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Do HIV Care Outcomes Differ by Provider Type?

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Abstract

Background: We compared HIV care outcomes by HIV provider type to inform efforts to strengthen the HIV provider workforce.

Setting: U.S.

Methods: We analyzed data from CDC's Medical Monitoring Project collected during 6/2019-5/2021 from 6,323 adults receiving HIV medical care. Provider types were infectious disease physicians only (ID physicians), non-ID physicians only (non-ID physicians), nurse practitioners only (NPs), physician assistants only (PAs), and ID physicians plus NPs and/or PAs (mixed providers). We measured patient characteristics, social determinants of health (SDOH), and clinical outcomes including retention in care; antiretroviral therapy prescription; antiretroviral therapy adherence; viral suppression; gonorrhea, chlamydia, and syphilis testing; satisfaction with HIV care; and HIV provider trust.

Results: Compared with patients of ID physicians, higher percentages of patients of other provider types had characteristics and SDOH associated with poor health outcomes and received HIV care at Ryan White HIV/AIDS Program-funded facilities. After accounting for these differences, most outcomes were not meaningfully different, however higher percentages of patients of non-ID physicians, NPs, and mixed providers were retained in care (6.5, 5.6, and 12.7 percentage points, respectively) and had STI testing in the past 12 months, if sexually active (6.9, 7.4, and 13.5 percentage points, respectively).

Conclusion: Most HIV outcomes were equivalent across provider types. However, patients of non-ID physicians, NPs, and mixed providers were more likely to be retained in care and have recommended STI testing. Increasing delivery of comprehensive primary care by ID physicians and including primary care providers in ID practices could improve HIV primary care outcomes.

Introduction

The increase in persons with HIV (PWH) who receive diagnoses and are linked to care as a result of the Ending the HIV Epidemic in the U.S. (EHE) initiative[1] will further stress the HIV workforce, which remains in crisis, with a substantial proportion of providers

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dissatisfied with practice or planning to leave the workforce.[2-4] Achieving the goals of the National HIV/AIDS Strategy for the United States 2022-2025 (NHAS)[5] will require increasing the number of infectious disease (ID) physicians, primary care physicians (internal medicine and family medicine), nurse practitioners (NPs), and physician assistants (PAs) who know how to select an ART regimen and recognize and respond to obstacles affecting adherence to ART and retention in care, such as mental health and substance use disorders, structural barriers to care, and internalized HIV-related stigma.[6,7] This will require increases in formal training opportunities and incentives to choose a career in HIV medicine, such as higher compensation for HIV care, reduced administrative burden, and assurance of safe and sustainable caseload.[8] However, it is unclear how various provider types should be prioritized in these rebuilding efforts. A previous survey found that self-reported delivery of recommended HIV care was equivalent across provider types and that NPs were more likely than ID physicians to provide certain services considered key to providing comprehensive HIV care.[8] But differences in key HIV outcomes among patients receiving care from providers of various professions and physician specialties has not been examined in the past two decades. We analyzed representative data from the CDC's Medical Monitoring Project to evaluate differences in HIV outcomes among PWH by the type of providers they saw for HIV care, to inform efforts to strengthen the HIV workforce.

Methods

Design and Data Collection

The Medical Monitoring Project (MMP) is an annual cross-sectional survey designed to produce nationally representative estimates of the behavioral and clinical characteristics of adults with diagnosed HIV in the United States. MMP data collection constitutes routine public health surveillance and was thus determined by the CDC to be nonresearch. This activity was conducted consistent with applicable federal law and CDC policy.[9] When required, participating jurisdictions obtained local institutional review board approval to collect data. All participants provided informed consent.

MMP methods have been described previously.[10] Briefly, MMP uses two-stage sampling in which, during the first stage, 16 states and Puerto Rico, including six separately funded metropolitan areas within selected states—were sampled from all states, the District of Columbia, and Puerto Rico. During the second stage, simple random samples of people with diagnosed HIV aged ≥18 years are drawn annually for each participating area from the National HIV Surveillance System (NHSS), a census of people with diagnosed HIV in the United States. People sampled during the 2019 and 2020 data collection cycles were recruited for a phone or face-to-face interview. Medical records were then abstracted at the facility identified by participants as their most frequent source of HIV care in the previous two years. Abstractions were performed directly from electronic or paper medical records or by reviewing digital or printed copies of medical records delivered to state and local health departments. Data were collected from June of each cycle year until the following May. All outpatient encounters at the usual place if HIV care were abstracted, including those from outside facilities if available in the medical record at the usual place of HIV care. Medical record information included the provider's profession, selected laboratory test

results, and medications prescribed during a 2-year, retrospective observation period ending on the interview date.

All sampled areas and separately funded jurisdictions within states participated in MMP, including California (including Los Angeles County and San Francisco), Delaware, Florida, Georgia, Illinois (including Chicago), Indiana, Michigan, Mississippi, New Jersey, New York (including New York City), North Carolina, Oregon, Pennsylvania (including Philadelphia), Puerto Rico, Texas (including Houston), Virginia, and Washington. At the first stage, the response rate was 100%; at the second stage, response rates for adults with diagnosed HIV were 45% in 2019 and 40% in 2020. During the 2019 and 2020 data collection cycles, 7,304 sampled people were interviewed and had a medical record abstraction (Figure).

Clinicians with prescribing privileges were classified as HIV care providers if they were identified as such by HIV care facility leadership. Medical record documentation of ordering a CD4+ lymphocyte cell (CD4) count or HIV viral load test or prescribing antiretroviral medication did not in itself constitute being an HIV care provider.

