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A world of choices: Preference elicitation methods for improving the delivery and uptake of HIV prevention and treatment

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Abstract

Purpose of review: Despite the growing availability of effective HIV prevention and treatment interventions, there are large gaps in their uptake and sustained use across settings. It is crucial to elicit and apply patients' and stakeholders' preferences to maximize the impact of existing and future interventions. This review summarizes quantitative preference elicitation methods (PEM) and how they can be applied to improve the delivery and uptake of HIV prevention and treatment interventions.

Recent findings: PEM are increasingly applied in HIV implementation research, however, discrete choice experiments (DCEs) have predominated. Beyond DCEs, there are other underutilized PEM that may improve the reach and effectiveness of HIV prevention and treatment interventions among individuals by prioritizing their barriers to engagement and determining which attributes of interventions and delivery strategies are most valued. PEM can also enhance the adoption and sustained implementation of strategies to deliver HIV prevention and treatment interventions by assessing which attributes are the most acceptable and appropriate to key stakeholders.

Summary: Greater attention to and incorporation of patient's and stakeholders' preferences for HIV prevention and treatment interventions and their delivery has the potential to increase the number of persons accessing and retained in HIV prevention and treatment services.

Keywords

HIV; preference elicitation; stated preference; prevention; treatment; implementation science; RE-AIM

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Introduction

Progress in the implementation of public health interventions requires a shift in scientific lens to end users, rather than our present focus on delivery. The response to the HIV pandemic globally provides an important example. Despite the near-universal availability of effective combination antiretroviral therapy (ART) globally, in 2020, more than 10 million persons living with HIV were not on treatment, and there were 680,000 AIDS-related deaths [1]. That same year, despite the availability of a widening array of effective HIV prevention interventions (e.g., oral daily pre-exposure prophylaxis (PrEP), condoms, voluntary medical male circumcision), 1.5 million persons were newly infected with HIV [1]. Gaps in the uptake of and sustained adherence to HIV prevention and treatment interventions undermine benefits for individuals and threaten progress toward global HIV control. While existing gaps in the global HIV prevention and treatment cascades are multifactorial and context specific, they in part reflect limited focus on understanding the preferences of patients and key stakeholders – including methods to deepen our understanding of acceptability, and the desires and choices of people, particularly those who live under conditions of economic and social constraints.

Preference elicitation methods (PEM) – quantitative methods that can estimate the relative value of health- or healthcare-related attributes (e.g., features and characteristics) to individual end users – represent a class of research methods that are growing in prominence but are still underutilized [2,3]. While PEM are standard practice in commercial marketing, their application in medicine and public health can advance our understanding of how to design interventions and services to conform to end user preferences, and therefore be most likely to be sought out and used. Notably, these methods are increasingly being used to understand the market of new HIV prevention and treatment interventions (e.g., long-acting formulations, and different drug delivery mechanisms such as injectables and vaccines, intravaginal rings, microbicides, implants, patches, etc.) [3-6]. This paper will summarize (1) promising available PEM, (2) their use in HIV prevention and treatment implementation research to date, and (3) highlight how they can be used to enhance overall effects using the Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) framework [7].

Overview of preference elicitation methods

Broadly conceptualized, PEM are quantitative methods involve that enable researchers to gain insight into persons' (e.g., community members, patients, healthcare workers [HCWs], administrators, implementing partners, policy makers) relative acceptability, desirability or importance for different attributes [2,8]; they involve participants' valuation of different attributes that yield preference weight estimates. Many of these methods emerge from economics and are based on a theory explaining human behavior through our desire to maximize "utilities," which are units of happiness or satisfaction derived from consuming a good or service [9,10]. Utility theory postulates a number of assumptions but one of them is that individuals have different preferences that lead them to choose different goods and services under budget constraints [9]. In the context of health and implementation research, PEM offers participants choices among alternative attributes (or their respective levels) that

represent different possible characteristics for one the seven intervention types - “7 P’s” (pills, programs, practices, principles, products, policies, and procedures) [11]- and what tradeoffs they may be willing to make to get their preferred attribute(s). Examples of PEM for a pharmacologic intervention might assess the relative prioritization or preferences for: effectiveness, likelihood of side effects, route of administration (e.g., oral vs intramuscular), or frequency of dosing. For healthcare delivery strategies (e.g., implementation strategies [12]), PEM may evaluate the value ascribed to attributes such as: the location of services, cost, accessibility (e.g., same-day availability vs scheduled appointment), and wait time duration to receive services.

To gain an improved understanding of available preference methods for health research, Soekhai et al, undertook a systematic review of the literature, building on two prior reviews [8,13], to develop a compendium; 32 unique preference research methods were identified [2]. They then developed a taxonomy of available methods, which included 10 qualitative preference exploration methods, and 22 PEM that were further categorized into discrete-choice-based, indifference-, rating-, and ranking-methods. In brief, discrete-choice-based methods evaluate tradeoffs for attributes (and their levels) through a series of questions where they must choose among hypothetical alternative profiles; indifference methods vary the attribute of one alternative until a participant no longer has a preference between alternatives; ranking methods utilize ranking exercises to evaluate a participant’s preferred order of attributes within a set; rating methods use a comparative rating approach and often allow participants to directly express importance/preference/agreement along a labeled scale [2]. To provide insight as to what preference research methods may be useful at different stages of the translational research process, Whichello et al. undertook a rigorous stakeholder-engaged review process to rank and compare the potential usefulness of available preference research methods for decision-making in the medical product lifestyle [14]. This yielded 15 promising or potentially promising preference elicitation methods that are likely to meet the different needs of intervention developers and health decision-makers; Table 1 provides a brief description for each of these methods.

