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SUBSTANTIVE REVIEW

HIV Prevention Product Acceptability and Preference Among Women in Sub-Saharan Africa to Inform Novel Biomedical Options in Development: A Systematic Review

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Abstract

The availability of several HIV prevention options may allow women to choose a product that suits their lifestyle and preferences. Product attributes and contextual factors influence product acceptability, which affects uptake and effective use. We conducted a systematic review of acceptability and preference for biomedical HIV prevention products among women in sub-Saharan Africa (SSA) to inform the development of novel products. We used a comprehensive strategy to search three databases for peer-reviewed literature from SSA published between January 2015 and December 2023. A two-stage review process assessed references against eligibility criteria. Data were abstracted using a standardized spreadsheet, then organized by constructs from two theoretical frameworks of acceptability. Results were synthesized based on product classes defined by route of administration. We identified 408 unique references; 100 references met eligibility criteria. References assessed oral PrEP (n = 65), vaginal ring (n = 44), long-acting systemic products (injectable, implant, microarray patch) (n = 28), and other vaginal products (film, insert, gel) (n = 20). Over two-thirds reported qualitative or mixed-methods data, primarily from adolescent girls and young women. Frequent dosing, especially noted for daily oral PrEP, and perceived/experienced side effects were notably negative influences. Most end-users preferred long-acting products (systemically or vaginally delivered), though on-demand products offering user control were also valued. Influencing factors, especially partners, shaped end-user perceptions of product attributes and acceptability. All products were linked to at least some barriers to uptake and/or use, highlighting the need to provide end-users with a range of options and assist them in identifying one that best suits their circumstances and needs. Biomedical HIV prevention development should advance products that address gaps in available options while optimizing favorable product attributes to achieve high acceptability that ultimately supports adoption and use.

Keywords HIV prevention · Biomedical options · Acceptability · Preferences · Sub-Saharan Africa · Women · Systematic review

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Introduction

The HIV prevention field has begun to realize a key goal of having multiple safe and effective options that offer women choice in HIV prevention that best fits their needs and preferences [1–5]. Incorporating choice is a critical strategy to achieving HIV prevention targets to end the epidemic because it supports women's agency to make informed decisions about their sexual and reproductive health. The need for HIV prevention choice was well conveyed by African women advocates in the September 2023 HIV Prevention Choice Manifesto for Women and Girls in Africa [6] that

articulated a 12-point action plan to achieve a diverse and accessible mix of HIV prevention choices.

Additionally, the World Health Organization (WHO) has recommended three biomedical products as effective options for the prevention of HIV acquisition: daily oral pre-exposure prophylaxis (oral PrEP) in 2015 [7], the dapivirine vaginal ring (PrEP ring) in 2021 [8], and long-acting injectable cabotegravir (CAB-LA) in 2022 [9]. Despite the availability of oral PrEP and the promise of these two additional HIV prevention options, gaps remain in their accessibility and affordability. Also, key product attributes and contextual factors influence their acceptability and preference, which have implications for sustained uptake and prevention effective use by women.

Biomedical HIV prevention research has shown that no single product will fit the needs and desires of all individuals. Importantly, the contraceptive field has previously demonstrated the importance of choice in increasing population-level use, and that having multiple options will allow users to select prevention that is aligned with their circumstances over time [10–13]. Consequently, it is essential to develop a variety of products to ensure that end users can choose an HIV prevention product best suited to them.

Despite the clear need to expand choice in prevention options for women, addressing gaps in the existing product development pipeline will need to take into consideration factors that make products highly acceptable, affordable, scalable, and deliverable. Consequently, product developers and policymakers will need to think beyond safety and efficacy and consider the broader social context influencing product choice, such as why and how end users make prevention decisions and how local health systems prioritize products to rollout in the public health setting. Theoretical frameworks informed by a considerable body of end-user research highlight numerous factors, both broad and product-specific, that affect end users' use of biomedical HIV prevention products [14–16]. By identifying common barriers and facilitators to the use of different classes of products – both existing and in development– lessons learned can be applied to those earlier in development.

Recent systematic reviews have examined the evidence base on product acceptability and preference for individual HIV prevention products with different drug delivery modalities, including oral PrEP [17], PrEP ring [18], and injectable PrEP [19]. However, no reviews have examined constructs of acceptability and preference across product class by drawing on research from the three approved products alongside products in development. Consequently, we conducted a systematic review of the existing literature on acceptability and preferences of biomedical HIV prevention products and synthesized the evidence based on product classes defined by route of administration. The objective in examining product attributes and influencing factors within product classes was to characterize what factors may influence the acceptability and preference of various product classes in development, identify gaps, and inform the design of novel biomedical products in development.

Methods

Databases and Search Terms

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [20]. In consultation with a reference librarian, we developed a search strategy to identify peer-reviewed literature from SSA examining values, preferences, and acceptability of biomedical HIV prevention products (approved and in development). We included publications between January 1, 2015, and December 31, 2023. The lower bound was established to evaluate more recent research reflecting the current pipeline of products in development or approved for use. We chose 2015 as a cut-off to build on an existing review that summarized the values and preferences of early vaginal microbicide products prior to 2015 [21]. Initially, in November 2022, we conducted searches in PubMed, Web of Science, and Embase. The search was rerun in January 2024 to ensure references through December 2023 were included**.** Briefly, our core search terms included the following constructs: (values, preferences, acceptability) AND HIV prevention AND product class/type AND SSA AND (women, key influencers). The complete search strategy, including specific terms, is provided in **Supplemental** Table 1**.**

Eligibility Criteria

References needed to meet inclusion criteria (Table 1). We included references examining cisgender women and key influencers, on women's uptake of HIV prevention. We included references reporting quantitative and qualitative data that explored values, preferences, and acceptability for HIV prevention products in SSA. We excluded references that did not explore biomedical interventions, studies that were not conducted in SSA, and references published before 2015.

Reference Screening, Data Management, and Analysis

After conducting database searches, a reference list was uploaded into Covidence, a systematic review collaborative data management software program (Veritas Health Innovation, Melbourne, Australia). Two reviewers used a multiphase screening strategy to determine inclusion: Stage

Table 1 Eligibility criteria

Criteria	Include
Location	Research with populations in sub-Saharan Africa (if multiple locations, findings should be disaggregated for each SSA location)
Publication date	Published between 2015 and 2023
Content	Social and behavioral research related to values, preferences, and acceptability of biomedical HIV prevention products (or factors driving these outcomes)
Intervention	Examines biomedical HIV prevention products, including oral PrEP, injectable PrEP, vaginal ring or vaginally inserted products, novel products in development (excluding male and female condoms)
Data type	Quantitative and qualitative studies
Reference type	Peer-reviewed manuscript presenting original research findings
Population	Cis-gender women, women's sexual partners and health care providers

1: title/abstract review; Stage 2: full text review. Any discrepancies were resolved by a third reviewer. Quantitative and qualitative data were independently extracted by two reviewers using a standardized Excel-based form. Any data extraction differences were resolved by a third reviewer. From each included reference we extracted the following: (1) reference identification: authors, reference type and publication year; (2) description: objectives, location, population characteristics, study aims, product types, study design, and sample size; and (3) outcomes: findings related to values, preferences, and acceptability of biomedical HIV prevention products.

To guide the analysis of factors influencing acceptability and preferences for biomedical HIV prevention products, we also extracted data based on an analytic framework (Fig. 1), which we adapted to incorporate key aspects of two frameworks focused on acceptability and use of biomedical products: Role of Product Acceptability in Adherence (Mensch, et al.) and Theoretical Framework of Acceptability (as presented in Ortblad, et al.) [14, 16]. Foremost, this framework is underpinned by the social ecological model, which posits that influences should be considered at multiple levels, including social and structural context, providers and health systems, partner influences, and individual levels [22]. This framework allows flexibility to examine factors for the distinct classes of products included in this review.

The results of this systematic review are summarized in narrative and tabular formats. To present product class-focused syntheses of results, we first developed product-specific summary memos that highlighted key outcomes related to influencing factors and acceptability and preference constructs. We examined evidence derived from different types of studies within product classes to assess where findings aligned and when they diverged. In studies where acceptability and preference were assessed hypothetically (e.g., discrete choice experiment), a range of education about actual or theoretical products was provided across references to make assessments more concrete, including educational

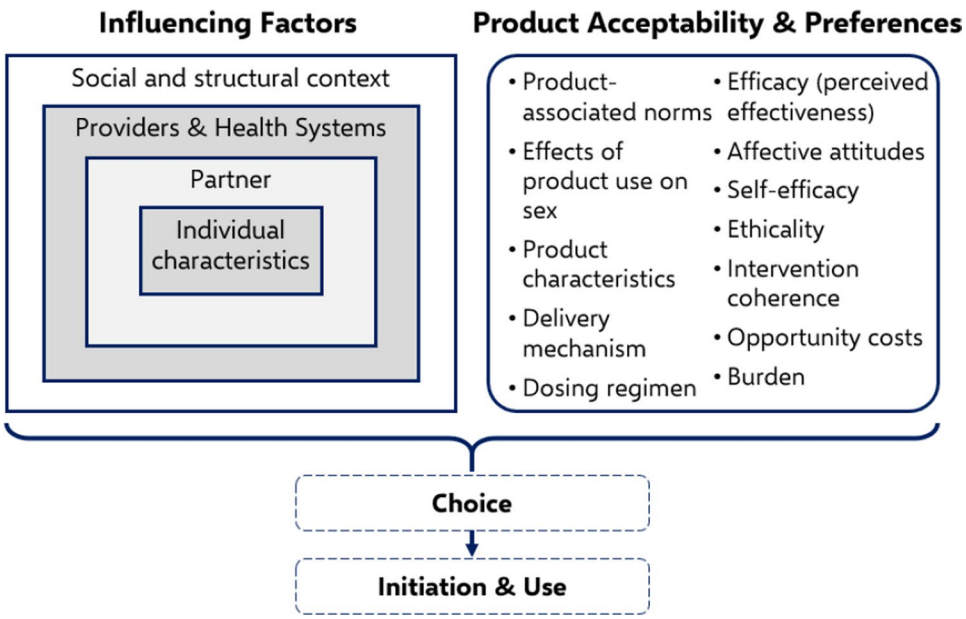


Fig. 1 Adapted conceptual model merging influencing factors and product attributes examining acceptability and preference of biomedical HIV prevention products

videos, images, and product models. We then summarized and assessed themes to identify similarities and differences across classes. Specifically, for constructs related to product acceptability, we constructed a heat map with the goal of summarizing the level of evidence and identifying key themes across product classes. The constructs examined were guided by the theoretical model presented in Fig. 1. Certain salient dimensions or subthemes were identified through the coding process and are presented separately from the main construct.

