International Journal of Infectious Diseases 167 (2026) 108582

Contents lists available at ScienceDirect

International Journal of Infectious Diseases

journal homepage: www.elsevier.com/locate/ijid

HIV/HCV prevalence and the retention paradox in marginalized populations in Madrid (2019-2023): A large-scale cross-sectional study

Jorge Valencia [1,2,3,†], Pablo Ryan [1,2,4,5,†], Helena Codina [6], Guillermo Cuevas [1], Samuel Manzano [1], Samuel Estévez [1], Isidoro Martínez [2,6,‡], Daniel Sepúlveda-Crespo [2,6,‡], Salvador Resino [2,6,‡,*]

[1] Hospital Universitario Infanta Leonor, Madrid, Spain
[2] Instituto de Salud Carlos III, Centro de Investigación Biomédica en Red en Enfermedades Infecciosas (CIBERINFEC), Madrid, Spain
[3] Unidad de Reducción de Daños "SMASD", Madrid, Spain
[4] Universidad Complutense de Madrid (UCM), Madrid, Spain
[5] Instituto de Investigación Sanitaria Gregorio Marañón (IiSGM), Madrid, Spain
[6] Unidad de Infección Viral e Inmunidad, Instituto de Salud Carlos III, Centro Nacional de Microbiología, Madrid, Spain

A R T I C L E I N F O

Article history:
Received 14 January 2026
Revised 18 March 2026
Accepted 19 March 2026

Keywords:
HIV
HIV/HCV coinfection
Screening
Vulnerable populations
Link to care

A B S T R A C T

Objectives: Marginalized urban populations experience a high burden of HIV and HCV. We assessed the prevalence and risk factors for both infections and characterized the care cascades in a cohort of vulnerable individuals in Madrid, Spain.
Methods: We conducted a cross-sectional study (2019-2023) of 4582 individuals via mobile units in high-risk hotspots, offering integrated rapid HIV/HCV testing with point-of-care HCV-RNA confirmation. Multivariable logistic regression identified independent HIV risk factors.
Results: HIV prevalence was 6.3% (95% CI: 5.6-7.0). Among people with HIV (PWH), 17.0% of known cases were not receiving antiretroviral therapy; PrEP uptake was zero among HIV-negative individuals. A history of injecting drug use was the primary HIV risk factor (adjusted odds ratio[aOR] 6.6; 95% CI: 4.6-9.5), followed by age >50 years, Spanish origin, and alcohol/benzodiazepine misuse (all $P < 0.05$). Active HCV prevalence was 5.5% (95% CI: 4.9-6.2); 15.7% in PWH vs 4.8% in people without HIV ($P < 0.001$). Among confirmed cases, HCV linkage (≥95.2%) and treatment (≥88.6%) were high; however, 16.8% of all antibody-positive individuals (23.2% among PWH) missed confirmatory RNA testing.
Conclusions: HIV and HCV remain prevalent, characterized by discontinuities in retention rather than diagnosis. Integrated, low-threshold strategies combining harm reduction with social support are required to address this syndemic.

Introduction

Spain has an estimated 150,000 people with HIV (PWH), corresponding to a 0.4% general prevalence and 0.1% undiagnosed infection [1]. These national averages mask disparities among socially vulnerable groups [2]. Marginalized populations—specifically people experiencing homelessness, undocumented migrants, and people who inject drugs (PWID)—experience a disproportionate burden [3]. Systemic barriers in these groups drive delayed diagnoses, suboptimal adherence to antiretroviral therapy (ART), and ongoing transmission [4].

Achieving the Joint United Nations Programme on HIV/AIDS (UNAIDS) 95-95-95 targets requires expanded testing, yet late diagnosis remains a primary barrier. In Western Europe and Spain,

Abbreviations: aOR, Adjusted odds ratio; ART, Antiretroviral therapy; AUC, Area under the receiver operating characteristic curve; CI, Confidence interval; ECDC, European Centre for Disease Prevention and Control; GLM, General linear model; HCV, Hepatitis C virus; HIV, Human immunodeficiency virus; IDU, Injecting drug use; MSM, Men who have sex with men; PrEP, Pre-exposure prophylaxis; PWH, People with HIV; PWID, People who inject drugs; PWoH, People without HIV; REDCap, Research Electronic Data Capture; UNAIDS, Joint United Nations Programme on HIV/AIDS.

* Corresponding author: Salvador Resino, Centro Nacional de Microbiología, Instituto de Salud Carlos III; Carretera Majadahonda- Pozuelo, Km 2.2, ES-28220 Majadahonda, Madrid, Spain.
E-mail address: sresino@isciii.es (S. Resino).
† These first authors contributed equally to this article.
‡ These senior authors contributed equally to this article.

https://doi.org/10.1016/j.ijid.2026.108582
1201-9712/

nearly 50% of diagnoses occur at CD4 counts <350 cells/mm³ [5], necessitating targeted screening strategies [6]. Diagnosis alone is insufficient; while national incidence has declined, retaining marginalized populations in care remains difficult [7]. Unlike men who have sex with men (MSM), these groups face distinct systemic barriers to sustained engagement [8]. Consequently, public health efforts must shift beyond detection to ensure long-term ART adherence and viral suppression [7].

Hepatitis C virus (HCV) coinfection affects marginalized PWH due to shared risk factors such as injecting drug use [9]. Despite general improvements in care [10], data on active HCV prevalence and care cascade outcomes within these vulnerable groups remain scarce [11]. To address this dual burden, the European Centre for Disease Prevention and Control (ECDC) advocates for integrated testing and linkage strategies. Since conventional healthcare is often inaccessible to these populations due to structural barriers [12], mobile health units have emerged as a strategy to deliver low-threshold, integrated services directly to the community, overcoming access barriers and facilitating treatment uptake [10,13,14].