The use of preference elicitation methods in HIV prevention and treatment studies to-date

Over the last decade there has been a surge in studies utilizing PEM to inform strategies to improve the delivery and uptake of HIV prevention and treatment interventions. Several reviews have been published to synthesize the findings of preference research studies related to this topic [3-6]. In a recent systematic review of studies utilizing PEM for HIV prevention and testing interventions (from 1998 to 2020; both intervention design and service delivery), 84 studies used only six methods among the 22 method archetypes identified by Soekhai et al [3]. Discrete choice experiments (DCE) were the most used (33%), followed by conjoint analysis (CA) (25%), willingness to accept (21%), willingness to pay (18%), and best-worst scaling (BWS) (2%). Another review focused on DCEs, CA, and BWS for both HIV prevention and treatment [4]; from 2000-2017, they identified only 57 studies - 63% involved DCEs, 34% CA, and 4% used BWS. Collectively, these reviews highlight major gaps in use of the full scope of available PEM to improve implementation of HIV prevention

and treatment interventions (summarized in Table 1). Given the underutilization of different PEM to-date, Table 1 also provides a hypothetical example for how each method could be applied to provide insight to patients' and stakeholders' preferences and enhance HIV prevention and treatment interventions and their delivery.

Preference elicitation methods for improving HIV prevention and treatment implementation outcomes

PEM have immense potential to increase the impact of HIV prevention and treatment interventions in real-world settings. For example, a recent review of DCEs for HIV treatment services identified that, across diverse settings, patients strongly preferred friendly, patient-centered HCWs and were willing to trade substantial amounts of time or money for this service feature [5]. Understanding such tradeoffs and how preferences differ across patient groups can help focus implementation efforts, thereby improving the acceptability and reach of HIV prevention and treatment services. RE-AIM is a widely utilized implementation science planning and evaluation framework, comprised of five dimensions - reach, effectiveness, adoption, implementation, and maintenance (**definitions provided in** Table 2) - that represent crucial implementation outcomes that influence the impact of translating health innovations into practice and understanding why programs and strategies do or do not achieve their desired goals [7,64]. This section describes the potential of available PEM among patients, HCWs, decision makers, and other key stakeholders to enhance each dimension of RE-AIM as they relate to the implementation of HIV prevention and treatment interventions (Table 2). While this review focuses on PEM, preference exploration (qualitative) methods [2,13] have important utility across all implementation phases and for each RE-AIM dimension to (1) explore stakeholders' preferences (e.g., acceptability or importance) for different attributes and to inform and improve the design of preference elicitation studies by ensuring local relevance and meaningfulness (e.g., final list of attributes), and (2) better understand reasons underlying stakeholders' preferences identified from preference elicitation studies [65,66] .

Increasing Reach of current and future HIV prevention and treatment interventions

Often, many HIV prevention and treatment interventions are healthcare facing and focus on what clinical and public health practitioners/researchers feel that patients 'need' in order to achieve an outcome of interest. But how can we do better to ensure that such interventions and how we deliver them are also aligned with what patients actually 'need' and 'want'? PEM can significantly increase the reach and equity of HIV prevention and treatment by providing insight into these crucial questions. Optimizing 'reach' begins well before implementation in real-world settings and incorporating patient preferences should begin during the earliest phases of product development. This helps ensure that HIV prevention and treatment interventions are 'acceptable,' including the tradeoff between gaining novel features (e.g., new delivery method or longer dosing intervals) and their potential adverse effects (e.g., injection site pain), as well as whether they may be appealing, especially in the context of currently available interventions. Notably, patient preference research is increasingly being incorporated into the regulatory decision-making process for medical

products and devices by the US Food and Drug Administration (FDA) and European Medicines Agency (EMA) [67,68].

PEM in conjunction with implementation science theories, models and frameworks (TMFs) [69], can improve the number of persons and populations who are able to access and uptake (e.g., reach) effective HIV prevention and treatment interventions in several ways (Table 2). First, TMFs such as the theoretical domains framework [70] and the Consolidated Framework for Implementation Research [71,72] can help elucidate multi-level determinants of access to and uptake of interventions and PEM can then identify priorities among theoretically derived barriers. PEM can also be applied to identify individuals' most preferred features of potential implementation strategies; then, using a theoretically-based design approach [73-75], and with input from key stakeholders (see "Adoption" section below), the preference data can inform implementation strategies to improve intervention coverage. Additionally, PEM may also be utilized to identify the most preferred communication channels and messengers and the most resonant and appealing messages for driving uptake of interventions and services [76].

An important feature of PEM is their potential to provide insight into the diversity of audience segments (e.g., preference heterogeneity), and therefore allow public health programs to be designed to reach all segments. Latent class analysis of preference elicitation data can be especially useful for identifying end user groups with distinct preferences that are "hidden from view," and can give a window into how big such groups may be (e.g., preference archetypes) [77-81]. This can help to determine whether a diverse offering of tailored delivery and communication strategies may be needed to appeal to and increase reach among different preference archetypes. Further, for researchers, implementation partners, and decision-makers, simulations using preference elicitation data can help predict the expected uptake of introducing new interventions or implementing new delivery strategies, including among persons who are not currently engaged in HIV prevention and treatment services [82-84]. Collectively, this also suggests that PEM represent a powerful suite of research tools to improve health equity by increasing the reach of HIV prevention and treatment interventions and services (and their associated health benefits) to underserved populations [85,86].