Measures

Variables related to demographic characteristics and social determinants of health included gender (male, female, or transgender), sexual orientation (lesbian or gay, heterosexual or straight, bisexual, or other), race/ethnicity (non-Hispanic/Latino Black/African American [Black], Hispanic/Latino of any race, non-Hispanic/Latino White [White], and other race/ethnicities), age group, and educational attainment (less than high school, high school diploma or GED, or more than high school). Measures describing participants' experience during the past 12 months included household income (below the federal poverty level [FPL], ≥100% to <139% FPL, ≥139% FPL to <400% FPL, or ≥400% FPL), unstable housing or homelessness, incarceration, type of health insurance or coverage for antiretroviral medication (any private, public only excluding Ryan White HIV/AIDS Program [RWHAP] assistance [Medicaid, Medicare, Tricare/CHAMPUS and/or Veterans Administration, and other or unknown public insurance], RWHAP/AIDS Drug Assistance Program only, and no insurance or coverage), and ≥1 unmet need for HIV ancillary services (defined as needing but not receiving ≥1 service that supports care and viral suppression among PWH, including those related to HIV support, non-HIV medical care, or subsistence). Participants were asked how well they trusted their HIV provider; responses from the 13-item validated scale were summarized in a score ranging from zero to 52.[11] HIV stigma was measured by the score on a 10-item scale ranging from 0 (no stigma) to 100 (high stigma) that includes 4 dimensions of HIV stigma: personalized stigma during the past 12 months, current disclosure concerns, current negative self-image, and current perceived public attitudes about people living with HIV.[12] Participants were also classified as experiencing discrimination if any of seven questions about discrimination while receiving HIV care at a doctor's office were answered *rarely, most of the time*, or *always*. and whether they were very satisfied with their HIV care (versus somewhat satisfied, somewhat dissatisfied, or very dissatisfied).

All clinical variables, unless otherwise specified, are based on the 12 months prior to the interview. Clinical variables obtained by self-report included heavy alcohol use in the past 30 days,[13] any injection or non-injection drug use (including marijuana), having >1 sexual partner (among sexually active persons), symptoms of moderate or severe anxiety based on the Generalized Anxiety Disorder-7 scale[14] or major or other depression based on the Patient Health Questionnaire-8 scale[15] in the past two weeks, ART adherence in the past 30 days (a three-item scale that ranges from zero to 100, with a score of 100 indicating perfect adherence),[16] no missed appointments for HIV care, any emergency department visit, and any inpatient hospitalization. Clinical variables calculated from the most recent 12 months of medical record data included ART initiation within the past 6 months; ongoing antiretroviral therapy (ART) prescription, including classes of antiretrovirals prescribed; retention in care, defined as ≥2 elements of HIV care (including documented or self-reported outpatient encounters with an HIV care provider, HIV-related laboratory test results, ART prescriptions), at least 90 days apart; number of outpatient encounters with an HIV care provider; geometric mean and lowest CD4+ lymphocyte cell (CD4) count; documentation of HIV resistance mutations during the observation period; advanced (stage-3) HIV; sustained viral suppression, defined as all viral load test results undetectable or <200 copies/mL; and testing for gonorrhea, chlamydia, and syphilis if sexually active. We classified participants by the profession of HIV care providers with whom they had medical encounters in the past 12 months: ID physicians only (referred to as ID physicians); non-ID physicians only (referred to as non-ID physicians); NPs only (referred to as NPs); PAs only (referred to as PAs); or a combination of ID physicians plus NPs and/or PAs (referred to as mixed providers), which combined represented 90% of sampled participants with ≥1 visit with a provider of known type; and other provider combinations, which were not analyzed, including ID and non-ID physicians, non-ID physicians and NPs and/or PAs, and NPs and PAs. We also ascertained whether the facility where patients received HIV care received any RWHAP funding.

Statistical Analysis

Data were weighted based on known probabilities of selection at the state or territory and person levels, adjusted for nonresponse, and post-stratified to known population totals by age, race/ethnicity, and sex from the National HIV Surveillance System. This design allows for reporting of representative estimates among all adults with diagnosed HIV in the United States.[17]

Among 6,323 adults with diagnosed HIV who had ≥1 encounter with an HIV care provider of known type during the past 12 months (87% of sampled participants with a medical record abstraction), we estimated the weighted prevalence and associated 95% confidence intervals (CIs) of demographic and clinical characteristics, social determinants of health, and selected HIV clinical outcomes during the past 12 months, overall and among 5,709 patients who received HIV care from ID physicians, non-ID physicians, NPs, PAs, and mixed providers. We used Rao-Scott chi square tests to assess differences in characteristics and outcomes among PWH who received care from any other provider type or combination of providers for HIV care, compared with patients who received care from ID physicians only. For a selected number of clinical outcomes that are directly affected by HIV care, we

used logistic regression with predicted marginals to estimate prevalence differences (PDs) of HIV clinical outcomes with corresponding 95% CIs and *t*-test *P* values, among PWH who received HIV care from the various provider types compared with ID physicians. For the ART adherence scale and provider trust scale, we estimated differences in mean score. We adjusted models individually for demographic and clinical characteristics, social determinants of health, facility RWHAP funding status, and geographic location, if these variables were associated with provider type and the outcome of interest. Covariates were added to models in a forward stepwise fashion and were retained if inclusion changed the adjusted PD (aPD) point estimate by ≥10%. Covariates included in the final models are listed in the Supplementary Table. We considered aPDs ≥|5| percentage points with CIs that did not cross the null to be meaningful from a public health perspective. *P* values <0.05 were considered statistically significant.

Results

Table 1 displays characteristics and social determinants of health of PWH overall and by the type of providers they saw for HIV care. Compared with patients of ID physicians, patients of non-ID physicians differed by race/ethnicity and educational attainment and were more likely to report discrimination in the HIV care setting. Compared with patients of ID physicians, patients of NPs differed by race/ethnicity, age, poverty level, educational attainment, and health care coverage, and were more likely to have experienced unstable housing or homelessness or recent incarceration and to receive HIV care at a RWHAP-funded facility. They were less likely than patients of ID physicians to have had advanced HIV in the past 12 months. Compared with patients of ID physicians, patients of PAs differed by age, type of health insurance or coverage for antiretroviral medications, and poverty level, were more likely to have been unstably housed or incarcerated, to have used any injection or non-injection drugs in the past 12 months, and to receive HIV care at a RWHAP-funded facility. Compared with patients of ID physicians, patients of mixed providers differed by race/ethnicity, age, poverty level, and type of health insurance or coverage for antiretroviral medications, and were more likely to be unstably housed or incarcerated, to have unmet needs for ancillary services and advanced HIV in the past 12 months, major or other depression in the past two weeks, and to receive HIV care at a RWHAP-funded facility.