Objective

We aimed to assess HIV and HCV prevalence, identify associated risk factors, and characterize the full care cascades in a large cohort of marginalized individuals in Madrid.

Methods

Study population

This cross-sectional study was conducted in Madrid, Spain, between February 2019 and April 2023. Methodological details regarding screening protocols for other bloodborne viruses have been published previously [15–17]. We utilized a mobile health unit accompanied by a support van, operating on a predefined schedule to recruit adult participants (≥18 years) through a targeted, venue-based sampling strategy.

Recruitment sites were selected in collaboration with public health agencies and community organizations to target epidemiological hotspots, including social assistance institutions, migrant centers, homeless shelters, public gathering spaces, and harm reduction facilities. The mobile unit visited these locations weekly or biweekly. Recruitment relied on presence at these high-risk venues as a proxy for social vulnerability, capturing a diverse population regardless of sexual orientation or specific risk behaviors.

During operation, a multidisciplinary team comprising a registered nurse and a trained peer navigator invited individuals in the vicinity to participate. Peer navigators conducted structured interviews to collect sociodemographic and epidemiological data, while nurses performed rapid HIV testing. All participants received risk-reduction counseling. Any participant not on ART was offered an immediate, accompanied referral to a hospital to facilitate linkage to care.

Ethical approval statement

Informed consent was obtained from all participants before enrollment. The research adhered to the ethical principles of the Declaration of Helsinki (2013 revision) and followed STROBE guidelines (**Supplementary Table 1**).

Data collection

Sociodemographic and behavioral data were collected via confidential, 20-minute interviewer-administered surveys using Research Electronic Data Capture (REDCap) software (Vanderbilt University, Nashville, TN, USA) hosted on tablets [15–18]. Procedures were maintained during the COVID-19 pandemic following public health safety protocols. Trained peer navigators entered all information directly; participants did not self-administer surveys.

Confidentiality was maintained through data anonymization and unique study identifiers. No personally identifiable information was recorded, and data were stored in encrypted databases in compliance with European General Data Protection Regulations (GDPR).

Screening for HIV and HCV infection

HIV screening was performed by a registered nurse using the OraQuick ADVANCE Rapid HIV-1/2 Antibody Test (OraSure Technologies, Bethlehem, PA, USA; sensitivity 98%, specificity 100%) [19].

For HCV, a two-step algorithm was implemented [15–17]. Capillary blood samples were first screened for anti-HCV antibodies using the OraQuick HCV Rapid Antibody Test. Antibody-positive participants underwent confirmatory HCV-RNA testing with the Xpert® HCV Viral Load Fingerstick assay (Cepheid, Sunnyvale, CA, USA) to diagnose active infection.

To prevent duplication, individuals tested multiple times were included only once per year in the analysis, considering only the first test result of the calendar year.

All people without HIV (PWoH) reporting injecting drug use or condomless sex in the past year were informed about pre-exposure prophylaxis (PrEP) access, per Spanish national guidelines [20].

Linkage to care

Participants with positive results received immediate counseling and peer-navigated referral to specialized healthcare facilities. Peer navigators coordinated appointments and provided accompaniment to facilitate linkage. Retention was supported through follow-up calls and in-person reminders. For PWH with HCV coinfection, clinical follow-up included liver fibrosis assessment (elastography) and screening for cirrhosis and hepatocellular carcinoma.

Risk factors and outcomes

Covariates were collected via structured interviews and categorized as follows: (i) Demographics: sex, age, year of screening, and country of origin. (ii) Social determinants: homelessness (past 6 months) and irregular migration status (residing in Spain without legal authorization). (iii) Substance use: alcohol misuse (self-reported >50 g/day), benzodiazepine misuse (physician-diagnosed compulsive use associated with harm), and use of cocaine, heroin, or marijuana. History of injecting drug use (IDU) was stratified as: never [reference], past (nonactive in the last year), or active (last year). (iv) Sexual behavior: condomless sex (past year).

The primary outcome was confirmed HIV infection. The secondary outcome was HIV/HCV coinfection.

Statistical analysis

Prevalence was calculated as the proportion of positive results among the total number of participants screened for each infection, with 95% confidence intervals (CIs) estimated using the exact binomial (Clopper-Pearson) method.

Continuous variables were compared using the Mann-Whitney U test, and categorical variables using the Chi-square or Fisher's exact test. To identify independent predictors of HIV infection, we employed multivariable logistic regression models (Generalized Linear Models with binomial distribution and logit link). Variables were included in the model if data missingness was <5%. Collinearity was assessed using Spearman correlation coefficients (>0.5)