Increasing Effectiveness of current and future HIV prevention and treatment interventions

PEM can improve the individual-level (e.g., improved health and quality of life) and population-level effectiveness (e.g., reduced HIV incidence and mortality) in several ways. First, by understanding and incorporating individuals' needs during the development phase and then providing a choice among several effective interventions (see "Reach" section above), individuals may be more likely to have sustained adherence and retention in services because products are more closely aligned with their needs and wants. It is important to note that even if some prevention interventions are less efficacious than other available options, they can still help increase population-level effectiveness if they are highly appealing to and used by persons at high risk for HIV acquisition who not currently engaged / retained in HIV prevention services (for example, if patients would trade efficacy for convenience, privacy, or fewer side effects) - this concept is known as mosaic effectiveness [87]. PEM

can further improve effectiveness by helping to prioritize individuals' contextually specific barriers to adherence to available interventions and retention in HIV services – again with special attention to persons at high risk for adverse HIV prevention or treatment outcomes. These methods could then then help determine which features of an implementation strategy to facilitate improved adherence and retention are the most appropriate, useful, and appealing to those with the greatest unmet need [73-76].

Improving Adoption, Implementation, and Maintenance of HIV prevention and treatment interventions and strategies for delivering them

PEM can also help optimize the adoption, implementation and maintenance (e.g., sustainability) of HIV prevention and treatment interventions and services by understanding and incorporating the priorities and preferences of HCWs, implementation partners and decision-makers (Table 2). This may start with determining what HCWs and other stakeholders believe are the most promising interventions that may better meet the needs of the patients and clients they serve and should be prioritized for implementation. Further, PEM guided by TMFs can help prioritize potential multi-level barriers (e.g., HCWs-, clinic-, systems-, community-) to adopting and implementing the delivery of new and existing interventions in their setting and across settings. This preference evidence can then inform further preference research studies among key implementation stakeholders to understand which potential implementation strategy features for facilitating the delivery and uptake of HIV prevention and treatment interventions they prefer most on the basis of perceived acceptability, feasibility, and effectiveness (including, patient-centeredness, and equity) [88,89]; this can also provide insight into the tradeoffs that stakeholders are willing to make, to adopt and implement new interventions using preferred strategies. Incorporating the preferences of HCWs, implementers and other key stakeholders not only increases the likelihood of their buy-in (adoption) and willingness to continue to engage in the delivery strategy (implementation), but it also increases the likelihood that implementation strategies are contextually appropriate and can be delivered as intended (fidelity) and sustained using available resources, e.g., funds, time, personnel, infrastructure, and systems strength (maintenance) [64,88]. Further, following implementation, PEM among stakeholders can help to prioritize adaptations perceived as most appropriate to facilitate continued delivery of HIV prevention and treatment interventions with fidelity to maintain high reach and effectiveness among their target population; these methods may also provide more objective means for prioritizing the de-implementation of existing, low-value HIV prevention and treatment interventions [90].

Considerations and challenges for preference elicitation studies

There are several considerations for maximizing the utility of PEM for HIV prevention and treatment implementation research. First, is choosing the most appropriate method (Table 1). While there is no specific recommended approach for selecting the most appropriate method, there are several factors researchers may consider to determine the 'best fit,' including the research question of interest (e.g., number of attributes to assess, estimating weights of attributes, assessment of tradeoffs between attributes, quantifying preference heterogeneity), available resources (e.g., costs, existing experience/expertise, sample size,

study duration, time needed to administer), and participant characteristics (e.g., complexity of instructions and potential cognitive burden). Once a PEM has been selected, it is crucial that where available, best practices for the design, implementation and analysis are followed to ensure internal validity of the study results [16,17,49,91]. An additional important consideration is the external validity of different PEM - how well do participants' hypothetical choices predict their actual choices (e.g., stated vs. revealed)? Evidence from the health-literature is most robust for DCEs (given their widespread application) and suggests good predictive value but is based on limited studies [92]; further research is required, especially to compare the predictive value for revealed choice among different PEM for different health research questions [23,45]. Finally, an important extension of preference elicitation studies is understanding how knowledge of patients' preferences (including preference heterogeneity) can be best operationalized in real-world settings. In addition to providing interventions and tailored services directly informed by PEM, there is ongoing interest in identifying simple screening questions that could accurately predict which preference archetype a patient belongs to, and in-real time guide discussion of product and service offerings most likely to be acceptable and appealing to them [93].

Conclusion

PEM have enormous potential for reducing existing gaps in the global HIV prevention and treatment cascades by helping to ensure that interventions and service delivery models are aligned with the needs and wants of patients and key stakeholders.

