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MAJOR ARTICLE

Receipt of Baseline Laboratory Testing Recommended by the HIV Medicine Association for People Initiating HIV Care, United States, 2015–2019

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Background. The HIV Medicine Association of the Infectious Disease Society of America publishes Primary Care Guidance for Persons with Human Immunodeficiency Virus. We assessed receipt of recommended baseline tests among newly diagnosed patients initiating HIV care.

Methods. The Medical Monitoring Project is a Centers for Disease Control and Prevention survey designed to produce nationally representative estimates of behavioral and clinical characteristics of adults with diagnosed HIV in the United States. We analyzed data for 725 participants in the 2015–2019 data collection cycles who received an HIV diagnosis within the past 2 years and had ≥1 HIV provider visit. We estimated the prevalence of having recommended tests after the first HIV provider visit and between 3 months before and 3/6 months after the first HIV provider visit and estimated prevalence differences of having 4 combinations of tests by sociodemographic and clinical characteristics.

Results. Within 6 months of care initiation, HIV monitoring tests were performed for 91.3% (95% CI, 88.7%–93.8%) of patients; coinfection blood tests, 27.5% (95% CI, 22.5%–32.4%); site-based STI tests, 59.7% (95% CI, 55.4%–63.9%); and blood chemistry and hematology tests, 50.8% (95% CI, 45.8%–55.8%). Patients who were younger, gay, or bisexual were more likely to receive site-based STI tests, and patients receiving care at Ryan White HIV/AIDS Program (RWHAP)–funded facilities were more likely than patients at non-RWHAP-funded facilities to receive all test combinations.

Conclusions. Receipt of recommended baseline tests among patients initiating HIV care was suboptimal but was more likely among patients at RWHAP-funded facilities. Embedding clinical decision support in HIV provider workflow could increase recommended baseline testing.

Keywords. HIV Medicine Association; guidelines; baseline laboratory testing; HIV; provider.

In 2020, the HIV Medicine Association (HIVMA) of the Infectious Disease Society of America updated its Primary Care Guidance for Persons with Human Immunodeficiency Virus [1]. The recommendations include baseline laboratory testing as part of the initial evaluation of persons with HIV (PWH), including HIV-specific monitoring tests and tests for identification and prevention of infectious, metabolic, renal, hepatic, and hematologic comorbidities or complications. The recommendations are essentially unchanged from previous HIVMA guidance, last updated in 2013 [2], and closely align with other national guidelines, including Antiretroviral Drugs for Treatment and Prevention of HIV Infection in Adults: 2020 Recommendations of the International Antiviral Society-USA Panel [3], Guidelines for the Use of Antiretroviral Agents in Adults and Adolescents with HIV, US Department of Health and Human Services [4], Sexually Transmitted Infections Treatment Guidelines from the Centers for Disease Control and Prevention (CDC) [5], and Guidelines for the Prevention and Treatment of Opportunistic Infections in Adults and Adolescents with HIV: Recommendations from the CDC, the National Institutes of Health, and HIVMA [6].

Achieving the goal of the National HIV/AIDS Strategy to improve HIV-related health outcomes among PWH [7] requires adoption of these recommendations by health care providers. However, little is known about receipt of recommended baseline laboratory testing among PWH initiating HIV care. To address this knowledge gap, we analyzed data from the Medical Monitoring Project (MMP)—a CDC HIV surveillance system.

METHODS

Design and Data Collection

The MMP is an annual cross-sectional survey designed to produce nationally representative estimates of the behavioral and

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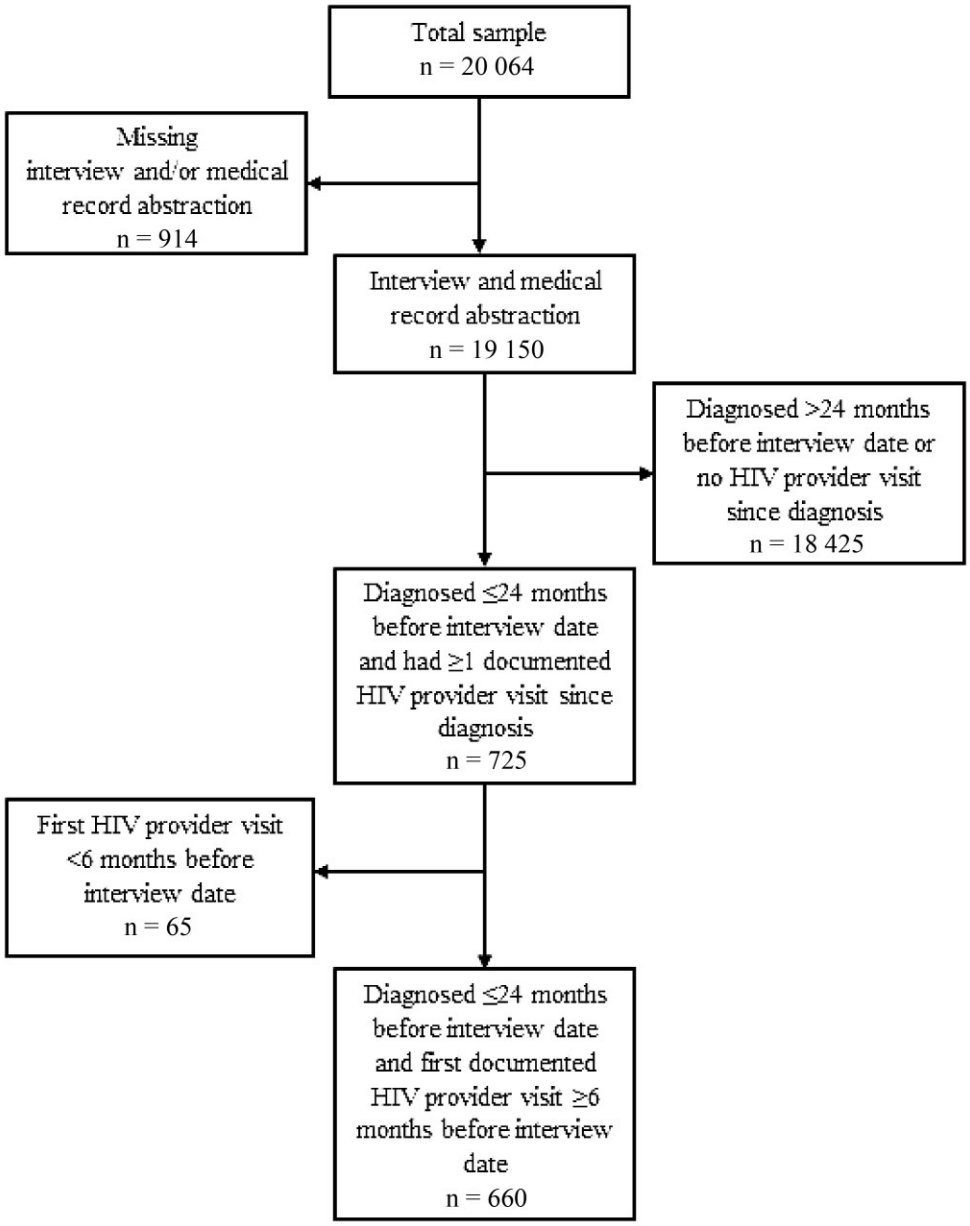

Figure 1. Sample flowchart.

clinical characteristics of adults with diagnosed HIV in the United States. This analysis presents estimates of adults drawn from this sample who were diagnosed with HIV within the past 2 years and initiated HIV care since diagnosis. 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 [8]. When required, participating states or territories obtained local institutional review board approval to collect data. All participants provided informed consent.

