parameters such as costs and health outcomes [29].

2.6 Ethical Aspects

All human subject protocols and materials implemented during the PrEP Seguro study were approved by ethics committees at Brown University (Institutional Review Board (IRB) Authorization Agreement no. 18–70) and Mexico's Instituto Nacional de Salud Pública (National Institute of Public Health) (protocol no. P33-18, project CI: 1551). All trial participants provided written informed consent for study participation and for the use of their data for research purposes.

3 Results

Table 1 shows the average total cost per participant in each trial arm. Among standard care recipients, the average cost per participant was US $104.65 for medications, US $4.17 for care provision during study visits, and US $52.41 for sexually transmitted infection (STI) testing. Conversely, patients receiving standard care with CEIs for PrEP adherence ($n = 42$) had slightly higher costs, with mean values of US $107.21 for medications, $4.27 for care provision,

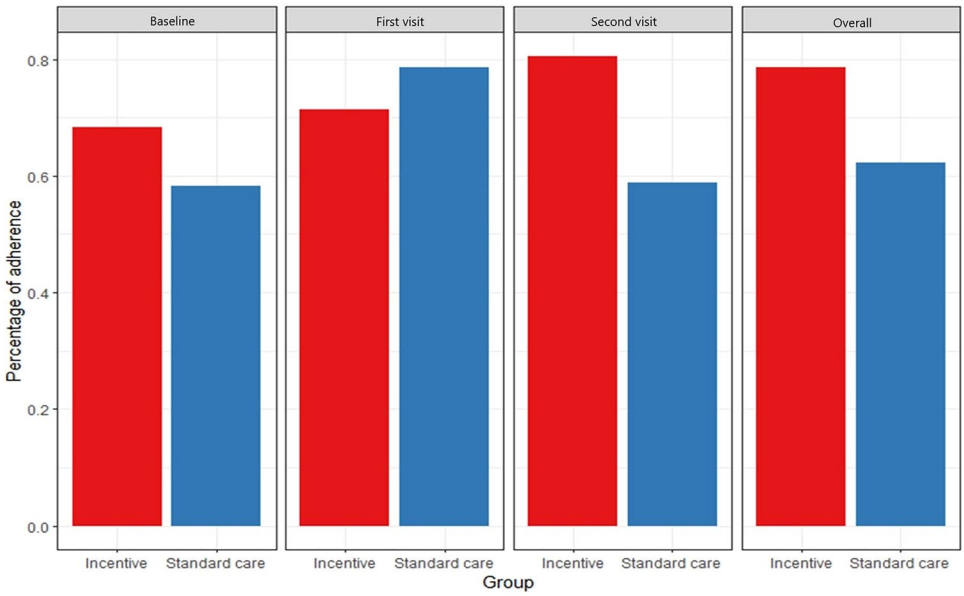

Fig. 2 Proportion of participants adherent to PrEP at each study visit, by randomization assignment. Participants with TDF/FTC concentrations of at least 0.043 (ng/mg), consistent with taking five to seven pills per week. Those with concentrations between 0.011 (ng/mg) and 0.042 (ng/mg), indicating taking three to four pills per week. Participants with concentration levels below 0.011 (ng/mg), consistent with taking two or fewer pills per week. These participants were divided into adherent = TDF/FTC concentrations > 0.011 and non-adherent (the complement)

Table 2 Incremental cost-effectiveness ratio

	Total cost per participant in US $	Incremental cost in US $ (ΔC)	Total QALYs	Incremental effectiveness (ΔE)	ICER ($\Delta C/\Delta E$)
Standard care recipients	$165.53	(ref.)	9.17	(ref.)	(ref.)
Incentives recipients	$179.55	$14.02	9.84	0.67	20.92

QALY quality-adjusted life year

and US $52.15 for tests. Notably, the inclusion of incentives for this group resulted in an additional average cost of US $15.92 per patient. The average total cost per patient was US $165.53 for standard care and US $179.55 for standard care with CEIs for PrEP adherence.