Table 2 displays the prevalence of HIV care outcomes during the past 12 months, overall and by the type of provider patients saw for HIV care. PDs assessing differences compared with patients of ID physicians were adjusted for patient characteristics, social determinants of health, and facility RWHAP funding status, according to the criteria described in Methods. There were no meaningful or statistically significant differences between patients of ID physicians and other provider types in ART prescription, sustained viral suppression, satisfaction with HIV care, or trust in providers. However, the prevalence of retention in care was higher among patients of non-ID physicians (aPD, 6.5; 95% CI: 2.7–10.3; P=0.001), NPs (aPD, 5.6; 95% CI: 2.3–8.9, P<0.001) and mixed providers (aPD, 12.7; 95% CI: 9.4–16.0; P<0.001). The prevalence of testing for syphilis, gonorrhea, and chlamydia among sexually active persons was higher among patients of non-ID physicians (aPD, 6.9; 95% CI: (0.8–13.1); P=0.026), NPs (aPD, 7.4; 95% CI: 1.6–13.3; P=0.012), and mixed providers

(aPD, 13.5; 95% CI: 7.6–19.4; P<0.001). The mean antiretroviral adherence score was 1.8 points lower (95% CI: (−3.2–−0.4); P=0.011) for patients of NPs, on a scale of 0–100. Data for additional HIV outcomes are displayed in Appendix Table.

Discussion

Compared with patients of ID physicians, higher percentages of patients of other provider types had characteristics and social determinants of health associated with poor health outcomes. After accounting for these differences, patients of non-ID physicians, NPs, and mixed providers were more likely to be retained in care and have recommended STI testing in the past 12 months, if sexually active. The mean antiretroviral adherence score was 1.8 points lower on a scale of 0-100 for NPs than ID physicians, which was statistically significant, but the magnitude was small and of unknown clinical significance. Other key HIV outcomes, including ART prescription, viral suppression, satisfaction with HIV care, and provider trust, did not differ meaningfully or statistically significantly by provider type.

Studies conducted from 1999-2005 found that more experience caring for patients with HIV, but not provider profession or physician specialty, was associated with delivery of recommended care and favorable clinical outcomes.[18-20] Our study is the first to examine clinical outcomes by provider type using a nationally representative sample of adults with HIV in the U.S.

Our finding that sexually active patients of non-ID physicians, NPs, and mixed providers were more likely than patients of ID physicians to have recommended annual STI testing,[21] after accounting for patient and facility differences, is important, considering surging rates of STIs in the U.S., resulting in increasing health disparities.[22] In addition to this finding, a previous MMP analysis found that NPs were twice as likely as ID physicians to report providing comprehensive sexual behavior-related risk-reduction services.[8]

There are several potential explanations for our finding that patients of ID physicians were less likely than others to be retained in care. It is possible patients of ID physicians on average require less frequent visits than patients of other provider types because of lower medical complexity due to having fewer comorbidities or differing social determinants of health for which we did not control. However, national guidelines recommend a viral load test at least every six months for all PWH.[23] All patients, regardless of level of complexity, who received care consistent with this recommendation would have been classified as retained in care (≥2 elements of HIV care ≥90 days apart in the past 12 months). Therefore, lower levels of complexity would not justify lower retention in care.

Differences in how care is delivered could explain higher retention in care and receipt of recommended STI testing among patients of non-ID physicians, NPs, and mixed providers than among patients of ID physicians. An MMP survey of HIV care providers found that equivalent percentages of ID and non-ID physicians, NPs, and PAs met HIV specialist criteria of the HIV Medicine Association or American Academy of HIV Medicine. However, one-third of ID physicians reported not providing primary care for HIV patients, defined as being the point of first contact, providing comprehensive care, and emphasizing

prevention and coordination of care, compared with one in ten non-ID physicians and NPs and less than 1% of PAs.[8] Another analysis of MMP data found that, among patients who needed HIV case management, those who received care from ID physicians were more likely than patients of NPs to have that need remain unmet, even after accounting for patient differences and the availability of onsite HIV case management services at the HIV care facility (publication pending), suggesting coordination of care may more often be lacking among some patients of ID physicians with complex needs. In addition, a 2014 MMP survey of HIV care providers found that NPs are more likely than ID physicians to provide care for >50 HIV patients and are five times as likely to be full-time HIV care providers,[8] which aligns with previous findings that experience, rather than provider profession, is associated with favorable outcomes.[18-20]

Retention in care and recommended STI testing are dependent on the coordination of care and prevention elements of primary care.[24] ART prescription and viral suppression, which did not differ by provider type, are more reflective of HIV disease-specific care than of primary care. Although 80% of ID physicians report having sufficient time with patients to provide necessary HIV information, only about 40% spend >20 minutes with HIV patients during follow-up visits, compared with two-thirds of NPs and PAs (8). A focused approach to HIV care and treatment by some ID physicians may exclude an emphasis on prevention and coordination of care that primary care physicians, NPs, and PAs routinely address.[25]

Including providers with primary care training and experience in ID medicine practices could lessen differences in primary care outcomes. However, a potential barrier to broadening the HIV provider workforce is high levels of dissatisfaction with administrative burden, time available to provide necessary care, and remuneration among non-ID physician HIV care providers.[8] Also of concern, the percentage of NPs planning to leave HIV practice within five years is triple that of ID physicians,[8] which could have implications for meeting NHAS/EHE goals[1,5] and goals of the STI National Strategic Plan.[26]

Other strategies for ensuring patients of ID physicians receive comprehensive primary care include ongoing training in primary care delivery, multidisciplinary case conferences, and use of decision support to nudge ID physicians to routinely provide recommended preventive care and assess their patients' psychosocial needs.

