Assessment of Knowledge and Use of HIV Primary and Secondary Prevention Strategies in Portugal: A Scoping Review

João Brázia

simoesbrazia.j@northeastern.edu

Northeastern University London https://orcid.org/0009-0009-8882-0786

Boxuan Wang

Institut Pierre Louis d'Epidémiologie et de Santé Publique https://orcid.org/0000-0001-7276-370X

Paula Meireles

Instituto de Saúde Pública da Universidade do Porto https://orcid.org/0000-0001-9055-7491

Eugenio Valdano

Institut Pierre Louis d'Epidémiologie et de Santé Publique https://orcid.org/0000-0002-9246-6195

Andreia Sofia Teixeira

Northeastern University London https://orcid.org/0000-0002-2758-1891

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Abstract

Portugal remains one of the countries in the EU with the highest annual number of reported HIV cases and the highest proportion of AIDS diagnosis, despite its commitment to achieve UNAIDS 2030 targets. This scoping review aims to map how knowledge and usage of primary and secondary prevention strategies are being assessed in Portugal across key populations, such as sex workers (SW), men who have sex with men (MSM), people who inject drugs (PWID), migrants and transgender. Following PRISMA-ScR guidelines, we searched PubMed, Web of Science, and Scopus for peer-reviewed articles in English or Portuguese, between 2008 and 2025, that reported knowledge and/or use assessment of condoms, HIV testing, pre-exposure prophylaxis (PrEP), or post-exposure prophylaxis (PEP) in key populations. From 655 studies identified, 54 met the eligibility criteria. Most studies assessed condom use (n=44) and HIV testing (n=42), with fewer examining PrEP (n=16) and PEP (n=12). No studies assessed condom knowledge. Condom use was characterized by partnership type, gender, sexual intercourse type, and sexual role across key populations. Knowledge about HIV testing was characterized as knowing where to get tested and/or that HIV testing is confidential and free. PrEP and PEP were often assessed coupled with condom usage. Assessment methods across prevention strategies showed inconsistent recall periods and reported frequencies. This heterogeneity makes comparison across studies challenging, within and across key populations, and limits the development of mathematical modelling studies that can inform public health policies. Standardized assessment metrics are urgently needed to strengthen evidence-based HIV prevention programs in Portugal.

Introduction

Since the signature of the Dublin declaration in 2004 [1], Portugal has made, together with other countries in western Europe, substantial progress in the fight against the HIV/AIDS epidemic. According to the latest ECDC report (2023), Portugal has already reached the first of the three UNAIDS 95-95-95 targets adopted in 2021 to end the AIDS epidemic by 2030 [2]: to ensure that at least 95% of people living with HIV know their status, 95% of those who know their status are on antiretroviral therapy (ART), and 95% of those on ART achieve viral suppression.

Improvements in primary prevention have allowed Portugal to reduce HIV acquisitions by 37% from 2014 to 2023. Notwithstanding, Portugal still has one of the highest rates of HIV diagnosis in the European Union (8.5 infection cases per 105 inhabitants for Portugal vs. 5.1 in the European Union overall, in 2022), and HIV diagnosis at the AIDS stage is also three times more likely (1.6 infection cases per 105 inhabitants for Portugal vs. 0.5 in the European Union overall, in 2022) [3,4]. These figures show the need for Portugal to improve both primary and secondary prevention of HIV. Primary prevention aims to reduce the risk of HIV acquisition [5] and its tools in Europe are condom, post-exposure prophylaxis (PEP) [6] , and pre-exposure prophylaxis (PrEP) [7–10]. Secondary prevention reduces the burden of the infection (delaying or avoiding, for instance, progression to AIDS) through early detection and antiretroviral treatment. Additionally, effective ART treatment is known to prevent transmission in sero-discordant partnerships [11].

In Portugal, several national prevention programs have been targeting both the general population and key populations, including risk reduction programs for people using drugs, scale-up of PrEP, promotion of sexual and reproductive health, and prevention of violence and stigma reduction [3]. Particularly, between 2019 and 2023, non-governmental and community-based organizations, schools, and healthcare facilities distributed 25 million condoms and 6 million lubricant packages to the general population and to key populations [3]. In addition, a scale up of PrEP was possible through the decentralization and expansion of the PrEP referral network, as well as its full reimbursement through the Portuguese National Health Service. PrEP coverage is, however, still limited, averaging 7,000 users in 2023 [3]. The number of HIV tests performed – provided by primary and urgent healthcare services, as well as by community based and/or non-profit organizations [3,4] – also increased gradually over the years, reaching 89,000 in 2023 leading the country to meet the first UNAIDS target for 2030. Stepping up the scope and effectiveness of public health programs for HIV prevention now requires an understanding of the knowledge and use of primary and secondary prevention strategies by key populations in Portugal, which include sex workers (SW), men who have sex with men (MSM), people who inject drugs (PWID), migrants and transgender people [12]. Previous research focusing on key populations in Portugal has contributed to characterizing their sexual behavior, including condom use [13–23], PrEP knowledge [12], eligibility [24–27], uptake/use [28,29], and HIV testing [30–39]. However, such studies typically focus on one prevention outcome and specific key populations. The aim of this scoping review is to contribute with observational evidence regarding the coverage, scope, and broad community impact of HIV prevention in key populations in Portugal for a better evidence-based public health action.

Methods

Search Strategy and Eligibility Criteria

We conducted a scoping review on HIV prevention strategies among key populations in Portugal according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR) [40] (Table 1 in Supplementary Information (SI)–1). This review is registered at Open Science Framework under https://doi.org/10.17605/OSF.IO/PD8HS.

To design the search strategy, we defined a PCC (Population, Context and Concept) framework according to Pollock et. al [41], which aimed to identify studies driven in Portugal (context), characterizing HIV primary and secondary strategies such as oral PrEP, PEP, condoms and testing (concept) within and between high-risk populations such as MSM, SW, transgender people, migrant people, and PWID (population). Article selection was restricted to studies published between 2008 and 2025, period of significant output in HIV prevention, collected from three electronic databases: PubMed, Scopus and Web of Science Core Collection. The query search involved a Boolean combination of keywords such as “Portugal”, “MSM”, “gay”, “sex workers”, “migrants”, “transgender”, “persons who inject drugs”, “key populations”, “HIV”, “prevention”, “testing”, “screening”, “PrEP”, “PEP”, “condom” and “unprotected sex” (Table 1 and 2 in SI–2). The latest search was performed on August 20th, 2025. Studies included were limited to Portuguese and English languages. No other search filters were applied,

and the search was conducted across all fields to ensure that no relevant research studies were excluded. All articles were transferred to Zotero, a bibliographic management system software. Duplicate articles were either manually or automatically identified by the software and removed. The article selection and screening processes were performed in a hierarchical way and split into two parts. First, records were screened by title/abstract such that those not driven in Portugal or qualitative studies were excluded. Second, articles were screened through a full-text assessment. Non-original and/or unpublished studies such as conference abstracts, study protocols, reviews and letters were excluded. For records without available full text, attempts to contact the authors were made, but no responses were obtained. Included studies focused on at least one of the previously defined key population groups and report assessment towards knowledge and/or use of at least one of the defined primary and/or secondary prevention methods. Additional records were collected through hand searching of peer-reviewed journals and/or reports published by national healthcare institutions or organizations and were screened and selected according to the previously defined eligibility criteria (Fig. 1). To reduce the potential for reviewer bias, titles and abstracts of all identified records were independently screened by two authors (JB and BW) and checked for agreement. Subsequently, the full text of potentially relevant studies was read and independently screened for the eligibility criteria. Discrepancies in the study selection were resolved by consensus or were discussed with a third author (PM) for a final decision.

Data Charting and Extraction

Data charting followed the established approach for scoping reviews. Study characteristics, such as year of publication, first author, study population size, key population under study, prevention strategies and respective assessment were extracted (Table 1 in SI-3). The number of publications during the period of analysis was assessed and represented through a graph. We synthetized the instrument variables used to assess HIV primary and secondary prevention strategies, recall periods and frequency stratified by knowledge and use, and by key population, when available.

Results

Search and Article Selection

From the three electronic databases, a total of 655 peer-reviewed articles were identified, particularly 269 from PubMed, 279 from Web of Science, 107 from Scopus. Of those, 263 duplicate articles were identified and removed, leaving 392 articles for screening. In the first stage, 294 were excluded based on their title and/or abstract using broader criteria: first, articles that were not conducted in Portugal (n=289) followed by additional qualitative studies (n=5). For the second screening phase, 98 full-text articles were considered relevant for full-text eligibility assessment, from which 57 were excluded through the following hierarchical process: first we removed non-original studies including conference posters/abstracts (n=4), reviews (n=2), letters (n=2) and study protocols (n=2); second articles without available full text (n=3); third studies not focusing on any of the key populations under study or

combined with other population groups (n=20); and finally, records that did not provide estimates of uptake, usage or knowledge of any of the prevention methods (n=24).