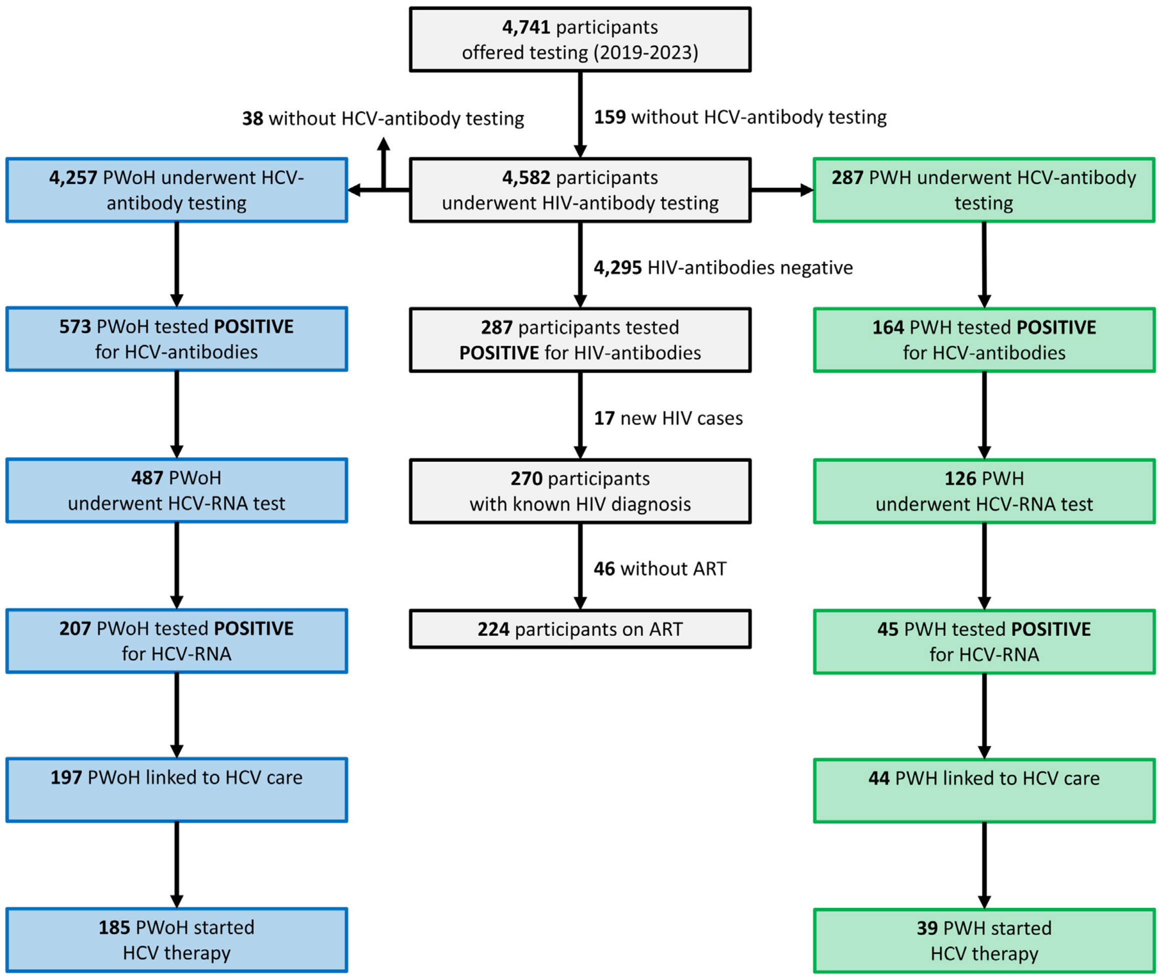

Figure 1. Participant flow diagram. The diagram illustrates participant screening, testing, and outcomes for HIV and HCV. Abbreviation: HIV, human immunodeficiency virus; HCV, hepatitis C virus.

and Variance Inflation Factors (VIF >5). These regression models provided the adjusted odds ratio (aOR) and 95% confidence intervals (95% CI). Standard errors and 95% CIs were estimated using 1000 bootstrap replications. Model performance was evaluated using the Area Under the Receiver Operating Characteristic Curve (AUC) and internally validated via 10-fold cross-validation. Post hoc pairwise comparisons were conducted for identified risk factors.

Statistical analysis was performed using Stata v18 (StataCorp LLC, College Station, TX, USA). Figures and graphs were generated using GraphPad Prism v10 (GraphPad Software, Inc., San Diego, CA, USA).

Results

HIV screening and care cascade

Of 4741 individuals offered testing, 4582 (96.6%) consented to screening (Figure 1). HIV prevalence was 6.3% (287/4582; 95% CI: 5.6-7.0). These cases comprised 17 (5.9%) new diagnoses and 270 individuals with previously known infection. Within the care cascade, 46 (17.0%) of the 270 participants with a known diagnosis were not on antiretroviral therapy (ART). PrEP uptake was zero among HIV-negative individuals who were informed about PrEP.

Participant characteristics

The population (Table 1) was predominantly male (68.4%) with a median age of 43 years. Participants experienced homelessness (58.6%) and were of non-Spanish origin (49.7%). Alcohol and benzodiazepine misuse were reported by 36.5% and 34.9%, respectively, and a history of IDU was reported by 26.0%.

Stratification by HIV status indicated that, compared to PWoH, PWH were significantly older (median 49 vs 42 years), more likely to be of Spanish origin (74.6% vs 48.7%), and reported higher rates of alcohol, benzodiazepine, and cocaine/heroin use (all $P < 0.001$). A history of IDU was more frequent in PWH (72.8% vs 22.8%; $P < 0.001$). Among PWH, those with new diagnoses were significantly younger than those with known infection (median 41 vs 50 years; $P < 0.05$).

Risk factors and HIV infection

Multivariable logistic regression identified five independent factors associated with HIV infection (Figure 2). A history of IDU was associated with the highest odds of infection (aOR 6.6, 95% CI: 4.6-9.5; $P < 0.001$). Other significant factors included alcohol misuse (aOR 1.5, $P = 0.008$), benzodiazepine misuse (aOR 1.5, $P = 0.021$), age >50 years (aOR 1.4, $P = 0.007$), and Spanish origin (aOR 1.3, $P = 0.046$). HIV infection prevalence was highest among participants with a history of IDU (17.6%), followed by benzodiazepine misuse (11.6%), Spanish origin (9.3%), age >50 (9.2%), and alcohol misuse (7.9%) (all $P < 0.001$ vs reference groups).

The five-factor model yielded an AUC of 0.79 (95% CI: 0.76-0.82). The AUC of IDU history alone was 0.75 (95% CI: 0.72-0.78), confirmed by cross-validation.

Table 1
Participant epidemiological characteristics.