Unlike patients of NPs, patients of PAs did not differ from patients of ID physicians in retention in care and receipt of recommended STI testing. Although the practice style and training of NPs and PAs has not been rigorously compared, one institution that trains both NPs and PAs noted that PA training uses the medical model, which focuses on treatment of the disease. NPs train on the nursing model, which focuses on treatment of the patient with the disease.[27] This patient-centered approach to treatment provided by NPs might account for the differences in our findings.

Our study had limitations. We recorded medical record information at the patient's usual place of outpatient HIV care, including information from outside facilities, if available. It is possible some patients had tests performed elsewhere that were not available in the medical record of the HIV care provider,[28] resulting in lower estimates of retention

in care and STI testing and potentially biasing our estimates. Regardless, our findings describe whether HIV care providers ensured and documented that their patients received care consistent with guidelines. Second, MMP does not collect information about informal physician consultations by NPs and PAs and its effect on outcomes. Our findings compare outcomes across models of care based on the profession of the provider of record. Some of these models of care might include informal consultation with other HIV specialists. Third, most data on social determinants of health and some data on clinical outcomes, e.g., substance use, depression, and anxiety, were self-reported and could be subject to information bias. Forth, data collection for a portion of the 2019 and the entire 2020 MMP cycle took place during the COVID-19 pandemic, which could have affected our findings. However, the overall proportion of persons linked to HIV care, prescribed antiretroviral therapy, and virally suppressed remained stable from 2019 through 2021.[29] Fifth, MMP data are cross-sectional; therefore, causality is not implied. Sixth, although our models accounted for differences in demographic and clinical characteristics and social determinants of health between patient groups, which increased our ability to identify independent associations between provider type and clinical outcomes, there could be residual confounding. Finally, response rates were suboptimal, but results were adjusted for non-response and post-stratified to known population totals by age, race/ethnicity, and sex from the NHSS using established, standard methodology. Even with suboptimal response rates, there is still value in results obtained from unbiased sampling methods.[30]

Conclusions

Compared with patients of ID physicians, patients receiving HIV care from other provider types were more likely to have characteristics and social determinants of health associated with poor health outcomes and to receive HIV care at RWHAP-funded facilities. After accounting for these differences, most HIV clinical outcomes were equivalent across provider types. However, patients of non-ID physicians, NPs, and mixed providers were more likely to be retained in care and have recommended STI testing in the past 12 months, if sexually active. Strengthening delivery of comprehensive primary care by ID physicians who provide outpatient care for PWH and increasing the role of primary care providers in ID physician practices could help advance the national goal of improving clinical outcomes for PWH.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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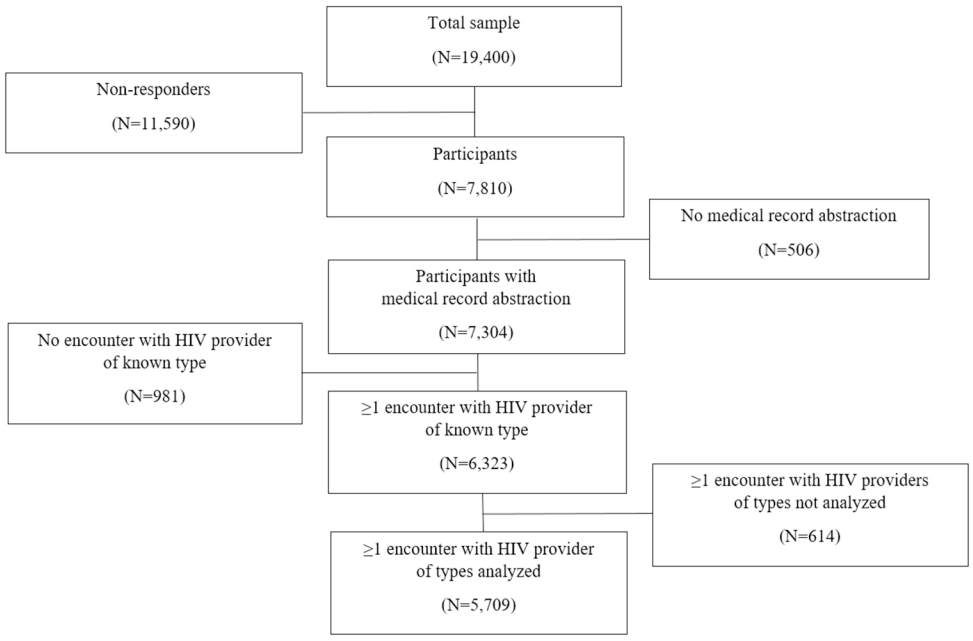

Figure.

Sample disposition for this analysis, Medical Monitoring Project, 2019 and 2020 data collection cycles

Table 1.

Prevalence of Demographic Characteristics, Social Determinants of Health, and Clinical Characteristics of Adults with HIV Who Had Encounters in the Past 12 Months with Infectious Disease (ID) Physicians Only, vs. Other Provider Types—United States, 2019–2021 (N = 6,323).