Manual searching further added articles from the Journal of AIDS & Clinical Research (n=3) and from Intechopen (n=1). Other literature sources considered were reports published by the European Centre for Disease Prevention and Control (ECDC) (n=8), the Portuguese Directorate-General of Health (DGS) (n=2), and Grupo de Ativistas em Tratamentos (GAT), a community-based organization located in Lisbon (n=1). Two reports from the search did not enter in the study as they did not focus on any of the prevention strategies under study. The whole selection process resulted in the inclusion of 54 studies. See Figure 1 for the PRISMA flowchart of the study selection and the main reasons for article exclusion in the screening process.

General characteristics

Study characteristics were collected and summarized according to year of publication, first author, study population size, key population under study, prevention strategies and respective assessment (Table 1 in SI–3). The number of studies examining primary and secondary HIV prevention strategies has increased between 2008 and 2025, with over half (57.4%) published since 2019 (Fig. 2). Most studies focused on condom usage (n=44) and testing (n=42). Fewer examined PrEP (n=16) and PEP (n=12). Some studies presented knowledge and/or used data by grouping multiple prevention strategies together. For instance, three studies reported PEP usage alongside condomless sex in the previous six months [24–27], one study reported PrEP and PEP (knowledge and usage) combined with condomless sex in the last 12 months, or ever having tested for HIV [12], and studied the combination between PrEP use and HIV testing [42].

The distribution of key populations under study varied across studies. Most studies were focused on MSM (n=34) followed by migrants (n=20), SW (n=11), transgender (n=6) and PWID (n=6). Additionally, some studies examined overlapping or intersecting key population groups, such as transgender migrants [43], transgender SW [14,20], MSM migrants [42,44] and MSM SW [18,44].

In some studies, primary and secondary prevention strategies were also reported based on how participants were stratified or considering subcategories of a given key population. For example, knowledge and/or usage of a given prevention strategy was characterized for individuals adopting COVID-19 preventive measures [45,46], or based on HIV status and stage [14,31,44,47,48], PrEP status and uptake [26,42], PrEP eligibility status [27], follow-up visits [27], according to the type of visited venues [13], testing status [36], gender [14,18,20,47], immigration status [33], age [44,49,50], year of visit of a community center [44] and sexual orientation [44] (Fig. 3).

Condom Usage

We found 44 studies that characterized condom usage, but none characterizing knowledge. Only a few studies addressed PWID and transgender people. Condom usage was defined according to the type of

partnerships, gender, type of sexual intercourse, sexual role preference, time window, frequency across key populations (Fig. 4).

Among MSM, a substantial number of studies detailed the type of condomless sexual intercourse, with many reporting on condomless anal sex [13,15,17,22,24,27,31,36,45,49,51–58], oral sex [15,18,21,51,59], and vaginal sex in combination (or not) with anal intercourse [21,24,25,31,42,58,59]. One study among male SW also reported condom usage for each type of sexual intercourse [18].

Condom usage was estimated through surveys with varying recall periods. Among MSM, condom usage was assessed based on the last time they had sex [18,21,22,42,50,56,60], or within a specific time window: last 2 months [51,61], 3 months [62], 6 months [24–27,49,50], 12 months [12,13,17,21,36,48,52–58,58] or ever [63]. The recall period was not specified in some studies. One study assessed condom usage among MSM during bathhouses visits [15] or during COVID-19-related movement restrictions [45,46]. Among SW studies, including transgender SW, the recall periods were the last month [20], 6 months [14,20] and 12 months [12,14,20,64,65]. For migrants, condom usage was reported according to the last time of sexual intercourse [42,43,60,66,67], and 12 months [16,19,47,68,69]. For PWID, condomless sex was only assessed at the last sexual interaction [70].

Another important metric used to characterize consistency in condom usage was its frequency, defined in multiple ways across studies. In studies on migrants, MSM and SW, some used Likert-type scales [71] to assess general condom usage trends [13–15,18–21,47,57,59,62,68,69].

Among MSM, some reported the number of condomless sexual partnerships [15,49,51,53–56,61], while others also characterized condom use frequency according to sexual role preference, type of sexual intercourse, and/or number of condomless acts with men [15,24,51,61].

Condom consistency was also characterized by partnership type (steady/regular, non-steady, occasional) for migrants, MSM and SW [13,16,17,21,24,47,49,52,56,64,72]. Among MSM, group sex [13,48,58], sex in serodiscordant partnerships [13,17,24,52] and sex with partners with unknown HIV status [13,21,22,24–27,36,56,62] were also reported. One study, which focused on migrants, reported condomless sex with SW [47]. Among SW, including transgender SW, condom usage was also studied across paying/commercial, non-paying partners and group sex [14,64,65].

Finally, condom breakage and slippage were reported for MSM [17,21], male, female and transgender SW [14,20].

PrEP and PEP

From the selected articles, we identified 16 studies focused on PrEP and 12 on PEP. Knowledge and usage were evaluated using multiple assessment metrics (Fig. 5).

One study used a Likert-type scale by asking participants to measure their understanding of each prophylactic strategy. Particularly, they assessed participant ability to recognize PEP as post-exposure

prophylaxis that can be initiated as quickly as possible after exposure or how it should be taken [12,52,56], and to recognize PrEP as prophylaxis to be taken before exposure and regime [12,56]. One study assessed PrEP and PEP knowledge but does not specify how it was assessed [57]. Regarding usage, one study characterized both PrEP and PEP usage proportional to each key population [12].

Some studies focused exclusively on PrEP, reporting the number or proportion of participants who initiated and/or took PrEP in the previous 12 months [3,4,29,42,44,57,60], as well as those who had ever received PrEP [3,4,73] or the proportion of PrEP users at the time of first visit [44]. However, some studies reported only the proportion of key populations among PrEP users, without providing the proportion within each group [3,4,65,73]. No studies were found characterizing knowledge and/or usage of injectable PrEP.

A broader set of assessment indicators was found in MSM-focused studies. Current PrEP status was characterized (defined as taking a daily PrEP tablet in the last 30 days) [29,74,75], as well as prior PrEP experience, and the type of PrEP regimen used (daily, on-demand, or single-use) [29,57]. One focused on the interaction between PrEP use and COVID-19-related nonpharmaceutical interventions [46]. Some studies also distinguished PrEP usage before and after 2018 [29], the year when Portugal started to deliver PrEP for HIV prevention, fully reimbursed [76,77]. Two MSM focused studies also assessed if participants have ever taken PrEP [25,45]. Regarding PEP usage, the typical reported period was within the last 6 months [24,26].

Testing

We identified 42 studies that characterized HIV testing knowledge and use across key populations (Fig. 6). Knowledge was defined across studies as being aware of where to get tested and/or the fact that HIV testing is confidential and free [33,52]. Two studies focused on MSM and characterized both knowledge and use of HIV testing using other different testing modalities such as self-testing kits, self-sampling kits, and community-based testing [53,56].

The most reported indicator was the proportion of participants who have ever been tested for HIV, found in 18 articles from the available literature and available for all key populations, including MSM [13,21,24,25,36,59,61], PWID [70], female, male and transgender SW [14,20,33,64], and migrants [16,19,23,32,33,37,67,68]. Testing in the last 12 months was also frequently reported across MSM [17,36,42,46,49,50,52,56,60], female, male and transgender SW [14,18,20,64,65], migrants [16,23,42,60] and PWID [78]. One study focused on migrants also reported the number of participants who got tested in the last 12 months [43] rather than the proportion. The testing frequency was also assessed, mainly through a Likert-type scale. Within the most reported recall period, MSM focused studies reported HIV testing frequency (e.g., more than once, once, less than once, never) [48] or ever (never, yearly, more than yearly, or only after risky exposure) [58,62], and the number of lifetime tests [21,54,55,61]. Studies on SW also reported frequency of testing (e.g., every 3 or 6 months, yearly, every two years or more) [18]. Different recall periods to survey HIV testing were used, presenting the year participants got tested [49] or the time since last test: : 0-1 months, 1-3 months, 3-6 months and 6-12 months [26], more than 12

months ago or less than 12 months ago [53] or <3 months, 3-12 months, 1-2 years and >2 years [54,55]. For studies exclusively focused on migrants, additional assessment instruments included the time since the HIV test was performed (less than a year or more than a year) [68].

Discussion

This work provides a comprehensive overview of studies published between 2008 and 2025 estimating and investigating the use, uptake and knowledge of primary and secondary prevention strategies of HIV among key populations in Portugal. Our findings highlight an increase in research output over time, with more than half of the studies published between 2019 and 2025. This trend has been keeping up with improvements in the current national HIV prevention programs focused on the promotion of tailored interventions among key populations by increasing the availability and coverage of HIV testing tools, PrEP and condoms [4]. Important gaps, however, still exist in the literature, mostly related to the lack of characterization and high heterogeneity in the assessment of HIV prevention methods within and across key populations. These gaps identify areas where future investigation is needed.