Two reviewers analyzed the extracted data to identify references that made either positive (+) or negative (−) reports on a given construct. For example, where participants reported negative side effects related to a product, the reference was noted in the negative (−) column. If a reference reported both positive and negative findings, the reference was listed in both columns for that construct. Minority views were not captured in the heat map; for example, if fewer than 20% of participants reported experiencing side effects, the reference was not reported in the negative (−) column. After all references were coded, we summarized the level of evidence by applying colors and using a gradient to identify where more references addressed a given topic.

Results

Reference Characteristics

As shown in Fig. 2, we identified 408 unique references through our database searches, and 100 references met eligibility criteria for this review, with reasons for exclusion noted. Of the 100 references, 77 report results from 46 unique studies (with some studies having more than one reference) and 33 references not naming a specific study. A summary of key characteristics of the included references is presented in Table 2**,** with a full list of references available in Table 3.

Of note, 65 references included oral PrEP, 44 included the vaginal ring, 28 examined long-acting systemic product forms (injectable, implant, microarray patch [MAP]) and 20 included other vaginal products, such as the film, insert, and gel (a reference may include products from more than one category). Approximately half of the references (n = 47) included an active product, 12 utilized a placebo product, and 41 assessed acceptability for hypothetical future products or approved options without use experience. Over two-thirds of the references

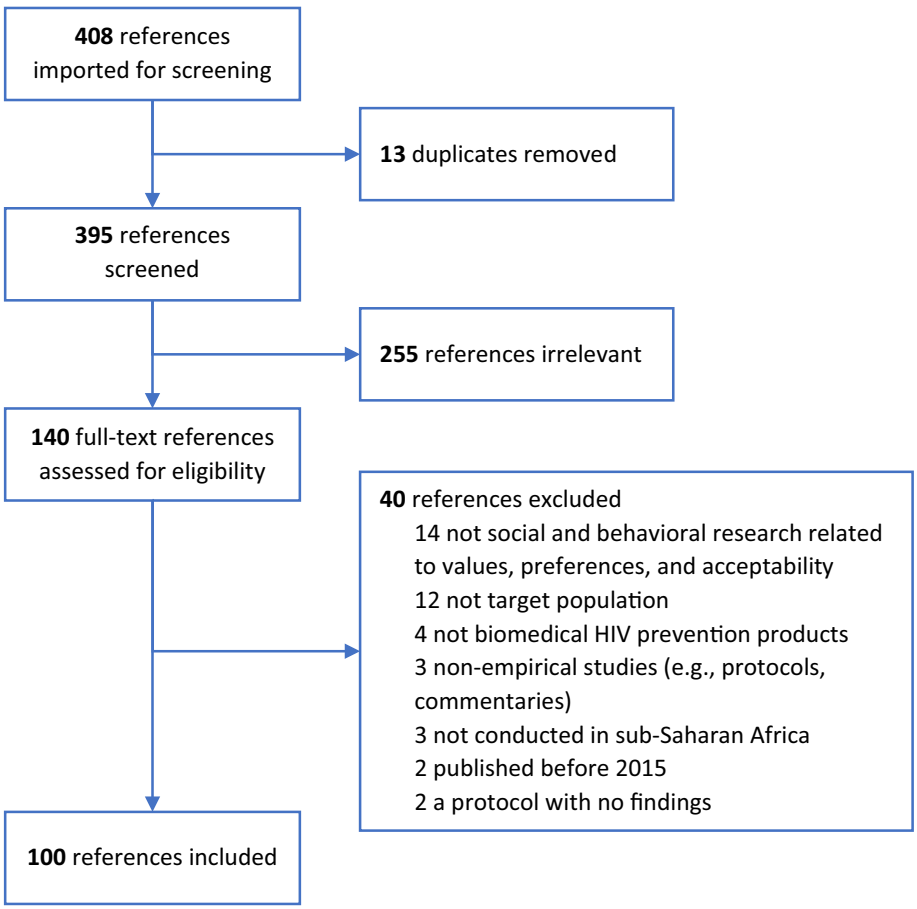


Fig. 2 PRISMA diagram

Table 2 Characteristics of references included in detailed extraction

Peer-reviewed manuscript	100*
Product type	
Oral daily dosing (Tablets)	65
Vaginally delivered	53
Short-acting (Film, Insert, Gel, Other)**	20
Long-acting (Vaginal Ring)	44
Systemic long-acting (Injections, Implants, MAPs)***	28
Product use during study	
Active product used or active/placebo RCT	47
Placebo product used	12
Hypothetical / no product used	41
Study design/data type	
Qualitative or mixed methods	68
Quantitative questionnaires	23
Discrete choice experiments	9
Populations	
Cisgender women	98
Adolescent girls & young women results reported separately	27
Female sex workers	13
Pregnant and/or breastfeeding women	5
Men / Male partners	35
Couples	3
Healthcare providers or other key informants	7

*The denominator for each characteristic is 100, thus percentages are not reported alongside frequencies

**Short-acting vaginal products include vaginal gel (n = 16), film (n = 7), insert or suppository (n = 7), and other products including a hypothetical vaginally delivered product, vaginal fabric, and a non-woven vaginal insert (all n = 1). Short-acting vaginal includes on demand, daily dosing, and products designed to provide up to 7 days of protection. Long-acting vaginal includes one-month and three-month rings

***Systemic long-acting products include injections (n = 22), implants (n = 8), and microarray patches (MAPs) (n = 2). Systemic long-acting includes products that provide one month to one year (or more) of protection

(n = 68) reported qualitative or mixed method research findings, whereas other references reported quantitative survey data and discrete choice experiments. Nearly all references included data from adolescent girls and young women (AGYW), with over one quarter reporting these results separately (n = 27). Female sex workers (n = 13) and pregnant and breastfeeding women (n = 5) were also represented as key groups. Male partners (n = 35) and health care providers or other key informants (n = 3) were included. As shown in Fig. 3, South Africa represented the highest number of references (n = 65), followed by Uganda (n = 32), Zimbabwe (n = 32), Kenya (n = 22), and Malawi (n = 20).

Acceptability and Preference Evidence by Product Class

As shown in Fig. 4**,** the heat map provides an overview of the evidence related to acceptability. For each product class, evidence was broken into positive or negative insights relative to a given acceptability construct in the left-hand column. Darker color gradients represent an increased number of references reporting on that theme.

Much of the literature on values and preferences for biomedical HIV prevention products was framed around barriers to use; consequently, challenges or negative perceptions may be overrepresented. Nevertheless, we found that a greater number of references reported on themes related to daily oral PrEP over other product classes. The frequency of the dosing regimen and perceived or experienced side effects related to oral PrEP were often discussed as negative aspects. Despite these challenges, many references noted an overall positive affective attitude toward oral PrEP.

Similarly, there was a generally positive affective attitude toward vaginal products from product experienced and naive end-users, especially long-acting (one month or more) products, with references reporting approval of the dosing regimen, which supported ease of use and ability to adhere. In general, long-acting (one month or more) systemic products were also viewed favorably, especially for their discreetness; however, end users expressed concerns over side effects and injection site pain. The sections below further elaborate key findings for each product class.

Oral PrEP—Daily Dosing

We included 65 references on daily oral PrEP [12, 13, 23–85]: 34 references focused exclusively on oral PrEP and 31 references included a comparison between oral PrEP and other delivery forms. Across references, women reported moderate positive affective attitude driven by familiarity with oral tablets as an HIV prevention delivery form. Also, most women reported willingness to use oral PrEP as a prevention tool [28, 34, 37, 47, 48, 57, 67]. However, in clinical trials and in demonstration projects, achieving high adherence to daily use of oral PrEP has proven challenging [12, 23, 28–32, 36, 38, 41, 42, 46]. Despite delivery form familiarity, in studies that included a comparator, women overwhelmingly preferred longer-acting products compared with daily oral PrEP [13, 24, 26, 45, 49, 51, 54, 72].

As indicated in Fig. 4, not wanting to or not being able to adhere to the daily dosing regimen was a prominent barrier to acceptability and a critical reason women chose not to initiate oral PrEP [34, 38, 49, 54, 55, 58, 59, 65, 72, 78, 80–82]. Women often found tablets burdensome because they interfered with daily work and personal life, were hard to remember to take, easy to lose, and difficult to access

Table 3 References reporting biomedical HIV prevention product acceptability and preferences

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Amico 2017	Experiences with HPTN 067/ADAPT Study-Provided Open-Label PrEP Among Women in Cape Town: Facilitators and Barriers Within a Mutuality Framework	South Africa	HPTN 067 / ADAPT	60	Women 18–44	Active	O
Atujuna 2018	Contexts of vulnerability and the acceptability of new biomedical HIV prevention technologies among key populations in South Africa: A qualitative study	South Africa	*none named*	56	Adolescents 15–17 Women ≥ 18 MSW ≥ 18 MSM ≥ 18	Prototype	VR, O, Inj, VG
Bazzi 2018	Perspectives on biomedical HIV prevention options among women who inject drugs in Kenya	Kenya	*none named*	9	Women ≥ 18	Hypothetical	O, VR, VG
Beckham 2022	Acceptability of multiple modalities of pre-exposure prophylaxis (PrEP) among female sex workers in Tanzania: a mixed-methods study	Tanzania	Project Shikamana	293	FSW ≥ 18	Hypothetical	O, Inj
Bhushan 2022	Making the Case for Joint Decision-Making in Future Multipurpose Prevention Technology (MPT) Choice: Qualitative Findings on MPT Attribute Preferences from the CUPID Study (MTN-045)	Uganda and Zimbabwe	MTN 045	78	Women 18–40 Men ≥ 18	Hypothetical	VR, O