	Total		ID physicians only		Non-ID physicians only			Nurse practitioners only			Physician assistants only			ID physician and either nurse practitioner or physician assistant			
	No.	Col. % (95% CI)	No.	Col. % (95% CI)	No.	Col. % (95% CI)	P value	No.	Col. % (95% CI)	P value	No.	Col. % (95% CI)	P value	No.	Col. % (95% CI)	P value	Overall P value
Total (row percentages)	6323		2856	47.5 (43.4–51.7)	1099	14.6 (9.1–20.1)		907	16.1 (14.3–18.0)		240	4.2 (3.3–5.0)		607	9.3 (7.9-10.7)		
Gender							0.478			0.355			0.071			0.052	0.059
Male	4619	74.7 (72.5–76.9)	2100	75.8 (73.6–77.9)	854	78.2 (73.6–82.7)		650	73.1 (68.8–77.4)		185	77.2 (70.1–84.2)		421	70.7 (65.8–75.6)		
Female	1566	23.3 (21.1–25.5)	702	22.5 (20.3–24.6)	224	19.9 (15.3–24.5)		239	25.2 (21.1–29.2)		43	18.7 (11.6–25.8)		170	26.4 (22.3–30.6)		
Transgender	131	2.0 (1.6–2.4)	50	1.8 (1.2–2.3)	20	1.9 (1.0–2.8)		18	1.8 (0.8–2.7)		10	4.1* (1.3–7.0)		16	2.9 (1.3–4.5)		
Sexual orientation							0.693			0.221			0.092			0.186	0.179
Lesbian or gay	2708	43.6 (40.6–46.7)	1193	43.8 (40.5–47.0)	536	47.3 (40.3–54.2)		363	40.9 (34.6–47.3)		124	51.6 (42.9–60.3)		232	38.6 (32.9–44.3)		
Heterosexual or straight	2815	44.1 (40.8–47.3)	1306	44.4 (41.2–47.6)	443	42.5 (33.2–51.8)		408	43.9 (39.7–48.2)		84	35.0 (25.8–44.1)		298	49.2 (43.5–54.9)		
Bisexual	532	9.1 (8.1–10.1)	246	9.0 (7.7–10.3)	71	7.4 (5.1–9.7)		95	11.2 (8.5–14.0)		21	10.4 (5.7–15.0)		49	8.7 (6.0–11.5)		
Other sexual orientation	188	3.2 (2.6–3.8)	75	2.8 (2.1–3.5)	26	2.8 (1.3–4.4)		33	3.9 (2.4–5.4)		8	3.0* (0.8–5.2)		20	3.5 (2.0–5.0)		
Race/ethnicity							<0.001			0.001			0.075			0.015	<0.001
Black, non-Hispanic	2530	40.7 (34.3–47.2)	1183	40.4 (34.8–45.9)	215	21.8 (12.7–31.0)		480	53.3 (43.6–63.0)		116	48.8 (40.3–57.3)		289	47.9 (42.5–53.3)		

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	Total		ID physicians only		Non-ID physicians only			Nurse practitioners only			Physician assistants only			ID physician and either nurse practitioner or physician assistant			
	No.	**Col. % (95% CI)**	**No.**	**Col. % (95% CI)**	**No.**	**Col. % (95% CI)**	**P value**	**No.**	**Col. % (95% CI)**	**P value**	**No.**	**Col. % (95% CI)**	**P value**	**No.**	**Col. % (95% CI)**	**P value**	**Overall P value**
Hispanic/Latino	1503	23.7 (17.6–29.7)	548	20.4 (17.6–23.2)	502	46.0 * (26.3–65.7)		132	15.0 (11.5–18.4)		48	20.2 (14.3–26.1)		115	19.3 (15.5–23.2)		
White, non-Hispanic	1901	29.4 (25.4–33.4)	941	32.7 (29.3–36.2)	326	27.3 (15.5–39.2)		241	26.0 (18.4–33.5)		65	25.3 (18.2–32.5)		160	25.6 (21.2–30.0)		
Other	389	6.2 (5.1–7.3)	184	6.5 (4.9–8.2)	56	4.8 (2.7–7.0)		54	5.8 (4.0–7.7)		11	5.7 (2.7–8.6)		43	7.2 (4.7–9.6)		
Age (years)							0.983			<0.001			0.003			0.044	<0.001
18-34	964	16.0 (14.6–17.4)	389	14.1 (12.4–15.8)	132	13.8 (11.6–16.0)		193	20.2 (17.2–23.2)		54	23.4 (18.0–28.8)		98	17.4 (14.0–20.7)		
35-44	1014	17.3 (16.2–18.5)	433	16.2 (14.6–17.9)	160	16.2 (14.1–18.4)		173	20.6 (17.6–23.7)		44	18.8 (13.3–24.4)		99	17.3 (14.2–20.4)		
45-54	1681	26.8 (25.6–28.1)	760	26.6 (24.9–28.3)	291	26.2 (23.7–28.6)		224	27.0 (23.2–30.8)		65	25.7 (17.8–33.5)		178	28.4 (24.7–32.1)		
≥55	2664	39.8 (38.2–41.5)	1274	43.1 (40.8–45.4)	516	43.8 (40.8–46.7)		317	32.1 (28.5–35.8)		77	32.1 (24.9–39.3)		232	37.0 (33.0–41.0)		
Household income with respect to the federal poverty level (FPL)							0.096			<0.001			0.045			0.002	<0.001
<100% FPL	2284	38.8 (36.2–41.4)	960	35.4 (32.8–38.0)	440	44.0 (34.2–53.9)		332	40.6 (36.8–44.5)		65	31.5 (25.3–37.7)		225	40.6 (35.9–45.4)		
≥100% – <139% FPL	703	12.3 (11.5–13.2)	302	11.8 (10.4–13.2)	112	11.2 (8.1–14.4)		111	12.6 (10.3–14.8)		30	16.8 (9.9–23.7)		83	15.4 (12.4–18.5)		
≥139% FPL – <400% FPL	1982	35.2 (33.3–37.1)	924	35.9 (33.9–38.0)	293	30.3 (25.8–34.8)		308	38.4 (34.9–41.9)		89	40.9 (33.6–48.1)		187	33.7 (28.8–38.6)		
≥400% FPL	804	13.7 (12.4–14.9)	418	16.9 (15.2–18.6)	173	14.4 (9.3–19.5)		66	8.4 (5.6–11.2)		31	10.8 (6.5–15.2)		57	10.2 (7.2–13.3)		