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* of special interest

** of outstanding interest

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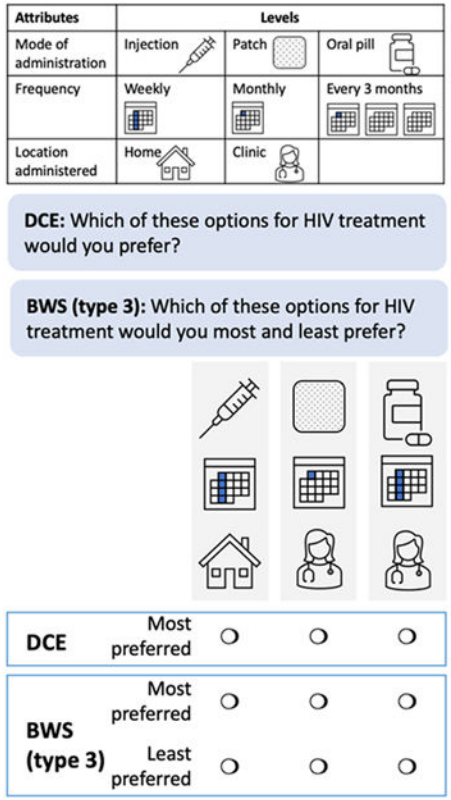
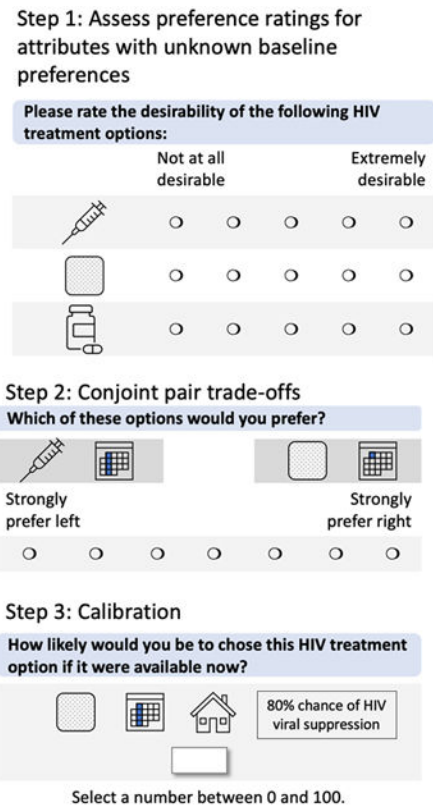
Key points:

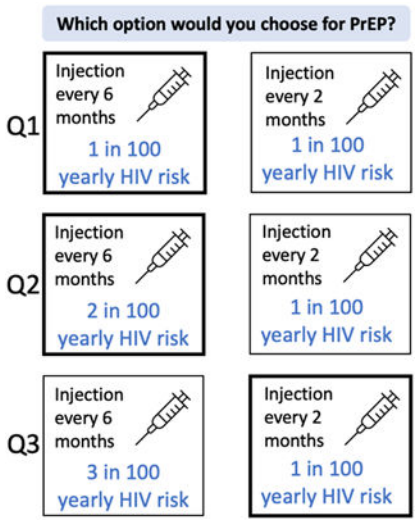
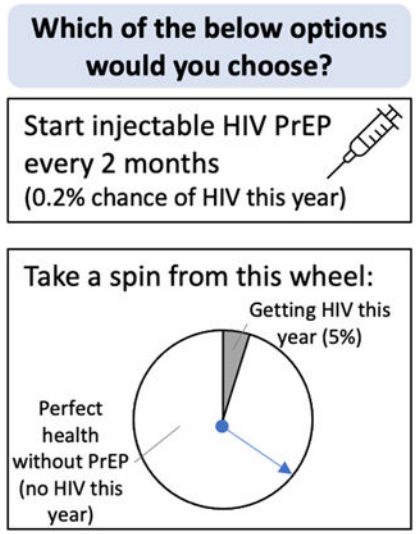
- There are many preference elicitation methods available that can help quantify the relative acceptability, desirability, or importance of different attributes of interventions and service delivery models among patients, healthcare workers, and other implementation stakeholders.
- Preference elicitation methods are increasingly being applied in HIV prevention and treatment research, however, certain methods – namely discrete choice experiments (DCEs) – have predominated, suggesting that the potential of other available methods may be underutilized.
- Preference elicitation data can directly inform the design of future interventions and strategies that has the potential to improve the reach, implementation and impact of HIV prevention and treatment interventions and services.

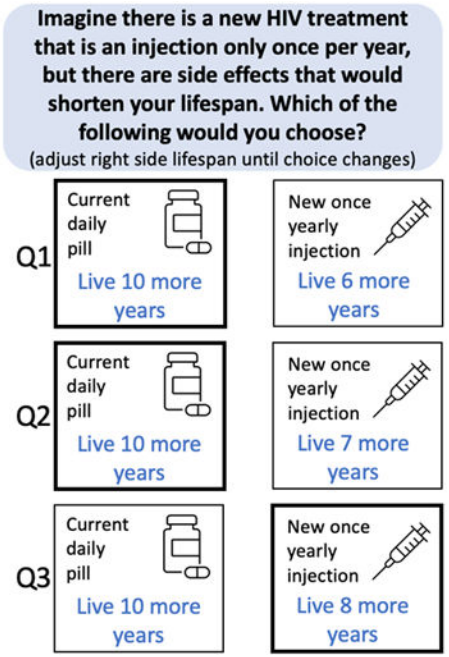
Table 1.

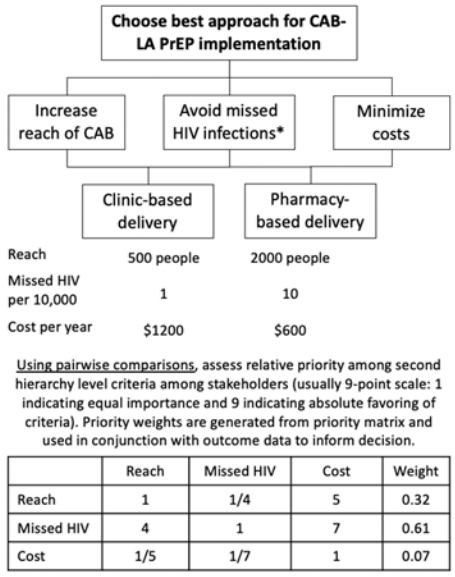
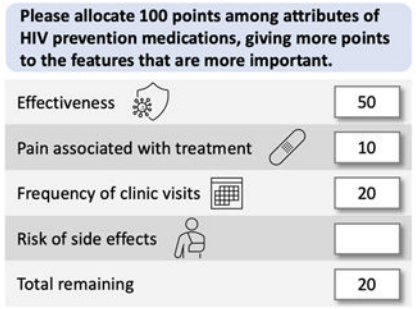
Overview of preference elicitation methods that have potential utility in HIV prevention and treatment research*

