

Female Sex Worker Preferences for HIV Pre-Exposure Prophylaxis Delivery in Uganda: A Discrete Choice Experiment

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ABSTRACT

Background: Cisgender female sex workers (FSWs) in sub-Saharan Africa have a high risk of HIV acquisition, highlighting the need for innovative approaches to expand coverage of evidence-based HIV prevention methods, including oral pre-exposure prophylaxis (PrEP). Our study aimed to identify FSWs' preferences for a PrEP delivery model with structured choices for delivery location, services offered, and adherence support.

Methods: We conducted a discrete choice experiment (DCE) among FSWs ≥ 18 years recruited from the Most At-Risk Population Initiative (MARPI) clinic in Kampala, Uganda, between October and November 2023. FSWs were recruited using consecutive sampling. To determine the most effective PrEP delivery method for FSWs, we created eight choice sets, each with three alternative combinations of PrEP service attributes and an opt-out using a D-efficient experimental design. Participants were presented with three alternatives, the fourth being an opt-out (no model selected), and asked to make selections based on four distinct attributes: the PrEP provider, place of delivery, delivery channel, and support services. We assessed FSW preferences and attribute trade-offs using a panel data mixed model and identified the preferred PrEP delivery model using the highest median utility score.

Results: Overall, 203 participants completed the DCE. The median age was 24 years (interquartile range [IQR] 20-32). Most FSWs preferred receiving PrEP from a healthcare worker at the clinic with short message service (SMS) reminders for adherence support (median utility score 0.87; interquartile range [IQR] 0.82, 0.94). This preference remained consistent across all age groups, with a median utility score of 0.88 for ages 15-19, 0.87 for ages 20-24, and 0.85 for ages ≥ 25 .

Conclusion: FSWs preferred to receive PrEP care directly from providers at healthcare facilities and highlighted the need for additional support in the form of SMS reminders to improve adherence and prevent HIV acquisition. This preferred model, if implemented, could increase prevention coverage and inform future approaches to delivering PrEP through the Uganda National PrEP Program.

INTRODUCTION

Cisgender female sex workers (FSWs) are at high risk of HIV acquisition but have limited access to effective HIV prevention interventions⁽¹⁾. This underscores the urgency for innovative strategies to increase the uptake of evidence-based biomedical HIV prevention methods, including oral pre-exposure prophylaxis (PrEP)^(2, 3). However, a one-size-fits-all- approach to HIV prevention may not effectively address the diverse needs and preferences of key populations. Discrete choice experiments (DCEs) have revealed diverse stated preferences for HIV prevention within individuals and communities⁽⁴⁾. Person-centered care models may overcome these barriers, but they are inconsistently implemented for key populations globally^{(5),(6)}. Therefore, it is imperative to better understand how to effectively implement person-centered PrEP care and optimize HIV prevention delivery approaches.

Uganda has established facility and community models for PrEP delivery, consisting of four main components: the target population, infrastructure for providing PrEP, trained PrEP providers, and designated delivery channels. However, these models do not consider FSWs' unique needs and preferences⁽⁷⁾. As a result, FSWs who receive PrEP through the facility model often face challenges such as long travel distances to the clinic and lengthy waiting times. This can lead to significant direct costs, such as transportation expenses, and indirect costs, like loss of work time. These barriers hinder their ability to adhere to and remain in PrEP care⁽⁸⁻¹⁰⁾. Despite being an effective biomedical intervention for reducing HIV transmission when taken correctly, PrEP persistence among FSWs in Uganda is low⁽¹¹⁾. Given the high HIV prevalence (37%)(¹²) among FSWs in Uganda, it is crucial to understand which PrEP delivery model would best meet their specific needs and promote effective PrEP use and retention in care to decrease HIV incidence^{(13),(14)}.

Prior research has emphasized incorporating choice within person-centered models for HIV service delivery⁽¹⁵⁾ This includes providing additional support for medication adherence and offering flexibility in clinic-based or off-site delivery. Despite this, there is currently limited literature documenting the specific preferences of FSWs for PrEP delivery options⁽⁸⁾. With the expansion of PrEP programs, it is crucial to establish effective and feasible delivery models to ensure maximum coverage^{(16), (17)}. To address these gaps, our study sought to identify Ugandan FSW preferences for a

PrEP delivery model that offered structured options for location, services provided, and adherence support.