Figure 2 shows the proportion of participants in each arm of the trial who were sufficiently adherent to PrEP at each visit (i.e., whose scale hair samples showed PrEP concentrations of at least 0.011 ng/mg). Over the 6-month follow-up period, 58–62% of individuals receiving standard care were adherent to PrEP, whereas 69–78% of incentive recipients were adherent at a given visit. Though modest, we see steady improvements in adherence at each visit among intervention recipients. We do not see the same trends among standard care participants.

Table 2 present the incremental cost-effectiveness ratios (ICER) comparing the incentive recipients with the standard care patients over the 6 months of the trial. Delivering the CEI-based intervention incurred an addition US $14.02 per patient on top of usual care costs and contributed to an additional 0.67 QALYs gained through additional averted HIV infections owing to higher PrEP adherence. The resulting ICER was US $20.92 per additional QALY in conditional incentive recipients compared with standard care patients.

Results of the probabilistic sensitivity analysis (PSA) are shown in Fig. 3. Incentive recipients, on average, almost always incurred slightly higher costs while achieving slightly more benefits in terms of additional QALYs. We observe minimal variation in average costs and effects within the northeast cost-effectiveness quadrant, which indicates that our model is less sensitive to, with less uncertainty in, parameter values.

Figure 4 shows the acceptability curve of the intervention. The probability that the CEI-based intervention was cost-effective was 100% for both the threshold of US $3850 proposed by Wood [28] and the threshold of US $8655 per additional QALY (1 times Mexico's GDP per capita in 2020) proposed by the World Health Organization (WHO).

4 Discussion

This analysis builds on effectiveness findings from a pilot randomized trial to estimate the incremental cost-effectiveness of providing tiered economic incentives conditional on sufficient PrEP adherence among male sex workers in Mexico. Over 6 months, providing incentives conditional

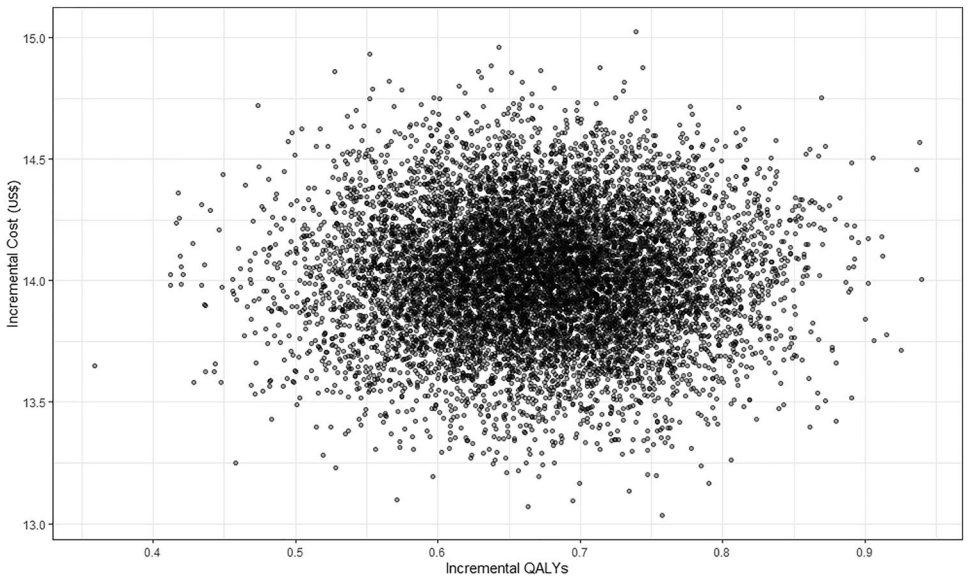

Fig. 3 Probabilistic sensitivity analysis: cost (US $) and effectiveness comparison between standard care and incentive program