The MMP uses 2-stage sampling in which, during the first stage, 16 states and 1 territory—including 6 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 were drawn annually for each participating area from the National HIV Surveillance System, a census of people with diagnosed HIV in the United States. People sampled during the 2015–2019 data collection cycles were recruited for a phone or face-to-face interview and medical record abstraction at their self-reported most frequent source of HIV medical care. 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

Table 1. Characteristics of Adults who Were Diagnosed With HIV Within 24 Months and Received HIV Care Since Diagnosis, United States, 2015–2019 MMP Data Collection Cycles (n = 725)[a]

	No.[b]	Weighted Col %[c] (95% CI)
Gender		
Male	560	78.8 (75.3–82.3)
Female	151	19.0 (15.7–22.4)
Transgender[d]	13	2.1 (0.9–3.4)
Sexual orientation		
Gay or lesbian	304	43.3 (39.0–47.5)
Heterosexual or straight	290	39.7 (35.5–43.8)
Bisexual	92	13.4 (10.6–16.2)
Other sexual orientation	24	3.6 (2.0–5.2)
Race/ethnicity[e]		
Black/African American	344	47.0 (40.9–53.2)
Hispanic/Latino	177	25.7 (20.6–30.8)
White	148	19.4 (15.8–22.9)
Multiple races	42	5.7 (3.8–7.6)
Other (including Asian, American Indian/ Alaska Native, Native Hawaiian/other Pacific Islander)	14	2.2 (1.0–3.5)
Age at time of interview, y		
18–24	102	14.1 (10.6–17.6)
25–34	262	38.5 (34.3–42.7)
35–44	169	22.6 (19.1–26.1)
45–54	116	14.8 (11.8–17.7)
≥55	76	10.0 (7.5–12.5)
Education		
Less than high school	109	15.7 (12.7–18.8)
High school diploma or GED	204	28.7 (24.4–32.9)
More than high school	402	55.6 (51.3–59.9)
Homeless at any time in past 12 mo[f]		
Yes	111	15.8 (12.9–18.7)
No	604	84.2 (81.3–87.1)
Incarcerated >24 h in past 12 mo		
Yes	49	7.1 (4.9–9.2)
No	665	92.9 (90.8–95.1)
Health insurance or coverage for medical care or medications		
Yes	701	99.0 (98.3–99.8)
No	[g]	[g]
Type of health insurance or coverage for medical care or medications[h]		
Ryan White HIV/AIDS Program		
Yes	350	49.7 (45.7–53.7)
No	342	50.3 (46.3–54.3)
Medicaid		
Yes	305	41.7 (37.3–46.0)
No	390	58.3 (54.0–62.7)
Private health insurance		
Yes	242	35.7 (31.5–39.9)
No	453	64.3 (60.1–68.5)
Medicare		
Yes	63	8.0 (5.8–10.2)
No	626	92.0 (89.8–94.2)
Other public insurance		
Yes	89	11.3 (7.5–15.1)
No	606	88.7 (84.9–92.5)
Tricare/CHAMPUS or Veterans Administration		
Yes	13	2.2 (0.9–3.5)
No	678	97.8 (96.5–99.1)
Insurance type unknown[i]		
Yes	[g]	[g]
No	685	99.5 (98.9–100.0)
Household poverty[j]		
Above poverty threshold	356	55.5 (50.6–60.3)
At or below poverty threshold	295	44.5 (39.7–49.4)
Received HIV medical care within 30 d of testing positive (2018–2019 cycles only)		
Yes	235	92.9 (89.7–96.2)
No	17	7.1 (3.8–10.3)
Stage 3 disease in past 24 mo		
Yes	236	30.7 (27.3–34.0)
No	489	69.3 (66.0–72.7)
Geometric mean CD4 count in past 24 mo, cells/μL		
0–199	117	15.8 (12.9–18.6)
200–349	112	15.1 (12.3–17.8)
350–499	150	20.4 (17.1–23.7)
≥500	330	48.8 (44.5–53.2)
Lowest CD4 count in past 24 mo, cells/μL		
0–49	72	9.4 (7.1–11.8)
50–199	113	15.1 (12.0–18.2)
200–349	167	23.2 (20.1–26.3)
350–499	169	22.8 (19.3–26.2)
≥500	190	29.5 (25.3–33.7)
Length of time from first visit with an HIV care provider to end of observation		
<1 mo	[g]	[g]
1 to <3 mo	15	2.1 (1.0–3.1)
3 to <6 mo	45	6.1 (4.4–7.9)
6 to <12 mo	205	26.8 (22.8–30.7)
12 to 24 mo	455	64.2 (60.0–68.4)
Prescription for antiretroviral therapy, by time from first visit with an HIV care provider to end of observation (row percentages)[k]		
<1 mo	[g]	[g]
1 to <3 mo	[g]	[g]
3 to <6 mo	43	93.0 (82.7–100.0)
6 to <12 mo	199	97.0 (94.5–99.6)
12 to 24 mo	441	95.8 (93.0–98.7)
Total	699	95.5 (93.3–97.7)
No missed doses of antiretroviral therapy, past 30 d (self-reported among persons taking antiretroviral therapy)		
Yes	403	59.0 (55.0–63.0)
No	269	41.0 (37.0–45.0)
Viral suppression		
Most recent viral load documented undetectable or <200 copies/mL	585	77.5 (73.7–81.3)
Most recent viral load ≥200 copies/mL or missing/unknown[l]	140	22.5 (18.7–26.3)
Any alcohol use in the past 30 d		
Yes	426	62.1 (58.3–65.9)
No	282	37.9 (34.1–41.7)
Heavy drinking in the past 30 d[m]		
Yes	48	6.1 (4.3–7.9)
No	656	93.9 (92.1–95.7)

Table 1. Continued

	No.[b]	Weighted Col %[c] (95% CI)
Binge drinking in the past 30 d[n]		
Yes	156	22.0 (18.9–25.0)
No	552	78.0 (75.0–81.1)
Any drug use in the past 12 mo		
Yes	291	40.1 (36.0–44.2)
No	418	59.9 (55.8–64.0)
Noninjection drug use in the past 12 mo		
Yes	287	39.7 (35.6–43.8)
No	422	60.3 (56.2–64.4)
Injection drug use in the past 12 mo		
Yes	29	3.7 (2.3–5.1)
No	682	96.3 (94.9–97.7)

Abbreviations: No., sample number; CHAMPUS, Civilian Health and Medical Program of the Uniformed Services; Col, column; GED, general educational development.

[a]Restricted to participants who first received a positive HIV test result ≤24 mo before the end of observation (interview date), had a medical record abstraction, and had a valid date of first HIV care.

[b]Sample numbers are unweighted. Numbers might not add to total because of missing data. Percentages might not sum to 100 because of rounding.

[c]Percentages are weighted percentages.

[d]Patients were classified as transgender if sex at birth and gender reported by the patient were different or if the patient chose transgender in response to the question about self-identified gender.

[e]Hispanic or Latino persons may be of any race. Patients are classified in only 1 race/ethnicity category.

[f]Living on the street, in a shelter, in a single-room occupancy hotel, or in a car.

[g]Data not presented because coefficient of variation was ≥0.30, the absolute CI width was ≥0.30, or the absolute CI width was between 0.05 and 0.30 (ie, 0.05–0.30) and the relative CI width was >130%.

[h]Patients could select >1 response for health insurance or coverage for antiretroviral medications.

[i]Unknown insurance type means that the patient reported insurance or coverage for care or medications, but the type of insurance or coverage could not be determined.

[j]Poverty guidelines as defined by the Department of Health and Human Services (HHS); the 2014 guidelines were used for patients interviewed during the 2015 cycle, and the 2015 guidelines were used for patients interviewed during the 2016 cycle, etc. More information regarding the HHS poverty guidelines can be found at https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines/frequently-asked-questions-related-poverty-guidelines-poverty.

[k]The denominator for each category is the number of participants in each category of time from first HIV care visit until the end of observation: for 3 to ≤6 mo, 53; for 6 to ≤12 mo, 205; for 12 to ≤24 mo, 455.

[l]Approximately 14% missing and 8% >200 copies/mL.

[m]For men, heavy drinking was defined as consuming an average of >2 drinks per day or >14 drinks per week. For women, heavy drinking was defined as consuming an average of >1 drink per day or >7 drinks per week (https://www.cdc.gov/alcohol/faqs.htm).

[n]Defined as ≥5 alcohol drinks in 1 sitting for men, ≥4 alcohol drinks in 1 sitting for women.

health departments. Data were collected from June of each cycle year until the following May. Medical record data included selected laboratory test results and all outpatient encounters with providers (defined as clinicians with prescribing privileges in their jurisdiction), inpatient hospitalizations, and diagnoses recorded in medical records during a 2-year, retrospective observation period ending on the interview date (end of observation period). For the 2015–2019 data collection cycles, this period spanned June 2013–May 2020.

All sampled areas and separately funded jurisdictions within states participated in the 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. Annual response rates for adults with diagnosed HIV ranged from 40% to 45%. During the 2015–2019 data collection cycles, 19 150 sampled people were interviewed and had a medical record abstraction (Figure 1).