MATERIALS AND METHODS

Study population and setting

We conducted a discrete choice experiment (DCE) at the Most at Risk Population Initiative (MARPI) clinic within the Mulago National Referral Hospital complex in Kampala, Uganda, from October to November 2023. A discrete choice design is a research method used to understand and predict how people make decisions when faced with a set of alternatives. We recruited 203 FSWs from the MARPI clinic, which serves an estimated 10,000 FSWs annually. Before participation in the DCE, FSWs received information about the study's objectives and procedures and were asked to provide informed consent. They were informed that the DCE was a quantitative research method that explored individual preferences by presenting hypothetical options and evaluated responses to specific program, product, or service attributes⁽¹⁸⁾. Eligibility criteria included being ≥ 18 years, on PrEP for at least two months, consent to participate in the study, selling sex within Kampala, Mukono, or Wakiso districts in Central Uganda, and receiving PrEP refills at the MARPI clinic. Participants were excluded from the study if they met the following criteria: currently participating in another PrEP or HIV prevention study, allergic to tenofovir, lamivudine, emtricitabine, or other PrEP medication, being infected with Hepatitis B virus or having chronic kidney disease (based on self-report or medical records), as these individuals would eventually be discontinued from PrEP.

Attributes and levels

We conducted a systematic review and qualitative study to identify DCE attributes^(19, 20). These findings were used to inform our study's final selection of attributes (**Table 1**). To create the choice sets, we employed a fractional factorial design; fractional D-efficiency designs are valuable for optimizing experimental efficiency when full factorial designs are not feasible. We relied on assumptions about factorial structure, D-efficiency, balance, confounding, additivity, variance homogeneity, and sample size, which resulted in eight sets (**Table 2**). Previous studies have established that more than eight choice tasks can impose cognitive and time limitations on participants^(21, 22). We also included an opt-out response option where respondents could choose

128 "neither" to indicate their dissatisfaction with the provided PrEP delivery models. This
129 resulted in a final design with a D-efficiency of 88.4%.

130 **Table 1: DCE attributes and levels based on a systematic review and qualitative**
131 **findings and expert panel review**

No.	Attribute	Level	Attribute definition for this study
1.	PrEP provider	1. Health worker	This can be a doctor, nurse, PrEP counselor, or other healthcare provider
		2. Peer	An FSW who is on PrEP and serves as a role model to the other FSW
		3. None	No preference for either
2.	Place of PrEP delivery	1. Home	A place where the FSW lives
		2. Community	A designated place in the community where health workers come and offer HIV testing services and drug refills
		3. Health facility	Health care setting that provides PrEP
		4. Hotspot	A specific location where FSWs gather and transact sex
3.	Delivery channel	1. In-person visits	FSW picks their own PrEP drugs
		2. Family member	A brother, spouse, sister, or member of the extended family picks the drug
		3. Peer	An FSW who is on PrEP and serves as an example to the other FSW
4.	Additional support	1. Phone call reminder	A text message sent to a mobile phone 30 minutes before taking PrEP
		2. SMS reminder	A telephone call made to a mobile phone 30 minutes before taking PrEP
		3. None	No preference for either

132 SMS (Short message service)

133 **Table 2: DCE choice sets with neither option**

Choice set	Alternative	Place of PrEP Delivery	PrEP Provider	Delivery Channel	Additional support
1	I	Hotspot	None	Peer	SMS reminder
	II	Home	Peer	In-person	call reminder
	III	Community	Peer	Family member	SMS reminder
	IV	Neither			
2	I	Home	HW	Family member	call reminder
	II	Community	Peer	Family member	SMS reminder
	III	Health Facility	None	In-person	SMS reminder
	IV	Neither			
3	I	Hotspot	None	Family member	call reminder
	II	Health Facility	HW	Peer	SMS reminder
	III	Community	Peer	Family member	SMS reminder
	IV	Neither			