	Total		ID physicians only		Non-ID physicians only			Nurse practitioners only			Physician assistants only			ID physician and either nurse practitioner or physician assistant			
	No.	**Col. % (95% CI)**	**No.**	**Col. % (95% CI)**	**No.**	**Col. % (95% CI)**	**P value**	**No.**	**Col. % (95% CI)**	**P value**	**No.**	**Col. % (95% CI)**	**P value**	**No.**	**Col. % (95% CI)**	**P value**	**Overall P value**
Educational attainment							0.013			0.009			0.771			0.313	0.007
Less than high school	1011	15.6 (14.2–17.0)	401	14.1 (12.4–15.7)	186	18.0 (14.6–21.4)		151	15.2 (12.6–17.9)		36	14.8 (10.6–19.1)		107	16.6 (13.3–19.9)		
High school diploma or GED	1612	25.7 (24.4–27.0)	733	25.3 (23.6–27.0)	227	21.9 (19.0–24.7)		272	29.8 (26.9–32.8)		62	26.9 (20.8–33.1)		160	25.8 (21.8–29.9)		
More than high school	3670	58.7 (57.0–60.4)	1706	60.6 (58.6–62.6)	681	60.1 (55.2–65.1)		480	54.9 (51.7–58.2)		141	58.3 (51.4–65.1)		336	57.6 (53.4–61.8)		
Experienced unstable housing or homelessness [†] in the past 12 months	1111	17.4 (16.2–18.6)	430	14.9 (13.5–16.4)	176	15.7 (12.9–18.6)	0.616	194	19.8 (16.7–23.0)	0.011	61	28.4 (20.4–36.5)	<0.001	124	21.7 (17.2–26.3)	0.001	<0.001
Incarcerated >24 hours in the past 12 months	188	3.3 (2.8–3.8)	64	2.2 (1.7–2.8)	27	3.0 (1.8–4.3)	0.224	45	5.4 (3.5–7.4)	<0.001	14	6.4 (3.2–9.6)	<0.001	19	3.9 (2.0–5.9)	0.044	<0.001
Type of health insurance or coverage for antiretroviral medication							0.674			<0.001			0.008			<0.001	<0.001
Any private	2291	37.0 (34.9–39.1)	1087	39.6 (36.9–42.2)	422	35.9 (29.3–42.4)		295	35.1 (31.4–38.9)		101	42.1 (34.7–49.6)		186	30.0 (25.6–34.4)		
Public only (excluding Ryan White/ADAP)	3404	53.2 (50.3–56.1)	1525	52.6 (50.0–55.2)	593	56.1 (47.1–65.0)		473	49.8 (43.6–56.0)		111	45.6 (38.7–52.5)		339	55.2 (50.8–59.6)		
Ryan White/ADAP only	504	9.2 (7.5–11.0)	187	7.5 (5.7–9.2)	65	7.6 (4.2–11.0)		118	14.1 (10.1–18.2)		23	10.7 (6.6–14.8)		68	13.8 (10.2–17.3)		
No insurance or coverage	34	0.6 (0.3–0.9)	11	0.4 * (0.1–0.6)	5	0.5 * (0.0–0.9)		5	1.0 * (0.0–2.1)		4	1.5 * (0.0–3.1)		5	1.0 * (0.0–2.0)		
≥1 unmet need for HIV ancillary services [≠]	2544	41.2 (38.9–43.6)	1102	39.6 (36.8–42.3)	432	39.9 (36.0–43.8)	0.875	410	45.2 (39.5–51.0)	0.053	105	44.5 (37.7–51.3)	0.158	260	44.7 (40.0–49.3)	0.043	0.061

	Total		ID physicians only		Non-ID physicians only			Nurse practitioners only			Physician assistants only			ID physician and either nurse practitioner or physician assistant			
	No.	**Col. % (95% CI)**	**No.**	**Col. % (95% CI)**	**No.**	**Col. % (95% CI)**	**P value**	**No.**	**Col. % (95% CI)**	**P value**	**No.**	**Col. % (95% CI)**	**P value**	**No.**	**Col. % (95% CI)**	**P value**	**Overall P value**
Mean HIV stigma score, past 12 months [§]	6025	35.0 (34.2–35.7)	2719	34.7 (33.6–35.8)	1039	35.1 (33.5–36.7)	0.646[¶]	876	35.9 (34.2–37.5)	0.179[¶]	231	34.5 (31.6–37.4)	0.869[¶]	577	34.8 (31.8–37.7)	0.982[¶]	
Any occurrence of discrimination in HIV care setting, past 12 months [‖]	1277	20.8 (18.7–23.0)	538	20.0 (17.7–22.4)	253	23.6 (20.5–26.8)	0.031	153	16.7 (12.5–20.9)	0.105	41	18.1 (11.7–24.5)	0.570	133	23.7 (19.3–28.1)	0.088	0.017
Advanced (stage 3) HIV in the past 12 months	929	14.5 (13.6–15.4)	427	14.7 (13.3–16.1)	145	13.3 (11.4–15.3)	0.211	103	11.1 (9.2–13.1)	0.008	36	14.1 (9.6–18.6)	0.806	117	19.4 (16.3–22.6)	0.005	<0.001
Geometric mean CD4 count (cells/μL) in past 12 months							0.224			0.111			0.143			0.903	0.240
0-199	420	7.7 (6.9–8.5)	181	7.5 (6.3–8.7)	61	7.0 (5.2–8.8)		60	7.2 (5.5–9.0)		20	8.8 (4.9–12.8)		48	8.4 (5.9–10.9)		
200-349	597	10.4 (9.4–11.4)	288	11.3 (9.8–12.8)	95	9.7 (7.2–12.3)		77	9.0 (7.2–10.7)		13	6.4[*] (2.6–10.2)		68	11.8 (8.8–14.7)		
350-499	915	17.0 (15.8–18.2)	425	18.0 (16.1–19.8)	147	16.1 (13.1–19.0)		128	15.7 (12.9–18.5)		32	14.7 (8.3–21.0)		100	18.2 (14.5–21.9)		
≥500	3631	64.9 (63.5–66.4)	1547	63.2 (60.9–65.5)	670	67.2 (63.6–70.8)		567	68.1 (65.2–71.1)		147	70.1 (62.9–77.3)		342	61.7 (57.5–65.8)		
Heavy alcohol use[**] **in the past 30 days**	320	5.1 (4.4–5.7)	134	4.7 (3.8–5.7)	68	5.6 (3.9–7.3)	0.381	50	5.2 (3.4–7.0)	0.628	19	7.5 (3.8–11.2)	0.116	22	4.8 (2.5–7.1)	0.963	0.574
Any drug use in the past 12 months	2034	32.2 (29.8–34.5)	861	30.5 (27.9–33.2)	376	33.6 (26.4–40.8)	0.428	303	33.1 (28.9–37.3)	0.301	93	37.7 (29.2–46.3)	0.034	181	30.1 (24.6–35.7)	0.892	0.473
Sexually active and non-monogamous in the past 12 months	1569	42.9 (40.2–45.6)	627	40.2 (36.6–43.8)	294	44.0 (37.2–50.7)	0.333	255	46.5 (42.0–50.9)	0.020	81	50.2 (41.0–59.5)	0.024	158	44.3 (38.8–49.8)	0.183	0.090