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Bjertrup 2021	PrEP reminds me that I am the one to take responsibility of my life: a qualitative study exploring experiences of and attitudes towards pre-exposure prophylaxis use by women in Eswatini	Eswatini	*none named*	46	AGYW 16–25 PBW ≥ 16 HCP Men	Active	O
Browne 2020	Efficacy is Not Everything: Eliciting Women's Preferences for a Vaginal HIV Prevention Product Using a Discrete-Choice Experiment	South Africa and Zimbabwe	Quatro Study	395	Women 18–30	Hypothetical	VOth
Browne 2023	Acceptability of the dapivirine vaginal ring for HIV-1 prevention among women reporting engagement in transactional sex	Malawi, South Africa, Uganda, and Zimbabwe	MTN-020 / ASPIRE	2614	women 18–45	Active	VR
Celum 2021	PrEP uptake, persistence, adherence, and effect of retrospective drug level feedback on PrEP adherence among young women in southern Africa: Results from HPTN 082, a randomized controlled trial	South Africa, Zimbabwe	HPTN 082	451	Women 16–25	Active	O
Chimbindi 2022	Antiretroviral therapy based HIV prevention targeting young women who sell sex: a mixed method approach to understand the implementation of PrEP in a rural area of KwaZulu-Natal, South Africa	South Africa	DREAMS	2296	AGYW 10–24 YWSS AB and Men 12–35 HCP, KI	Active	O

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Chitukuta 2019	Negative rumours about a vaginal ring for HIV-1 prevention in sub-Saharan Africa	Malawi, South Africa, Uganda, and Zimbabwe	MTN 020 / ASPIRE	214	Women 18–45	Active	VR
Corneli 2016	Participants' Explanations for Nonadherence in the FEM-PrEP Clinical Trial	Kenya, South Africa	FEM-PrEP	312	Women 18–35	Active	O
Duby 2020	Hygiene, Blood Flow, and Vaginal Overload: Why Women Removed an HIV Prevention Vaginal Ring During Menstruation in Malawi, South Africa, Uganda and Zimbabwe	Malawi, South Africa, Uganda and Zimbabwe	MTN 020 / ASPIRE	214	Women 18–45	Active	VR
Eakle 2018	Exploring acceptability of oral PrEP prior to implementation among female sex workers in South Africa	South Africa	*none named*	69	Women ≥ 18	Active	O
Eakle 2019	"I am still negative": Female sex workers' perspectives on uptake and use of daily pre-exposure prophylaxis for HIV prevention in South Africa	South Africa	TAPS Demonstration Project	18	Women ≥ 18	Active	O
Emmanuel 2020	Community perspectives on barriers and challenges to HIV pre-exposure prophylaxis access by men who have sex with men and female sex workers access in Nigeria	Nigeria	*none named*	739	FSW ≥ 18 MSM ≥ 18	Active	O

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Fowler 2015	Attitudes of serodiscordant couples towards antiretroviral-based HIV prevention strategies in Kenya: a qualitative study	Kenya	*none named*	38	Women or men ≥ 18	Active	O
Gachigua 2023	Microarray patch for HIV prevention and as a multipurpose prevention technology to prevent HIV and unplanned pregnancy: an assessment of potential acceptability, usability, and programmatic fit in Kenya	Kenya	*none named*	127	AGYW 15–24 FSW MSM Providers Male partners Stakeholders	Prototype	MAP
Gill 2020	Acceptability, safety, and patterns of use of oral tenofovir disoproxil fumarate and emtricitabine for HIV pre-exposure prophylaxis in South African adolescents: an open-label single-arm phase 2 trial	South Africa	PlusPills	148	Adolescents 15–19	Active	O
Giovenco 2021	Adolescent-Centered HIV Prevention: Perspectives on Acceptability of Oral Antiretroviral Pre-exposure Prophylaxis for Adolescents in a Global Priority Setting	South Africa	*none named*	82	Adolescents 16–17 HCP	Hypothetical	O

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Gombe 2020	Key barriers and enablers associated with uptake and continuation of oral pre-exposure prophylaxis (PrEP) in the public sector in Zimbabwe: Qualitative perspectives of general population clients at high risk for HIV	Zimbabwe	*none named*	60	People ≥ 16	Active	O
Govender 2017	Influences of geo-spatial location on pre-exposure prophylaxis use in South Africa: positioning microbicides for better product uptake	South Africa	CAPRISA 008 post-trial ppts	104	Women ≥ 18	Active	G
Govender 2018	Understanding women and men's acceptability of current and new HIV prevention technologies in KwaZulu-Natal, South Africa	South Africa	*none named*	112	Women and men 18–49	Hypothetical	O, VR, Inj
Hart 2019	Acceptability and performance of a nonwoven device for vaginal drug delivery among women and their male partners in KwaZulu-Natal, South Africa	South Africa	*none named*	50	Women ≥ 18 Men ≥ 18	Placebo	VOth
Inghels 2022	PrEP uptake and delivery setting preferences among clients visiting six healthcare facilities in Eswatini	Eswatini	*none named*	470	Women and men ≥ 16	Active	O

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Ismail 2023	Exploring user and stakeholder perspectives from South Africa and Uganda to refine microarray patch development for HIV PrEP delivery and as a multipurpose prevention technology	South Africa, Uganda	*none named*	288	AGYW 18–25 FSW Men 18–40	Prototype	MAP
Kabarambi 2021	The dapivirine vaginal ring from the perspective of married men in Uganda	Uganda	DREAM OLE of the DVR Phase 3 trial IPM027	10	Men ≥ 18	Active	VR
Kagaayi 2020	Uptake and retention on HIV pre-exposure prophylaxis among key and priority populations in South-Central Uganda	Uganda	*none named*	2985	Women and men ≥ 15 Data broken out for FSW, AGYW	Active	O
Katz 2020	The Power of the Shared Experience: MTN-020/ASPIRE Trial Participants' Descriptions of Peer Influence on Acceptability of and Adherence to the Dapivirine Vaginal Ring for HIV Prevention	Malawi, South Africa, Zimbabwe, Uganda	MTN 020 / ASPIRE MTN 032 / AHA	187	Women aged 18–45 (at ASPIRE enrollment) Broken out by 18–21 vs. 22–45	Active	VR
Katz 2021	Using Emoji Stickers to Understand End-User Opinions of the Dapivirine Vaginal Ring for HIV Prevention	Malawi, South Africa, Zimbabwe, Uganda	MTN 025 / HOPE MTN 032 / AHA	58	Women aged 23–48	Active	VR
Kawuma 2022	"I prefer to take pills when I plan to have sex": Perceptions of on-demand versus daily oral pre-exposure prophylaxis among adolescents in Kampala, Uganda	Uganda	FERDAR	50	Males and Females 16–19	Hypothetical	O

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Kebaabetswe 2015	Factors Associated with Adherence and Concordance Between Measurement Strategies in an HIV Daily Oral Tenofovir/Emtricitibine as Pre-exposure Prophylaxis (Prep) Clinical Trial, Botswana, 2007–2010	Botswana	TDF2	1219	Women and men 18–39	Active	O
Kidman 2020	Interest in HIV pre-exposure prophylaxis (PrEP) among adolescents and their caregivers in Malawi	Malawi	Malawi Longitudinal Study of Familes and Health	3542	Adolescents aged 10–16 Primary caregivers	Hypothetical	O, Inj
Krogstad 2018	Perspectives of South African youth in the development of an implant for HIV prevention	South Africa	*none named*	105	Women 18–24 Men 18–24	Prototype	Imp
Kuteesa 2019	Acceptability and Predictors of Uptake of Anti-retroviral Pre-exposure Prophylaxis (PrEP) Among Fishing Communities in Uganda: A Cross-Sectional Discrete Choice Experiment Survey	Uganda	HIVCOMB	713	Women ≥ 18 Men ≥ 18	Hypothetical	O, VR, Imp, Inj
Laborde 2018	Perceptions of the "Fabric"—An exploratory study of a novel multipurpose technology among women in Sub Saharan Africa	South Africa, Uganda, Zimbabwe	Fabric Study	55	Women ≥ 25	Prototype	VOth
Laher 2020	Willingness to use HIV prevention methods among vaccine efficacy trial participants in Soweto, South Africa: discretion is important	South Africa	HVTN 702	38	Women and Men 18–35 years	Hypothetical	Unspecified

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Lahuerta 2017	Feasibility, Acceptability, and Adherence with Short-Term HIV Preexposure Prophylaxis in Female Sexual Partners of Migrant Miners in Mozambique	Mozambique	*none named*	74	Women ≥ 18	Active	O
Lancaster 2020	Preferences for Preexposure Prophylaxis Service Delivery Among Female Sex Workers in Malawi: A Discrete Choice Experiment	Malawi	*none named*	153	FSW ≥ 18	Hypothetical	O
Little 2022	HIV Pre-exposure Prophylaxis Implant Stated Preferences and Priorities: Results of a Discrete Choice Experiment Among Women and Adolescent Girls in Gauteng Province, South Africa	South Africa	*none named*	600	AG 15–17 YW 18–30 FSW ≥ 18	Hypothetical	O, Imp
Luecke 2016	Stated product formulation preferences for HIV pre-exposure prophylaxis among women in the VOICE-D (MTN-003D) study	South Africa, Zimbabwe, Uganda	MTN 003D / VOICE-D	68	Women 21–41 results stratified by age ≤ 25	Hypothetical	CB, Imp, Inj, O, VG, VF, VR, VI
Lunkuse 2022	Low awareness of oral and injectable PrEP among high-risk adolescent girls and young women in Kampala, Uganda	Uganda	*none named*	285	AGYW 14–24	Hypothetical	O, Inj