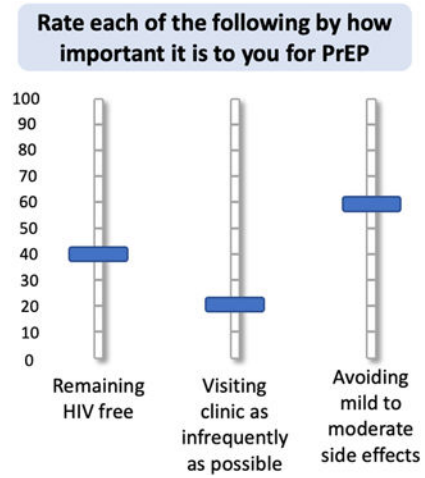
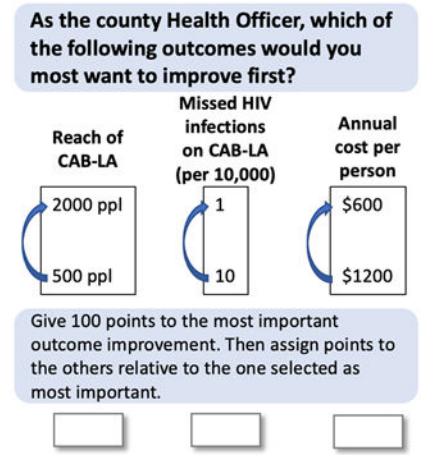
Preference elicitation method	Brief description [2,8,13]	Hypothetical HV-related example	References
Discrete choice-based methods			
Discrete choice experiment (DCE) / Best-worst scaling (BWS) Type 3 (multi-profile case)	DCEs seek to determine which attributes and their corresponding levels are the most important, and which combination of attribute levels (e.g., intervention) would maximize preferences. Participants are asked to complete a set of questions - called choice tasks - in which they choose their preferred profile from two or more alternatives. For each choice task, the alternative profiles differ according to the attribute levels. DCEs are grounded in random utility theory which is used to model human choice behavior. DCEs allow for estimation of the relative importance of attributes and attribute levels, and also participants' willingness to trade (money, time, travel, etc.) for preferred features. An extension of DCEs is the constant sum paired comparisons (CSPC) method, in which participants are instead asked to allocate points (out of 100) to each alternative profile in a choice task. This method can be applied when an all-or-nothing allocation may not be appropriate (e.g., budgeting). Best-worst scaling (BWS) type 3 is very similar to DCEs, except that rather than being asked to choose their most preferred profile in each choice task, participants are instead asked to indicate their most and least preferred profile out of three or more alternatives. This is in comparison to BWS type 2 where participants are shown only one profile at a time. All BWS types are grounded in random utility theory.		**Recommended:** DCE: [15-19] CSPC: [20,21] BWS 3: [22-24] **HIV-related applications:** [3-6]

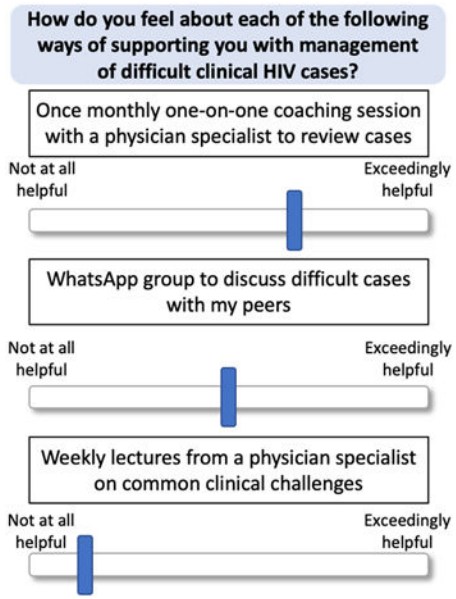
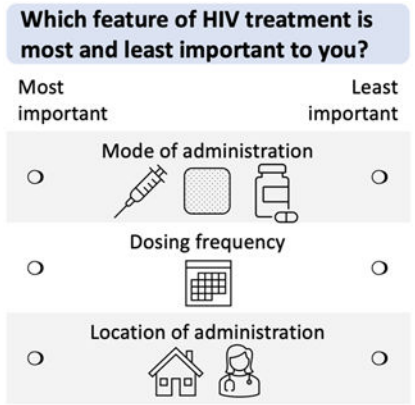
Preference elicitation method	Brief description [2,8,13]	Hypothetical HV-related example	References
Adaptive conjoint analysis (ACA)	ACAs seek to determine which attributes and their corresponding levels are the most important, and which combination of attribute levels (e.g., intervention) would maximize preferences. This method uses a computerized multi-step process. Participants are first asked to rank or rate attribute levels for which preferences are unknown. Then participants are asked to complete a series of paired comparison trade-off questions that are customized profiles based on participants' responses to earlier questions (focusing on more preferred features). Many ACAs will include a final step in which participants are asked to rank or rate customized profiles that are used to further improve estimates (e.g., calibration). Adaptive choice-based conjoint (ACBC) is a distinct and different methodology that combines features of both ACAs and DCEs. ACA (and ACBC) may be especially useful when trying to determine the relative importance or desirability of a large number of attributes and/or attribute levels. While similar in appearance to DCEs, conjoint analyses originated in psychology and are grounded in the theory of conjoint measurement rather than random utility theory.		**Recommended:** [17,19,25] **HIV-related applications:** [26,27]
Indifference methods			