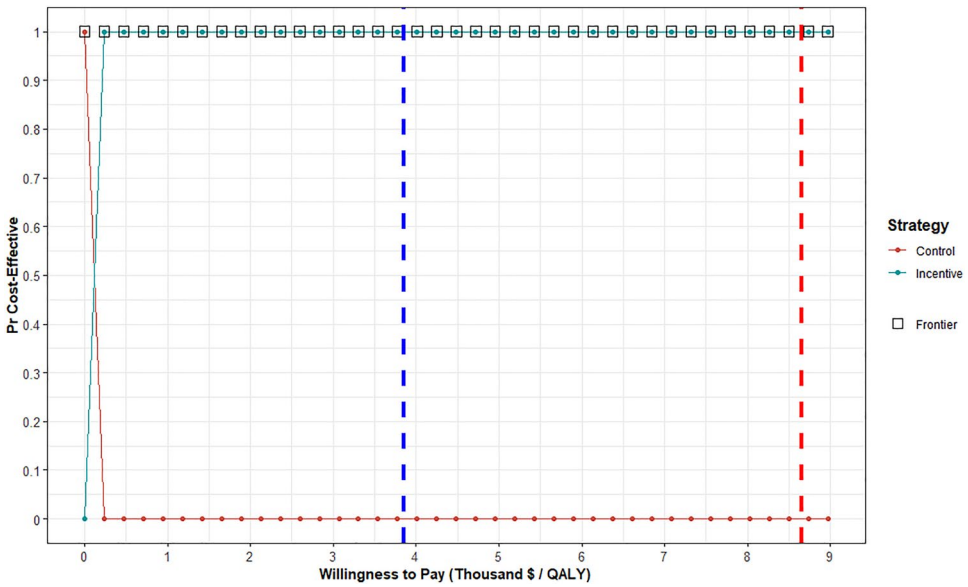

Fig. 4 Acceptability curves: cost-effectiveness comparison between standard care and incentive program. The vertical red dashed line represents the willingness-to-pay threshold of US $8 655 (1 times Mexico's 2020 per capita GDP) and the vertical blue dashed line represents the willingness-to-pay threshold of US $3850

on TDF/FTC concentrations in hair alongside standard HIV prevention services cost US $14.02 more per patient on average compared with standard care without incentives. Providing sex workers conditional incentives gained an additional 0.67 QALYs through additional averted HIV infections compared with standard care patients. The conditional economic incentive program cost an additional US $20.92 per additional QALY gained compared with standard care, which was highly cost-effective at a willingness to pay of 1 times Mexico's GDP per capita. Cost-effectiveness inferences were the same even at highly conservative (i.e., < US $300/QALY) willingness-to-pay thresholds.

The ICERs observed in the present analysis are lower than those observed in economic evaluations of PrEP interventions among MSM populations. In simulation-based studies of the implementation of PrEP in men who have sex with men, findings suggest it would take up to 40 years of intervention for PrEP alone to be cost-effective and achieve less than £13,000 (~US $16,000) per QALY gained [30]. Other studies have reported that injectable PrEP would reach an ICER ≤ US $100,000/QALY after 10 years [31]. In this way, in our study we show the great potential that conditional economic incentives have to make PrEP interventions cost-effective in men who have sex with men.

Conditional economic incentives can help address the financial barriers associated with adherence to preventive measures such as PrEP. Individuals often make decisions on the basis of short-term benefits and costs rather than considering the future consequences or health gains [32]. Conditional incentives can motivate individuals to adhere

to PrEP even when the longer-term health benefits are not immediately visible, leading to improved health outcomes and potential cost savings for both the society and the healthcare system [32]. Our study contributes to existing literature by being the first to evaluate the cost-effectiveness of conditional incentives in the context of PrEP for male sex workers specifically. Centering our economic evaluation within a randomized pilot trial allows for robust evaluation of the impact of incentives on adherence rates and associated outcomes.

A main limitation of this analysis was the short follow-up period. Incentives appeared to be cost-effective over 6 months of follow-up, but it remains unknown whether incentives will remain cost-effective if adherence behaviors change over time. Also, we evaluated cost-effectiveness based on primary data collected during the pilot trial. We did not model the cost-effectiveness of incentives under longer-term or wider adoption scale-up scenarios, which is an important avenue for future research.

A second limitation of this study is related to the availability of health state values for estimating QALYs in Mexico [33]. While such estimations now exist [33], they were not available at the time of data collection (2019–2020), as these values were only published in 2021. As a result, we relied on indirect measures based on health outcomes, such as the number of HIV infections averted, which provided a more feasible and appropriate approach for our analysis. This methodological choice allowed us to deliver a meaningful cost-effectiveness assessment within the constraints of the available data and resources, while still offering valuable insights into the economic viability of the intervention.