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
MacQueen 2016	Social Context of Adherence in an Open-Label 1Â % Tenofovir Gel Trial: Gender Dynamics and Disclosure in KwaZulu-Natal, South Africa	South Africa	CAPRISA 106 (ancillary study of CAPRISA 008)	76	Women ≥ 18 Men ≥ 18	Active	VG
Mataboge 2023	Preferences, educational messaging, and demand creation channels for multipurpose-prevention technologies (MPTs) among women in South Africa	South Africa	*none named*	261	AGYW 18–24 Women > 24 FSW 18 +	Hypothetical	Imp
Mayanja 2022	Oral pre-exposure prophylaxis preference, uptake, adherence and continuation among adolescent girls and young women in Kampala, Uganda: a prospective cohort study	Uganda	*none named*	285	AGYW 14–24	Hypothetical	O
Mayo 2021	Acceptability of the Dapivirine Vaginal Ring for HIV-1 Prevention and Association with Adherence in a Phase III Trial	Malawi, South Africa, Zimbabwe, Uganda	MTN 020 / ASPIRE	2562	Women aged 18–45	Active	VR
Mbewe 2020	Male partners' influence on women's acceptance and use of PrEP products across two high HIV-burdened districts in South Africa	South Africa	*none named*	89	Women 18–49 Men 18–49	Hypothetical	VG, Inj, VR, O

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
McLellan-Lemal 2022	Acceptability of an intravaginal ring for simultaneously preventing HIV infection and pregnancy: Qualitative findings of the Kisumu combined ring study, 2019	Kenya	Kisumu Combined Ring Study (KCRS)	25	Women 18–34	Active	VR
Miller 2020	Prevention, Partners, and Power Imbalances: Women's Views on How Male Partners Affected Their Adherence to Vaginal Microbicide Gels During HIV Prevention Trials in Africa	South Africa, Tanzania	Former MDP301 or VOICE ppts	46	Women 24–73 years	Active	VG
Miller 2021	Women design their own vaginal microbicide trial: Suggestions on how to improve adherence from former participants of HIV prevention trials	South Africa, Tanzania	Former MDP301 or VOICE ppts	46	Women 24–73 years	Active	VG
Minnis 2018	Young Women's Ratings of Three Placebo Multipurpose Prevention Technologies for HIV and Pregnancy Prevention in a Randomized, Cross-Over Study in Kenya and South Africa	Kenya, South Africa	TRIO	258	Women 18–30	Placebo	O, Inj, VR
Minnis 2019a	Young Women's Stated Preferences for Biomedical HIV Prevention: Results of a Discrete Choice Experiment in Kenya and South Africa	Kenya and South Africa	TRIO	536	Women 18–30	Placebo	O, Inj, VR

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Minnis 2019b	Insights for Implementation Science From 2 Multiphased Studies With End-Users of Potential Multipurpose Prevention Technology and HIV Prevention Products	South Africa, Kenya, Zimbabwe	TRIO and Quatro	1536	Women 18–30 Men ≥ 18 HCP	Placebo	O, Inj, VR, VI, VF, VG
Minnis 2020	Preferences for long-acting Pre-Exposure Prophylaxis (PrEP) for HIV prevention among South African youth: results of a discrete choice experiment	South Africa	iPrevent	807	Women 18–24 Men 18–24	Hypothetical	Inj, Imp
Minnis 2021	Giving voice to the end-user: input on multipurpose prevention technologies from the perspectives of young women in Kenya and South Africa	Kenya, South Africa	TRIO	277	Women 18–30	Placebo	O, Inj, VR
Minnis 2022	Couples' Preferences for "2 in 1" Multipurpose Prevention Technologies to Prevent Both HIV and Pregnancy: Results of a Discrete Choice Experiment in Uganda and Zimbabwe	Uganda, Zimbabwe	MTN 045 / CUPID	800	Women 18–40 Men ≥ 18	Hypothetical	O, VR, VF, VI
Montgomery 2015	Male Partner Influence on Women's HIV Prevention Trial Participation and Use of Pre-exposure Prophylaxis: the Importance of "Understanding"	South Africa	MTN 003C / VOICE-C	124	Women 19–40 Men 22–45	Active	O, VG
Montgomery 2017	Acceptability and use of a dapivirine vaginal ring in a phase III trial	Uganda, Malawi, Zimbabwe, South Africa	MTN 020 / ASPIRE	214	Women 18–45	Active	VR

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Montgomery 2018	Reasons for nonadherence to the dapivirine vaginal ring: narrative explanations of objective drug-level results	Malawi, South Africa, Uganda, and Zimbabwe	MTN 032 / AHA	187	Women 18–45 findings reported separately for 18–21	Active	VR
Montgomery 2019a	End-user preference for and choice of four vaginally delivered HIV prevention methods among young women in South Africa and Zimbabwe: the Quatro Clinical Crossover Study	South Africa, Zimbabwe	Quatro Study	200	Women 18–30	Placebo	VR, VG, VF, VI
Montgomery 2019b	The Invisible Product: Preferences for Sustained-Release, Long-Acting Pre-exposure Prophylaxis to HIV Among South African Youth	South Africa	iPrevent	95	Males and females 18–24	Active	O, Inj, Imp, VR
Montgomery 2023	Acceptability of the Dapivirine Vaginal Ring and Oral Truvada Among African Users in Late-Stage of Pregnancy	Malawi, Uganda, South Africa, Zimbabwe	MTN-042 / DELIVER	48	Pregnant Women 18–40	Active	O, VR
Morar 2023	Male Partner Opinions of the Dapivirine Vaginal Ring Used During an Open-Label Extension HIV Prevention Trial in KwaZulu-Natal, South Africa	South Africa	MTN-032 / AHA	18	male partners 23–49	Active	VR
Mudzviti 2020	Perspectives on oral pre-exposure prophylaxis use amongst female sex workers in Harare, Zimbabwe	Zimbabwe	*none named*	131	FSW	Hypothetical	O

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Muhumuza 2021	Exploring Perceived Barriers and Facilitators of PrEP Uptake among Young People in Uganda, Zimbabwe, and South Africa	South Africa, Uganda, Zimbabwe	Combined HIV Adolescent PrEP and Prevention (CHAPS)	227	Males and females 13–24	Hypothetical	O
Musara 2021	Preferences and Acceptability of Vaginal Delivery Forms for HIV Prevention Among Women, Male Partners and Key Informants in South Africa and Zimbabwe: Qualitative Findings	South Africa, Zimbabwe	Quatro Study	81	women 18–30	Placebo	VR, VG, VF, VI
Musara 2022	Understanding the role of men in women's use of the vaginal ring and oral PrEP during pregnancy and breastfeeding: multi-stakeholder perspectives	Malawi, Uganda, South Africa, Zimbabwe	MTN-041 / MAMMA	196	Women 18–40 Men ≥ 18	Prototype	O, VR
Naidoo 2021	Qualitative Perceptions of Dapivirine VR Adherence and Drug Level Feedback Following an Open-Label Extension Trial	Malawi, South Africa, Zimbabwe, Uganda	MTN-032 / AHA	58	Women aged 18–45 (at ASPIRE enrollment)	Active	VR
Nakamanya 2022	Assessing acceptability of pre-exposure prophylaxis (PrEP) among participants in an HIV vaccine preparedness study in southwestern Uganda	Uganda	*none named*	49	Men and Women 18–45 (FGD split out young and older women)	Active	O

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Namey 2016	When and why women might suspend PrEP use according to perceived seasons of risk: implications for PrEP-specific risk-reduction counselling	Kenya and South Africa	*none named*	60	Women 18–32	Hypothetical	O
Ngure 2023	Baseline preferences for oral pre-exposure prophylaxis (PrEP) or dapivirine intravaginal ring for HIV prevention among adolescent girls and young women in South Africa, Uganda and Zimbabwe (MTN-034/IPM-045 study)	South Africa, Uganda, Zimbabwe	MTN-034 / REACH	247	AGYW 16–21	Active	O, VR
Nkomo 2023	Prospective acceptability of a multipurpose technology (MPT) implant in preclinical development to prevent HIV and unplanned pregnancy: Qualitative insights from women end users and health care providers in South Africa and Zimbabwe	South Africa, Zimbabwe	SCHIELD	127	Women 18–30 HCP	Prototype	Imp
Nyblade 2022	Stigma in the health clinic and implications for PrEP access and use by adolescent girls and young women: conflicting perspectives in South Africa	South Africa	PrEPARE Pretoria Project	264	AGYW 18–24	Hypothetical	O
Ongolly 2021	"I Just Decided to Stop:" Understanding PrEP Discontinuation among Individuals Initiating PrEP in HIV Care Centers in Kenya	Kenya	Partners Scale-Up	46	males and females 18–55	Active	O

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Pintye 2017	"I Did Not Want to Give Birth to a Child Who has HIV": Experiences Using PrEP During Pregnancy Among HIV-Uninfected Kenyan Women in HIV-Serodiscordant Couples	Kenya	Partners Demonstration Project	21	pregnant women 20–36	Active	O
Pintye 2018	HIV-Uninfected Kenyan Adolescent and Young Women Share Perspectives on Using Pre-exposure Prophylaxis During Pregnancy	Kenya	*none named*	68	pregnant and postpartum adolescent (14–18) and nonadolescent (> 18) women	Hypothetical	O
Pintye 2021	Influences on Early Discontinuation and Persistence of Daily Oral PrEP Use Among Kenyan Adolescent Girls and Young Women: A Qualitative Evaluation From a PrEP Implementation Program	Kenya	PrIYA Program	93	AGYW 15–24	Active	O
Quaife 2018	Divergent Preferences for HIV Prevention: A Discrete Choice Experiment for Multipurpose HIV Prevention Products in South Africa	South Afica	*none named*	661	adult men and women 18–49 adolsecent girls 16–17	Hypothetical	O, VG, VR, Inj
Reddy 2022	Ring-ing in the Future: Participant and Male Partner Perspectives Regarding Future Use of the Dapivirine Vaginal Ring for HIV Prevention	Malawi, South Africa, Uganda, Zimbabwe	MTN-032 / AHA	112	Women aged 18–45 (at ASPIRE enrollment) Men > 18	Active	VR