The analytic data set included 725 participants who reported receiving a positive HIV test result ≤24 months before the end of observation and had ≥1 visit with an HIV care provider recorded in the medical record since diagnosis. Clinicians were classified as HIV care providers if identified as such by the HIV care facility. 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. We identified 660 participants with ≥6 months between their first visit with an HIV care provider and the end of observation and measured the percentage who had selected tests after HIV diagnosis and between 3 months before and 3/6 months after their first HIV provider visit.

Variables

Sociodemographic variables included gender, race/ethnicity (non-Hispanic/Latino American Indian/Alaska Native, Asian, Black, Native Hawaiian/other Pacific Islander, White, or multiracial, and Hispanic/Latino of any race), age group, sexual orientation, educational attainment, homelessness or incarceration in the past 12 months, and health insurance or coverage type during the past 12 months (Ryan White HIV/AIDS Program [RWHAP] assistance [9], Medicaid, private health insurance, Medicare, other public insurance, Tricare/Civilian Health and Medical Program of the Uniformed Services and/or Veterans Administration, unknown), and household income above or below the federal poverty threshold during the past 12 months.

Laboratory variables included CD4 count, HIV viral load, HIV genotype, serologic or virologic hepatitis C test, hepatitis B serology panel (hepatitis B surface antigen, hepatitis B core antibody, and hepatitis B surface antibody), treponemal or nontreponemal serologic test for syphilis, gonorrhea and chlamydia tests from any anatomic site, trichomonas test for people reporting receptive vaginal sex in the past 12 months, anal cytology screening for people reporting receptive anal sex in the past 12 months or having a documented diagnosis of an abnormal cervical Pap test or anal condyloma, tuberculosis testing for people without a documented history of latent or active tuberculosis (purified-protein derivative or interferon-gamma release assay), lipid panel (total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and triglycerides), blood glucose or hemoglobin A1c, serum creatinine, liver function panel (aspartate aminotransferase,

Table 2. Receipt of Recommended Baseline Laboratory Tests Performed After HIV Diagnosis and Between 3 Months Before and 3/6 Months After First HIV Provider Visit, United States, 2015–2019 (n = 660)[a]

Test Performed	Tested Since Date of First HIV Diagnosis and Within 3 Months Before the First HIV Provider Visit			
	Within 3 Months After First HIV Care		Within 6 Months After First HIV Care	
	No.[b]	Weighted %[c] (95% CI)	No.[b]	Weighted %[c] (95% CI)
CD4+ T-lymphocyte cell count	589	89.1 (86.0–92.3)	621	94.0 (91.8–96.2)
HIV viral load	580	88.1 (85.1–91.1)	613	92.7 (90.3–95.0)
HIV genotype	269	40.5 (35.9–45.1)	273	41.0 (36.4–45.7)
Hepatitis C[d]	391	58.2 (53.3–63.2)	411	61.2 (56.5–65.8)
HBV serology tests (surface antibody)	355	53.3 (48.1–58.5)	375	55.9 (50.5–61.2)
HBV serology tests (surface antigen)	337	50.3 (44.9–55.7)	354	52.4 (47.0–57.9)
HBV serology tests (core antibody)	275	41.7 (36.9–46.4)	290	43.5 (38.8–48.2)
Hepatitis B panel[e] (all 3 tests)	215	32.5 (27.5–37.5)	223	33.5 (28.5–38.5)
Hepatitis B panel (any of 3 tests)	407	60.6 (55.6–65.6)	432	63.9 (58.8–69.0)
Syphilis[f]	453	68.3 (64.0–72.5)	494	74.7 (70.7–78.7)
Gonorrhea[g]	369	54.2 (50.2–58.3)	410	60.2 (55.9–64.5)
Chlamydia[g]	372	55.0 (50.9–59.0)	411	60.6 (56.4–64.8)
Trichomonas (among persons who had receptive vaginal sex in the past 12 mo)[h]	i	i	12	12.0 (5.2–18.9)
Anal cancer screening (among people reporting receptive anal sex in the past 12 mo or a diagnosis of abnormal cervical Pap or anogenital warts)	i	i	i	i
Tuberculosis[j]	292	43.7 (39.3–48.1)	319	47.9 (43.3–52.4)
Toxoplasma antibody	212	31.9 (27.6–36.3)	218	32.8 (28.4–37.2)
Lipid panel[k]	339	50.8 (45.5–56.1)	391	58.9 (54.1–63.6)
Glucose or hemoglobin A1C	568	87.4 (84.3–90.4)	606	92.0 (89.6–94.4)
Serum creatinine	577	88.9 (86.1–91.6)	615	93.5 (91.4–95.6)
Liver function test panel[l]	554	84.9 (81.3–88.4)	595	90.3 (87.6–93.0)
Serum albumin	553	85.2 (81.8–88.5)	596	90.5 (87.8–93.1)
Urine protein	271	42.1 (37.8–46.3)	304	46.2 (41.8–50.6)
Complete blood count[m]	520	78.6 (75.0–82.2)	550	82.2 (78.8–85.5)
Test groups				
HIV monitoring tests (viral load and CD4)	562	85.3 (81.9–88.7)	603	91.3 (88.7–93.8)
Serologic tests for coinfections (hepatitis B panel, hepatitis C, and syphilis)	167	26.1 (21.1–31.1)	178	27.5 (22.5–32.4)
Site-based STI testing (gonorrhea and chlamydia)	365	53.8 (49.7–57.9)	405	59.7 (55.4–63.9)
Blood chemistry and hematology tests (lipids, glucose or hemoglobin A1C, creatinine, liver function test panel, albumin, and complete blood count)	289	43.1 (37.7–48.5)	343	50.8 (45.8–55.8)

Abbreviations: ART, antiretroviral therapy; CD4, CD4 T-lymphocyte count; HBV, hepatitis B virus; HCV, hepatitis C virus; MAC, *Mycobacterium avium* complex; PCP, *Pneumocystis pneumonia.*

[a]Restricted to participants who first received a positive HIV test result ≤24 mo before the end of observation (interview date), who had a medical record abstraction, a valid date of first HIV care, and date of first HIV care visit ≥6 mo before the end of observation.

[b]Numbers are unweighted.

[c]Percentages are weighted percentages.

[d]Any of the following tests was performed: hepatitis C antibody or hepatitis C qualitative or quantitative RNA.

[e]All of the following were performed: hepatitis B surface antigen, hepatitis B surface antibody, hepatitis B core antibody.

[f]Any syphilis test was performed including VDRL, RPR, FTA-Ab, TP-TA, MHA-TP, TPHA, EIA, CIA, dark field, PCR, or unspecified treponemal antibody.

[g]Any test was performed including culture, DFA, DNA probe, EIA, gram stain, NAAT, or nucleic hybridization (probe) test from any source including anorectal, cervical, lymph node, ocular, pharynx, urine, urethra, or vagina.

[h]No. of participants with birth gender female = 137. Test type could include culture, DNA probe, EIA, immunochromatography, microscopy, NAAT, nucleic hybridization (probe) test, PCR, TMA, or wet mount. Source could be anorectal, cervical, urethral, urine, or vaginal.

[i]Data not presented because coefficient of variation was ≥0.30, the absolute CI width was ≥0.30, or the absolute CI width was between 0.05 and 0.30 (ie, 0.05–0.30) and the relative CI width was >130%.

[j]No. of participants without a history of tuberculosis = 659. Participants with a diagnosis of active or latent tuberculosis in the medical record were excluded. Test type could include purified protein derivative or interferon-gamma release assay.

[k]Total cholesterol, high-density cholesterol, low-density cholesterol, triglycerides.

[l]Aspartate aminotransferase, alanine aminotransferase, and total bilirubin.

[m]Hemoglobin, total white blood cell count, absolute neutrophil count, and platelet count.

alanine aminotransferase, and total bilirubin), serum albumin, urine protein, and complete blood count (hemoglobin, white blood count, neutrophil count, and platelet count).