4	I	Home	HW	In-person	SMS reminder
	II	Community	None	Peer	call reminder
	III	Community	Peer	Family member	SMS reminder
	IV	Neither			
5	I	Health Facility	HW	Peer	call reminder
	II	Community	Peer	Family member	SMS reminder
	III	Hotspot	Peer	In-person	SMS reminder
	IV	Neither			
6	I	Health Facility	Peer	In-person	call reminder
	II	Hotspot	HW	Family member	None
	III	Community	Peer	Family member	SMS reminder
	IV	Neither			
7	I	Community	Peer	Family member	SMS reminder
	II	Home	Peer	Peer	None
	III	Hotspot	HW	Family member	call reminder
	IV	Neither			
8	I	Community	Peer	Family member	SMS reminder
	II	Hotspot	HW	In-person	SMS reminder
	III	Home	Peer	Peer	call reminder
	IV	Neither			

The D-efficiency of the design was 88.4, % which is above the 80% recommended score

We developed visual aids for each choice set to accommodate individuals with limited literacy skills (**Supplementary File 1**). Data on age, marital status, education level, duration on PrEP, current method of obtaining PrEP, and underlying comorbidities were collected by trained research assistants experienced in quantitative research supervised by the Principal Investigator. Data was entered into Excel 2019 and exported to STATA version 17.0 for analysis.

DCE design

We employed a mixed methods design to sequentially determine an optimal PrEP delivery model. The first step involved analyzing previously collected qualitative data on barriers and facilitators faced by FSWs in Uganda when starting and adhering to PrEP(20). We used an inductive analytic approach to identify preferred attributes and desirable qualities of a PrEP delivery model based on input from current PrEP users. The second step involved a systematic review of PrEP uptake and retention among FSWs using various delivery approaches(19). The DCE design considered all factors that could impact the decision-making process regarding the choice of the PrEP

delivery model because failing to include crucial attributes in the study could introduce bias into the results⁽²³⁾. This mixed-method approach informed the creation of a comprehensive list of potential attributes and attribute levels that could influence the optimal hypothetical PrEP delivery model(19, 20).

Generation of choice sets

We utilized a fractional factorial (D-efficient) design to generate choice sets that were optimally balanced within the given constraints. This method was chosen due to the large number of variable attributes, each with varying levels. Additionally, we did pilot testing to reduce the number of hypothetical delivery models presented to participants and avoid respondent fatigue. To ensure accuracy and effectiveness, the pilot testing of the initial DCE utilized a "think aloud" approach guided by established best practice guidelines(24). This allowed participants to verbalize their thought processes while responding to the survey, thus identifying unclear or confusing questions and addressing other potential issues⁽¹⁸⁾. The pilot phase further evaluated the attribute's reliability among our target population. It permitted the assessment of participants' comprehension and interpretation of the tasks and questions and estimated the completion time for the survey. Based on feedback from the pilot, adjustments were made to attribute design, question phrasing, and overall survey structure to ensure accurate testing. The profiles identified by the experimental design were then grouped into choice sets that were presented to the 203 FSWs in the form of a questionnaire with three main sections: (i) an introduction of the purpose of the DCE and how to respond correctly; (ii) questions about the participants' socio-demographic characteristics that were expected to influence their preference for a particular PrEP delivery model; (iii) the choice sets. The DCE survey questionnaire is attached as **Supplementary File 1**.

Statistical Analysis

We analyzed the data using STATA 17.0 (Stata Corp, College Station, Texas, USA). We used descriptive statistics to summarize participants' socio-demographic characteristics. A panel-data mixed logit model was employed to assess FSW preferences and attribute trade-offs, accounting for correlated choice sets and case-specific covariates such as age, education level, current PrEP model, duration of PrEP, and use of non-PrEP drugs. The PrEP delivery models were constructed using

a backward elimination approach, with the opt-out option (selecting none of the alternative models) set as the baseline alternative. Models were compared using the Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC). The model with the lowest AIC and BIC values was determined to be superior. The finalized model, which consisted of age, education level, and current PrEP delivery model as case-specific covariates, was selected based on these criteria. The number of simulations was increased from 300 to 1,000 to ensure robustness before the model was finalized. The "margin" command was utilized to calculate expected probabilities for selecting alternative PrEP delivery models.