	Total		ID physicians only		Non-ID physicians only			Nurse practitioners only			Physician assistants only			ID physician and either nurse practitioner or physician assistant			
	No.	Col. % (95% CI)	No.	Col. % (95% CI)	No.	Col. % (95% CI)	P value	No.	Col. % (95% CI)	P value	No.	Col. % (95% CI)	P value	No.	Col. % (95% CI)	P value	Overall P value
Non-monogamous and had condomless sex in the past 12 months	1148	75.3 (72.3–78.3)	447	73.5 (69.6–77.5)	228	77.3 (68.6–86.0)	0.406	191	76.7 (71.0–82.5)	0.401	53	69.4 (59.1–79.7)	0.451	115	78.3 (70.5–86.1)	0.306	0.602
Moderate or severe anxiety in the past 2 weeks ††	882	14.2 (12.6–15.7)	360	12.7 (11.0–14.4)	167	14.8 (11.8–17.9)	0.182	118	13.9 (10.6–17.2)	0.449	33	14.5 (9.7–19.2)	0.438	91	16.0 (12.5–19.5)	0.051	0.345
Major or other depression in the past 2 weeks‡‡	980	15.2 (13.9–16.6)	404	14.1 (12.4–15.7)	182	15.9 (12.7–19.1)	0.262	136	14.6 (12.4–16.9)	0.671	38	14.4 (8.8–20.0)	0.902	103	17.9 (14.6–21.1)	0.029	0.296
Received HIV care at a facility with any RWHAP funding	4417	70.2 (64.5–75.8)	1767	61.4 (54.4–68.5)	719	67.8 (56.1–79.5)	0.329	757	83.3 (77.4–89.2)	<0.001	184	80.7 (72.0–89.5)	0.001	511	83.8 (78.6–89.1)	<0.001	<0.001

Abbreviations: ID, infectious disease; No, number; Col %, weighted column percentage; P value, Rao Scott chi square P value; FPL, federal poverty level; GED, general educational development; ADAP, AIDS Drug Assistance Program; RWHAP, Ryan White HIV/AIDS Program

*Coefficient of variation is ≥0.3, absolute confidence (CI) width is ≥0.30, or absolute CI width is between 0.05 and 0.30 and relative CI width is >130%. Estimate and associated statistical test should be interpreted with caution

†Unstable housing or homelessness defined as experiencing unstable housing (i.e., moving 2 or more times, being evicted, or moving in with others due to financial problems) or homelessness (i.e., living on the street, in a shelter, in a single- room–occupancy hotel, or in a car).

‡Ancillary services are those that support retention in routine HIV medical care and viral suppression, e.g., HIV case management, mental health services, and shelter or housing services. Having ≥1 unmet need for HIV ancillary services was defined as needing but not receiving at least one HIV ancillary service during the past 12 months. The denominator for this measure is all participants who had ≥1 encounter with an HIV care provider of known profession during the 2-year observation period.

§HIV stigma score defined as the weighted mean score on a 10-item scale ranging from 0 (no stigma) to 100 (high stigma) that measures 4 dimensions of HIV stigma: personalized stigma during the past 12 months, current disclosure concerns, current negative self-image, and current perceived public attitudes about people living with HIV (12)

‖Any of seven questions about discrimination while receiving HIV care at a doctor's office were answered *rarely, most of the time*, or *always*.

¶T-test P value for difference in mean scores

**Five or more drinks (for males) or four or more drinks (for females) on the same occasion if the person reported last using any alcohol in the past 30 days

††Responses to the GAD–7 were used to define "mild anxiety," "moderate anxiety," and "severe anxiety" according to criteria from the DSM-IV. "Severe anxiety" was defined as having a score of ≥15; "moderate anxiety" was defined as having a score of 10–14; and "mild anxiety" was defined as having a score of 5–9 (14)

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[##] Responses to the items on PHQ-8 were used to define “major depression” and “other depression” according to criteria from the DSM-IV. “Major depression” was defined as having at least 5 symptoms of depression; “other depression” was defined as having 2–4 symptoms of depression. The PHQ-8 classification “other depression” comprises the DSM-IV categories of dysthymia and depressive disorder, not otherwise specified, which includes minor or subthreshold depression (15)

Table 2.

Differences in Prevalence of HIV Care Outcomes Among Adults with HIV Who Had Encounters in the Past 12 Months with Infectious Disease (ID) Physicians Only, vs. Other Provider Types—United States, 2019–2021 (N = 6,323).