Clinical variables obtained by self-report included whether participants received HIV medical care within 30 days of testing positive, as well as number of missed antiretroviral therapy

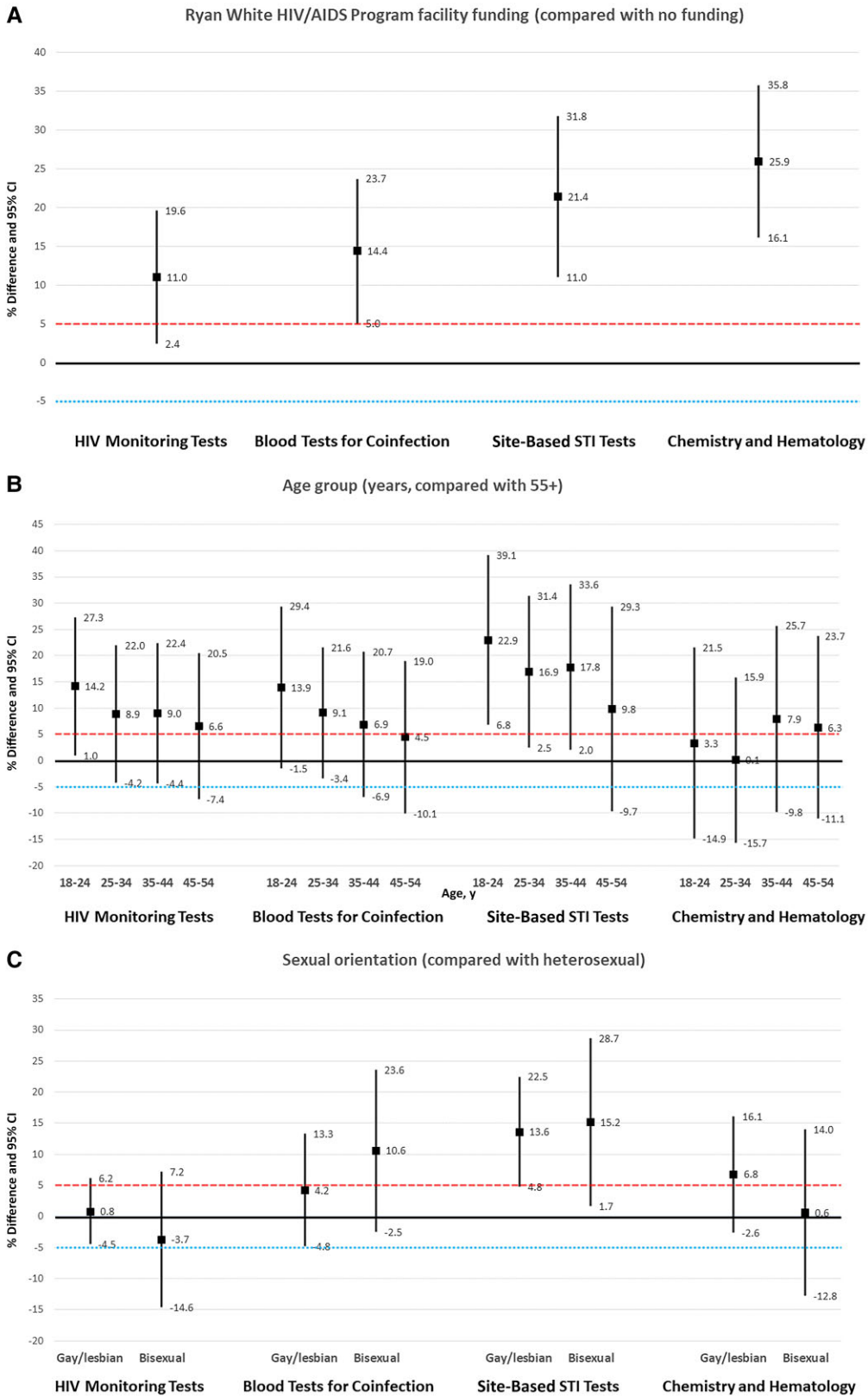

Figure 2. Prevalence differences with 95% CIs of receiving 4 groups of tests by selected patient characteristics. The solid black horizontal line represents no difference. The dashed red line represents a meaningful positive difference, and the dashed blue line represents a meaningful negative difference. A, RWHAP funding of the facility where patients received most of their HIV care, adjusted for age and race/ethnicity (reference is no RWHAP funding). B, Age group (reference is age ≥55 years). C, Sexual orientation (reference is heterosexual). Abbreviations: RWHAP, Ryan White HIV/AIDS Program; STI, sexually transmitted infection.

Table 3. Receipt of a Combination of Recommended Initial HIV Monitoring Tests (CD4 and Viral Load)[a] Performed After HIV Diagnosis and Between 3 Months Before and 6 Months After First HIV Provider Visit, by Sociodemographic Characteristic, United States, 2015–2019 (n = 660)[b]

	No.	Weighted %[c] (95% CI)	Rao Scott Chi-square *P* Value	Prevalence Difference (95% CI)	*P* Value for Prevalence Difference
Gender			.551		
Male	471	91.7 (88.7–94.7)		Reference	
Female	120	90.5 (85.2–95.8)		−1.2 (−7.0 to 4.6)	.690
Transgender[d]	[e]	[e]		[e]	[e]
Sexual orientation			.742		
Gay or lesbian	259	92.3 (89.0–95.7)		0.8 (−4.5 to 6.2)	.758
Heterosexual or straight	237	91.5 (87.3–95.7)		Reference	
Bisexual	79	87.8 (78.0–97.6)		−3.7 (−14.6 to 7.2)	.505
Other sexual orientation	19	90.0 (76.8–100.0)		−1.5 (−15.8 to 12.8)	.841
Race/ethnicity					
White, non-Hispanic	121	88.5 (80.4–96.5)		Reference	
Black, non-Hispanic	282	92.7 (89.7–95.7)		4.2 (−4.3 to 12.8)	.332
Hispanic or Latino[f]	152	91.8 (87.3–96.2)		3.3 (−5.9 to 12.4)	.483
Other (including Asian, American Indian/Alaska Native, Native Hawaiian/other Pacific Islander)	[e]	[e]		[e]	[e]
Multiracial	34	83.5 (70.9–96.2)		−5.0 (−20.3 to 10.3)	.525
Age at time of interview, y Total			.049		
18–24	87	97.0 (93.8–100.0)		14.2 (1.0–27.3)	.035
25–34	228	91.8 (88.2–95.3)		8.9 (−4.2 to 22.0)	.182
35–44	131	91.9 (88.0–95.7)		9.0 (−4.4 to 22.4)	.186
45–54	96	89.4 (83.2–95.7)		6.6 (−7.4 to 20.5)	.356
55+	61	82.9 (70.1–95.6)		Reference	
Age at time of interview, y RWHAP-funded facility					
18–24	76	97.8 (95.1–100.0)		5.9 (−4.6 to 16.3)	.275
25–34	178	94.1 (90.9–97.3)		2.1 (−8.5 to 12.7)	.699
35–44	107	92.0 (87.9–96.0)		0.0 (−11.0 to 10.9)	.997
45–54	73	92.4 (86.1–98.8)		0.5 (−11.6 to 12.5)	.941
55+	46	92.0 (81.8–100.0)		Reference	
Age at time of interview, y Non-RWHAP-funded facility					
18–24	11	91.0 (74.3–100.0)		25.5 (−10.8 to 61.8)	.169
25–34	48	84.0 (71.3–96.8)		18.5 (−16.0 to 53.0)	.294
35–44	22	91.2 (80.5–100.0)		25.7 (−9.3 to 60.7)	.150
45–54	[e]	[e]		[e]	[e]
55+	[e]	[e]		Reference	
Education			.998		
Less than high school	90	91.2 (83.5–98.9)		−0.2 (−8.7 to 8.3)	.963
High school diploma or GED	172	91.4 (88.0–94.7)		0.0 (−4.9 to 4.9)	1.000
More than high school	337	91.4 (87.7–95.1)		Reference	
Homeless at any time in past 12 mo[g]			.148		
Yes	89	94.9 (90.9–98.9)		4.2 (−0.7 to 9.2)	.094
No	510	90.7 (87.7–93.7)		Reference	
Poverty guidelines[h]			.526		
Above poverty threshold	300	92.9 (89.8–96.0)		Reference	
At or below poverty threshold	246	91.3 (87.5–95.2)		−1.6 (−6.5 to 3.4)	.531
Received HIV medical care within 30 d of testing positive (18–19 only)					
Yes	192	91.1 (86.8–95.3)		Reference	
No	[e]	[e]		[e]	[e]
Facility RWHAP funding status					
Unadjusted			<.001		
Funded	480	93.8 (91.8–95.7)		11.5 (2.4–20.6)	.013
Nonfunded	116	82.2 (73.3–91.1)		Reference	

Table 3. Continued

	No.	Weighted %[c] (95% CI)	Rao Scott Chi-square *P* Value	Prevalence Difference (95% CI)	*P* Value for Prevalence Difference
Adjusted for age and race/ethnicity					
Funded		93.7 (91.4–95.4)		11.0 (2.4–19.6)	.012
Nonfunded		82.7 (72.6–89.6)		Reference	

Abbreviations: GED, general educational development; HHS, Department of Health and Human Services; RWHAP, Ryan White HIV/AIDS Program.