Most studies included in this scoping review were focused on HIV testing and condoms, while a lower amount of literature was found for PrEP and PEP. PrEP was authorized in the European Union through a recommendation by the European Medicines Agency in 2016 [79]. In February 2018, Portugal started to provide and fully reimburse PrEP through the nation healthcare service [76,77]. PEP, while being available before PrEP, is still limited in its access, largely being reserved to occupational exposures among healthcare workers [80]. This might explain the smaller amount of literature covering PEP. Despite the limited available literature, some studies combine PEP or PrEP knowledge and usage with other prevention strategies. Specifically, PEP and/or PrEP usage was reported alongside with condom usage in the past 6 [26,27] and 12 months [12], making it difficult to disentangle the adoption and impact of each prevention method and, consequently, to compare them across key populations. Another relevant knowledge gap is the lack of studies assessing knowledge and usage of injectable PrEP. Currently, two types of injectable PrEP are authorized in the European Union: cabotegravir since September 2023 [81], and lenacapavir, very recently, since August 2025 [82]. Since injectable PrEP has proven to be more efficient than oral PrEP, further studies are required to understand whether this new prevention tool is reaching high risk populations. The recent availability of injectable PrEP and the fact that it is currently not provided by the national healthcare service of Portugal obviously explain the knowledge gap in the literature. Notwithstanding, the high effectiveness and reduced adherence burden of injectable PrEP make it a cornerstone of future primary prevention of HIV[83,84]. Studies regarding the acceptability and effectiveness of injectable PrEP among key populations in Portugal are urgently needed to inform future public health policies and cost-effectiveness analyses.

Our scoping review highlights the uneven distribution of studies across key populations, entailing substantial knowledge gaps. Specifically, SW and PWID were underrepresented, and no study focused exclusively on transgender people. MSM have been the focus of active research through various research projects such as the Lisbon Cohort [17,21,24,25,27,29,57], EURO HIV EDAT [53–55], Project

PREVIH [22], In PrEP [42,45], Sialon II [49,50], EMIS-17 [56] and EMIS 2010 [36,52], which explains the broader and richer knowledge and use prevention strategies characterization within this key population. Other key populations vulnerable to HIV have instead been covered less effectively. This is also true in the case of overlapping vulnerabilities, such as transgender SW and migrant SW [85]. Their experience of intersectional stigma may constitute a barrier to HIV detection and evidence-based preventative policies [86,87]. Our scoping review clearly highlights the need to expand knowledge in this field.

The assessment of knowledge and usage within primary prevention strategies was also unequal. Specifically, no studies were conducted to characterize knowledge about condom. Further studies could incorporate knowledge assessment by asking participants if condoms are the best way of protecting against HIV [88], and about the appropriate conditions for condom use, such as timing and correct usage techniques [89].

A high methodological heterogeneity was found across studies in the assessment of primary and secondary prevention strategies. First, HIV testing and condom usage were assessed for different frequency ranges and timeframes. Second, metrics assessment for the same prevention strategy outcome was also inconsistent. Particularly, while some studies reported the assessment outcome as a proportion, others only present the number of participants or the proportion of each key population group that uses and/or knows a given prevention strategy [3,4]. This heterogeneity within and across instruments assessment, was also reported by the mapping of HIV/STI behavioral surveillance in Europe report [90,91] which might be explained by the fact that studies were conducted in different recruitment places, target populations, study type, objectives, lack of resources and/or cost. However, in order to design more targeted and tailored interventions to high risk populations, surveys on behavioral data for HIV prevention and control need to be robust and comparable [91]. The need for standardized metrics of knowledge, uptake and behavioral effect of prevention strategies is important to develop modeling studies that can help evaluate and propose public health policies, as it will be necessary, for instance, for injectable PrEP. This can partially explain a methodological knowledge gap that we identified: the absence of modeling studies that evaluate the effectiveness and cost-effectiveness of HIV prevention in Portugal and will be crucial in helping guide future public health policies, such as the introduction of injectable PrEP. The lack of harmonized and comparable data across studies also restricts the capability of mathematical models to capture, for example, transmission pathways across key populations, which potentially exist [47,92]. Consequently, if models simplify population structure by treating key populations as isolated and homogeneous groups, overlooking the complex network of interactions that more realistically drives HIV transmission, they will underestimate transmission and bias policy evaluation. In order to harmonize the comparability of different indicators, a possible solution would be to drive further studies following the recommended guidelines proposed in the Global AIDS Monitoring 2025 designed to enable the best use of available data at the national level, to standardize reporting from different HIV epidemics and sociopolitical contexts [93].

Limitations

Our work has limitations. First, in our article search we compared articles that represent populations at different moments in time, which can explain why we detected a significant amount of heterogeneity across studies and key populations. Second, even though we attempted to mitigate the issue of potentially missing relevant studies by hand searching, we acknowledge that this approach may still not capture all pertinent studies. Third, the characterization of the primary and secondary prevention strategies of each key population based on knowledge and usage might have excluded important assessment indicators. These include adherence to prevention methods and follow up patterns [94–96] which are crucial for understanding the sustained effectiveness of interventions. Furthermore, the exclusion of the willingness to use prevention strategies may have overlooked important data on potential uptake of existing methods. The assessment of HIV transmission-related knowledge, accessibility, perception of prevention methods [52,56], and respective coverage [14,16,33] were also not captured in our review framework, also important in characterizing the effectiveness of current healthcare programs within and across key populations.

Conclusions

This scoping review examined the assessment of primary and secondary prevention of HIV among key populations in Portugal. Our review identified important knowledge gaps in selected key populations, notably transgender and PWID, and suggested areas where immediate research is needed, such as the acceptability and effectiveness of injectable PrEP. Additionally, prevention uptake was better studied than knowledge of prevention among all key populations. We also found a high level of heterogeneity in methodological approaches to assess prevention outcomes. This highlights the importance of driving further studies to develop more standardized tools to improve knowledge and use of primary and secondary HIV prevention assessment metrics comparison between and across key populations and to drive mathematical modelling studies to improve the efficiency of the current implemented HIV prevention programs.

References

1. European Commission. Dublin Declaration on Partnership to fight HIV/AIDS in Europe and Central Asia. Brussels: European Commission; 2004.
2. European Centre for Disease Prevention and Control. HIV testing in Europe and Central Asia: monitoring implementation of the Dublin Declaration on partnership to fight HIV/AIDS in Europe and Central Asia : 2022 progress report. LU: Publications Office; 2023.
3. Direção-Geral da Saúde, Instituto Nacional de Saúde Doutor Ricardo Jorge. Infeção por VIH em Portugal - 2024. Lisboa: Direção-Geral da Saúde; 2024.
4. Direção-Geral da Saúde, Instituto Nacional de Saúde Doutor Ricardo Jorge. Infeção por VIH em Portugal - 2023. Lisboa: Direção-Geral da Saúde; 2023.
5. Primary and Secondary HIV Prevention. Substance Abuse Treatment for Persons With HIV/AIDS [Internet], Substance Abuse and Mental Health Services Administration (US); 2000.

6. Beekmann SE, Henderson DK. Prevention of HIV/AIDS: Post-Exposure Prophylaxis (including Healthcare Workers). Infect Dis Clin North Am. 2014;28:601–13. https://doi.org/10.1016/j.idc.2014.08.005.
7. Grant Robert M., Lama Javier R., Anderson Peter L., McMahan Vanessa, Liu Albert Y., Vargas Lorena, et al. Preexposure Chemoprophylaxis for HIV Prevention in Men Who Have Sex with Men. New England Journal of Medicine. 2010;363:2587–99. https://doi.org/10.1056/NEJMoa1011205.
8. Mayer KH, Molina J-M, Thompson MA, Anderson PL, Mounzer KC, De Wet JJ, et al. Emtricitabine and tenofovir alafenamide vs emtricitabine and tenofovir disoproxil fumarate for HIV pre-exposure prophylaxis (DISCOVER): primary results from a randomised, double-blind, multicentre, active-controlled, phase 3, non-inferiority trial. The Lancet. 2020;396:239–54. https://doi.org/10.1016/S0140-6736(20)31065-5.
9. Fonner VA, Dalglish SL, Kennedy CE, Baggaley R, O'Reilly KR, Koechlin FM, et al. Effectiveness and safety of oral HIV preexposure prophylaxis for all populations. AIDS. 2016;30:1973. https://doi.org/10.1097/QAD.0000000000001145.
10. Molina J-M, Charreau I, Spire B, Cotte L, Chas J, Capitant C, et al. Efficacy, safety, and effect on sexual behaviour of on-demand pre-exposure prophylaxis for HIV in men who have sex with men: an observational cohort study. The Lancet HIV. 2017;4:e402–10. https://doi.org/10.1016/S2352-3018(17)30089-9.
11. Rodger AJ, Cambiano V, Bruun T, Vernazza P, Collins S, Degen O, et al. Risk of HIV transmission through condomless sex in serodifferent gay couples with the HIV-positive partner taking suppressive antiretroviral therapy (PARTNER): final results of a multicentre, prospective, observational study. The Lancet. 2019;393:2428–38. https://doi.org/10.1016/S0140-6736(19)30418-0.
12. Simoes D, Meireles P, Rocha M, Freitas R, Aguiar A, Barros H. Knowledge and Use of PEP and PrEP Among Key Populations Tested in Community Centers in Portugal. Front Public Health. 2021;9. https://doi.org/10.3389/fpubh.2021.673959.
13. Gama A, Abecasis A, Pingarilho M, Mendão L, Martins MO, Barros H, et al. Cruising Venues as a Context for HIV Risky Behavior Among Men Who Have Sex With Men. Arch Sex Behav. 2017;46:1061–8. https://doi.org/10.1007/s10508-016-0707-5.
14. Gama A, Martins MRO, Mendão L, Barros H, Dias S. HIV Infection, risk factors and health services use among male-to-female transgender sex workers: a cross-sectional study in Portugal. AIDS Care. 2018;30:1–8. https://doi.org/10.1080/09540121.2017.1332736.
15. Samuel Monteiro HP. HIV Prevalence and HIV-Related Sexual Practices among Men Who Have Sex with Men in Portuguese Bathhouses. J AIDS Clin Res. 2015;06. https://doi.org/10.4172/2155-6113.1000415.
16. Dias S, Marques A, Gama A, Martins MO. HIV risky sexual behaviors and HIV infection among immigrants: a cross-sectional study in Lisbon, Portugal. Int J Environ Res Public Health. 2014;11:8552–66. https://doi.org/10.3390/ijerph110808552.