Characteristics	All	PWoH	PWH	*P*-value
No.	4582	4295	287	
Male, N (%)	3132 (68.4)	2930 (68.2)	202 (70.4)	0.470
Age, median (IQR)	43 (33-52)	42 (33-52)	49 (42-55)	**<0.001**
Age > 50 years, N (%)	1309 (28.6)	1189 (27.7)	120 (41.8)	**<0.001**
Source population, N (%)				
Spain	2304 (50.3)	2090 (48.7)	214 (74.6)	**<0.001**
Migrants				
Europe	499 (10.9)	478 (11.1)	21 (7.3)	0.050
Africa	562 (12.3)	551 (12.8)	11 (3.8)	**<0.001**
Latin America	1047 (22.9)	1011 (23.5)	36 (12.5)	**<0.001**
Asia	120 (2.6)	120 (2.8)	0 (0)	**<0.001**
Unknown	50 (1.1)	45 (1.0)	5 (1.7)	0.240
Social situation, N (%)				
Homelessness	2684 (58.6)	2516 (58.6)	168 (58.5)	0.753
Undocumented status	538 (11.7)	513 (11.9)	25 (8.7)	0.107
Substance misuse, N (%)				
Alcohol (>50 g/day)	1671 (36.5)	1539 (35.8)	132 (46.0)	**<0.001**
Benzodiazepines	1598 (34.9)	1413 (32.9)	185 (64.5)	**<0.001**
People who used drugs (last year), N (%)				
Cocaine	1680 (36.7)	1503 (35.0)	177 (61.7)	**<0.001**
Heroin	1094 (23.9)	966 (22.5)	128 (44.6)	**<0.001**
Marijuana	520 (11.3)	483 (11.2)	37 (12.9)	0.387
People who injected drugs, N (%)				
History of injecting drug use	1190 (26.0)	981 (22.8)	209 (72.8)	**<0.001**
Active (last year)[a]	392 (32.9)	322 (32.8)	70 (33.5)	0.852
Sexual behavior (last year), N (%)				
No condom use[a]	896 (20.3)	852 (20.6)	44 (16.5)	0.107

[a] Percentages for these variables are calculated within the relevant subset of participants. **Statistics**: Values are expressed as numbers (percentage) and median (P_{25th}–P_{75th}).Abbreviations: HIV = human immunodeficiency virus; PWoH = people without HIV; PWH = people with HIV; IQR = interquartile range; N = number.

HCV infection and care cascades stratified by HIV status

HCV antibody prevalence was significantly higher in PWH (57.1%, 164/287) compared to PWoH (13.5%, 573/4257) ($P < 0.001$) (Figure 1). Among antibody-positive individuals, confirmatory HCV-RNA testing was completed by 76.8% (126/164) of PWH and 85.0% (487/573) of PWoH ($P = 0.014$). Active HCV infection was found in 45 PWH (35.7%, 45/126) and 207 PWoH (42.5%, 207/487), with an overall active HCV prevalence of 5.5% (252/4582; 95% CI: 4.9-6.2) in the entire cohort. Of these active infections, recurrent viremia (history of prior HCV treatment) accounted for 15.6% (7/45) in PWH and 8.7% (18/207) in PWoH.

Linkage to care was achieved by 97.8% (44/45) of PWH and 95.2% (197/207) of PWoH; treatment initiation among those linked was 88.6% (39/44) and 93.9% (185/197), respectively.

Two complementary analyses were performed (Figure 3). In the step-by-step conditional analysis (Figure 3a), among antibody-positive individuals, PWH were less likely to complete confirmatory RNA testing compared to PWoH (76.8% vs 85.0%; $P = 0.014$). In the cumulative analysis (Figure 3b), active HCV prevalence was three-fold higher in PWH (15.7% vs 4.8%; $P < 0.001$). The proportion of the total screened cohort that ultimately required and initiated therapy was 13.6% (39/287) for PWH and 4.3% (185/4295) for PWoH.

Among participants with active HCV infection (Supplementary Table 2), PWH and PWoH shared similar sociodemographic profiles, differing only in the higher prevalence of lifetime IDU among PWH (88.9%, 40/45 vs 77.3%, 160/207; $P = 0.041$).

Discussion

This study identifies discontinuities in the HIV and HCV care cascades among marginalized populations in Madrid, indicating that current public health strategies are insufficient to contain these syndemics. We documented a high HIV prevalence (6.3%), associated with a history of IDU, with only 5.9% of people newly diagnosed, but 17.0% of diagnosed individuals not receiving ART. The HCV burden was higher, particularly among PWH, where antibody prevalence was fourfold higher than in HIV-negative counterparts. Conversely, the HCV care cascade demonstrated high linkage to care and treatment initiation rates (>88%) among those with confirmed viremia without difference between PWH and PWoH.

The high acceptance of rapid testing (96.6%) validates mobile units as effective tools for case-finding. However, high uptake masked a failure in retention: 17.0% of participants with known HIV were not on ART. This gap aligns with established literature citing substance use, mental illness, and housing insecurity as primary drivers of disengagement [21,22]. While 'seek-test-treat' strategies—such as the ARISTOTLE programme [23,24]— are essential for initial engagement, our results demonstrate that they are insufficient in isolation. To bridge the gap between diagnosis and viral suppression, interventions must transition to integrated care models that provide sustained psychosocial and adherence support [25,26].

Our study (2019-2023) spanned the COVID-19 pandemic, a period that exacerbated structural inequalities and disrupted conventional healthcare. Although we did not quantify its specific impact, these disruptions likely heightened the vulnerability of our cohort. The uninterrupted operation of our mobile unit during this time highlights the resilience of low-threshold, community-based models. Such services are necessary for maintaining continuity of care during public health crises when traditional systems are compromised.

We confirmed a disproportionate HIV prevalence of 6.3%, exceeding the 0.4% national average [1,27]. While consistent with global trends for high-risk groups [1,28], our data reveal that this is predominantly an epidemic of established infection. New diagnoses comprised only 5.9% of the cohort, mirroring national surveillance where these populations account for a minority of incident cases [29].