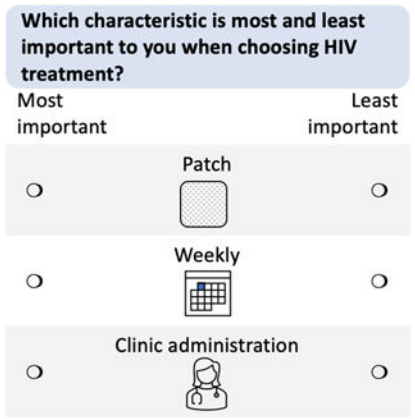
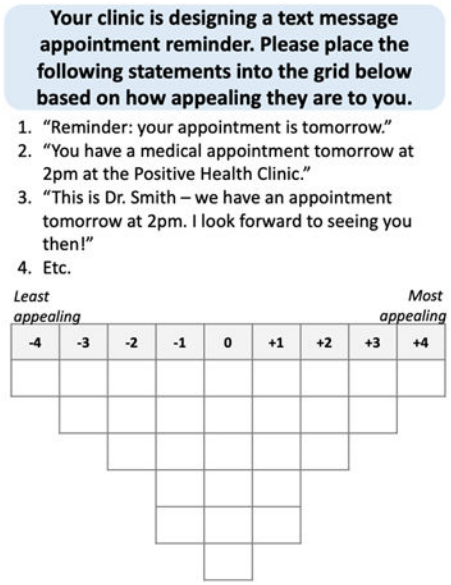
Preference elicitation method	Brief description [2,8,13]	Hypothetical HV-related example	References
Threshold technique	The threshold technique seeks to determine the maximum change in one attribute level that participants are willing to accept in order to obtain a preferred profile (e.g., intervention). Participants are asked to complete a series of questions in which they choose between a reference profile (e.g., status quo) and an alternative profile (e.g., target option) that has differing values of one attribute level for each question (e.g., risk, effectiveness, costs, etc). If the reference profile is chosen, the target option attribute level is improved until the participant chooses the study object profile (or vise-versa). The attribute level at which a participant switches between the reference profile and the target option profile is their choice for the threshold that they are willing to accept. Known efficacy is a method similar to the threshold technique, but uses a specific, known starting point. Both methods are well suited for understanding patients' willingness to trade-off between risks and benefits of interventions.		**Recommended:** [28,29]
Standard Gamble (SG)	SG seeks to determine the chance (e.g. risk threshold) that participants are willing to gamble on to avoid a non-ideal health state. Participants are asked to complete a series of questions in which they choose between an outcome that is certain or take a gamble that might result in either a better outcome than the certain outcome (with a probability P) or a worse outcome than the certain outcome (with a probability 1-P). The probability of the negative outcome is varied with subsequent questions until the participant switches their choice between the certain outcome and their willingness to take a gamble. SG has its theoretical basis in expected utility theory. SG is often used to measure quality of life using quality-adjusted life years (QALYs). SG can be applied to understand patients' willingness to trade-off between risks and benefits of interventions.		**Recommended:** [30-33] **HIV-related applications:** [34,35]

Preference elicitation method	Brief description [2,8,13]	Hypothetical HV-related example	References
Time trade-off (TTO)	TTO seeks to determine how much time participants are willing to give up, to gain a healthier life state. Participants are asked to complete a series of questions in which they choose between two states of life – one with a healthier state but for a shorter duration of time and another with a less healthy state but for a longer period of time. In subsequent questions time is varied between the two states until the participant is indifferent. TTO is more consistent with the principles of prospect theory than expected utility theory. TTO is often used to measure quality of life using quality-adjusted life years (QALYs). Test trade-off is extension of the TTO method that is used in the development of new biomarkers and evaluates tradeoffs in risks between false positive and negative results rather than time. These methods could be adapted and applied to understand patients' willingness to trade-off between risks and benefits of interventions.		**Recommended:** [33,36,37] **HIV-related applications:** [38,39]
Rating methods			

Preference elicitation method	Brief description [2,8,13]	Hypothetical HV-related example	References
Analytic hierarchy process (AHP)	AHP is a decision-making tool that seeks to achieve an objective (e.g., priority setting) by considering the different options for achieving that objective, and the relative importance of key attributes (or criteria) for evaluating the alternative options. Attributes that comprise the alternative options are organized into a matrix, and participants are asked to assess all attribute pairs according to their relative importance, in relation to the other (1 indicates equal importance, 1/9 the least important, and 9 the most important). This process is continued until all pairs of attributes to the right of the diagonal are completed; the remaining attribute pairs to the left of the diagonal are filled using reciprocal values for each attribute pair. The completed matrix is used to calculate importance weights for each attribute, which are then used to estimate the total utility of different options under consideration. The option providing the highest overall utility is chosen. AHP may be especially useful for determining key priorities among stakeholders and policymakers and helping to arrive at a consensus in a transparent manner.	 | | Reach | Missed HIV | Cost | Weight | |---|---|---|---|---| | Reach | 1 | 1/4 | 5 | 0.32 | | Missed HIV | 4 | 1 | 7 | 0.61 | | Cost | 1/5 | 1/7 | 1 | 0.07 | *Assumes that breakthrough infections that occur on CAB-LA PrEP will be 'missed' if viral load monitoring is not conducted. In this hypothetical example, viral load monitoring is conducted in 95% of patients in the clinic-based model and 50% of patients in the pharmacy-based model.	**Recommended:** [40-43] **HIV-related applications:** [44]
Constant sum scaling (CSS)	CSS seeks to determine which attributes are the most important. Participants are shown a list of attributes and asked to allocate a fixed number of points to each attribute (e.g., a constant sum) based on its relative importance related to a given criterion and in relation to the other attributes. Points across all attributes typically sum to 100 and participants are asked to assign zero points to any attribute they believe is not important. CSS is useful as an easy to implement and intuitive method for quickly understanding the relative importance/ desirability of a limited list of attributes (e.g., features, statements, outcomes, etc.). Constant sum paired comparisons (CSPC) is a distinct and different methodology (see DCE above for description).		**Recommended** [45]