Additionally, we evaluated the impact of increasing age and categorical variable levels on the probabilities of choosing these alternative models through contrasts. Subsequently, marginal utilities for each alternative PrEP delivery model were calculated using linear predictions from the final model. Finally, based on the highest median utility score and interquartile range (IQR), we identified our preferred option among the alternative models for delivering PrEP.

Validity and reliability of the experiment

To ensure that the DCE accurately measured what it intended to measure and that the results were reliable and applicable, we consulted with experts on the list of attributes drawn from our prior qualitative research(20). This process ensured that the attributes and levels included in the DCE were relevant to the decision-making process and covered all important aspects of the choice context. We also conducted a pilot test with a small sample of 20 FSWs to identify any issues with the design, such as confusing questions or unrealistic choice scenarios. We used the feedback from the pilot test to refine the DCE. We used the likelihood ratio test, AIC, and BIC to check how well the choice model fit the data.

Ethics approval

The study was approved by the Makerere University School of Medicine Research Ethics Committee (Mak-SOMREC-2022-299) and the Uganda National Council for Science and Technology (SS1223ES). Administrative clearance was obtained from Makerere University's Clinical Epidemiology Unit and Mulago National Referral Hospital Ethics Committee. All participants provided written informed consent before

participating in the study. They received an IRB-approved reimbursement of 20,000 Uganda Shillings (\$5.30) for their time, effort, and transportation costs.

RESULTS

Participant characteristics

The median age of study participants was 24 years (IQR 20, 32), and 97.5% (198/203) were single and living in Kampala. Forty-one percent (84/203) of FSWs received PrEP from health facilities. Another 41% accessed PrEP through community delivery, while 37% (75/203) had been on PrEP for over one year. Nearly two-thirds of the participants reported taking other medications in addition to their PrEP pills (**Table 3**).

Table 3: Characteristics of study participants

Variable	Categories	Frequency (N=203) (%)
Age	Median (IQR)	24 (20, 32)
Marital status	Married	5 (2.5)
	Not married	198 (97.5)
Residence	Outside Kampala	5 (2.5)
	Within Kampala	198 (97.5)
Education level	No Education	12 (5.9)
	Primary level	95 (46.8)
	Secondary level	86 (42.4)
	Post-secondary	10 (4.9)
Duration on PrEP	Less than six months	84 (41.4)
	>6months-1 year	44 (21.7)
	>1 year	75 (37.0)
Current PrEP model	Facility	84 (41.4)
	Community	84 (41.4)
	Both	35 (17.2)
Comorbidity	Present	128 (63.0)
	Absent	75 (37.0)

PrEP delivery model preferences and attributes

Model 4 (health facility/HCW/in-person/SMS) had the highest utility score of being chosen (0.867), followed by utility scores for model 2 (home/peer/in-person/phone call) (0.749), and model 3 (Home/HCW/CHW/phone call) (0.727), (**Table 4**). Still, model 4 (health facility/healthcare worker/in-person/short message service) was the preferred model for delivering PrEP services across the ages of 15-19, 20-24, and ≥ 25 years, with median utility scores of 0.88, 0.87, and 0.85, respectively (**Table 5**).