17. Meireles P, Lucas R, Carvalho C, Fuertes R, Brito J, Campos MJ, et al. Incident risk factors as predictors of HIV seroconversion in the Lisbon cohort of men who have sex with men: first results, 2011-2014. Euro Surveill. 2015;20:21091. https://doi.org/10.2807/1560-7917.es2015.20.14.21091.
18. Pereira H. Male Sex Workers in Lisbon, Portugal: A Pilot Study of Demographics, Sexual Behavior, and HIV Prevalence. J AIDS Clin Res. 2014;05. https://doi.org/10.4172/2155-6113.1000342.
19. Dias S, Gama A, Abrantes P, Gomes I, Fonseca M, Reigado V, et al. Patterns of Sexual Risk Behavior, HIV Infection, and Use of Health Services Among Sub-Saharan African Migrants in Portugal. J Sex Res. 2020;57:906–13. https://doi.org/10.1080/00224499.2019.1601154.
20. Dias S, Gama A, Fuertes R, Mendão L, Barros H. Risk-taking behaviours and HIV infection among sex workers in Portugal: results from a cross-sectional survey. Sex Transm Infect. 2015;91:346–52. https://doi.org/10.1136/sextrans-2014-051697.
21. Meireles P, Lucas R, Martins A, Carvalho AC, Fuertes R, Brito J, et al. The Lisbon Cohort of men who have sex with men. BMJ Open. 2015;5:e007220. https://doi.org/10.1136/bmjopen-2014-007220.
22. Blondeel K, Dias S, Furegato M, Seuc A, Gama A, Fuertes R, et al. Sexual behaviour patterns and STI risk: results of a cluster analysis among men who have sex with men in Portugal. BMJ Open. 2021;11:e033290. https://doi.org/10.1136/bmjopen-2019-033290.
23. Dias S, Gama A, Martins MO, Dias S, Gama A, Martins MO. HIV/AIDS Among Immigrants in Portugal: Socio-Demographic and Behavioural Correlates of Preventive Practices. IntechOpen. 2012. https://doi.org/10.5772/30018.
24. Meireles P, Plankey M, Rocha M, Brito J, Mendão L, Barros H. Different guidelines for pre-exposure prophylaxis (PrEP) eligibility estimate HIV risk differently: an incidence study in a cohort of HIV-negative men who have sex with men, Portugal, 2014-2018. Euro Surveill. 2020;25:1900636. https://doi.org/10.2807/1560-7917.ES.2020.25.28.1900636.
25. Meireles P, Plankey M, Rocha M, Rojas J, Brito J, Barros H. Eligibility for Pre-exposure Prophylaxis According to Different Guidelines in a Cohort of HIV-Negative Men Who Have Sex with Men in Lisbon, Portugal. Sex Res Soc Policy. 2020;17:688–99. https://doi.org/10.1007/s13178-019-00426-9.
26. Ribeiro S, Rocha M. Pre-Exposure Prophylaxis Counseling in a Community Sexual Health Clinic for Men Who Have Sex with Men in Lisbon, Portugal. Acta Med Port. 2019;32:441–7. https://doi.org/10.20344/amp.11474.
27. Meireles P, Moreira C, Rocha M, Plankey M, Barros H. Transitions Between Preexposure Prophylaxis Eligibility States and HIV Infection in the Lisbon Cohort of HIV-Negative Men Who Have Sex With Men: A Multistate Model Analysis. Am J Epidemiol. 2022;191:287–97. https://doi.org/10.1093/aje/kwab260.
28. Fernandes F, Meireles P, Rocha M, Rojas J, Barros H. PrEP users among Lisbon MSM Cohort participants – A first look after PrEP implementation in Portugal. European Journal of Public Health. 2019;29:ckz185.355. https://doi.org/10.1093/eurpub/ckz185.355.

29. Meireles P, Fernandes F, Rocha M, Plankey M, Barros H. Provision of Preexposure Prophylaxis at the Portuguese National Health Service and Uptake in the Lisbon Cohort of Men Who Have Sex with Men. AIDS Behav. 2021;25:1975–83. https://doi.org/10.1007/s10461-020-03127-2.
30. Shivaji T, Diniz A, Cortes-Martins H. Characteristics of late presentation of HIV infection in MSM and heterosexual adults in Portugal 2011-2013. J Int AIDS Soc. 2014;17:19690. https://doi.org/10.7448/IAS.17.4.19690.
31. Miranda AC, Miranda M, Pingarilho M, Pimentel V, Torres J, Peres S, et al. Determinants of HIV-1 Late Presentation in a Cohort of Portuguese HIV-1 Patients. AIDS Res Hum Retroviruses. 2021;37:846–51. https://doi.org/10.1089/AID.2020.0175.
32. Dias S, Gama A, Severo M, Barros H. Factors associated with HIV testing among immigrants in Portugal. Int J Public Health. 2011;56:559–66. https://doi.org/10.1007/s00038-010-0215-7.
33. Dias S, Gama A, Pingarilho M, Simões D, Mendão L. Health Services Use and HIV Prevalence Among Migrant and National Female Sex Workers in Portugal: Are We Providing the Services Needed? AIDS Behav. 2017;21:2316–21. https://doi.org/10.1007/s10461-016-1511-x.
34. Dias S, Gama A, Cortes M, de Sousa B. Healthcare-seeking patterns among immigrants in Portugal. Health Soc Care Community. 2011;19:514–21. https://doi.org/10.1111/j.1365-2524.2011.00996.x.
35. Costa JP, Meireles P, Aguiar A, Schmidt AJ, Barros H. HIV test and knowledge of U=U: insights from MSM living in Portugal and participating in EMIS 2017. European Journal of Public Health. 2020;30:ckaa165.996. https://doi.org/10.1093/eurpub/ckaa165.996.
36. Carvalho C, Fuertes R, Lucas R, Martins A, Campos MJ, Mendão L, et al. HIV testing among Portuguese men who have sex with men--results from the European MSM Internet Survey (EMIS). HIV Med. 2013;14 Suppl 3:15–8. https://doi.org/10.1111/hiv.12058.
37. Gama A, Fraga S, Dias S. Impact of socio-demographic factors on HIV testing among African immigrants in Portugal. J Immigr Minor Health. 2010;12:841–6. https://doi.org/10.1007/s10903-010-9324-x.
38. Meireles P, Rocha M, Brito J, Mendão L, Barros H. Time trends in HIV reactive tests among men who have sex with men testing for the first time at CheckpointLX in Lisbon, Portugal. Revue d'Épidémiologie et de Santé Publique. 2018;66:S396–7. https://doi.org/10.1016/j.respe.2018.05.438.
39. Dias SF, Severo M, Barros H. Determinants of health care utilization by immigrants in Portugal. BMC Health Services Research. 2008;8:207. https://doi.org/10.1186/1472-6963-8-207.
40. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–73. https://doi.org/10.7326/M18-0850.
41. Pollock D, Peters MDJ, Khalil H, McInerney P, Alexander L, Tricco AC, et al. Recommendations for the extraction, analysis, and presentation of results in scoping reviews. JBI Evid Synth. 2023;21:520–32. https://doi.org/10.11124/JBIES-22-00123.