[a]Includes the following: HIV viral load test; CD4+ T-lymphocyte cell count.

[b]Restricted to participants who first received a positive HIV test result ≤24 mo before the end of observation (interview date), who had a medical record abstraction, a valid date of first HIV care, and date of first HIV care visit ≥6 mo before the end of observation.

[c]Percentages are weighted percentages.

[d]Patients were classified as transgender if sex at birth and gender reported by the patient were different or if the patient chose transgender in response to the question about self-identified gender.

[e]Data not presented because coefficient of variation was ≥0.30, the absolute CI width was ≥0.30, or the absolute CI width was between 0.05 and 0.30 (ie, 0.05–0.30) and the relative CI width was >130%.

[f]Hispanic or Latino persons may be of any race. Patients are classified in only 1 race/ethnicity category.

[g]Living on the street, in a shelter, in a single-room occupancy hotel, or in a car.

[h]Poverty guidelines as defined by the HHS; the 2014 guidelines were used for patients interviewed during the 2015 cycle, and the 2015 guidelines were used for patients interviewed during the 2016 cycle, etc. More information regarding the HHS poverty guidelines can be found at https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines/frequently-asked-questions-related-poverty-guidelines-poverty.

(ART) doses, alcohol use including binge drinking and heavy drinking, and use of injection and noninjection drugs in the past 30 days. Clinical variables calculated from medical record data included geometric mean and lowest CD4 count in the past 24 months, stage 3 HIV in the past 24 months, ART prescription, and viral suppression, defined as the most recent viral load documented as undetectable or <200 copies/mL. We ascertained whether facilities where medical records were reviewed received any funding from the RWHAP.

Combined Outcomes

We created 4 combined measures of selected diagnostic tests grouped by test type and HIV provider workflow: HIV monitoring tests (CD4 count and HIV viral load), blood tests for coinfections (syphilis, hepatitis B, and hepatitis C), site-based tests for sexually transmitted infections (STIs; gonorrhea and chlamydia), and routine blood chemistry and hematology tests (lipid panel, glucose or hemoglobin A1c, creatinine, liver function tests, albumin, and complete blood count). For a combination of tests to be counted as performed, all tests in the group had to be performed.

Statistical Analysis

Data were weighted based on known probabilities of selection at the state or territory and person levels, adjusted for nonresponse, and poststratified to known population totals by age, race/ethnicity, and sex from the National HIV Surveillance System. This design allows inference to all adults with diagnosed HIV in the United States [10].

We estimated the prevalence, with 95% CIs, of sociodemographic and clinical characteristics and percentages of patients in the study population who had specific tests and combinations of tests. We used logistic regression with predicted marginals to estimate prevalence differences (PDs), with corresponding 95% CIs and *t* test *P* values, for having the combined test measures by sociodemographic characteristics, receipt of HIV medical care within 30 days of first receiving a positive HIV test result, and health care facility RWHAP funding status. We adjusted the RWHAP facility funding models to control for possible confounding of the association of RWHAP funding with test combinations by differences in age and race/ethnicity. To assess if the relationship of age with the combined measures of testing was modified by RWHAP funding, we stratified age groups by RWHAP funding status. We considered PDs ≥5 percentage points to be meaningful from a public health perspective.

To assess whether we underestimated testing among patients who received HIV care at >1 facility, we repeated the analysis excluding 27 participants (4%) who reported receiving HIV care at >1 facility. To assess whether some patients had an initial HIV provider visit but did not continue in care, we counted the number of documented HIV provider visits in the medical record of each participant.

RESULTS

Table 1 displays sociodemographic and clinical characteristics of adults who were diagnosed with HIV within 24 months and received HIV care since diagnosis in the United States during the 2015–2019 MMP data collection cycles. Among patients who initiated HIV care ≥6 months before the end of observation, the percentages with medical record documentation of recommended tests and combinations of tests at their usual place of HIV medical care within 3 months before until 3/6 months after the first HIV provider visit are displayed in Table 2. Within 6 months of initiating HIV care, HIV monitoring tests (CD4 count and viral load) were documented for an estimated 91.3% (95% CI, 88.7%–93.8%) of patients; coinfection blood

Table 4. Receipt of a Combination of Recommended Initial Serologic Tests for Coinfection (Hepatitis B, Hepatitis C, Syphilis)[a] Performed After HIV Diagnosis and Between 3 Months Before and 6 Months After First HIV Provider Visit, by Sociodemographic Characteristic, United States, 2015–2019 (n = 660)[b]

	No.	Weighted %[c] (95% CI)	Rao Scott Chi-square *P* Value	Prevalence Difference (95% CI)	*P* Value for Prevalence Difference
Gender			.931		
Male	135	27.5 (22.1–32.8)		Reference	
Female	37	26.5 (18.1–34.9)		−1.0 (−10.0 to 8.0)	.832
Transgender[e]	[d]	[d]		[d]	[d]
Sexual orientation			.120		
Gay or lesbian	80	28.8 (21.2–36.4)		4.2 (−4.8 to 13.3)	.361
Heterosexual or straight	68	24.6 (18.1–31.0)		Reference	
Bisexual	24	35.1 (23.7–46.6)		10.6 (−2.5 to 23.6)	.112
Other sexual orientation	[d]	[d]		[d]	[d]
Race/ethnicity			.537		
White, non-Hispanic	33	25.3 (17.7–33.0)		Reference	
Black, non-Hispanic	75	25.3 (17.9–32.6)		−0.1 (−10.5 to 10.4)	.99
Hispanic or Latino[f]	55	32.6 (25.0–40.3)		7.3 (−3.4 to 18.0)	.18
Other (including Asian, American Indian/Alaska Native, Native Hawaiian/other Pacific Islander)	[d]	[d]		[d]	[d]
Multiracial	[d]	[d]		[d]	[d]
Age at time of interview, y			.424		
18–24	30	33.7 (22.5–44.8)		13.9 (−1.5 to 29.4)	.077
25–34	70	28.9 (21.8–36.0)		9.1 (−3.4 to 21.6)	.152
35–44	37	26.7 (18.2–35.1)		6.9 (−6.9 to 20.7)	.328
45–54	26	24.2 (14.8–33.7)		4.5 (−10.1 to 19.0)	.548
55+	15	19.8 (9.1–30.5)		Reference	
Age at time of interview, y RWHAP-funded facility					
18–24	27	34.9 (22.8–47.0)		9.4 (−9.4 to 28.2)	.327
25–34	56	32.0 (23.2–40.8)		6.4 (−9.0 to 21.8)	.414
35–44	33	29.3 (19.7–38.9)		3.8 (−12.0 to 19.5)	.640
45–54	23	29.7 (18.2–41.2)		4.2 (−13.4 to 21.7)	.642
55+	13	25.5 (12.1–39.0)		Reference	
Age at time of interview, y Non-RWHAP-funded facility					
18–24	[d]	[d]		[d]	[d]
25–34	[d]	[d]		[d]	[d]
35–44	[d]	[d]		[d]	[d]
45–54	[d]	[d]		[d]	[d]
55+	[d]	[d]		Reference	
Education			.298		
Less than high school	30	34.4 (21.1–47.6)		9.0 (−3.7 to 21.8)	.165
High school diploma or GED	52	28.2 (20.5–35.9)		2.9 (−5.7 to 11.5)	.508
More than high school	95	25.3 (20.2–30.5)		Reference	
Homeless at any time in past 12 mo[g]			.211		
Yes	31	33.2 (21.8–44.6)		6.7 (−4.5 to 17.8)	.242
No	146	26.5 (21.7–31.4)		Reference	
Poverty guidelines[h]			.256		
Above poverty threshold	82	25.0 (19.3–30.8)		Reference	
At or below poverty threshold	78	30.0 (22.9–37.2)		5.0 (−3.8 to 13.8)	.264
Received HIV medical care within 30 d of testing positive (18–19 only)			.251		
Yes	64	32.5 (23.8–41.1)		Reference	
No	[d]	[d]		[d]	[d]
Facility RWHAP funding status					
Unadjusted			.002		
Funded	152	30.9 (24.8–37.1)		14.8 (5.8–23.8)	.001
Nonfunded	26	16.1 (10.0–22.3)		Reference	

Table 4. Continued

	No.	Weighted %[c] (95% CI)	Rao Scott Chi-square *P* Value	Prevalence Difference (95% CI)	*P* Value for Prevalence Difference
Adjusted for age and race/ethnicity					
Funded		30.8 (25.1–37.2)		14.4 (5.0–23.7)	0.003
Nonfunded		16.4 (10.8–24.1)		Reference	

Abbreviations: GED, general educational development; HHS, Department of Health and Human Services; RWHAP, Ryan White HIV/AIDS Program.