Table 4: Utility scores of choosing PrEP delivery

#	Model	Median utility	IQR
1	Health facility/HCW/in-person/SMS	0.867	0.823, 0.941
2	Home/peer/in-person/phone call	0.749	0.646, 0.787
3	Home/HCW/CHW/phone call	0.727	0.605, 0.800
4	Hotspot/HCW/CHW/phone call	0.678	0.490, 0.715
5	Home/HCW/in-person/SMS	0.674	0.617, 0.748
6	Health facility/peer/in-person/phone call	0.579	0.470, 0.661
7	Home/peer/in-person/None	0.568	0.311, 0.674
8	Health facility/HCW/peer/SMS	0.558	0.471, 0.608
9	Community/pharmacist/peer/SMS	0.547	0.320, 0.591
10	Health facility/HCW/peer/phone call	0.504	0.431, 0.538
11	Opt-out (None of the models)	0.500	0.500, 0.500
12	Hotspot/peer/in-person/SMS	0.478	0.246, 0.561
13	Community/HCW/CHW/None	0.470	0.280, 0.526
14	Hotspot/HCW/in-person/phone call	0.460	0.237, 0.564
15	Community/peer/in-person/ phone call	0.456	0.438, 0.610
16	Hotspot/HCW/in-person/SMS	0.448	0.383, 0.629

Table 5: Utility scores of PrEP delivery models by age groups

PrEP delivery model	15-19 years	20-24 years	≥ 25 years
	Median utility (IQR)	Median utility (IQR)	Median utility (IQR)
Health facility/HCW/in-person/SMS	0.88 (0.84, 0.95)	0.87 (0.85, 0.94)	0.85 (0.80, 0.93)
Home/peer/in-person/phone call	0.73 (0.61, 0.76)	0.74 (0.63, 0.77)	0.78 (0.68, 0.82)
Home/HCW/CHW/phone call	0.61 (0.56, 0.75)	0.66 (0.59, 0.78)	0.76 (0.67, 0.84)
Hotspot/HCW/CHW/phone call	0.67 (0.48, 0.69)	0.68 (0.49, 0.70)	0.69 (0.50, 0.73)
Home/HCW/in-person/SMS	0.67 (0.62, 0.74)	0.67 (0.62, 0.74)	0.68 (0.62, 0.76)
Health facility/peer/in-person/phone call	0.61 (0.59, 0.72)	0.58 (0.55, 0.67)	0.51 (0.43, 0.63)
Home/peer/in-person/None	0.53 (0.27, 0.62)	0.57 (0.25, 0.62)	0.63 (0.39, 0.71)
Health facility/HCW/peer/SMS	0.61 (0.54, 0.68)	0.59 (0.52, 0.61)	0.49 (0.43, 0.58)
Community/pharmacist/peer/SMS	0.53 (0.29, 0.55)	0.53 (0.30, 0.57)	0.58 (0.35, 0.63)

Opt-out (None of the models)	0.50 (0.50, 0.50)	0.50 (0.50, 0.50)	0.50 (0.50, 0.50)
Health facility/HCW/peer/phone call	0.50 (0.41, 0.50)	0.51 (0.42, 0.52)	0.52 (0.46, 0.56)
Hotspot/peer/in-person/SMS	0.46 (0.27, 0.50)	0.43 (0.29, 0.52)	0.54 (0.33, 0.62)
Community/HCW/CHW/None	0.44 (0.25, 0.49)	0.46 (0.26, 0.50)	0.51 (0.31, 0.58)
Hotspot/HCW/in-person/phone call	0.43 (0.20, 0.49)	0.43 (0.22, 0.53)	0.52 (0.28, 0.64)
Community/peer/in-person/ phone call	0.56 (0.44, 0.61)	0.53 (0.44, 0.61)	0.46 (0.44, 0.60)
Hotspot/HCW/in-person/SMS	0.35 (0.34, 0.37)	0.40 (0.38, 0.42)	0.55 (0.46, 0.67)

The study participants who had previously experienced health facility and community-based PrEP delivery models generally preferred the health facility/healthcare worker/in-person/short message service model. However, those who had not utilized both health facility and community-based models simultaneously showed a greater preference for the hotspot/healthcare worker/community health worker/phone call model, although their perceived utility was similar to that of the health facility/healthcare worker/in-person/short message service model (median utility scores 0.94 and 0.81, respectively) (Table 6).