42. Sousa ÁFL, Lima SVMA, Ribeiro CJN, de Sousa AR, Camargo ELS, de Oliveira LB, et al. Pre-exposure prophylaxis among Brazilian men who have sex with men: a comparative study between migrants and non-migrants. Front Public Health. 2023;11:1198339. https://doi.org/10.3389/fpubh.2023.1198339.
43. European Centre for Disease Prevention and Control. HIV and migrants in the EU/EEA: monitoring the implementation of the Dublin Declaration on partnership to fight HIV/AIDS in Europe and Central Asia : 2024 progress report (2023 data). LU: Publications Office; 2024.
44. Rocha M, Meireles P, Carreira P, Morais P, Branco T. The HIV PrEP UP project: technical report. Key findings on PrEP implementation in Portugal and scale-up recommendations. Lisboa: GAT – Grupo de Ativistas em Tratamentos; 2023.
45. de Sousa AFL, de Oliveira LB, Queiroz AAFLN, de Carvalho HEF, Schneider G, Camargo ELS, et al. Casual Sex among Men Who Have Sex with Men (MSM) during the Period of Sheltering in Place to Prevent the Spread of COVID-19. Int J Environ Res Public Health. 2021;18. https://doi.org/10.3390/ijerph18063266.
46. Chone JS, Lima SVMA, Fronteira I, Mendes IAC, Shaaban AN, Martins M do RO, et al. Factors associated with chemsex in Portugal during the COVID-19 pandemic. Rev Lat Am Enfermagem. 2021;29:e3474. https://doi.org/10.1590/1518-8345.4975.3474.
47. Miranda MNS, Pimentel V, Graça J, Seabra SG, Sebastião CS, Diniz A, et al. Sociodemographic, Clinical, and Behavioral Factors Associated with Sexual Transmitted Infection among HIV-1 Positive Migrants in Portugal: Are There Differences between Sexes? Pathogens. 2024;13. https://doi.org/10.3390/pathogens13070598.
48. Abrantes R, Pimentel V, Miranda MNS, Silva AR, Diniz A, Ascenção B, et al. Determinants of HIV late presentation among men who have sex with men in Portugal (2014–2019): who's being left behind? Front Public Health. 2024;12:1336845. https://doi.org/10.3389/fpubh.2024.1336845.
49. Mirandola M, Gios L, Sherriff N, Toskin I, Marcus U, Schink S, et al. The Sialon II Project. Report on a Bio-behavioral Survey among MSM in 13 European cities; 2016.
50. Mirandola M, Gios L, Sherriff N, Marcus U, Toskin I, Rosinska M, et al. Quantifying unmet prevention needs among MSM in Europe through a multi-site bio-behavioural survey. Euro Surveill. 2018;23. https://doi.org/10.2807/1560-7917.ES.2018.23.49.1800097.
51. Pereira H. Condom Use and HIV-Related Behaviors in Portuguese Men who have Sex with Men: A Study of Sexual Behavior and Sexual Pleasure. Journal of AIDS & Clinical Research. 2014;5:1–5. https://doi.org/10.4172/2155-6113.1000294.
52. European Centre for Disease Prevention and Control. EMIS 2010, the European men-who-have-sex-with-men internet survey :findings from 38 countries. LU: Publications Office; 2013.
53. Hoyos J, Maté T, Indave BI, Agustí C, Chanos S, Pichon F, et al. Knowledge, actual and potential use of HIV self-sampling testing kits among MSM recruited in eight European countries. HIV Med. 2018;19 Suppl 1:27–33. https://doi.org/10.1111/hiv.12593.

54. Maté T, Hoyos J, Guerras JM, Agustí C, Chanos S, Kuske M, et al. Potential of HIV Self-Sampling to Increase Testing Frequency Among Gay, Bisexual, and Other Men Who Have Sex With Men, and the Role of Online Result Communication: Online Cross-Sectional Study. J Med Internet Res. 2020;22:e21268. https://doi.org/10.2196/21268.
55. Hoyos J, Maté T, Guerras J-M, Donat M, Agustí C, Kuske M, et al. Preference towards HIV Self-Testing above Other Testing Options in a Sample of Men Who Have Sex with Men from Five European Countries. Int J Environ Res Public Health. 2021;18. https://doi.org/10.3390/ijerph18094804.
56. European Centre for Disease Prevention and Control., Sigma Research (London School of Hygiene and Tropical Medicine)., Robert Koch Institute. EMIS-2017: the European men who have sex with men Internet survey : key findings from 50 countries. LU: Publications Office; 2019.
57. Dias R, Rocha M, Veríssimo L, Ferreira F, Novais MJ, Severo M, et al. Combination HIV Prevention Strategies in the Lisbon Cohort of Men who Have Sex with Men: A Longitudinal Cluster Analysis of Data from 2014 to 2021. AIDS Behav. 2025. https://doi.org/10.1007/s10461-025-04693-z.
58. Abrantes R, Pimentel V, Sebastião C, Miranda MNS, Seabra S, Silva AR, et al. Determinants of HIV-1 transmission clusters and transmitted drug resistance in men who have sex with men: A multicenter study in Portugal (2014-2019). International Journal of Infectious Diseases. 2025;155:107888. https://doi.org/10.1016/j.ijid.2025.107888.
59. Nodin N, Carballo-Diéguez A, Leal IP. Comportamentos sexuais de risco e preventivos masculinos: resultados de uma amostra recolhida através da internet em Portugal. Saude soc. 2015;24:607–19. https://doi.org/10.1590/S0104-12902015000020
60. Sousa AFL de, Lima SVMA, Ribeiro CJN, de Sousa AR, Barreto NMPV, Camargo ELS, et al. Adherence to Pre-Exposure Prophylaxis (PrEP) among Men Who Have Sex with Men (MSM) in Portuguese-Speaking Countries. Int J Environ Res Public Health. 2023;20. https://doi.org/10.3390/ijerph20064881.
61. Pereira H. Sexual Behavior and HIV Testing Practices among Men who have Sex with Men in Portugal. J AIDS Clin Res. 2015;6. https://doi.org/10.4172/2155-6113.1000524.
62. Biello KB, Rosenberger JG, Novak DS, Robertson AM, Mayer KH, Mimiaga MJ. Epidemiology of sexual health in the virtual environment: a multinational online survey of Spanish- and Portuguese-speaking men who use an internet sexual networking site. AIDS Behav. 2014;18:1675–85. https://doi.org/10.1007/s10461-014-0844-6.
63. Ribeiro S, de Sousa D, Medina D, Castro R, Lopes A, Rocha M. Prevalence of gonorrhea and chlamydia in a community clinic for men who have sex with men in Lisbon, Portugal. International Journal of STD & AIDS. 2019;30:951–9. https://doi.org/10.1177/0956462419855484.
64. Almeida N, Melo M, Soares I, Carvalho H. Screening of Human Immunodeficiency Virus and Other Sexually Transmitted Infections in a Group of Sex Workers in Indoor Settings in the Porto Metropolitan Area. Acta Med Port. 2020;33:166–73. https://doi.org/10.20344/amp.11687.

65. European Centre for Disease Prevention and Control. HIV and sex workers: monitoring implementation of the Dublin Declaration on partnership to fight HIV/AIDS in Europe and Central Asia : 2022 progress report. LU: Publications Office; 2024.
66. Gaspar de Matos M, Gaspar T, Simons-Morton B, Reis M, Ramiro L. Communication and information about “Safer sex”: Intervention issues within communities of African migrants living in poorer neighborhoods in Portugal. Journal of Poverty. 2008;12:333–50. https://doi.org/10.1080/10875540802198628.
67. Dias S, Gama A, Loos J, Roxo L, Simões D, Nöstlinger C. The role of mobility in sexual risk behaviour and HIV acquisition among sub-Saharan African migrants residing in two European cities. PLoS One. 2020;15:e0228584. https://doi.org/10.1371/journal.pone.0228584.
68. Farias R, Couto I, Pingarilho M, Fronteira I. Tuberculosis and/or HIV Infection and Associated Socio-Behavioural Factors in Immigrants, in Portugal: A Cross-Sectional, Community-Based Descriptive Study. Portuguese Journal of Public Health. 2021;39:163–9. https://doi.org/10.1159/000521726.
69. Dias S, Gama A, Tavares AM, Reigado V, Simões D, Carreiras E, et al. Are Opportunities Being Missed? Burden of HIV, STI and TB, and Unawareness of HIV among African Migrants. Int J Environ Res Public Health. 2019;16. https://doi.org/10.3390/ijerph16152710.
70. Curado A, Nogueira PJ, Virgolino A, Santa Maria J, Mendão L, Furtado C, et al. Hepatitis C antibody prevalence and behavioral correlates in people who inject drugs attending harm reduction services in Lisbon, Portugal. Front Public Health. 2022;10:952909. https://doi.org/10.3389/fpubh.2022.952909.
71. Sullivan GM, Artino AR. Analyzing and Interpreting Data From Likert-Type Scales. J Grad Med Educ. 2013;5:541–2. https://doi.org/10.4300/JGME-5-4-18.
72. The role of sexually transmitted diseases in HIV transmission. Nature Reviews Microbiology. https://www.nature.com/articles/nrmicro794. Accessed 24 February 2024.
73. European Centre for Disease Prevention and Control. Pre-exposure prophylaxis for HIV prevention in Europe and Central Asia - Monitoring the implementation of the Dublin Declaration on partnership to fight HIV/AIDS in Europe and Central Asia: 2024 progress report (2023 data).
74. Cordeiro R, Caetano CP, Sobral D, Ferreira R, Coelho L, Pelerito A, et al. Viral genetics and transmission dynamics in the second wave of mpox outbreak in Portugal and forecasting public health scenarios. Emerg Microbes Infect. 2024;13:2412635. https://doi.org/10.1080/22221751.2024.2412635.
75. Caria J, Pinto R, Leal E, Almeida V, Cristóvão G, Gonçalves AC, et al. Clinical and Epidemiological Features of Hospitalized and Ambulatory Patients with Human Monkeypox Infection: A Retrospective Observational Study in Portugal. Infect Dis Rep 2022;14:810–23. https://doi.org/10.3390/idr14060083.
76. Serviços Partilhados do Ministério da Saúde. Circular Normativa Conjunta Nº 02/2018 INFARMED/ACSS/DGS/SPMS. 2018. https://www.spms.min-saude.pt/2018/03/circular-normativa-

conjunta-no-02-2018-infarmed-acss-dgs-spms/. Published March 2018. Accessed 20 November 2024.