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Restar 2017	Perspectives on HIV Pre- and Post-Exposure Prophylaxes (PrEP and PEP) Among Female and Male Sex Workers in Mombasa, Kenya: Implications for Integrating Biomedical Prevention into Sexual Health Services	Kenya	*none named*	44	FSW and MSW ≥ 18	Hypothetical	O
Roberts 2016	Intimate Partner Violence and Adherence to HIV Pre-exposure Prophylaxis (PrEP) in African Women in HIV Serodiscordant Relationships: A Prospective Cohort Study	Kenya, Uganda	Partners Prep	1785	adult women	Active	O
Sarr 2020	Uptake, retention, and outcomes in a demonstration project of pre-exposure prophylaxis among female sex workers in public health centers in Senegal	Senegal	Senegal Demonstration Project	267	FSW ≥ 18	Active	O
Schuler 2017	Male engagement in women's microbicide use in Kenya: Navigating gender norms	Kenya	*none named*	98	women and men 18–40	Active	VG
Sekhon 2021	Pregnant and breastfeeding women's prospective acceptability of two biomedical HIV prevention approaches in Sub Saharan Africa: A multisite qualitative analysis using the Theoretical Framework of Acceptability	Malawi, South Africa, Uganda, and Zimbabwe	MTN-041 / MAMMA	65	Women 18–40	Prototype	VR, O

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Shamu 2021	Pre-exposure prophylaxis (PrEP) awareness, attitudes and uptake willingness among young people: gender differences and associated factors in two South African districts	South Africa	*none named*	1955	young people 18–24	Hypothetical	O
Shapley-Quinn 2019	"We are not the same": African women's view of multipurpose prevention products in the TRIO clinical study	Kenya, South Africa	TRIO	88	women 18–30	Placebo	O, VR, Inj
Sila 2020	High Awareness, Yet Low Uptake, of Pre-Exposure Prophylaxis Among Adolescent Girls and Young Women Within Family Planning Clinics in Kenya	Kenya	PrIYA Program	470	women 15–24	Hypothetical	O
Sullivan 2020	Views among Malawian women about joining HIV prevention clinical trials when pregnant	Malawi	Project Malawi	35	adult women	Hypothetical	O, VR
Tolley 2019	Acceptability of a long-acting injectable HIV prevention product among US and African women: findings from a phase 2 clinical Trial (HPTN 076)	Zimbabwe, South Africa, U.S	HPTN 076	136	women 18–45	Active	Inj
Tolley 2020	Acceptability of Long-Acting Injectable Cabotegravir (CAB LA) in HIV-Uninfected Individuals: HPTN 077	Brazil, Malawi, South Africa, US	HPTN 077	199	adult women and men	Active	Inj

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Tubert 2021	HIV prevention at drug shops: awareness and attitudes among shop dispensers and young women about oral pre-exposure prophylaxis and the dapivirine ring in Shinyanga, Tanzania	Tanzania	*none named*	82	AGYW 15–24	Hypothetical	O, VR
van der Straten 2017	Favoring "peace of Mind": A Qualitative Study of African Women's HIV Prevention Product Formulation Preferences from the MTN-020/ASPIRE Trial	Malawi, South Africa, Uganda, and Zimbabwe	MTN-020 / ASPIRE	71	women 18–45	Active, Hypothetical	VR, O, VG, VT, Inj, VF, VI, Imp
van der Straten 2018	The Tablets, Ring, Injections as Options (TRIO) study: what young African women chose and used for future HIV and pregnancy prevention	Kenya and South Africa	TRIO	277	women 18–30	Placebo	O, VR, Inj
van der Straten 2019	First Impressions Matter: How Initial Worries Influence Adherence to the Dapivirine Vaginal Ring	Malawi, South Africa, Uganda, and Zimbabwe	MTN-020 / ASPIRE	2799	women 18–45	Active	VR
van der Straten 2020	Influences on willingness to use vaginal or oral HIV PrEP during pregnancy and breastfeeding in Africa: the multisite MAMMA study	Malawi, South Africa, Zimbabwe, Uganda	MTN-041 / MAMMA	128	Women 18–40	Prototype	O, VR

Table 3 (continued)

Author year	Title	Country/-ies	Study name	Total # participants	Population	Product Used	Product(s)
Wagner 2022	Female and male partner perspectives on placebo Multipurpose Prevention Technologies (MPTs) used by women in the TRIO study in South Africa and Kenya	South Africa, Kenya	TRIO	127	women 18–30	Placebo	O, VR, Inj
Weinrib 2018	End-Users' Product Preference Across Three Multipurpose Prevention Technology Delivery Forms: Baseline Results from Young Women in Kenya and South Africa	Kenya, South Africa	TRIO	277	women 18–30	Placebo	O, VR, Inj
Weinrib 2020	Perspectives from Young South African and Zimbabwean Women on Attributes of Four (Placebo) Vaginal Microbicide Delivery Forms	South Africa and Zimbabwe	Quatro Study	230	Women 18–30	Placebo	VR, VI, VF, VG
Witte 2022	PrEP acceptability and initiation among women engaged in sex work in Uganda: Implications for HIV prevention	Uganda	*none named*	542	FSW 18 +	Hypothetical	O
Zhao 2022	Color, Scent and Size: Exploring Women's Preferences Around Design Characteristics of Drug-Releasing Vaginal rings	South Africa	*none named*	16	Women 20–34	Prototype	VR

*Product key

CB cervical barrier, *Imp* implant, *Inj* long-acting injectable, *MAP* microarray patch, *O* oral tablet, *VF* vaginal film, *VG* vaginal gel, *VI* vaginal insert/suppository, *VOth* vaginal other, *VR* vaginal ring

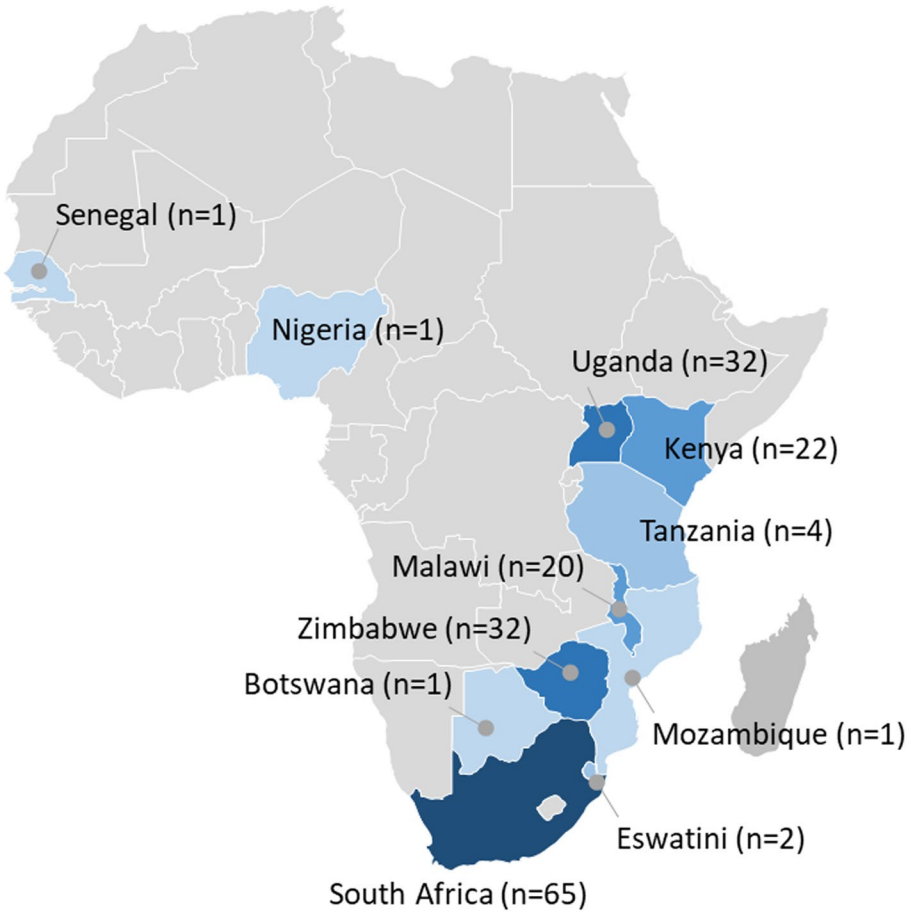


Fig. 3 Distribution of references per country

once they ran out [28, 49, 54, 58, 65, 73]. Many women also expressed concern over product characteristics, including the large size and shape of oral tablets [54, 58, 78] and the taste and smell [23, 36, 38, 54, 55, 58, 70]. These concerns acted as barriers to initiation and persistence.

Many references also cited women's concerns about side effects from oral PrEP as a barrier to uptake or persistence [23, 36, 38, 58, 59, 62, 65, 70, 82, 84]. Women reported that having information available about potential side effects was critical to enabling their continued use of oral PrEP [38, 70]. Although women expressed apprehension about side effects, many still believed that the protective advantages of oral PrEP outweighed possible adverse effects [38, 67].

Another frequent concern reported by women in 13 references was the lack of discretion related to oral PrEP [23, 26, 28, 35, 49, 50, 53, 55, 60, 62, 64, 65, 71], which was often tied to HIV-related stigma. This concern emerged across research with active product (e.g., demonstration projects) as well as in clinical trials and studies assessing hypothetical preferences among products. Stigma-related barriers specifically reflected women's concern, based primarily on findings reported in studies of actual use, that oral PrEP would be perceived as being antiretroviral medication used for HIV treatment (e.g., [23, 25, 34, 62, 78]) and others, both in actual use and hypothetical acceptability references, felt that it was or would be difficult to store, use, or get refills discreetly (e.g. [28, 34, 44, 60, 62, 65],).

Across multiple references, women expressed a belief that oral tablets were effective in providing systemic protection against HIV [23, 36, 38, 58, 59, 62, 65, 70] and positive affective attitudes toward having a product they could control and use for HIV prevention (e.g., [32, 33, 38, 46]). When compared with other routes of administration, one study found that women thought that oral administration would be less effective than an injection [72], whereas a second study found that women felt they would be better protected against HIV by an oral tablet than by local vaginal drug delivery [49]. Oral systemic administration during pregnancy and breastfeeding also raised safety-related concerns pertinent to fetal and infant health, with more local vaginal drug exposure potentially preferred [77].