Third, we considered the incentive program's cost-effectiveness solely from a health system perspective to strengthen the evidence base for policy changes that support permanent PrEP provision in Mexico. However, we acknowledge that incentivizing adherence to free PrEP may have important cost impacts for male sex workers (e.g., being able to work more because of improved health status, being able to charge a premium owing to being on HIV preventative treatment) [32]. Future analyses should consider cost-effectiveness using a societal perspective, which may potentially generate additional cost savings for patients and providers. One of the major strengths of our study is the rigorous randomized allocation of conditional incentives, which minimizes selection bias and strengthens the validity of the findings. In addition, the use of scalp hair samples provides a more reliable adherence measure compared with self-report, and a less invasive adherence measure compared with blood testing.

Another limitation of our study was that the analysis did not fully consider the potential economic impact of preventing HIV infections, which could have affected the conclusions. While the study focused on health care costs and incentives, potential long-term cost savings associated with fewer HIV infections, such as lifetime treatment costs and lost productivity, were not taken into account. Including these cost savings could have further strengthened the argument for the cost-effectiveness of conditional incentives for PrEP adherence.

The sustainability of such interventions in real-life settings hinges on the availability of consistent funding sources and the integration of these programs into existing healthcare structures. In terms of funding, potential sources could include government health budgets, international aid, and public–private partnerships. Governments might allocate funds for these incentives as part of their national HIV prevention strategies, especially if the intervention proves cost-effective in the long run by reducing the burden of new HIV infections. International organizations and global health initiatives could also provide financial support, particularly in middle-income countries such as Mexico, where targeted interventions can significantly impact public health outcomes. To ensure long-term sustainability, it is crucial to integrate conditional economic incentives into broader healthcare programs rather than relying solely on external funding. This might involve aligning these incentives with other health promotion strategies, such as comprehensive sexual health programs, to create a multi-faceted approach to HIV prevention. In addition, ongoing evaluation of the cost-effectiveness of these incentives will be necessary to justify their continued funding and to adapt the program as needed.

It is important to note that while conditional incentives have shown promising results, financial barriers may not be the sole determinants of PrEP adherence, especially among vulnerable populations. Logistical barriers, such as limited access to healthcare facilities or time constraints, have been identified as significant challenges for PrEP adherence in various populations. Therefore, a comprehensive approach that addresses not only financial barriers but also logistical and social determinants of adherence is essential for maximizing the cost-effectiveness of conditional incentives. To address the logistical and behavioral barriers that affect adherence, interventions should be multi-faceted. Offering flexible service delivery models, such as mobile PrEP clinics or telehealth support, could improve access for MSWs who face time and mobility constraints. Integrating PrEP provision with other sexual health services, such as STI testing and treatment, could streamline care and reduce stigma associated with seeking HIV-specific services.

5 Conclusions

We found that conditional economic incentives helped improve the adherence of male sex workers to free PrEP and were highly cost-effective in the short term, with an ICER of at less than 1 times Mexico's per capita GDP. Although our results are promising, larger implementation science trials are necessary to fully estimate the cost-effectiveness and potential cost savings of scaling up these behavioral economics interventions. The sustainability of effective and cost-effective incentive-based HIV prevention programs for high-risk populations depends on a status quo of free and publicly available PrEP, which is not yet the case in Mexico or much of Latin America.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s41669-025-00569-z.

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Declarations

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Conflicts of Interest All authors declare that they have no conflicts of interest.

Code Availability The code supporting the findings of this study is available upon reasonable request from the corresponding author.

Ethical Aspects All study protocols and materials implemented during the PrEP Seguro randomized pilot trial were approved by the ethics committees at Brown University (IRB Authorization Agreement no. 18–70) and Instituto Nacional de Salud Pública (INSP, National Institute of Public Health) in Mexico (protocol no. P33-18, project CI: 1551).

Consent to Participate All trial participants provided written informed consent for study participation.

Consent for Publication (from patients/participants) All trial participants provided written informed consent to the use of their data for research purposes.

Data Availability The data that support the findings of this study are available from the corresponding author upon reasonable request.

Clinical Trial Registration ClinicalTrials.gov identifier: NCT03674983.

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