77. INFARMED, Direção Geral de Saúde. Circular Informativa Conjunta Nº 01/2018/INFARMED/DGS: Programa de Acesso Precoce para Profilaxia de Pré-exposição da infeção por VIH-1 no Adulto. 2018. https://www.spms.min-saude.pt/2018/03/circular-normativa-conjunta-no-02-2018-infarmed-acss-dgs-spms/. Published March 23 2018. Accessed November 20 2024
78. European Centre for Disease Prevention and Control. People who inject drugs: monitoring implementation of the Dublin Declaration on Partnership to Fight HIV/AIDS in Europe and Central Asia : 2012 progress report. LU: Publications Office; 2013.
79. First medicine for HIV pre-exposure prophylaxis recommended for approval in the EU | European Medicines Agency (EMA). 2016. https://www.ema.europa.eu/en/news/first-medicine-hiv-pre-exposure-prophylaxis-recommended-approval-eu. Accessed 18 July 2025.
80. Ayieko J, Petersen ML, Kamya MR, Havlir DV. PEP for HIV prevention: are we missing opportunities to reduce new infections? J Int AIDS Soc. 2022;25:e25942. https://doi.org/10.1002/jia2.25942.
81. European Commission authorises ViiV Healthcare's Apretude (cabotegravir long-acting and tablets) for HIV prevention, GSK. 2023. https://www.gsk.com/en-gb/media/press-releases/european-commission-authorises-viiv-healthcare-s-apretude/ . Accessed 18 September 2025.
82. Gilead Sciences' HIV PrEP Injectable Approved by European Commission. PharmTech. 2025. https://www.pharmtech.com/view/gilead-sciences-hiv-prep-injectable-approved-by-european-commission. Accessed 18 September 2025.
83. Marshall BDL, Goedel WC, King MRF, Singleton A, Durham DP, Chan PA, et al. Potential effectiveness of long-acting injectable pre-exposure prophylaxis for HIV prevention in men who have sex with men: a modelling study. The Lancet HIV. 2018;5:e498–505. https://doi.org/10.1016/S2352-3018(18)30097-3.
84. Liegeon G, Ghosn J. Long-acting injectable cabotegravir for PrEP: A game-changer in HIV prevention? HIV Medicine. 2023;24:653–63. https://doi.org/10.1111/hiv.13451.
85. Stengaard AR, Combs L, Supervie V, Croxford S, Desai S, Sullivan AK, et al. HIV seroprevalence in five key populations in Europe: a systematic literature review, 2009 to 2019. Euro Surveill 2021;26:2100044. https://doi.org/10.2807/1560-7917.ES.2021.26.47.2100044.
86. Turan JM, Elafros MA, Logie CH, Banik S, Turan B, Crockett KB, et al. Challenges and opportunities in examining and addressing intersectional stigma and health. BMC Medicine 2019;17:7. https://doi.org/10.1186/s12916-018-1246-9.
87. Babel RA, Wang P, Alessi EJ, Raymond HF, Wei C. Stigma, HIV Risk, and Access to HIV Prevention and Treatment Services Among Men Who have Sex with Men (MSM) in the United States: A Scoping Review. AIDS Behav 2021;25:3574–604. https://doi.org/10.1007/s10461-021-03262-4.
88. Etowa J, Ghose B, Loemba H, Etowa EB, Husbands W, Omorodion F, et al. Factors Associated with Condom Knowledge, Attitude, and Use among Black Heterosexual Men in Ontario, Canada. ScientificWorldJournal 2021;2021:8862534. https://doi.org/10.1155/2021/8862534.

89. Bankole A, Ahmed FH, Neema S, Ouedraogo C, Konyani S. Knowledge of Correct Condom Use and Consistency of Use among Adolescents in Four Countries in Sub-Saharan Africa. African Journal of Reproductive Health / La Revue Africaine de La Santé Reproductive 2007;11:197–220. https://doi.org/10.2307/25549740.
90. Bhattacharjee P, McClarty LM, Musyoki H, Anthony J, Kioko J, Kaosa S, et al. Monitoring HIV Prevention Programme Outcomes among Key Populations in Kenya: Findings from a National Survey. PLOS ONE 2015;10:e0137007. https://doi.org/10.1371/journal.pone.0137007.
91. European Centre for Disease Prevention and Control. Mapping of HIV/STI behavioural surveillance in Europe. LU: Publications Office; 2009.
92. Fraser H, Borquez A, Stone J, Abramovitz D, Brouwer KC, Goodman-Meza D, et al. Overlapping Key Populations and HIV Transmission in Tijuana, Mexico: A Modelling Analysis of Epidemic Drivers. AIDS Behav. 2021;25:3814–27. https://doi.org/10.1007/s10461-021-03361-2.
93. Indicators and questions for monitoring progress on the 2021 Political Declaration on HIV and AIDS — Global AIDS Monitoring 2025, UNAIDS. https://www.unaids.org/en/resources/documents/2024/global-aids-monitoring-guidelines. Accessed 19 July 2025.
94. Liegeon G, Assoumou L, Béniguel L, Palich R, Pialoux G, Slama L, et al. Engagement in Preexposure Prophylaxis Care at 1 Year Among Men Who Have Sex With Men Enrolled in the French ANRS PREVENIR Cohort Study. Open Forum Infect Dis. 2025;12:ofae744. https://doi.org/10.1093/ofid/ofae744.
95. Goldwirt L, Bauer R, Liegeon G, Charreau I, Delaugerre C, Cotte L, et al. Estimated pill intake with on-demand PrEP with oral TDF/FTC using TFV-DP concentration in dried blood spots in the ANRS IPERGAY trial. Journal of Antimicrobial Chemotherapy. 2021;76:2675–80. https://doi.org/10.1093/jac/dkab253.
96. Landovitz RJ, Beymer M, Kofron R, Amico KR, Psaros C, Bushman L, et al. Plasma Tenofovir-levels to Support Adherence to TDF/FTC Pre-exposure Prophylaxis for HIV Prevention in MSM in Los Angeles, California. J Acquir Immune Defic Syndr. 2017;76:501–11. https://doi.org/10.1097/QAI.0000000000001538.