Vaginally Delivered Products

Short-acting Products – Film, Insert, Gel, Other

We examined 20 references on short-acting vaginally delivered products from mostly hypothetical and some placebo

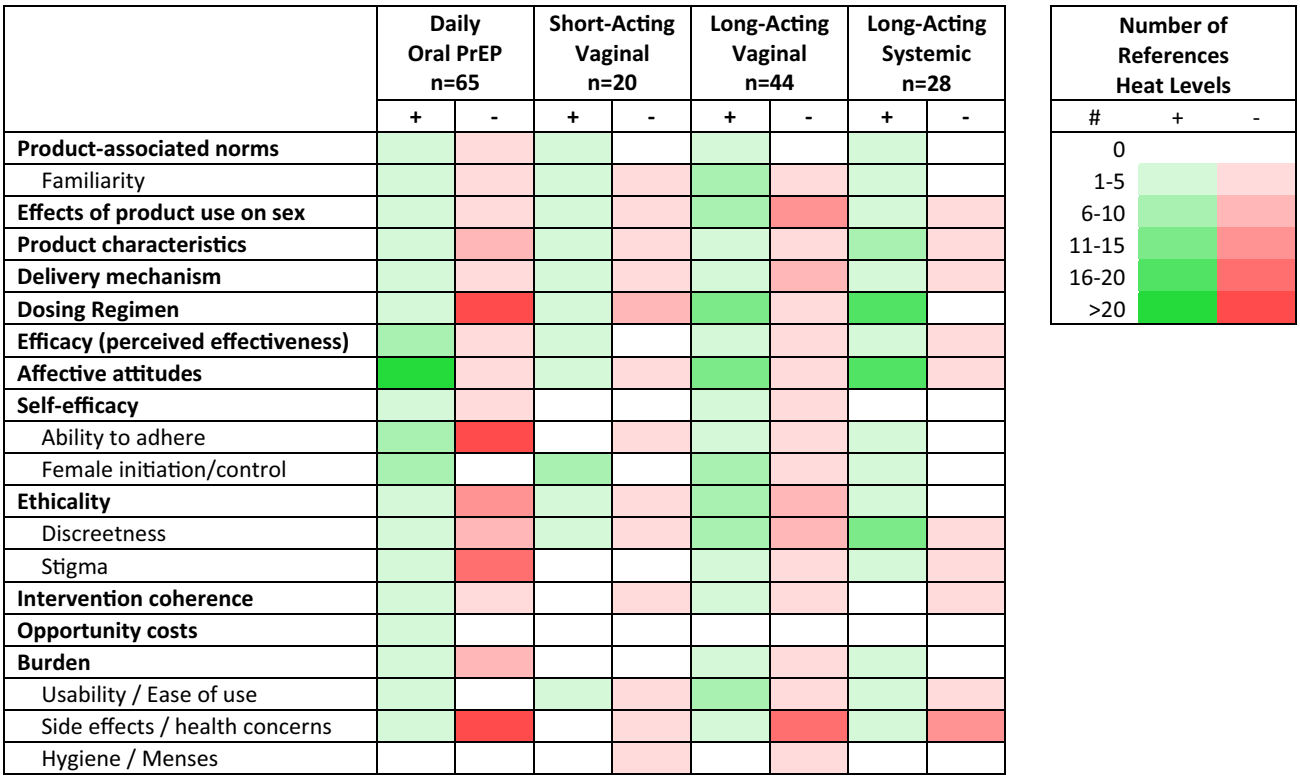


Fig. 4 Heat Map Summarizing the Frequency of Evidence for Key Acceptability and Preference Themes by Product Class

studies. This product class was defined to include products designed for on-demand use and products that may provide protection for 1 to 7 days, depending on the product. Short-acting delivery forms included vaginal films, inserts, gels, and other vaginal products (including an electrospun nanofiber, nonwoven drug delivery device, cervical barrier methods, and a generic hypothetical vaginally delivered product) [12, 24, 25, 49, 50, 52, 56, 66, 85–96]. Overall, many women liked short-acting vaginal products because of the lack of interference with daily activities, ease of use, and discreet delivery mechanism [24, 49, 50, 52, 87, 91, 93]. In several references, both women and some male partners found short-acting vaginal products acceptable and appreciated that they were female-initiated and would not necessarily require male partner cooperation when used (in contrast to a male condom) [12, 25, 91]. As evidenced in Fig. 4, perceptions varied among women regarding product attributes viewed as favorable or negative influences on acceptability, with several key influential factors, as described below.

Perceived ease of use of short-acting vaginal products was shaped prominently by familiarity and ease of insertion. Delivery forms perceived as similar to familiar vaginal products, including tampons or vaginal suppositories, were regarded as acceptable and easy to use in a placebo study [91]. In contrast, when presented with a novel product form (e.g., nanofiber "fabric") in hypothetical studies, women were less certain about its insertion and whether it would dissolve; however, confidence in the nanofiber fabric improved with an educational demonstration [96].

Direct experience using placebo vaginal products in the Quatro clinical cross-over study (film, insert, gel, ring) shifted acceptability and preferences, with product ratings that increased with familiarity, especially for novel delivery forms [12]. After the opportunity to try using the products, perceptions varied regarding what product forms were easy to use, with relatively even distribution of preferences across the four products evaluated. While some women raised concerns about difficulty with inserting vaginal films [91, 93] and expressed a preference for an applicator, the film was the most preferred product among Zimbabwean compared with South African women [91, 94]. The insert was viewed positively by other women because of its small size, ease of insertion, and complete dissolution after insertion [91]. Similarly, ease of insertion featured prominently in women's views of the nanofiber "fabric" insert, with a smaller size preferred for perceived ease of insertion [96].

The dosing of short-acting vaginal products constituted another important influence on acceptability and preference. A dosing regimen that is vaginally delivered for more localized protection was commonly of interest to women when evaluated. While a minority view, in several hypothetical and placebo studies, women were opposed to inserting

products into their vagina because of discomfort with the process and concerns about health effects, including future fertility or risk of cancer [25, 49, 90, 91]. In multiple references, product-naïve women reported less interest in vaginal products that need to be inserted daily [49, 52, 94], with consistent preference for on-demand dosing over daily dosing [49, 52]. However, there were concerns about the timing of on-demand dosing regarding not being ready for unanticipated sex [87] or making a partner wait [89], with women expressing a desire for greater flexibility around the timing of use of on-demand products to avoid coital dependency of dosing [93].

Additionally, individual sexual behavior patterns influenced preferences for on-demand vaginal products. In one hypothetical study, women with predictable sex patterns (e.g., a partner who travels for work, regular sex work) were more interested in on-demand products. However, women with less predictable sex patterns were more interested in the continuous prevention provided by a daily or longer-acting product [87].

Discreetness—specifically product use without partner knowledge, including during sex—was an important contributor to acceptability [50, 52, 91, 94–96]. Across multiple references, women reported that the gel made the vagina noticeably wetter [49, 89, 91]; product leakage and discharge were strongly disliked. Increased lubrication was also reported with the nonwoven vaginal insert [95] and the vaginal insert [93]. Women's views of the implications of changes to the vaginal environment varied; however, with more modest increases in lubrication noted as positively influencing sexual pleasure [49, 52, 95]. For some women, including in geographic settings where dry sex is culturally preferred, increased lubrication was viewed negatively, usually in relation to discussing male partner pleasure [89, 91]. While many of the vaginally-inserted products were noted as increasing lubrication – with implications for discreetness—the fast-dissolving placebo film was viewed as causing a drying or tightening effect, which was not universally liked, but overall resulted in positive use experiences during sex [91, 93].

Two references identified age-based differences in acceptability and preferences for vaginal gel; no age-related differences were noted for film, insert, or other short-acting vaginal products. In a discrete choice experiment conducted with women in Zimbabwe and South Africa, younger women had a stronger preference tied to mode of insertion, with less preference for finger insertion than older women [94]. In the VOICE-D study, younger women (aged 18 to 24 years) preferred oral PrEP over vaginal gel and were more likely to express concerns with gel leaking, whereas older women (aged 25 or older) preferred vaginal gel and were more likely to mention a positive effect on sexual enjoyment for themselves or their partner [49].

Long-acting Product—Vaginal Ring

We examined 44 references on the vaginal ring [12, 13, 24, 25, 27, 39, 45, 49–55, 66, 70, 72, 74–79, 83–86, 91, 93, 97–111]. Most of these references reported on a one-month duration ring; however, a longer-acting ring (up to 3 months) was assessed in several studies. In general, in studies assessing acceptability prior to use or hypothetical preferences, the initial preference for the vaginal ring, as compared with other prevention products, was relatively low because of a lack of familiarity with its delivery mechanism and lack of partner discretion. However, with actual user experience in clinical trials, many women found the vaginal ring to be highly acceptable, particularly because of the long-acting dosage, ease of use, strong ability to adhere, and it being a female-initiated option (Fig. 4).

Before using the vaginal ring, many women shared initial concerns about its size, the insertion process, whether it would stay in place, and its efficacy. These concerns often stemmed from a lack of familiarity with the ring, as women often knew less about the ring compared with other prevention products [25, 53, 77, 93, 105]. Community-based rumors and peer influence also contributed to hesitancy toward vaginal ring use because of the involvement of foreign researchers, fears of population control, and false beliefs that the ring would extract blood from the vagina [97, 101]. A common barrier to ring adherence was removal: women often reported removing the ring during sex and menses (for hygienic reasons) [98, 104, 106, 111]. In a few cases, women attributed illness to the ring, even if the cause was unrelated, such as a sexually transmitted infection [97, 106].

Many concerns declined significantly after women used the ring, and preference for it often increased with use [12, 54, 72, 84–86, 100, 105, 107, 108, 111]. However, while a relatively uncommon view, few women using the ring in clinical trial contexts still worried about the lack of licensing for the ring and the unknown long-term health effects for themselves, their future fertility, and, among pregnant or breastfeeding women, their babies [27, 77, 85, 103, 108]. Nevertheless, pregnant and breastfeeding women tended to prefer the ring because of concerns about other products contaminating breastmilk [70], which related to their perceptions about the localized protection provided by vaginal products compared with systemic protection from other products [49].