Table 6: Utility scores by current PrEP model being utilized by FSW

PrEP delivery model	Health Facility model	Community model	Both health facility & community
	Median utility (IQR)	Median utility (IQR)	Median utility (IQR)
Health facility/HCW/in-person/SMS	0.94 (0.94, 0.95)	0.81 (0.79, 0.85)	0.86 (0.84, 0.88)
Home/peer/in-person/phone call	0.64 (0.61, 0.68)	0.77 (0.75, 0.81)	0.79 (0.76, 0.82)
Home/HCW/CHW/phone call	0.66 (0.60, 0.73)	0.81 (0.78, 0.85)	0.50 (0.43, 0.60)
Hotspot/HCW/CHW/phone call	0.49 (0.47, 0.50)	0.69 (0.68, 0.71)	0.88 (0.87, 0.89)
Home/HCW/in-person/SMS	0.59 (0.55, 0.62)	0.70 (0.67, 0.74)	0.80 (0.76, 0.81)
Health facility/peer/in-person/phone call	0.47 (0.43, 0.55)	0.60 (0.55, 0.67)	0.72 (0.66, 0.75)
Home/peer/in-person/None	0.29 (0.25, 0.36)	0.67 (0.61, 0.71)	0.62 (0.56, 0.69)
Health facility/HCW/peer/SMS	0.52 (0.47, 0.58)	0.62 (0.58, 0.67)	0.42 (0.38, 0.47)
Community/pharmacist/peer/SMS	0.31 (0.29, 0.35)	0.57 (0.55, 0.61)	0.60 (0.57, 0.64)
Health facility/HCW/peer/phone call	0.43 (0.42, 0.45)	0.52 (0.51, 0.53)	0.58 (0.57, 0.60)
Opt-out (None of the models)	0.50 (0.50, 0.50)	0.50 (0.50, 0.50)	0.50 (0.50, 0.50)
Hotspot/peer/in-person/SMS	0.30 (0.26, 0.35)	0.56 (0.52, 0.62)	0.51 (0.46, 0.57)
Community/HCW/CHW/None	0.27 (0.25, 0.30)	0.50 (0.48, 0.55)	0.54 (0.52, 0.60)
Hotspot/HCW/in-person/phone call	0.23 (0.19, 0.28)	0.56 (0.50, 0.62)	0.53 (0.47, 0.61)
Community/peer/in-person/ phone call	0.46 (0.45, 0.61)	0.44 (0.44, 0.60)	0.68 (0.53, 0.68)
Hotspot/HCW/in-person/SMS	0.42 (0.37, 0.53)	0.42 (0.37, 0.51)	0.78 (0.72, 0.84)

The preferred PrEP delivery model among participants with no primary and secondary education levels was health facility/healthcare worker/in-person/short message service (utility score 0.86). However, post-secondary education participants preferred the health facility/healthcare worker/peer/short message service model (utility score 0.83). This choice closely aligned with participants' preferences in other education categories (Table 7).