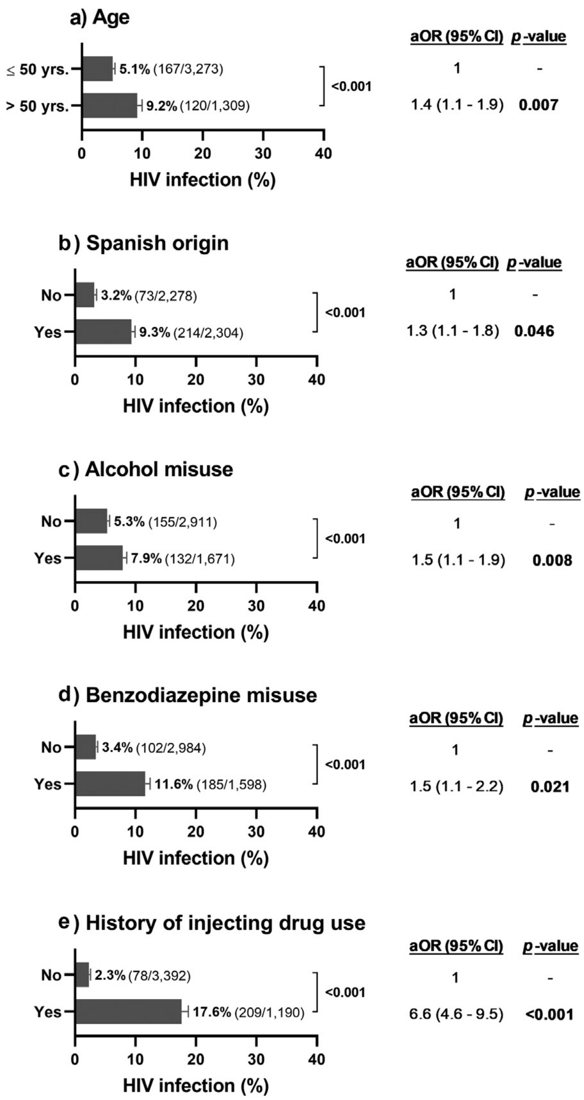

Figure 2. Risk factors for HIV infection and associated prevalence. Bar charts display HIV prevalence (%) stratified by key demographic and behavioral factors. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) were derived from a multivariable logistic regression model. Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; HIV, human immunodeficiency virus; yrs., years.

Although new diagnoses were infrequent, their concentration among younger participants (median age 40 vs 50 years) indicates persistent transmission. The complete absence of PrEP uptake in our cohort represents a prevention failure. This gap likely reflects systemic barriers, including provider stigma and misconceptions regarding candidacy, which exclude high-risk individuals from access [30]. To halt transmission, prevention strategies must integrate PrEP delivery with harm reduction and Treatment as Prevention [31].

Substance use, specifically a history of IDU, remains the primary driver of this epidemic. IDU was the strongest predictor, yielding a six-fold increase in infection odds (aOR=6.6) and moderate discriminatory power (AUC=0.75) [32]. Moreover, significant associations with alcohol and benzodiazepine misuse reflect a syndemic where substance use, mental health challenges, and homelessness intersect to amplify vulnerability [33,34]. Consequently, interventions must move beyond single-substance approaches to address these compounding risks comprehensively.

The association with age >50 and Spanish origin reflects a legacy cohort: long-term survivors of Spain's 1990s heroin epidemic, which was driven by IDU among nationals [29]. Decades later, these individuals face the intersection of aging, multimorbidity, and the sequelae of historical antiretroviral toxicities [35]. This reality demands a shift in care models, moving beyond simple viral suppression to address the complex geriatric and social needs of this survivor population.

We observed a disparity in HCV burden, with PWH exhibiting significantly higher rates of exposure and active infection than PWoH. This persists despite the universal availability of direct-acting antivirals and low national HCV prevalence among PWH [36]. The gap underscores that while shared risk factors—primarily IDU—drive transmission [32], systemic barriers continue to impede HCV cure even among those engaged in routine HIV care.

Provider hesitancy and irregular engagement are established global barriers to HCV elimination [11,12]. Consistent with European data [37], active substance use compromises treatment outcomes and correlates with the elevated recurrent viremia rates observed among PWH with a history of HCV treatment. However, once engaged, linkage and treatment initiation rates were high for both PWH and PWoH. This demonstrates that despite systemic impediments, high uptake is achievable through targeted, low-threshold care models.

HCV elimination is further complicated by evolving transmission dynamics, ranging from the USA opioid crisis [38] to sexually acquired infection among MSM [39]. Addressing this complexity demands more than treatment access; it requires sustained, multifaceted interventions. As evidenced by outcomes in Athens, reducing incidence relies on maintaining high-coverage harm reduction alongside routine testing and rapid linkage [40]. Future research must therefore evaluate the long-term durability of such integrated strategies on retention, viral suppression, and incidence within these underserved populations.

Implications for public health policy and health equity

Our findings support three policy shifts for Spain and similar high-income settings where conventional strategies fail marginalized populations:

i) Scale up low-threshold, integrated models: The 96.6% testing uptake validates mobile units as high-yield investments for reducing health inequities. These services must be institutionalized as core components of national HIV/HCV strategies to engage hard-to-reach groups effectively.
ii) Pivot resource allocation from diagnosis to retention: The 17.0% treatment gap among diagnosed individuals exposes a failure in long-term support. Funding must shift towards integrated care models that address the syndemic drivers of disengagement—substance use, mental health, and homelessness—rather than solely funding case-finding.
iii) Dismantle barriers to PrEP access: The absence of PrEP uptake confirms systemic exclusion. Prevention policies must be reformed to integrate PrEP delivery directly into harm reduction and low-threshold settings, ensuring equitable access for those at highest risk.