Preference elicitation method	Brief description [2,8,13]	Hypothetical HV-related example	References
Outcome prioritization tool (OPT)	OPT seeks to determine what outcomes are most important to patients and was developed to aid in shared treatment-related decision making with older patients. Participants are asked to prioritize different outcomes by indicating a value (between 0-100) corresponding to its relative importance to them. They are specifically instructed to consider what trade-offs in one or more health outcomes they are willing to make in order to gain toward their preferred health outcome and invited to share reasons underpinning their choices. OPT could be adapted to be an easy to implement and intuitive method for quickly understanding the relative importance of competing outcomes and priorities among patients and stakeholders.		**Recommended:** [46,47]
Swing weighting (SW)	SW is a multi-criteria decision analysis tool that allows stakeholders to assign relative value among a set of criteria or attributes for alternative options (e.g., interventions or delivery strategies). This method usually involves a two-step process. First, participants are asked to rank the importance of changes in attribute levels (e.g., "swings") between the alternatives from most to least important; swings correspond to the decision-relevant range for each attribute. Then participants are asked to allocate the relative value (between 0 and 100 points) they attach to the attribute swings. The most important attribute swing is assigned 100 points and all attributes swing (in decreasing order of importance) are assigned a value reflecting its importance relative to the first attribute swing. Points allocated are then transformed into weights that can be used to estimate total utility of different alternatives. SW has its theoretical basis in expected utility theory. SW can be applied to understand patients' and stakeholders' willingness to trade-off different attribute levels for those that are more preferred.		**Recommended:** [42,48,49]

Preference elicitation method	Brief description [2,8,13]	Hypothetical HV-related example	References
Visual analogue scale (VAS)	VAS seeks to determine the relative importance of different attributes. Participants are shown a straight, continuous line (e.g., no discrete options) ranging between two extreme options, and are asked to mark any point along this line corresponding to their subjective perspective, opinion or preference. VAS is useful as an easy to implement and intuitive method for quickly understanding the relative importance/ desirability of a list of attributes and offers finer discrimination between values than Likert-scales, potentially overcoming associated systematic scale biases.		**Recommended** [50-52] **HIV-related applications:** [35,53]
Ranking methods			
Best-worst scaling (BWS) Type 1 / Object case	BWS Type 1 seeks to determine which attributes are the most important or appealing. Participants are asked to complete a set of questions - called choice tasks - in which they indicate the most important (or appealing) and least important (or appealing) attribute from amongst a list of several alternative attributes. For each choice task, the list of alternative attributes shown to the participant differs. Note, that each choice task is comprised of a list of attributes and does not form a profile (BWS Type 2). All BWS types are grounded in random utility theory. BWS type 1 may be especially well suited for understanding the relative importance or desirability of a large number of attributes of interest and is not subject to scale biases.		**Recommended:** [22-24] **HIV-related applications:** [54-58]

Preference elicitation method	Brief description [2,8,13]	Hypothetical HV-related example	References
Best-worst scaling (BWS) Type 2 / Profile case	BWS Type 2 seeks to determine which attributes and their corresponding levels are the most important. Participants are asked to complete a set of questions - called choice tasks - in which they indicate the most important (or appealing) and least important (or appealing) attribute levels from a single profile. For each choice task, the profile is comprised of the same attributes, but differs according to the attribute levels. All BWS types are grounded in random utility theory. BWS type 2 may be cognitively easier for participants than BWS type 3 and DCEs, since they are only asked to focus on one (rather than two or more) profile(s) at a time in each choice task.		**Recommended:** [22-24]
Q-methodology	Q-methodology seeks to determine the relative importance of attributes among participants with differing viewpoints. Using a specially-designed response grid, participants are asked to rank attributes according to those they most agree with (or prefer) and least agree with (or prefer) – this process is known as Q-sorting. Factor analysis or principal component analysis is then used to reduce data and identify participants with similar Q-sorts – indicating similar opinions or preferences. Q-methodology may be especially useful for understanding differential preferences among stakeholders for a large number of attributes and the reasons for these preferences, as it typically includes a post Q-sort interview to understand participants' ranking of attributes.		**Recommended:** [59,60] **HIV-related applications:** [61-63]

*Taxonomy of preference elicitation (quantitative) methods based on systematic review by Soekhai et al [2], and the methods most likely to have utility for supporting HIV prevention and treatment research is based on a rigorous, multi-step, stakeholder-engaged process conducted by Whichello et al [14].

Attributes: may include different types of features, statements, criteria, outcomes (including treatment endpoints), and other items. **Attribute levels:** include the range of values (e.g., costs, risks, frequency) or characteristics (e.g., mode of delivery) that may be associated with an attribute.

Table 2.