Table 7: Utility scores of PrEP delivery models by education level

PrEP delivery model	No Education	Primary Education	Secondary education	Post-Secondary Education
	Median utility (IQR)	Median utility (IQR)	Median utility (IQR)	Median utility (IQR)
Health facility/HCW/in-person/SMS	0.85 (0.83, 0.91)	0.67 (0.55, 0.68)	0.86 (0.80, 0.94)	0.83 (0.78, 0.93)
Home/peer/in-person/phone call	0.63 (0.57, 0.67)	0.74 (0.65, 0.77)	0.77 (0.65, 0.79)	0.87 (0.79, 0.89)
Home/HCW/CHW/phone call	0.62 (0.44, 0.73)	0.52 (0.45, 0.59)	0.68 (0.61, 0.81)	0.75 (0.72, 0.84)
Hotspot/HCW/CHW/phone call	0.42 (0.28, 0.58)	0.67 (0.49, 0.69)	0.70 (0.50, 0.75)	0.68 (0.48, 0.70)
Home/HCW/in-person/SMS	0.72 (0.63, 0.76)	0.59 (0.51, 0.67)	0.74 (0.62, 0.76)	0.87 (0.79, 0.87)
Health facility/peer/in-person/phone call	0.58 (0.40, 0.69)	0.59 (0.51, 0.67)	0.50 (0.44, 0.60)	0.69 (0.63, 0.76)
Home/peer/in-person/None	0.76 (0.59, 0.81)	0.63 (0.35, 0.69)	0.57 (0.25, 0.62)	0.43 (0.16, 0.46)
Health facility/HCW/peer/SMS	0.47 (0.40, 0.61)	0.44 (0.44, 0.53)	0.59 (0.50, 0.64)	0.60 (0.58, 0.67)
Community/pharmacist/peer/SMS	0.39 (0.27, 0.46)	0.89 (0.85, 0.95)	0.56 (0.32, 0.60)	0.65 (0.40, 0.70)
Health facility/HCW/peer/phone call	0.46 (0.44, 0.53)	0.44 (0.44, 0.53)	0.51 (0.43, 0.57)	0.48 (0.41, 0.51)
Opt-out (None of the models)	0.50 (0.50, 0.50)	0.45 (0.23, 0.54)	0.50 (0.50, 0.50)	0.50 (0.50, 0.50)
Hotspot/peer/in-person/SMS	0.22 (0.17, 0.25)	0.48 (0.30, 0.54)	0.51 (0.31, 0.58)	0.62 (0.39, 0.63)
Community/HCW/CHW/None	0.51 (0.40, 0.59)	0.45 (0.27, 0.49)	0.50 (0.28, 0.54)	0.61 (0.39, 0.67)
Hotspot/HCW/in-person/phone call	0.36 (0.26, 0.45)	0.45 (0.44, 0.54)	0.54 (0.25, 0.61)	8.7X10 ⁻⁸ (2.3X10 ⁻⁸ , 1.0X10 ⁻⁷)
Community/peer/in-person/phone call	0.43 (0.41, 0.47)	0.45 (0.27, 0.49)	0.61 (0.60, 0.62)	7.7X10 ⁻⁸ (7.2X10 ⁻⁸ , 7.7X10 ⁻⁸)

Hotspot/HCW/in-person/SMS	0.18 (0.10, 0.34)	0.44 (0.37, 0.57)	0.45 (0.40, 0.68)	0.71 (0.68, 0.76)
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257 DISCUSSION

258 This discrete choice experiment, conducted with cisgender FSWs in Kampala,
 259 Uganda, utilized a cross-sectional survey to determine the most end-user-centric PrEP
 260 delivery model. FSW preferred delivery through a health provider at the sex worker-
 261 friendly MARPI clinic as the next best option, with additional support in the form of
 262 SMS reminders. Findings from the qualitative phase revealed that healthcare
 263 providers at the clinic were perceived as friendly and non-judgmental, creating a
 264 comfortable environment for these women(20). They were also seen as capable of
 265 maintaining confidentiality while delivering PrEP services. Participants reported feeling
 266 welcomed, included, and safe at the MARPI clinic, which encouraged them to continue
 267 utilizing its services(19, 20).

268

269 Prior studies have shown that FSWs appreciate PrEP introduction within familiar and
 270 trusted "friendly" clinics tailored for sex workers and value positive encouragement
 271 from clinic staff(25-27). In our study, healthcare workers were perceived as
 272 knowledgeable individuals with specialized knowledge about PrEP. This preference
 273 for healthcare workers as PrEP providers is consistent with previous research
 274 conducted in Uganda, which found that PrEP delivery based at health facilities
 275 required healthcare providers to have sufficient knowledge and confidence in
 276 discussing antiretroviral medications for HIV prevention with clients(28). Similar results
 277 have been demonstrated in family health programs in Brazil, Bangladesh, and Nepal,
 278 in which health workers positively influenced health by serving as entry points, bridges,
 279 and connectors to healthcare services, systems, and resources(29-31). Our results
 280 emphasize the importance of involving healthcare workers in PrEP delivery for
 281 FSWs(20).

282

283 In as much as most FSWs preferred healthy facility-based PrEP delivery, some
 284 preferred community-based healthcare services that involve community providers and
 285 peers rather than solely facility-based options, as this can help overcome stigma and
 286 discrimination barriers(32). The World Health Organization recommends differentiated
 287 approaches for delivering PrEP services, prioritizing the individual and community(33).