Strengths of the study

This study's primary strength lies in the large-scale recruitment (n = 4582) of a hard-to-reach population often excluded from conventional surveillance, providing adequate statistical power for precise prevalence estimates. Furthermore, the comprehensive collection of sociodemographic and behavioral data allowed for a granular analysis of infection drivers beyond basic demographics. Finally, methodological rigor was ensured through standardized testing algorithms, systematic data management (REDCap), and the deployment of specialized personnel, minimizing data entry errors.

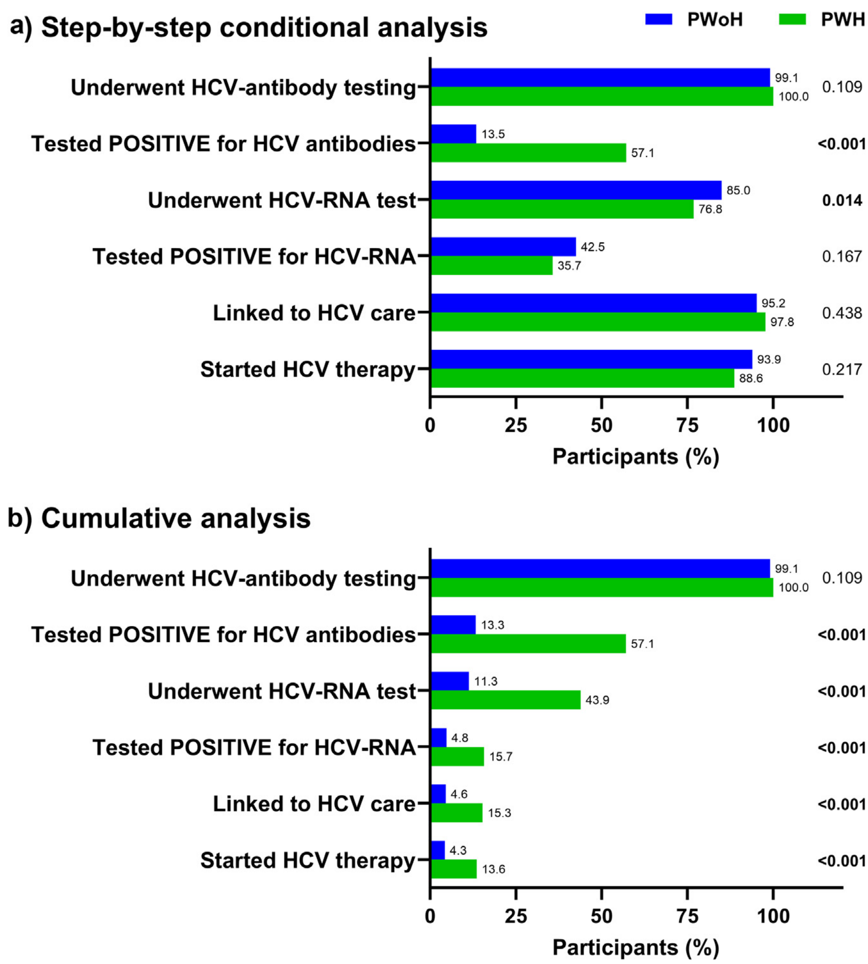

Figure 3. HCV clinical care cascade and population-level programmatic yield stratified by HIV status (PWH vs PWoH). (a) Step-by-step conditional analysis (Clinical Cascade), where percentages represent the proportion progressing from the previous step. (b) Cumulative analysis (Programmatic Yield), where percentages are calculated based on the total initial cohort for each group, reflecting both disease prevalence and cascade attrition. *P*-values were calculated using the Chi-square or Fisher's exact test to compare proportions between groups. Abbreviations: HCV, hepatitis C virus; PWH, people with HIV; PWoH, people without HIV.

Limitations of the study

Several limitations warrant mention. First, the cross-sectional design precludes causal inference and prevents the estimation of HIV incidence. Second, recruitment from specific high-risk hotspots introduces selection bias; thus, results should be interpreted as characteristic of these hard-to-reach networks rather than the broader vulnerable population. Third, reliance on self-reported data introduces recall and social desirability biases; crucially, ART status was not externally verified against medical records. Finally, the lack of long-term follow-up data prevented the assessment of sustained virologic response for HCV treatment. Consequently, without systematic genotype sequencing, we could not reliably differentiate true reinfections from treatment relapses, necessitating the conservative classification of these cases as recurrent viremia.

Conclusion

This study confirms the high prevalence of HIV and HCV coinfection among marginalized populations in Madrid, identifying retention—not diagnosis—as the primary failure of current health strategies. Controlling these syndemics requires a policy shift towards integrated, low-threshold models that address systemic drivers like homelessness and substance use. Ultimately, improving outcomes demands moving beyond case-finding to ensuring sustained, holistic engagement.

Ethical approval

This study received approval from the Research Ethics Committee of the Hospital General Universitario Gregorio Marañón (409/15 and 378/18).

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Funding

This work was supported by grants from Gilead Science (IN-ES-380-6205, IN-ES-987-5391, GLD19_0096 to PR, and GLD20_0144 to SR); Instituto de Salud Carlos III (ISCIII; grant numbers PI20CIII/00004 to SR, PI23CIII/00018 to DSC and IM); AbbVie; Madrid Positivo Association; and CIBER—Consorcio Centro de Investigación Biomédica en Red—(CB 2021), Instituto de Salud Carlos III, Ministerio de Ciencia e Innovación, and Unión Europea—NextGenerationEU (grant number CB21/13/00044 to SR).

DSC is supported by a 'Miguel Servet' contract from ISCIII (CP23CIII/00004).