[a]Includes all of the following: hepatitis B serologic tests (surface antigen, surface antibody, and core antibody), hepatitis C antibody or qualitative or quantitative RNA tests, and syphilis testing (VDRL, RPR, FTA-Ab, TP-TA, MHA-TP, TPHA, EIA, CIA, dark field, PCR, or unspecified treponemal antibody).

[b]Restricted to participants who first received a positive HIV test result ≤24 mo before the end of observation (interview date), who had a medical record abstraction, a valid date of first HIV care, and date of first HIV care visit ≥6 mo before the end of observation.

[c]Percentages are weighted percentages.

[d]Data not presented because the coefficient of variation was ≥0.30, the absolute CI width was ≥0.30, or the absolute CI width was between 0.05 and 0.30 (ie, 0.05–0.30) and the relative CI width was >130%.

[e]Patients were classified as transgender if sex at birth and gender reported by the patient were different or if the patient chose transgender in response to the question about self-identified gender.

[f]Hispanic or Latino persons may be of any race. Patients are classified in only 1 race/ethnicity category.

[g]Living on the street, in a shelter, in a single-room occupancy hotel, or in a car.

[h]Poverty guidelines as defined by the HHS; the 2014 guidelines were used for patients interviewed during the 2015 cycle, and the 2015 guidelines were used for patients interviewed during the 2016 cycle, etc. More information regarding the HHS poverty guidelines can be found at https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines/frequently-asked-questions-related-poverty-guidelines-poverty.

tests (hepatitis B serology panel, hepatitis C test, and syphilis test), 27.5% (95% CI, 22.5%–32.4%); site-based STI tests (gonorrhea and chlamydia), 59.7% (95% CI, 55.4%–63.9%); and blood chemistry and hematology tests (glucose or hemoglobin A1c, creatinine, liver function profile, albumin, and complete blood count), 50.8% (95% CI, 45.8%–55.8%).

Associations of the prevalence of receiving test combinations with sociodemographic and clinical characteristics are displayed in Tables 3–6 and Figure 2. The prevalence of receiving each test combination was higher among patients who received HIV care at RWHAP-funded vs non-RWHAP-funded facilities after adjusting for differences in age and race/ethnicity (HIV monitoring tests: PD, 11.0; 95% CI, 2.4–19.6; $P < .012$; coinfection blood tests: PD, 14.4; 95% CI, 5.0–23.7; $P = .003$; site-based STI tests: PD, 21.4; 95% CI, 11.0–31.8; $P < .001$; and chemistry and hematology tests: PD, 25.9; 95% CI, 16.1–35.8; $P < .001$). Compared with patients aged ≥55 years, the estimated prevalence of receiving HIV monitoring tests was higher among patients aged 18–24 (PD, 14.2; 95% CI, 1.0–27.3; $P = .035$), and the prevalence of receiving site-based STI testing was higher among patients aged 18–24 (PD, 22.9; 95% CI, 6.8–39.1; $P = .005$), 25–34 (PD, 16.9; 95% CI, 2.5–31.4; $P = .022$), and 35–44 (PD, 17.8; 95% CI, 2.0–33.6; $P = .027$). Compared with heterosexual patients, higher percentages of gay/lesbian and bisexual patients had site-based STI testing (PD, 13.6; 95% CI, 4.8–22.5; $P = .003$; and PD, 15.2; 95% CI, 1.7–28.7; $P = .027$, respectively). These data are consistent with meaningful differences in some cases and either meaningful or negligible differences in others (Figure 2).

There were no substantive changes in the estimated prevalence of receiving tests after excluding participants who reported receiving HIV care at >1 facility. Among patients with ≥1 HIV provider visit since diagnosis, 97% had ≥1 additional visit.

DISCUSSION

Within 6 months of their first HIV provider visit, 91.3% of patients had a CD4 count and HIV viral load test documented at their usual place of HIV care. However, less than two-thirds had documentation of tests for gonorrhea and chlamydia, half had all recommended chemistry and hematology tests, and one-quarter had all recommended serologic tests for syphilis and viral hepatitis. Patients who were younger, gay/lesbian, or bisexual were more likely to have gonorrhea and chlamydia tests, and patients receiving care at RWHAP-funded facilities were more likely than patients at non-RWHAP-funded facilities to have all combinations of recommended tests. To our knowledge, this is the first published study describing receipt of recommended baseline laboratory testing for people initiating HIV care.

More than one-third of people initiating HIV care did not have documentation of recommended tests for STIs at their usual place of HIV care, despite reported STIs in the United States reaching all-time highs [11]. If undiagnosed, STIs may increase genital HIV shedding and potentially facilitate transmission of HIV [12]. Receipt of recommended testing for hepatitis B and C was also low, even though coinfection is common among PWH, and knowledge of patients' viral hepatitis status has important implications for antiretroviral regimen selection, vaccination, and cancer screening [6]. Although most patients had HIV monitoring tests, the percentage with a baseline HIV genotype documented in the primary HIV medical record was unexpectedly low, at 41%. A modeling study published in 2020 suggested that for patients starting bictegravir- or dolutegravir-based triple-drug regimens, baseline genotype testing offers minimal clinical benefit and is not cost-effective [13]. However, all major guidelines still recommend baseline genotype testing for all patients initiating HIV care [1, 3, 4], and

Table 5. Receipt of a Combination of Recommended Initial Site-Based Tests for Sexually Transmitted Infections (Gonorrhea and Chlamydia)[a] Performed After HIV Diagnosis and Between 3 Months Before and 6 Months After First HIV Provider Visit, by Sociodemographic Characteristic, United States, 2015–2019 (n = 660)[b]

	No.	Weighted %[c] (95% CI)	Rao Scott Chi-square *P* Value	Prevalence Difference (95% CI)	*P* Value for Prevalence Difference
Gender			.223		
Male	321	61.4 (56.4–66.5)		Reference	
Female	76	51.8 (42.5–61.2)		−9.6 (−20.4 to 1.2)	.081
Transgender[e]	[d]	[d]		[d]	[d]
Sexual orientation			.002		
Gay or lesbian	191	65.8 (59.5–72.0)		13.6 (4.8–22.5)	.003
Heterosexual or straight	141	52.1 (45.5–58.7)		Reference	
Bisexual	59	67.3 (55.0–79.6)		15.2 (1.7–28.7)	.027
Other sexual orientation	[d]	[d]		[d]	[d]
Race/ethnicity			.020		
White, non-Hispanic	81	59.6 (50.2–69.0)		Reference	
Black, non-Hispanic	182	55.5 (49.2–61.7)		−4.1 (−16.2 to 8.0)	.503
Hispanic or Latino[f]	114	70.1 (62.0–78.2)		10.5 (−2.0 to 23.0)	.099
Other (including Asian, American Indian/Alaska Native, Native Hawaiian/other Pacific Islander)	[d]	[d]		[d]	[d]
Multiracial	[d]	[d]		[d]	[d]
Age at time of interview, y			.106		
18–24	64	67.4 (55.5–79.3)		22.9 (6.8–39.1)	.005
25–34	160	61.4 (54.1–68.7)		16.9 (2.5–31.4)	.022
35–44	87	62.3 (54.0–70.5)		17.8 (2.0–33.6)	.027
45–54	60	54.3 (42.7–65.8)		9.8 (−9.7 to 29.3)	.324
55+	34	44.5 (30.6–58.3)		Reference	
Age at time of interview, y RWHAP-funded facility					
18–24	58	69.4 (56.5–82.3)		16.0 (−1.3 to 33.4)	.071
25–34	132	68.0 (59.9–76.1)		14.6 (−1.6 to 30.8)	.077
35–44	72	63.4 (54.5–72.3)		10.0 (−7.4 to 27.5)	.260
45–54	49	60.0 (48.0–72.0)		6.6 (−14.9 to 28.2)	.547
55+	[d]	[d]		Reference	
Age at time of interview, y Non-RWHAP-funded facility					
18–24	[d]	[d]		[d]	[d]
25–34	[d]	[d]		[d]	[d]
35–44	[d]	[d]		[d]	[d]
45–54	[d]	[d]		[d]	[d]
55+	[d]	[d]		Reference	
Education			.239		
Less than high school	54	52.0 (40.0–64.0)		−7.7 (−20.6 to 5.2)	.244
High school diploma or GED	122	63.8 (56.2–71.5)		4.2 (−5.2 to 13.5)	.384
More than high school	226	59.7 (54.1–65.2)		Reference	
Homeless at any time in past 12 mo[g]			.703		
Yes	56	61.4 (52.5–70.4)		2.0 (−8.4 to 12.4)	.702
No	346	59.4 (54.5–64.3)		Reference	
Poverty guidelines[h]			.776		
Above poverty threshold	206	61.2 (55.3–67.2)		Reference	
At or below poverty threshold	162	59.9 (53.0–66.8)		−1.3 (−10.3 to 7.7)	.776
Received HIV medical care within 30 d of testing positive			.403		
Yes	147	70.1 (62.7–77.5)		Reference	
No	[d]	[d]		[d]	[d]
Facility RWHAP funding status					
Unadjusted			<.001		
Funded	339	64.7 (59.8–69.6)		22.1 (11.6–32.6)	<.001
Nonfunded	62	42.6 (33.5–51.7)		Reference	
Adjusted for age and race/ethnicity					