Figures

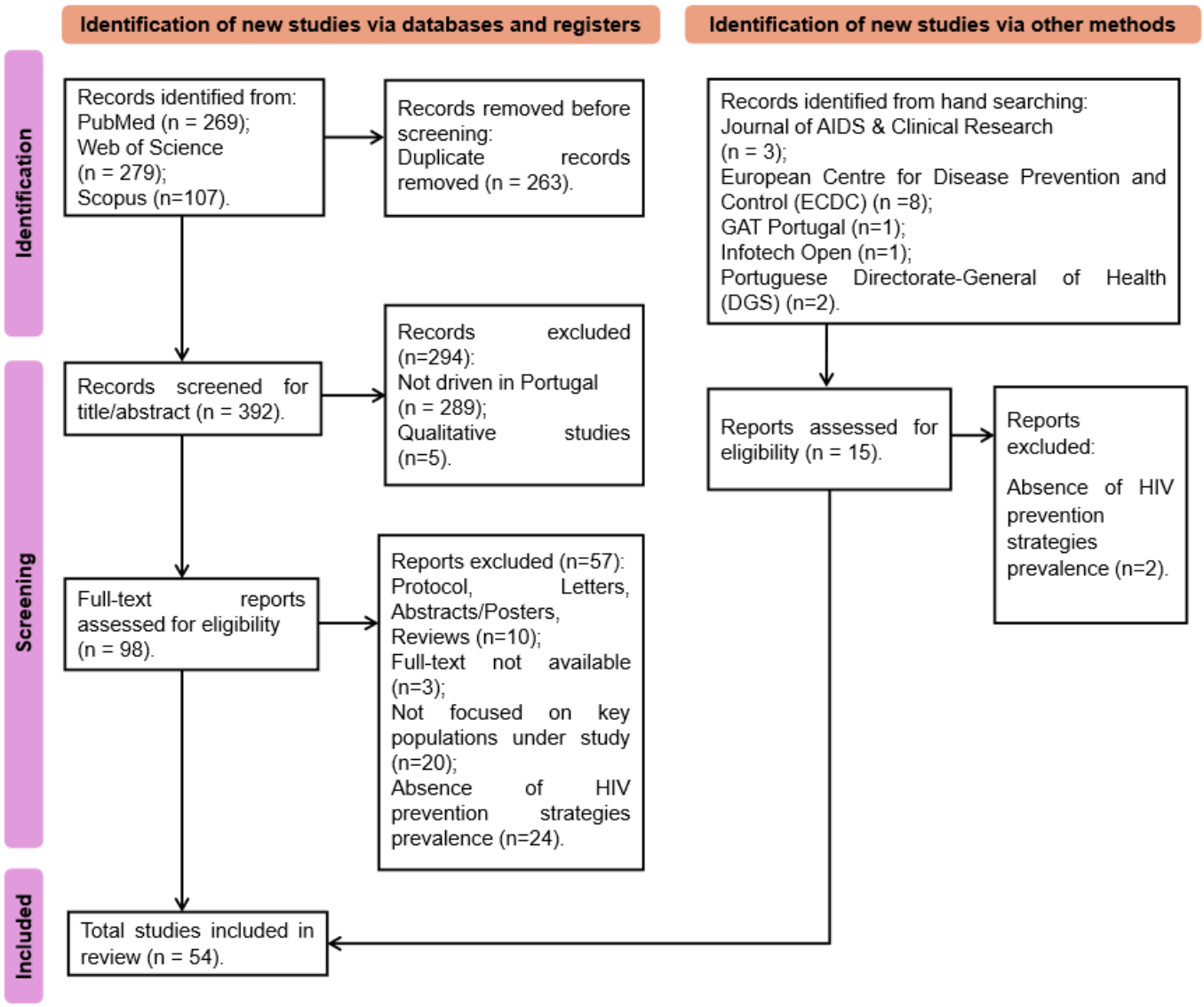

Figure 1

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

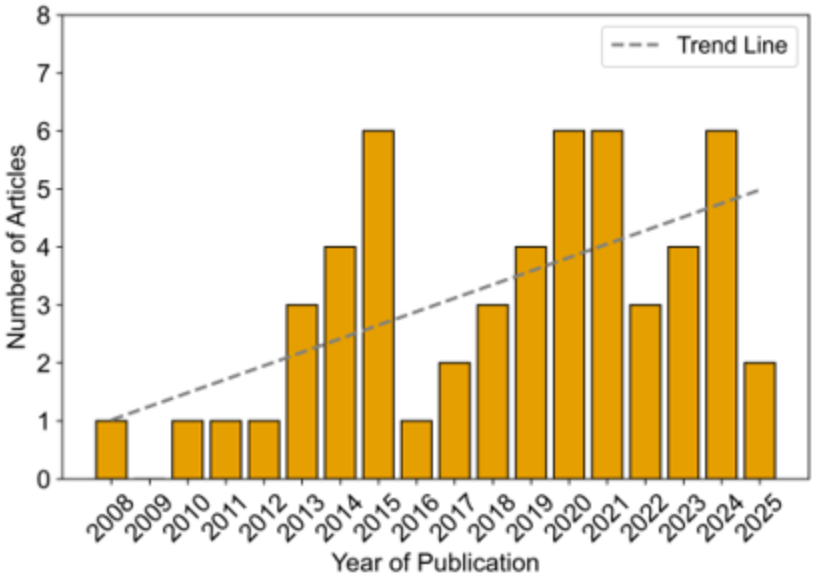

Figure 2

Temporal evolution of research output in HIV primary and secondary prevention strategies in high-risk populations published between 2008 and 2025.

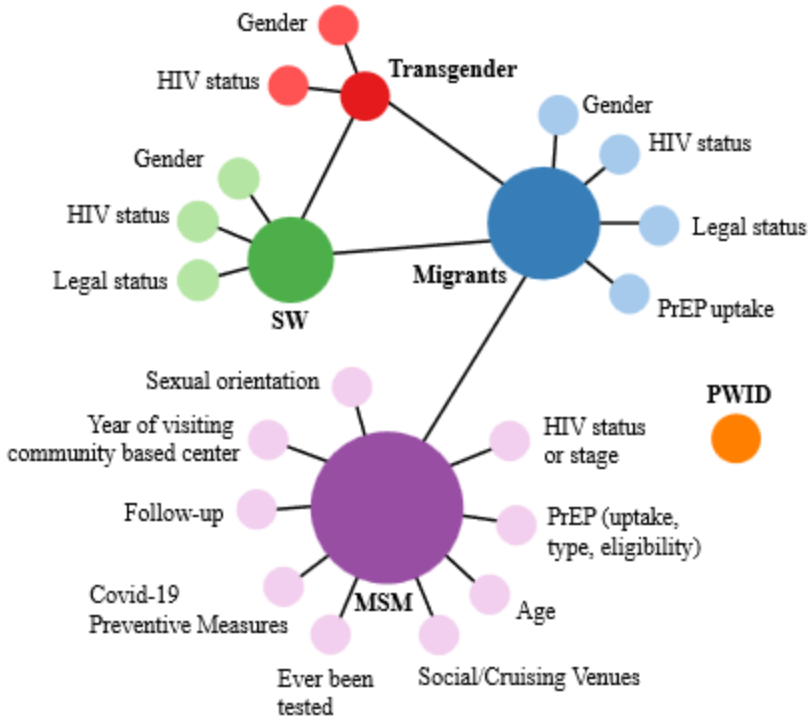

Figure 3

Network visualization of the overlapping and stratification of HIV prevention strategies among the key populations under study. The size of the blobs is proportional to the number of studies that characterizes each key population. The lines represent the intersection between different key populations and respective stratification in subcategories.

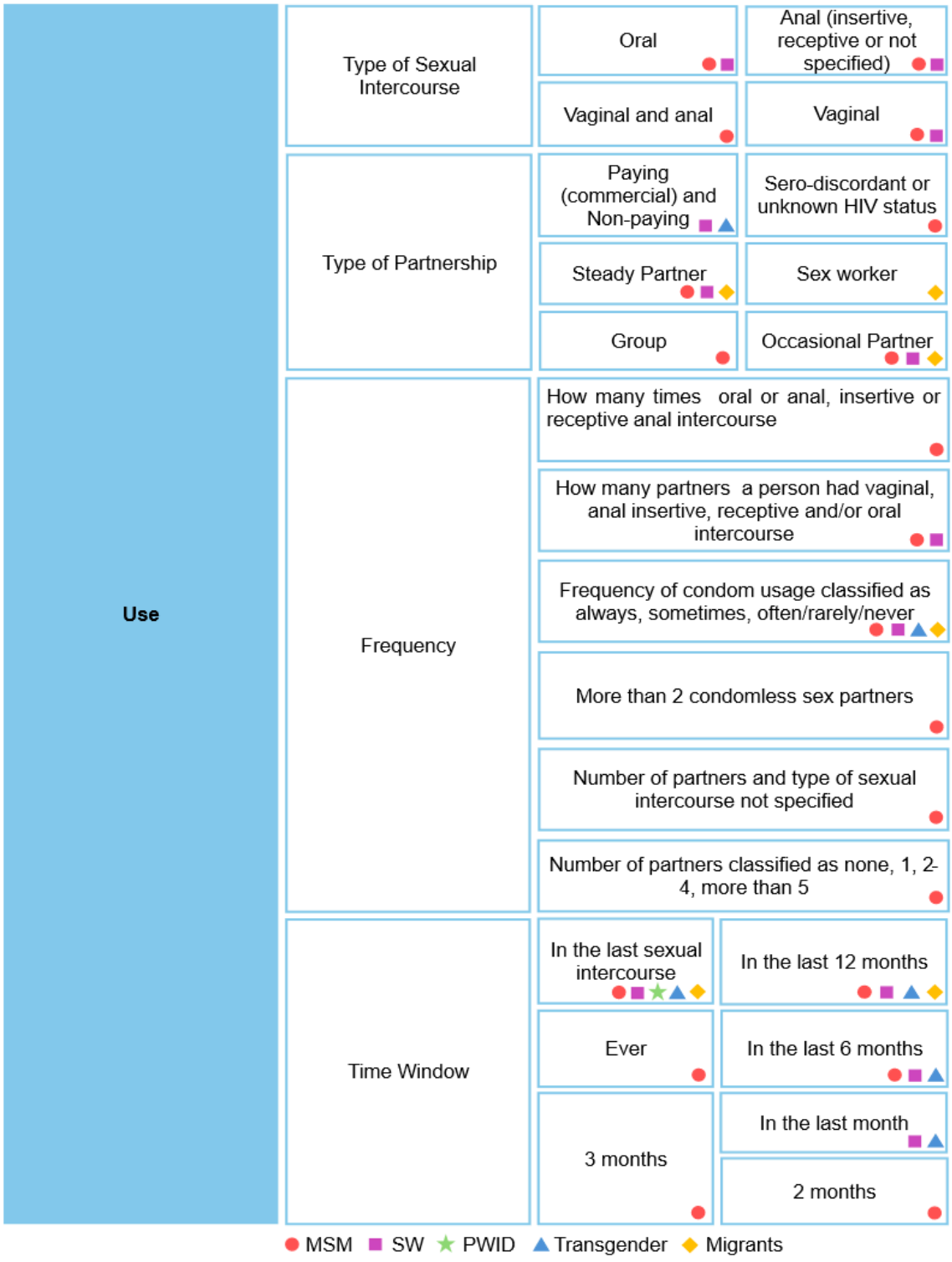

Figure 4

Characterization of variables to assess condom knowledge and use for all key populations. Condom use was defined according to the type of partnerships, gender, type of sexual intercourse, sexual role preference, time window, frequency. Each symbol represents a distinct key population. In cases where populations overlap, multiple symbols are shown to reflect all relevant groups.