When the ring was preferred over other products, its long-acting duration [24, 70, 85] and its being a discreet drug delivery mechanism [50, 52, 55, 70, 83, 85, 103, 107] were reasons cited for choice. Monthly dosing was often perceived as more convenient and less burdensome than shorter-acting regimens, overcoming forgetfulness related to daily pill-taking [24, 49, 55, 70, 72, 74, 78, 85, 91]. While

many women appreciated that the ring could be used without the knowledge of family or community members, others worried that the ring would be felt by their partners during sex, which hindered their ability to use it discreetly [91]. This was supported by results from a study involving male partners, where 3 of 10 partners interviewed said they felt the ring during sex [99].

Though in one study women reportedly desired a smaller more flexible ring [109], the MTN-020/ASPIRE dapivirine ring efficacy trial reported that most participants found the ring easy to insert and comfortable to use, with little to no interference on daily activities [102]. In ASPIRE most women reported liking that the ring was female-initiated and fully reversible, in contrast with other long-acting products such as injectables or implants [85, 100]. The ability for a ring to also have contraceptive properties and/or for prevention of sexually transmitted infections as a multipurpose prevention technology (MPT) was appealing for many women and greatly influenced interest in it [25, 51, 52, 66]. Nevertheless, the ring consistently ranked lower in preference than long-acting injectable options [12, 45, 51, 66, 76, 79].

For the vaginal ring, 24 references examined sociodemographic and behavioral characteristics related to vaginal ring acceptability and preference [24, 45, 49–52, 54, 66, 72, 74–79, 86, 91, 98–100, 102–104, 109]. Age, relationship status/sexual activity, perceived and actual risk of HIV acquisition, past product experience, and altruism (as participants in clinical trials) were found to affect women's interest in and adherence to the vaginal ring.

Several references found that older women were more likely to select the vaginal ring [13, 49, 79] or to state that the ring would be more acceptable to them and their male partners [102], as compared with younger women. Similarly, older age was found to be associated with better odds of adherence to the ring [76]. However, one study found that older women were likely to prefer condoms over new products like the ring and concluded that demand for the ring may be lower among older women [66].

Several similar associations were found between a woman's relationship status/sexual activity and preference for the ring. Women with a stable intimate partner were found to be more interested in using the ring [75, 76].

Long-acting Systemic Products

We reviewed 28 references on long-acting injections, implants, or microarray patches (MAPs) with one month or greater duration [12, 24, 26, 39, 44, 45, 48–51, 53–55, 66, 72, 76, 78, 79, 81, 85, 112–119]. Among these references, eight focused exclusively on injections, implants, or MAPs and 20 included a comparison between multiple delivery forms. The majority of these references report on research assessing hypothetical acceptability and preference. Overall, women identified several product attributes that influenced their high acceptability, with an emphasis on a generally positive attitude toward long-acting duration (see Fig. 4) [12, 24, 26, 44, 48, 51, 54, 66, 72, 76, 78, 79, 113, 114].

Long-acting duration was perceived as resulting in a lower burden on the user because it did not interfere with normal activities [12, 26, 39, 113] and because a user would not have to worry about forgetting to take a daily product [26, 54, 55, 72, 116, 117]. Long-acting injectables and MAPs were viewed favourably by women and male partners because of a perception that they would not interfere with or affect sex [12, 49, 55, 78, 117].

Though not prominent among references reviewed, injections and MAPs also addressed an important aspect of self-efficacy. For example, for women from Zimbabwe and South Africa, the perceived ability to use an injection or MAP with autonomy was critical [113, 114, 116, 117].

Overall, systemic drug delivery was viewed as a positive feature of these products, with a particular focus on the ability to use the product discreetly [26, 39, 45, 54, 55, 72, 78, 116–118]. However, two references reported concerns related to systemic drug delivery because of the inability to remove injectable drug from the body [26] and concerns related to impacts of physical activity on drug release and possible migration of implants from the insertion site [112].

The most frequently reported concerns related to long-acting products among product naive women were concerns about pain, bleeding, or scarring at the insertion site [26, 48, 72, 114] and worries about side effects, including side effects similar to those experienced with contraceptive injections or implants [44, 81, 112]. Women who were familiar with injectable contraceptives expressed less concern about pain with injections [54, 55]. Insertion pain concerns with the implant were allayed when users learned about the use of a numbing medication during insertion [48].

Women who expressed a preference for a hypothetical biodegradable implant over a nondegradable implant cited reasons such as reduced clinic visits and avoidance of the removal process that was perceived to be painful. However, a minority of women had concerns about the impact of biodegradation on their body and the ability to remove the implant early if they experienced side effects [112, 118, 119]. Despite few existing products with which to compare with MAPs, women were interested in MAP technology and found simulated use of MAPs easy to complete [116, 117].

Influencing Factors

Sexual Partner Influences

The literature reviewed underscored the important role of sexual partners in women's acceptability and use of biomedical HIV prevention across all classes of products. As

depicted in the conceptual model guiding this work (Fig. 1), broader influencing factors and product attributes often interact to yield an effect on preference, choice, and use. Male partner perceptions of product attributes often influenced women's decision-making. Men often desired to be involved in decisions related to their partner's sexual health [27, 77, 99], which sometimes manifested as the male providing final "approval" of sexual health decisions.

A substantial number of oral PrEP references reported on ways in which partners of female oral PrEP users affected their adherence, both positively and negatively [23, 31, 37, 38, 58, 60, 62, 65, 68]. Support provided by partners in the form of pill-taking reminders or encouragement acted as a facilitator for adherence [23, 38], whereas partner opposition to oral PrEP use often resulted in poor adherence and discontinuation altogether [31, 37, 60, 62]. For example, women in a microbicide trial indicated that involving their partners in decision-making supported product choice, use, and management of side effects [92]. Both changes in relationship status and geographic relocation of partners influenced pill-taking by decreasing women's perceptions of HIV risk [60, 62], whereas a lack of trust in partner faithfulness, or awareness of partner infidelity, increased perceptions of HIV risk and oral PrEP need [28, 32, 46, 62, 64, 65, 72]. Women who faced challenges negotiating condom use with partners viewed oral PrEP as a method of reducing risk of HIV acquisition from unprotected sex [35, 38, 47, 48, 65, 72, 74].

For vaginally-delivered products, references reported on male partners as playing a critical role in women's preferences for and acceptability of different delivery forms via direct influence or women's concerns about partners' desires and approval [24, 49, 50, 56, 88, 89, 91, 95, 110]. Gendered relationship dynamics constituted an important factor in disclosure, acceptability, and use of vaginally-delivered products [24, 89, 91]. Women expressed interest in use of a female-controlled PrEP product in the context of prevalent sexual assault, domestic violence, partner infidelity, and male dominance [24, 39]. Women and their male partners expressed mixed attitudes toward product attributes that might affect the vaginal environment. Preferences for changes, including vaginal tightness and wetness, were viewed as pleasure enhancers to a minority and as pleasure detractors to others [49, 50, 52, 84, 91, 93, 95, 110, 111]. Preferences for effects on sex were sometimes tied to discretion, with a few women fearing that their partner may notice vaginal changes and discover product use [88, 94, 103].

Male partners reported a desire to be involved in, or even a right to control, decision-making related to prevention product use [50, 56, 92]. For example, male partners expressed concerns about products being inserted in their partner's vagina as being encroachment on their "territory" [91] and fears about side effects, including the potential impact on fertility [56]. In one study, increased vaginal lubrication from the gel raised infidelity concerns [91] and other references reported male partner concerns that HIV prevention product use may invite promiscuity [56, 83, 110]. Male partners' preferences related to products in the TRIO and Quatro studies centered on a lack of interference with sex [12]. Few male partners of MTN-003/VOICE trial participants thought that the information, knowledge, services, and preventive products that their partners accessed posed a threat to their power in the relationship and control over women's sexuality. However, having a study clinician explain the study products to the male partner positively influenced acceptability by males [56].

While the ability to use a product discreetly was highly desirable across delivery forms, many women indicated that they would tell their partner about use. Two-thirds of women participating in a discrete choice experiment about vaginally-delivered products indicated that they would tell their primary partner if they were using an HIV prevention product, even if it could be used discreetly [94]. Similarly, in a another study, most women indicated that they would make the decision to use a microbicide jointly with their partner, or would tell their partner about product use if they made the decision on their own [92]. Women participating in a vaginal gel trial who did not disclose gel use to their partner worried about their partner's reaction, and a minority of women worried that their partner would disagree with their use of the product [88].

A notable number of references (n = 27) addressed partner perspectives on the vaginal ring [12, 27, 49–53, 55, 72, 74, 77, 78, 83, 85, 91, 94, 97, 99, 101–106, 108–110]. Women worried about negative partner reactions because of vaginal ring use and any potential impact to their partner's sexual pleasure and their own sexual health; these factors influenced ring adherence in clinical trials [104, 106]. Women worried that their partner might not approve of the product and feared negative repercussions if their partner discovered the ring while having sex (in nondisclosure situations) [85, 97, 105]. Participants' concerns revolved around their partner getting angry, abusive, or being accused of infidelity [103, 105]. Despite knowledge of a partner's infidelity, a few women reported being reluctant to use new biomedical products, such as the ring, for fear of invoking mistrust from their male partner [93] or introducing relationship conflict [85, 105]. Their partner's sexual pleasure was also of importance [49, 55, 83], with most women wanting a product that would enhance sexual pleasure for their male partners, or at minimum, would not interfere with sex [53].