Table 5. Continued

	No.	Weighted %[c] (95% CI)	Rao Scott Chi-square *P* Value	Prevalence Difference (95% CI)	*P* Value for Prevalence Difference
Funded		64.6 (59.7–69.1)		21.4 (11.0–31.8)	<.001
Nonfunded		43.2 (34.0–52.8)		Reference	

Abbreviations: GED, general educational development; HHS, Department of Health and Human Services; RWHAP, Ryan White HIV/AIDS Program

[a]Includes gonorrhea and chlamydia. Any test was performed including culture, DFA, DNA probe, EIA, gram stain, NAAT, or nucleic hybridization (probe) test from any source including anorectal, cervical, lymph node, ocular, pharynx, urine, urethra, or vagina.

[b]Restricted to participants who first received a positive HIV test result ≤24 mo before the end of observation (interview date), who had a medical record abstraction, a valid date of first HIV care, and date of first HIV care visit ≥6 mo before the end of observation. Numbers are unweighted.

[c]Percentages are weighted percentages.

[d]Data not presented because the coefficient of variation was ≥0.30, the absolute CI width was ≥0.30, or the absolute CI width was between 0.05 and 0.30 (ie, 0.05–0.30) and the relative CI width was >130%.

[e]Patients were classified as transgender if sex at birth and gender reported by the patient were different or if the patient chose transgender in response to the question about self-identified gender.

[f]Hispanic or Latino persons may be of any race. Patients are classified in only 1 race/ethnicity category.

[g]Living on the street, in a shelter, in a single-room occupancy hotel, or in a car.

[h]Poverty guidelines as defined by the HHS; the 2014 guidelines were used for patients interviewed during the 2015 cycle, and the 2015 guidelines were used for patients interviewed during the 2016 cycle, etc. More information regarding the HHS poverty guidelines can be found at https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines/frequently-asked-questions-related-poverty-guidelines-poverty.

CDC surveillance data do not suggest a decline in baseline genotype testing during 2015–2019 [14]. Of note, molecular cluster analysis can only be performed if baseline drug resistance testing has previously been performed.

Several provider and health care system factors could help explain our low estimates of the prevalence of recommended baseline testing, especially among patients who received HIV care at non-RWHAP-funded facilities.

An MMP HIV provider survey in 2013–2014 found that 72% of HIV providers at RWHAP-funded facilities met HIVMA HIV specialist criteria [15] or were credentialed as HIV specialists by the American Academy of HIV Medicine as HIV Medicine [16], compared with 43% of providers at non-RWHAP-funded private practices [17]. Providers at non-RWHAP-funded practices also cared for fewer patients with HIV than those at RWHAP-funded facilities and might therefore devote less time to reading HIV treatment guidelines. In addition, one-third of HIV providers at RWHAP-funded facilities and half of those at non-RWHAP-funded facilities were dissatisfied with the effort required to keep up with clinical advances. Therefore, lack of familiarity with the HIVMA recommendations among providers could contribute to the low prevalence of recommended baseline tests.

Health care system barriers, including a heavy provider workload and limited availability of support staff to assist with routine activities such as ordering baseline labs at intake, could also contribute to the low prevalence of recommended baseline testing, particularly among providers at non-RWHAP-funded facilities [17]. Twice the percentage of HIV providers at non-RWHAP-funded compared with RWHAP-funded facilities devoted >40 hours per week to direct patient care (83%) and were dissatisfied with their work schedule and call responsibilities (56%). The percentage of HIV providers whose practice did not utilize an integrated team was 6 times higher (85%) at non-RWHAP-funded facilities.

In addition, all RWHAP Parts A–D recipients and their contracted service providers (subrecipients) are required to report client-level data annually to the HIV/AIDS Bureau [18]. Providers at non-RWHAP-funded facilities may not be subject to the same level of monitoring of their lab ordering practices.

Possible strategies to address these barriers include disseminating HIVMA recommendations as part of continuing education activities, reducing provider workload to allow more time for comprehensive initial evaluations, assigning baseline lab ordering responsibility to nurses performing intake interviews [19], and embedding clinical decision support [20] or "nudges" [21] into provider workflows. Among these strategies, clinical decision support or nudges, which include electronic alerts and reminders for providers, condition-specific order sets, and provider-specific reports on past performance, may be among the simplest to implement, least costly, and most effective.

A 2021 systematic review of the effectiveness of nudges to promote adherence to guidelines found that strategies that direct providers' attention to desired choices were effective in 83% of studies and strategies that provide feedback about past performance were effective in 73% of studies [22]. A 2017 National Academy of Medicine report detailed the potential benefits of clinical decision support, technologic, financial, and human resource barriers to implementation, and strategies for addressing those barriers [23]. The Agency for Healthcare Research and Quality has funded initiatives to develop consensus in the health care field around the use of clinical decision support to promote safe and effective health care [20], and the Institute for Healthcare Improvement has identified strategies for embedding guidelines into the HIV care delivery system that make it difficult for providers to ignore guidance, as well

Table 6. Receipt of a Combination of Recommended Initial Routine Blood Chemistry and Hematology Tests[a] (Lipid Panel, Glucose or Hemoglobin A1C, Creatinine, Liver Function Test Panel, Albumin, and Complete Blood Count) Performed After HIV Diagnosis and Between 3 Months Before and 6 Months After First HIV Provider Visit, by Sociodemographic Characteristic, United States, 2015–2019 (n = 660)[b]