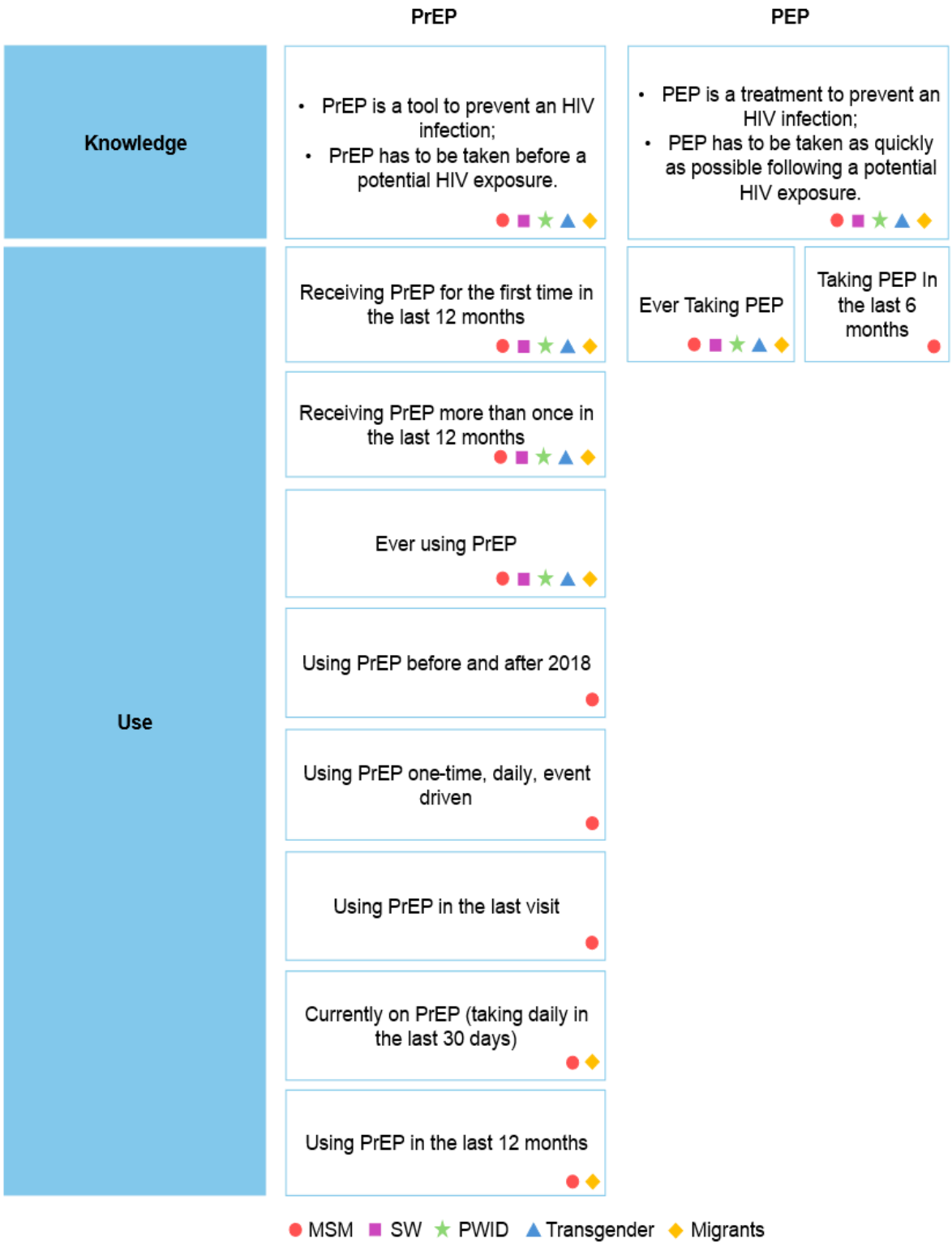

Figure 5

Characterization of variables used to assess PrEP and PEP knowledge and use across all key populations. Each symbol represents a distinct key population. In cases where populations overlap, multiple symbols are shown to reflect all relevant groups.

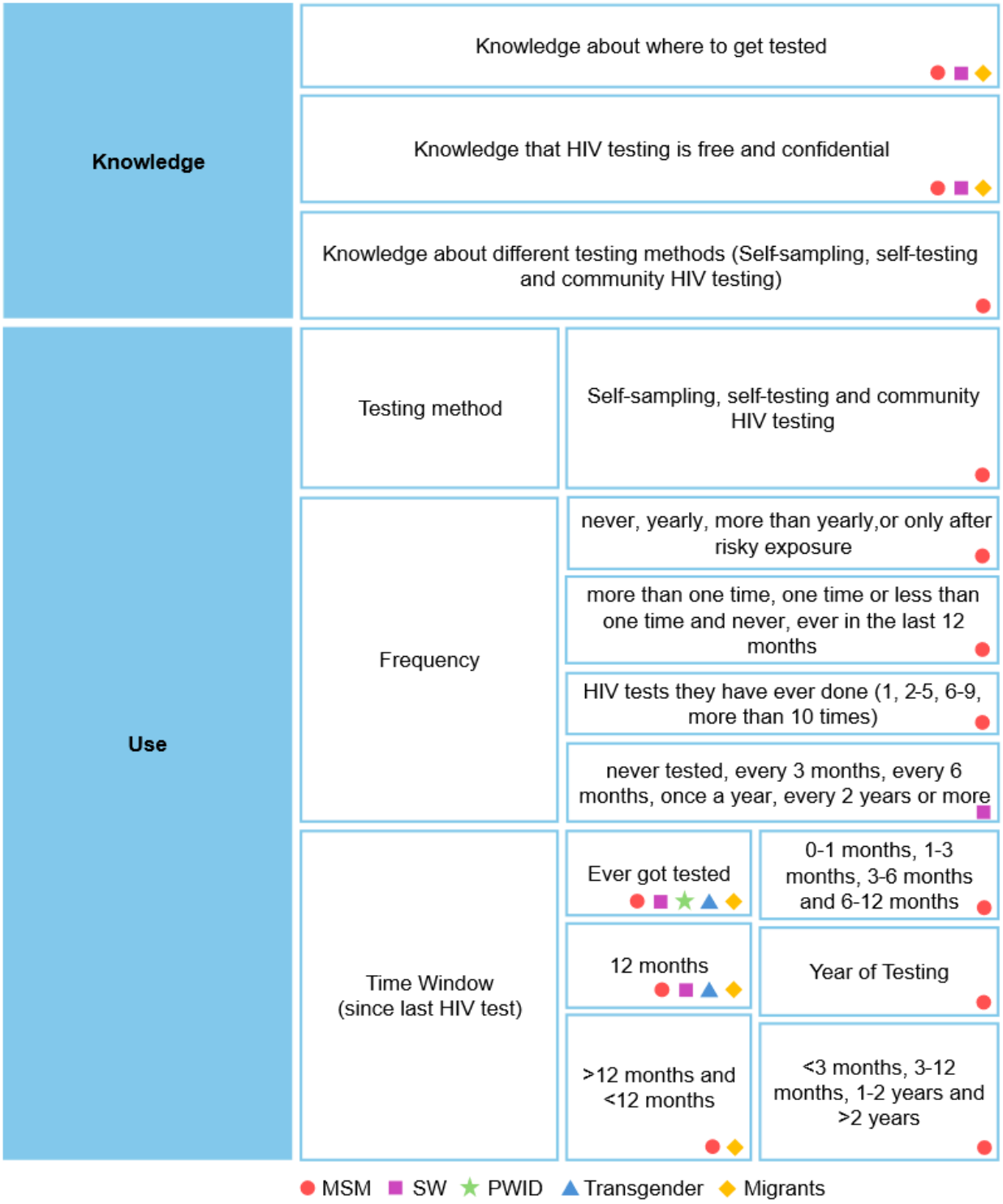

Figure 6

Characterization of variables used to assess HIV testing knowledge and use across all key populations. HIV testing was defined for different recall periods and frequency scales. Each symbol represents a

distinct key population. In cases where populations overlap, multiple symbols are shown to reflect all relevant groups.

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