Overview of ways in which preference elicitation methods can enhance each RE-AIM dimension as they relate to the implementation of HIV prevention and treatment interventions

RE-AIM dimensions[7,64]	Priority research questions that can be answered by preference elicitation methods and their potential utility
Reach *The number, proportion and representativeness of eligible individuals who uptake HIV prevention or treatment interventions.*	• What features of interventions do eligible individuals most prefer? – Potential: Inform the design of and prioritize the development of more acceptable, appropriate, and appealing interventions that are aligned with what eligible individuals want (e.g., focus on Reach from the outset during development). Understanding tradeoffs eligible individuals are willing to make to have preferred attributes (e.g., benefits vs. risks). • What are the most important barriers and facilitators to access and uptake of existing/future interventions among eligible individuals? – Potential: Determine the relative importance of and prioritize specific determinants that should be addressed as part of an implementation strategy (e.g., delivery strategy). Gain insight into how current interventions may fall short of individuals' needs. • What are the most preferred features of potential strategies (new and adaptations) to facilitate the uptake of interventions (existing and new to market)? – Potential: Inform the design of more acceptable, appropriate, and appealing implementation strategies that are aligned with what eligible individuals want and that directly account for factors influencing access and uptake. Gain insight into tradeoffs eligible individuals are willing to make to access preferred service features (e.g., willingness to pay, wait, or travel). • What are the most preferred features of a potential communication strategy to encourage the uptake of interventions (e.g. sources, channels, and messages)? – Potential: Inform the design of more resonant and appealing communication strategies to increase awareness of and generate demand for existing and new interventions among eligible individuals. • Do eligible individuals have distinct preferences (e.g., preference heterogeneity) and what is the size of different preference groups (e.g., segments)? – Potential: Inform the design of interventions, and implementation and communications strategies that are tailored to persons with distinct preferences. This has the potential to improve health equity by focusing on unique needs of persons not well-served by/engaged in HIV services, including groups experiencing disparities in access to existing interventions. • Is the implementation of new interventions and/or strategies likely to improve reach among groups with the largest current disparities in access to HIV prevention or treatment services? – Potential: Provide insight into how the introduction of new interventions and/or implementation strategies in the context of available services will affect population-level coverage of interventions among groups with greatest existing need (e.g., forecasting).
Effectiveness *The individual- and population-level impact of enhancing reach on important HIV prevention and treatment outcomes* *Individual-level: Protection against HIV infection (prevention), HIV viral suppression (treatment), improved quality of life (prevention and treatment);* *Population-level: New HIV infections and HIV-related deaths averted)*	• What features of interventions and delivery strategies do eligible individuals most prefer? – Potential: Improve adherence to interventions and retention in services because available interventions and delivery strategies (including strategies to directly facilitate adherence and retention) are more aligned eligible individual's needs and wants (Individual level effectiveness). • Do eligible individuals have distinct preferences (e.g., preference heterogeneity)? – Potential: Provide choice among several effective interventions (including new interventions) and using implementation and communication strategies that reach and appeal to diverse populations with distinct preferences, especially those at high risk and not well-served by/currently engaged in HIV services, to increase overall uptake and sustained engagement (Population level effectiveness/ health equity). • Do implementation strategies aligned with eligible individuals' needs and wants modify barriers to access and uptake?

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	– Potential: Evaluate the degree to which eligible individual's barriers to access and uptake of interventions is modified by implementation strategies that account for their preferences (e.g., repeated measures before and after implementation).
Adoption *The number, proportion and representativeness of HCWs and settings offering HIV prevention or treatment interventions.*	• What interventions are most appealing to HCWs, implementers, and key stakeholders to address the needs of individuals they serve/represent? – Potential: Increase contextual relevance as well as 'buy-in' from HCWs and implementation stakeholders. • What are the perceived barriers and facilitators to the adoption of interventions (existing and new to market)? – Potential: Elicit and prioritize barriers and facilitators to adoption among different stakeholders (HCWs, leadership, policy makers) and understand how this may differ or overlap by stakeholder type, and across sites and communities. • What are HCWs, implementers, and key stakeholders most preferred features of potential strategies (new and adaptations) to facilitate the implementation of interventions (existing and new to market)? – Potential: Understanding what attributes of different implementation strategies may be most preferred by HCWs, implementers, organizations, and systems, based on perceived acceptability, feasibility, effectiveness, and sustainability accounting for the implementation context and available resources (e.g., human resources, available time, and funding). Understand stakeholder/policymaker preferences and tradeoffs between preferred implementation strategy attributes and costs. Identify potential misalignments for preferred strategy attributes for service HCWs/implementers and the individuals they serve.
Implementation *The delivery of HIV prevention or treatment interventions and implementation strategies as intended across HCWs and settings.*	
Maintenance *Individual-level: The sustained impact (e.g., health benefits) of HIV prevention or treatment interventions to eligible individuals* Setting-level: *The extent to which prevention or treatment interventions and their associated delivery strategies are sustained and evolve over time and become integrated into routine practices and policies.*	• Do the preferences of eligible individuals change over time? – Potential: Characterize how the preferences of eligible individuals change over time, especially as new interventions and/or strategies to deliver them become available. Inform prioritization of which new interventions to implement and design of adapted/new delivery strategies that continue to reach and appeal to diverse populations with different preferences to increase overall uptake and sustained use of interventions. May also aid in prioritizing low value/non-preferred interventions and strategies for de-implementation. • What are the most important barriers and facilitators to sustained adherence to interventions and retention in services, and how do they change over time? – Potential: Inform adaptions/ design of new delivery strategies that account for and address the most important factors that influence adherence and retention over time. • What are the most important barriers and facilitators for HCWs and implementers and what are the most preferred potential adaptations to continue deliver interventions with high reach over time? – Potential: Identify the most important factors influencing the sustained delivery of interventions over time, especially as new ways to deliver them become available. Inform adaptations to existing implementation strategies or the design of new implementation strategies.