Total		ID physician only		Non-ID physician only				Nurse Practitioner only				Physician Assistant only				ID physician and either nurse practitioner or physician assistant			
No.	**Wt. Col. % (95% CI)**	**No.**	**Wt. Col. % (95% CI)**	**No.**	**Wt. Col. % (95% CI)**	**aPD (vs. ID) (95% CI)**	**P value**	**No.**	**Wt. Col. % (95% CI)**	**aPD (vs. ID) (95% CI)**	**P value**	**No.**	**Wt. Col. % (95% CI)**	**aPD (vs. ID) (95% CI)**	**P value**	**No.**	**Wt. Col. % (95% CI)**	**aPD (vs. ID) (95% CI)**	**Overall P value**
Retained in care (≥2 elements of HIV care ≥90 days apart)[*], past 12 months																			
5627	87.3 (85.6–89.0)	2432	83.1 (80.3–85.8)	998	89.7 (85.8–93.6)	6.5 (2.7-10.3)	0.001	813	88.6 (86.7–90.5)	5.6 (2.3–8.9)	<0.001	208	85.6 (80.9–90.2)	2.8 (−2.5-8.1)	0.292	581	95.8 (94.1–97.5)	12.7 (9.4–16.0)	<0.001
ART prescription, past 12 months																			
6121	96.7 (96.0–97.5)	2764	96.7 (95.6–97.7)	1057	95.7 (94.0–97.5)	−1.0 (−3.0-1.1)	0.348	872	96.1 (94.7–97.5)	−0.7 (−2.2-0.9)	0.393	233	97.4[†] (95.2–99.6)	≠		597	98.5[†] (97.4–99.5)	≠	
Antiretroviral therapy adherence scale, past 30 days[§](mean)																			
6158	91.0 (90.5–91.5)	2774	91.7 (91.1–92.3)	1078	91.2 (90.1–92.2)	−0.6[‖] (−2.0–0.8)	0.407	880	89.7 (88.5–90.9)	−1.8[‖] (−3.2–−0.4)	0.011	234	90.2 (88.2–92.3)	−0.5[‖] (−2.5–1.5)	0.641	594	89.7 (88.2–91.1)	−1.2[‖] (−3.0–0.5)	0.169
Sustained viral suppression, past 12 months [¶]																			
4755	73.2 (69.2–77.2)	2174	74.7 (70.5–78.9)	871	77.3 (73.7–80.8)	2.1 (−2.8–7.0)	0.395	615	65.4 (54.6–76.2)	−7.1 (−15.9-1.8)	0.115	167	68.3 (61.2–75.4)	−4.2 (−11.1-2.7)	0.230	461	74.4 (70.4–78.3)	2.6 (−2.2-7.3)	0.293
STI testing (gonorrhea, chlamydia, and syphilis), among sexually active persons, past 12 months																			
1712	47.3 (44.4–50.2)	614	40.1 (36.9–43.3)	327	49.5 (42.7–56.4)	6.6 (0.1-13.1)	0.044	281	51.5 (46.0–57.0)	6.8 (1.0-12.7))	0.021	75	48.9 (40.0–57.7)	0.0 (−7.4-7.4)	1	211	58.2 (53.0–63.3)	12.9 (7.1-18.6)	<0.001
Very satisfied with HIV care[**]																			
5250	83.8 (82.6–85.1)	2381	84.5 (82.8–86.2)	910	83.4 (80.0–86.8)	0.1 (−4.0-4.2)	0.962	744	83.1 (79.9–86.4)	−0.3 (−4.2-3.6)	0.893	203	86.2[†] (80.6–91.9)	2.8 (−3.2-8.9)	0.358	502	82.9 (79.4–86.4)	−1.3 (−5.2-2.7)	0.530
Provider trust scale[††](mean)																			

Total		ID physician only		Non-ID physician only				Nurse Practitioner only				Physician Assistant only				ID physician and either nurse practitioner or physician assistant			
No.	**Wt. Col. % (95% CI)**	**No.**	**Wt. Col. % (95% CI)**	**No.**	**Wt. Col. % (95% CI)**	**aPD (vs. ID) (95% CI)**	**P value**	**No.**	**Wt. Col. % (95% CI)**	**aPD (vs. ID) (95% CI)**	**P value**	**No.**	**Wt. Col. % (95% CI)**	**aPD (vs. ID) (95% CI)**	**P value**	**No.**	**Wt. Col. % (95% CI)**	**aPD (vs. ID) (95% CI)**	**Overall P value**
5905	48.9 (48.7–49.1)	2679	48.9 (48.6–49.2)	1028	48.7 (48.2–49.3)	0.0‖ (−0.7–0.7)	0.993	853	49.2 (48.7–49.7)	0.4‖ (−0.3–1.0)	0.247	225	49.3 (48.5–50.1)	0.8‖ (−0.2–1.8)	0.126	556	48.9‖ (48.3–49.5)	0.3 (−0.4–0.9)	0.424

Abbreviations: ID, infectious disease; No, number; Col %, weighted column percentage; aPD, adjusted prevalence difference; STI, sexually transmitted infection

*Elements of HIV care include outpatient encounters with an HIV care provider and laboratory tests including CD4 count, HIV viral load, genotype, phenotype, and tropism assay.

†Coefficient of variation is ≥0.3, absolute confidence (CI) width is ≥0.30, or absolute CI width is between 0.05 and 0.30 and relative CI width is >130%. Estimate and associated statistical test should be interpreted with caution

‡Sample size was too small to model

§Measured with a three-item scale that ranges from zero to 100, with a score of 100 indicating perfect adherence (1)

‖Adjusted difference in mean score

¶All HIV RNA test results undetectable or <200 copies/mL

**Participants indicated they were very satisfied with their HIV care (versus somewhat satisfied, somewhat dissatisfied, or very dissatisfied)

††Measured using a 13-item scale with a score that ranges from zero to 52, with 52 indicating complete trust

Note: Covariates included in each model are listed in the supplementary table.