Author contributions

Conceptualization: PR, JV, and SR.
Data Curation: PR, JV, SM, SE, and GC.
Formal Analysis: DSC and SR.
Funding Acquisition: PR and SR.
Investigation: PR, JV, and SR.
Methodology: PR, JV, and SR.
Project Administration: PR and SR.
Resources: PR, JV, HC, SM, SE, and GC.
Supervision and visualization: PR and SR.
Writing—Original Draft Preparation: DSC, JV, and SR.
Writing—Review and Editing: PR and IM
SR acts as the guarantor of the study. All authors read and approved the final manuscript.

Declaration of competing interest

The authors have no competing interests to declare.

Acknowledgments

The authors acknowledge the use of artificial intelligence (AI) tools, such as Gemini and ChatGPT, for assistance with language editing and for technical help with Stata code syntax. The conceptualization of the statistical analysis and the interpretation of the findings were performed entirely by the authors, who are fully responsible for the content of this paper.

We acknowledge the individuals' participation in this study and the support of the NGO "Madrid Positivo." The authors gratefully acknowledge the collaboration of the following institutions and organizations, without which this project would not have been possible: Madrid Council, Madrid Health Service (SERMAS), Spanish Red Cross, Fundación SEIMC-GESIDA, Ideas for Health Association, Health, Childhood and Social Welfare State Foundation (FCSAI), Archisocial S.L., and Instituto de Salud Carlos III.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijid.2026.108582.

References

[1] *Joint United Nations Programme on HIV/AIDS. UNAIDS DATA 2024*. Geneva, Switzerland: UNAIDS; 2024.
[2] GBD 2021 HIV Collaborators. Global, regional, and national burden of HIV/AIDS, 1990-2021, and forecasts to 2050, for 204 countries and territories: the Global Burden of Disease Study 2021. *Lancet HIV* 2024;**11**:e807–22.
[3] Mody A, Sohn AH, Iwuji C, Tan RKJ, Venter F, Geng EH. HIV epidemiology, prevention, treatment, and implementation strategies for public health. *Lancet* 2024;**403**:471–92.
[4] Rava M, Dominguez-Dominguez L, Bisbal O, Lopez-Cortes LF, Busca C, Antela A, et al. Late presentation for HIV remains a major health issue in Spain: results from a multicenter cohort study, 2004-2018. *PLoS One* 2021;**16**:e0249864.
[5] WHO/ECDC *HIV/AIDS surveillance in Europe 2024 –2023 data*, Copenhagen: WHO Regional Office for Europe; 2024. [accessed 28 November 2024]. https://www.ecdc.europa.eu/sites/default/files/documents/HIV_Surveillance_Report_2024.pdf
[6] Baggaley RF, Irvine MA, Leber W, Cambiano V, Figueroa J, McMullen H, et al. Cost-effectiveness of screening for HIV in primary care: a health economics modelling analysis. *Lancet HIV* 2017;**4**:e465–74.
[7] National AIDS Plan *Strategic Plan for the Prevention and Control of HIV and other Sexually Transmitted Infections in Spain (2021-2030)*. Madrid, Spain: Ministry of Health; 2023.
[8] Waters L, Childs K. Reaching zero: retention in HIV care is critical. *HIV Med* 2023;**24**:955–6.
[9] Ward Z, Simmons R, Fraser H, Trickey A, Kesten J, Gibson A, et al. Impact and cost-effectiveness of scaling up HCV testing and treatment strategies for achieving HCV elimination among people who inject drugs in England: a mathematical modelling study. *Lancet Reg Health Eur* 2025;**49**:101176.
[10] Handanagic S, Shadaker S, Drobeniuc J, Tsereteli M, Alkhazashvili M, Adesigbin C, et al. Lessons learned from global hepatitis C elimination programs. *J Infect Dis* 2024;**229**:S334–41.
[11] Rockstroh JK, Swan T, Chang J, Elamouri F, Lloyd AR. The path to hepatitis C elimination: who are we leaving behind and why? *J Int AIDS Soc* 2023;**26**:e26136.
[12] European Centre for Disease Prevention and Control (ECDC). Public health guidance on HIV, hepatitis B and C testing in the EU/EEA – An integrated approach. Stockholm, Sweden: ECDC; 2018. https://www.ecdc.europa.eu/sites/default/files/documents/hiv-hep-testing-guidance_0.pdf. (Accessed 12 December, 2025).
[13] Valencia J, Vazquez L, Lazarus JV, Cuevas G, Torres-Macho J, Domingorena J, et al. On-site testing and treatment of sexually transmitted infections among female sex workers using molecular point-of-care testing integrated into harm reduction services in Madrid, Spain. *Int J Drug Policy* 2024;**123**:104281.
[14] Beard N, Combined Hill A. Test and treat" campaigns for human immunodeficiency virus, hepatitis B, and hepatitis C: a systematic review to provide evidence to support World Health Organization treatment guidelines. *Open Forum Infect Dis* 2024;**11**:ofad666.
[15] Ryan P, Valencia J, Cuevas G, Amigot-Sanchez R, Martinez I, Lazarus JV, et al. Decrease in active hepatitis C infection among people who use drugs in Madrid, Spain, 2017 to 2023: a retrospective study. *Euro Surveill* 2024;**29**(29):2300712.
[16] Ryan P, Valencia J, Sepulveda-Crespo D, Amigot-Sanchez R, Cuevas G, Lazarus JV, et al. Prevalence of HCV infection among people experiencing homelessness in Madrid, Spain. *JAMA Netw Open* 2024;**7**:e2438657.
[17] Ryan P, Valencia J, Cuevas G, Troya J, Torres-Macho J, Munoz-Gomez MJ, et al. HIV screening and retention in care in people who use drugs in Madrid, Spain: a prospective study. *Infect Dis Poverty* 2021;**10**:111.
[18] Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)–a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009;**42**:377–81.
[19] Tang W, Chen W, Amini A, Boeras D, Falconer J, Kelly H, et al. Diagnostic accuracy of tests to detect Hepatitis C antibody: a meta-analysis and review of the literature. *BMC Infect Dis* 2017;**17**:695.
[20] Iniesta C, Hernando V, Jarrin I, Perez de la Camara S, De la Torre-Lima J, Villanueva V, et al. SIPrEP: a tool to monitor HIV pre-exposure prophylaxis in Spain. *Enferm Infecc Microbiol Clin (Engl Ed)* 2025;**43**:515–22.
[21] Rooks-Peck CR, Adegbite AH, Wichser ME, Ramshaw R, Mullins MM, Higa D, et al. Mental health and retention in HIV care: a systematic review and meta–analysis. *Health Psychol* 2018;**37**:574–85.
[22] Rajabiun S, Davis-Plourde K, Tinsley M, Quinn EK, Borne D, Maskay MH, et al. Pathways to housing stability and viral suppression for people living with HIV/AIDS: findings from the building a medical home for multiply diagnosed HIV-positive homeless populations initiative. *PLoS One* 2020;**15**:e0239190.
[23] Sypsa V, Psichogiou M, Paraskevis D, Nikolopoulos G, Tsiara C, Paraskeva D, et al. Rapid decline in HIV incidence among persons who inject drugs during a fast-track combination prevention program after an HIV outbreak in Athens. *J Infect Dis* 2017;**215**:1496–505.
[24] Hatzakis A, Sypsa V, Paraskevis D, Nikolopoulos G, Tsiara C, Micha K, et al. Design and baseline findings of a large-scale rapid response to an HIV outbreak in people who inject drugs in Athens, Greece: the ARISTOTLE programme. *Addiction* 2015;**110**:1453–67.
[25] Sweitzer S, Giegold M, Chen Y, Farber EW, Sumitani J, Henderson A, et al. The CARES Program: improving viral suppression and retention in care through a comprehensive team-based approach to care for people with HIV and complex psychosocial needs. *AIDS Patient Care STDS* 2023;**37**:416–24.
[26] Valencia J, Troya J, Lazarus JV, Cuevas G, Alvaro-Meca A, Torres-Machado J, et al. Effectiveness of an HIV care model integrated into addiction care based on medication-assisted treatment for HIV-positive people who use drugs. *AIDS Care* 2022;**34**:1297–304.
[27] 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**.
[28] Arum C, Fraser H, Artenie AA, Bivegete S, Trickey A, Alary M, et al. Homelessness, unstable housing, and risk of HIV and hepatitis C virus acquisition among people who inject drugs: a systematic review and meta-analysis. *Lancet Public Health* 2021;**6**:e309–23.
[29] National AIDS Plan. Epidemiological Surveillance of HIV and AIDS in Spain 2023: Information System on New HIV Diagnoses and National Registry of AIDS Cases. Madrid, Spain: Ministry of Health; 2024. (Accessed 12 December, 2025). https://www.sanidad.gob.es/ciudadanos/enfLesiones/enfTransmisibles/sida/vigilancia/docs/Informe_VIH_SIDA_2023_Nov_2024_def.pdf.
[30] Biello KB, Bazzi AR, Vahey S, Harris M, Shaw L, Brody J. Delivering preexposure prophylaxis to people who use drugs and experience homelessness, Boston, MA, 2018-2020. *Am J Public Health* 2021;**111**:1045–8.
[31] Bazzi AR, Shaw LC, Biello KB, Vahey S, Brody JK. Patient and provider perspectives on a novel, low-threshold HIV PrEP program for people who inject drugs experiencing homelessness. *J Gen Intern Med* 2023;**38**:913–21.
[32] Degenhardt L, Peacock A, Colledge S, Leung J, Grebely J, Vickerman P, et al. Global prevalence of injecting drug use and sociodemographic characteristics