Partners/relationships also influenced decision-making regarding injectable and implantable PrEP use, as examined in nine references on injections [12, 26, 49–51, 53, 55, 72, 78], four references on implants [49, 112, 118], and two references on MAPs [116, 117]. The systemic application and

discretion of an injection or implant was preferable within a relationship where use of an HIV prevention product, such as the ring, had not been disclosed or was disfavored [55]. In another study with female sex workers, the injection was preferred over oral PrEP because it was easy to hide from partners and clients [26]. In one study, women felt product formulations administered at the clinic could avoid storage at home and therefore reduce discovery by the partner [55]. The possibility of women's use of the injection without their partner's knowledge was also mentioned by a few men, acknowledging that this was an advantage for women whose partners may not want them using the product [78]. Both the injectable and implant were perceived not to interfere with sex by male partners [12, 78].

Health Care Providers and Health Care Access

Attitudes from and interactions with health care providers were important in shaping acceptability and, in clinical trials and demonstration studies, in facilitating adherence. Health care provider influences and health care access were addressed in 32 references [12, 23, 24, 30, 32–35, 38, 45, 47–49, 55, 56, 58, 61–63, 71, 72, 77–80, 85, 86, 103, 113, 116–118]. Key influences on acceptability centered on treatment by clinic staff (trust, perceived stigma), clinics and providers as trusted sources of information [35, 48, 56, 80, 113, 118], stigma tied to accessing HIV prevention services, opportunities for provider-delivered prevention to support discreet use [24, 32, 33, 35, 48, 58, 63, 77, 113], and services access and delivery considerations. For example, respectful and personable treatment at the clinic made it easier for users to come back for visits for oral PrEP [35] and promoted PrEP adherence [32, 63]. On the other hand, stigmatizing and disrespectful staff was cited as a common barrier to oral PrEP uptake and adherence [23, 24, 34, 58, 61]. Also, women preferred to get information about oral PrEP from clinicians [56, 80] and would be more willing to initiate PrEP if their providers recommended it [35]. Likewise, in studies with vaginally-delivered products, participants remarked that clinics served as important hubs for education, notably for dispelling rumors [97, 108], for providing counseling to support adherence [106] [72], and for increasing product acceptability for partners [74, 75].

Health care providers cited barriers to providing HIV prevention services, particularly for young people. For example, a few reported being confronted by angry parents during talks on oral PrEP because they perceived that it would encourage teens to be sexually active, with a minority of providers holding this belief themselves [30, 61]. Other providers were hesitant to provide services because of the stigma associated with providing HIV prevention to young women as signaling approval of sexual freedom [12]. The long distances to oral PrEP facilities, lack of money to pay for transport to the clinic, and challenges in getting to the clinic during standard operating hours were additional health care access barriers that affected uptake and continued use of oral PrEP [38, 59, 60].

Both injectables and implants are administered by health care providers in facilities, leading a few women to suggest that clinic-administered product formulations would improve adherence, reduce unintended misuse of products, and reduce the need by end users to store or hide products at home [49]. In one discrete choice experiment, young women preferred using a product that was offered at a health clinic over accessing it at a pharmacy [113]. However, another study noted reluctance by women to use public facilities because of protracted waiting times and perceptions that staff are judgmental and condescending [24].

Furthermore, health care providers interviewed in both the TRIO and Quatro studies noted that the demand for new products could strain an already taxed health system by increasing work burden on the limited staff [24] and present supply chain challenges [12]. Providers also commented that low-burden products were essential for successful introduction and uptake among end users [12, 24, 56, 116, 117].

Discussion

This systematic review examined biomedical HIV prevention acceptability and preferences across several product classes among women in sub-Saharan Africa, with the objective of synthesizing evidence to inform novel biomedical options in development. We identified a wealth of social and behavioral literature investigating biomedical HIV prevention product acceptability, preference, and use that ultimately underscores the importance of PrEP method choice to address diverse needs across end users and for women over their life course.

We found that each product evaluated, regardless of delivery mechanism or duration of protection, was linked to at least some reported barriers to uptake and effective use. This highlights that end users must be provided with a range of options and counseled to weigh the relative advantages and disadvantages of each product to identify one that best suits their circumstances and prevention needs. This aligns with evidence from the contraception literature demonstrating that increased method choice improves population-level use, reduces unwanted pregnancy, and improves alignment with women's reproductive needs [10]. Consequently, a critical charge for biomedical HIV prevention development is to design products that address gaps in available options while optimizing favorable product attributes to achieve high acceptability that ultimately supports adoption and use.

Across product classes and delivery forms, most end users expressed a preference for longer-acting products, both for systemic and vaginally-delivered options, as the

longer duration was often perceived to reduce barriers to adherence, particularly when compared with taking a daily oral tablet. This finding aligns with SSA-based studies that have reported discontinuation and adherence challenges with daily use of oral PrEP [120–122]. Longer-acting products were also typically perceived to offer greater discretion, which was paramount for some end users, especially women with limited ability to negotiate product or condom use with their partner(s). Relationship dynamics often interacted with perceptions of product attributes to influence preference and choice. Specifically, women valued products that limited interference with sex and/or improved the overall sexual experience. Long-acting injectables and implants were considered advantageous in these respects, although not as obviating these concerns uniformly across studies. Oral PrEP and some shorter-acting vaginal products were also perceived to have few negative effects on sexual pleasure.

Despite a general preference for longer-acting products, the research evidence underscores the smaller, albeit important, segment of women who express keen interest in short-acting and specifically on-demand products that offer user control and flexibility. Notably, end users reported some barriers to use of long-acting products, particularly pain and concern over side effects related to injections and implants. Short-acting and on-demand products were valued by end users, especially women who worried about adherence to a daily product or prolonged drug exposure with systemic products, and women who could readily anticipate sexual frequency; for example, female sex workers or women whose partners migrate for employment. On-demand product options are also critical for individuals who do not perceive themselves as needing consistent protection and value an option that can be used only when needed, including adolescent girls and young women whose risk perception is often dynamic related to partnerships and adoption of other prevention behaviors [123, 124]. Evidence that high (but imperfect) oral PrEP adherence confers high HIV protection for women [125] and increased attention to possible on-demand regimens for oral PrEP offer additional promising directions that may better meet some women's needs.

Across the multiple product classes synthesized, this review highlights that introduction of novel delivery forms requires strategies to build familiarity among potential end users and with key influential groups, such as partners. Several placebo clinical studies that evaluated preferences and choice among products demonstrated that with increased opportunity to use and gain experience with novel vaginally- administered products, acceptability ratings for products increased over time [54, 86]. Likewise, data from the MTN-034/REACH study with adolescent girls and young women signals the opportunity to introduce a novel product successfully, particularly with an initial trial period: two-thirds of adolescent girls and young women chose to use the dapivirine vaginal ring (an initially unfamiliar product) for HIV prevention after using the ring and oral PrEP for 6 months each [126]. This highlights the importance of experiential learning and a role for users to act as mentors or product ambassadors for new users.

Integrating end-user research throughout key points in the product development process allows for opportunities to refine counseling and instructional materials and build understanding of barriers and facilitators that can be addressed to inform introduction of novel products. Additionally, it provides preliminary evidence to shape the work of differentiating users into groups that may ultimately require different prevention technologies to meet their prevention needs.

Study Limitations and Recommendations for Future Research

This systematic review is limited by several important gaps in the literature. First, although our adapted conceptual model posited that acceptability and preferences would lead to product choice, few studies included in this review allowed for direct assessment of choice when offered multiple options. Multiple implementation studies in SSA are currently introducing choice in biomedical prevention, including the CATALYST study currently implemented in five SSA countries [127]. These studies will offer important opportunities to examine enacted preference based on the opportunity to use and switch among multiple effective HIV prevention options. Indeed, most studies reported on acceptability of attributes of the products themselves, though measures of acceptability – on their own – may not be strong predictors of choice. For example, despite notable challenges associated with the dosing regimen for oral PrEP, most references still reported an overall positive affective attitude for the product. Examining either of these constructs in isolation could lead to a misinterpretation about participants' future use (e.g., not liking a daily pill does not preclude effective use). It is important that future research includes multiple measures of acceptability and preferences and examines multilevel influences on acceptability, which we found were less frequently assessed.

Although we aimed to conduct a comprehensive review, we are limited in that our time bound may preclude the inclusion of key findings generated from early vaginal microbicide trials, which could provide insights for short-term products currently in the pipeline. Nevertheless, our work builds on previous studies such as the review by Woodsong et al. (2015), which assessed values and preferences for trials pre-2015 and highlighted many of the key attributes evaluated here, including dosage, ease of use, and effectiveness. Most of the evidence in this review comes from research

conducted in South Africa, Zimbabwe, Uganda, and Kenya. Most studies were conducted in urban or peri-urban areas and acceptability was frequently assessed among women enrolled in clinical trials, resulting in limited perspectives from end users. Women who join clinical trials may do so for numerous reasons, which may not always be related to a desire to use HIV prevention. The generalizability of the findings must consider the heterogeneity of women in the SSA region. While some multisite studies reported differences in salient product attributes and preferences by geographic setting, few assessed differences by participant sociodemographic characteristics or were designed to examine geographic differences. The documented acceptability differences by geographic region and adherence differences by age evident in oral PrEP implementation studies and rollout highlight the importance of multisite and multi-country clinical trials and research studies to inform future HIV prevention products. Relatively few studies have been conducted with providers and other community stakeholders, limiting ability to characterize their views in a more rigorous and substantive manner.

Conclusions

To improve access to and sustained use of biomedical HIV prevention products among women at risk of HIV acquisition, it is broadly acknowledged that end users require access to a range of options that can better meet their needs and preferences. To that end, as product developers consider novel products to introduce, it is crucial to evaluate if and how different product classes meet the needs and lifestyle choices of specific groups. For example, although there is broad interest in long-acting options because they reduce adherence-related burden, on-demand products continue to be valued by certain groups.

Overall, uptake and use of biomedical HIV prevention products will be driven by a combination of social influences that interact with dimensions of acceptability and product attributes. Cultural context and interpersonal relationships can be strongly influential in how an end user weighs and evaluates different product attributes. Engaging with partners or developing couples' interventions that support joint decision-making, especially in sero-different couples, may support sustained use across product classes. Future research should further examine how access considerations, including cost of products and provision via different service delivery models, may influence end-user perceptions and decision-making regarding product use.

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Declarations

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