These approaches are adapted to the specific needs and preferences of individuals who may benefit from PrEP. Implementing these differentiated services can improve PrEP acceptability and accessibility and support its ongoing use and effectiveness(34). Community-based delivery options such as pharmacies, community organizations, drop-in centers, and mobile clinics complement facility-based care by providing strong linkages and referral pathways for those seeking treatment(35). Our findings underscore the importance of customizing differentiated service delivery models for FSWs.

Research has demonstrated the effectiveness of SMS interventions in promoting medication adherence. Clients who received SMS reminders reported higher treatment adherence than those who did not(36, 37). This may be attributable to the non-intrusive nature of text message reminders compared to other adherence strategies(38). Furthermore, the simplicity and user satisfaction associated with such reminders make them a valuable tool in healthcare services. A study on improving medication adherence among type 2 diabetes patients through SMS reminders showed that this method was relatively simple and had minimal impact on daily routines (39). This review concluded that text messages increased adherence and improved health outcomes(37, 40), although there were limitations for those without access to a phone or reliable electricity.

Strengths and limitations

Our study has several strengths. We conducted a DCE in a busy health facility that provides comprehensive HIV care and prevention services to more than 80% of FSWs in Kampala. This approach allowed for a significant representation of FSWs' preferences regarding PrEP delivery. Additionally, our results are based on a robust sample size of >200 FSWs, surpassing the recommended number of 150 for DCEs. We deliberately selected FSWs taking PrEP for at least two months, ensuring their preferences were grounded in their firsthand experiences with current delivery methods. Additionally, we used pictograms to aid participants' understanding of choice sets and minimize strategic biases that may have skewed preferences. However, our study had limitations. Notably, our sample did not include pregnant FSWs despite being at twice the risk for HIV acquisition during pregnancy and postpartum compared to non-pregnant periods. The highest probability was noted on the opt-out model,

perhaps due to a lack of optimal knowledge of PrEP delivery models. The other limitation is that DCEs are theoretical in offering choices. Therefore, randomized controlled trials should be done as part of person-centered care to assess the effectiveness of various model preferences in prevention coverage. Future studies should address this gap and include pregnant FSWs and other vulnerable populations to gain a more comprehensive understanding of their perspectives.

Conclusions and recommendations

FSWs showed a clear preference for receiving PrEP directly from a health worker within a friendly and supportive healthcare setting. To enhance adherence and mitigate the risk of adverse health outcomes like HIV acquisition due to non-adherence, there is a significant need for supplementary support mechanisms. Implementing tools such as SMS reminders could improve adherence rates and ensure better health outcomes for FSWs using PrEP. These preferences should be considered when designing future approaches for delivering PrEP through the National PrEP Program. As mentioned above, further evaluation of this PrEP delivery model's feasibility and effectiveness is necessary, including vulnerable populations, such as pregnant FSWs. A study is underway to determine the feasibility and acceptability of our preferred PrEP delivery model for FSWs.

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Authors' contributions

Study conceptualization - RM, KMM, JK, CK, AK, MAH, ARK, MRK, and AM. Protocol development - RM, JN, FCS, and PK. DCE survey tool development, DCE data collection process and analysis - RM, RMM, LM, FW, KJD, SEG, and OK. First manuscript draft - RM and AM. Manuscript revisions - RM, SEG, RMM, FM, ARK, MRK, and AM. Supervision of data collection process and data management - RM. Overall study supervision - ARK, MRK, and AM. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and analyzed during the current study are available from the the corresponding author on reasonable request.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Option 1 COMMUNITY	Option 2 HOME	Option 3 HOTSPOT	Option 4 NEITHER
 Peer receiving PrEP from a pharmacist on behalf of the sex worker in the community.	 Peer delivering PrEP to a sex worker at her home.	 Healthworker delivering PrEP to a sex worker at a hotspot.	
 Sex worker receiving SMS reminders about taking PrEP.	 Sex worker receiving call reminders about taking PrEP.	 Sex worker receiving SMS reminders about taking PrEP.	

CARD H

☐ Write in this box the option number for the preferred modality of extending PrEP to you.