and prevalence of HIV, HBV, and HCV in people who inject drugs: a multistage systematic review. *Lancet Glob Health* 2017;**5**:e1192–207.
[33] Votaw VR, Geyer R, Rieselbach MM, McHugh RK. The epidemiology of benzodiazepine misuse: a systematic review. *Drug Alcohol Depend* 2019;**200**:95–114.
[34] Trillo AD, Merchant RC, Baird JR, Ladd GT, Liu T, Nirenberg TD. Interrelationship of alcohol misuse, HIV sexual risk and HIV screening uptake among emergency department patients. *BMC Emerg Med* 2013;**13**:9.
[35] Guaraldi G, Milic J, Mussini C. Aging with HIV. *Curr HIV/AIDS Rep* 2019;**16**:475–81.
[36] Berenguer J, Arcos M, Fanciulli C, Vivancos M, Domingo P, Hernando A, et al. Trends in hepatitis C virus infection prevalence among people with HIV in Spain over 2 decades (2002–2023). *Clin Infect Dis* 2026;**82**(3):e511–20. doi:10.1093/cid/ciaf407.
[37] Thomadakis C, Basoulis D, Tsachouridou O, Protopapas K, Paparizos V, Astriti M, et al. HCV cascade of care in HIV/HCV Co-infected individuals: missed opportunities for micro-elimination. *Viruses* 2024;**16**(6):885.
[38] Ciccarone D. The rise of illicit fentanyls, stimulants and the fourth wave of the opioid overdose crisis. *Curr Opin Psychiatry* 2021;**34**:344–50.
[39] Berenguer J, Gil-Martin A, Jarrin I, Montes ML, Dominguez L, Aldamiz-Echevarria T, et al. Reinfection by hepatitis C virus following effective all-oral direct-acting antiviral drug therapy in HIV/hepatitis C virus coinfected individuals. *AIDS* 2019;**33**:685–9.
[40] Roussos S, Bagos C, Angelopoulos T, Chaikalis S, Cholongitas E, Savvanis S, et al. Incidence of primary hepatitis C infection among people who inject drugs during 2012-2020 in Athens, Greece. *J Viral Hepat* 2024;**31**:466–76.