	No.	Weighted %[c] (95% CI)	Rao Scott Chi-square *P* Value	Prevalence Difference (95% CI)	*P* Value for PD
Gender			.382		
Male	272	52.2 (46.4–58.0)		Reference	
Female	64	46.0 (36.7–55.3)		−6.3 (−17.3 to 4.8)	.269
Transgender[e]	[d]	[d]		[d]	[d]
Sexual orientation			.501		
Gay or lesbian	154	54.4 (47.1–61.7)		6.8 (−2.6 to 16.1)	.157
Heterosexual or straight	131	47.6 (40.6–54.6)		Reference	
Bisexual	43	48.2 (36.0–60.4)		0.6 (−12.8 to 14.0)	.928
Other sexual orientation	[d]	[d]		[d]	[d]
Race/ethnicity			.351		
White, non-Hispanic	60	46.1 (37.0–55.2)		Reference	
Black, non-Hispanic	160	49.1 (41.1–57.2)		3.0 (−8.8 to 14.9)	.616
Hispanic or Latino[f]	98	57.2 (47.8–66.6)		11.1 (−2.2 to 24.3)	.101
Other (including Asian, American Indian/Alaska Native, Native Hawaiian/other Pacific Islander)	[d]	[d]		[d]	[d]
Multiracial	[d]	[d]		[d]	[d]
Age at time of interview, y			.679		
18–24	49	51.0 (38.5–63.5)		3.3 (−14.9 to 21.5)	.72
25–34	126	47.7 (40.2–55.3)		0.1 (−15.7 to 15.9)	.991
35–44	77	55.6 (46.4–64.8)		7.9 (−9.8 to 25.7)	.38
45–54	60	54.0 (44.2–63.8)		6.3 (−11.1 to 23.7)	.477
55+	31	47.7 (32.9–62.4)		Reference	
Age at time of interview, y RWHAP-funded facility					
18–24	45	53.7 (39.7–67.6)		1.2 (−19.0 to 21.4)	.909
25–34	113	58.2 (49.2–67.2)		5.7 (−12.8 to 24.2)	.545
35–44	65	57.9 (47.8–67.9)		5.4 (−14.4 to 25.1)	.592
45–54	47	57.6 (46.6–68.7)		5.2 (−14.5 to 24.8)	.606
55+	[d]	[d]		Reference	
Age at time of interview, y Non-RWHAP-funded facility					
18–24	[d]	[d]		[d]	[d]
25–34	[d]	[d]		[d]	[d]
35–44	[d]	[d]		[d]	[d]
45–54	[d]	[d]		[d]	[d]
55+	[d]	[d]		Reference	
Education			.966		
Less than high school	52	51.6 (39.5–63.7)		0.5 (−12.2 to 13.2)	.939
High school diploma or GED	99	50.1 (42.0–58.1)		−1.1 (−9.9 to 7.8)	.812
More than high school	190	51.1 (45.4–56.9)		Reference	
Homeless at any time in past 12 mo[g]			.735		
Yes	52	52.6 (41.6–63.6)		2.0 (−9.5 to 13.4)	.735
No	289	50.6 (45.3–55.9)		Reference	
Poverty guidelines[h]			.240		
Above poverty threshold	171	51.7 (45.2–58.3)		Reference	
At or below poverty threshold	131	46.4 (39.3–53.5)		−5.4 (−14.2 to 3.4)	.233
Received HIV medical care within 30 d of testing positive			.882		
Yes	115	51.4 (42.3–60.5)		Reference	
No	[d]	[d]		[d]	[d]
Facility RWHAP funding status					
Unadjusted			<.001		
Funded	296	56.8 (50.9–62.7)		25.8 (15.4–36.2)	<.001
Nonfunded	46	31.0 (22.3–39.6)		Reference	
Adjusted for age and race/ethnicity					

Table 6. Continued

	No.	Weighted %[c] (95% CI)	Rao Scott Chi-square *P* Value	Prevalence Difference (95% CI)	*P* Value for PD
Funded		56.8 (51.0–62.5)		25.9 (16.1–35.8)	<.001
Nonfunded		30.9 (23.2–39.9)		Reference	

Abbreviations: GED, general educational development; HHS, Department of Health and Human Services; RWHAP, Ryan White HIV/AIDS Program

[a]Includes all of the following: total cholesterol, high-density cholesterol, low-density cholesterol, triglycerides, glucose or hemoglobin A1c, creatinine, aspartate transferase, alanine transferase, total bilirubin, albumin, hemoglobin, total white blood cell count, absolute neutrophil count, and platelet count.

[b]Restricted to participants who first received a positive HIV test result ≤24 mo before the end of observation (interview date), a medical record abstraction, a valid date of first HIV care, and date of first HIV care visit ≥6 mo before the end of observation.

[c]Percentages are weighted percentages.

[d]Data not presented because the coefficient of variation was ≥0.30, the absolute CI width was ≥0.30, or the absolute CI width was between 0.05 and 0.30 (ie, 0.05–0.30) and the relative CI width was >130%.

[e]Patients were classified as transgender if sex at birth and gender reported by the patient were different or if the patient chose transgender in response to the question about self-identified gender.

[f]Hispanic or Latino persons may be of any race. Patients are classified in only 1 race/ethnicity category.

[g]Living on the street, in a shelter, in a single-room occupancy hotel, or in a car.

[h]Poverty guidelines as defined by the HHS; the 2014 guidelines were used for patients interviewed during the 2015 cycle, and the 2015 guidelines were used for patients interviewed during the 2016 cycle, etc. More information regarding the HHS poverty guidelines can be found at https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines/frequently-asked-questions-related-poverty-guidelines-poverty.

as recommendations for providing nonpunitive feedback to providers about their adherence to HIV care guidelines [24, 25].

Our study had potential limitations. Measurement error could have resulted in underestimation of testing prevalence. First, we did not capture tests ordered at outside facilities if not documented in the primary HIV medical record. However, prevalence estimates did not change when we excluded participants who reported receiving care at >1 facility. Second, some initial HIV provider visits might have been brief, with loss to follow-up before a subsequent more comprehensive visit, during which tests were ordered. However, 97% of patients with an initial HIV provider visit had ≥1 return visit. Third, because medical record data were recorded starting at the date of HIV diagnosis, some tests performed shortly before that date, which might satisfy testing recommendations, would not have been recorded. Fourth, results of tests, for example, genotypes, sent on paper from laboratories or HIV testing facilities and attached to electronic health records could have been overlooked by data collectors. Fifth, facilities were asked to provide complete medical records for a 2-year period, but some records might have been incomplete. Finally, data collectors might have not recorded all available test information from medical records. However, our quality assurance protocols, including reabstraction of ≥5% of abstractions by a more senior abstractor and comparison with the original abstraction, reduced the likelihood of this possibility.

Because most combination test outcomes were uncommon and sample sizes within some categories of characteristics were relatively modest, limited precision may have precluded detection of small differences in outcomes for race/ethnicity and other sociodemographic characteristics, and, conversely, meaningful differences could not be ruled out in some cases.

The strengths of our study included population-based sampling and weighting designed to produce nationally representative estimates of a wide range of sociodemographic and clinical characteristics of adults with diagnosed HIV, of which those recently diagnosed and receiving HIV care is a subset. Although not all sampled people participated in MMP, results were adjusted for nonresponse using standard methodology [26, 27]. Even with suboptimal response rates, there is still value in results obtained from unbiased sampling methods [28]. In addition, data were collected at facilities that were geographically diverse and included a wide range of types of care settings.

Baseline laboratory tests recommended for patients initiating HIV care were often not performed or available at the usual place of HIV care, especially at non-RWHAP-funded facilities. Closer adherence to guidelines is needed to prevent serious comorbidities and improve health outcomes among PWH. Increased use of clinical decision support and nudges to increase ordering of recommended baseline testing could improve baseline testing prevalence at relatively low cost and with little disruption to clinical workflow.

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Patient consent. Written informed consent was obtained for all Medical Monitoring Project participants. As public health surveillance, this activity

received a CDC nonresearch determination, and institutional review board approval was not required. State and local health departments obtained all required regulatory approvals. This activity was conducted consistent with applicable federal law and CDC policy (Protection of Human Subjects, US Federal Code Title 45 Part 46. 2009; available at 45 CFR 46 | HHS.gov).

References

1. Thompson MA, Horberg MA, Agwu AL, et al. Primary care guidance for persons with human immunodeficiency virus: 2020 update by the HIV Medicine Association of the Infectious Diseases Society of America. Clin Infect Dis **2020**; 73:e3572–605.
2. Aberg JA, Gallant JE, Ghanem KG, Emmanuel P, Zingman BS, Horberg MA. Primary care guidelines for the management of persons infected with HIV: 2013 update by the HIV Medicine Association of the Infectious Diseases Society of America. Clin Infect Dis **2013**; 58:e1–34.
3. Saag MS, Gandhi RT, Hoy JF, et al. Antiretroviral drugs for treatment and prevention of HIV infection in adults: 2020 recommendations of the International Antiviral Society-USA Panel. JAMA **2020**; 324:1651–69.
4. Panel on Antiretroviral Guidelines for Adults and Adolescents, Department of Health and Human Services. Guidelines for the use of antiretroviral agents in adults and adolescents with HIV. Available at: https://clinicalinfo.hiv.gov/sites/default/files/guidelines/documents/AdultandAdolescentGL.pdf. Accessed 2 December 2021.
5. Workowski KA, Bachman LH, Chan PA, et al. Sexually transmitted infections treatment guidelines. MMWR Recomm Rep **2021**; 70(No. RR-4):1–187.
6. Panel on Opportunistic Infections in Adults and Adolescents with HIV. Guidelines for the prevention and treatment of opportunistic infections in adults and adolescents with HIV: recommendations from the Centers for Disease Control and Prevention, the National Institutes of Health, and the HIV Medicine Association of the Infectious Diseases Society of America. Available at: https://clinicalinfo.hiv.gov/sites/. Accessed 2 December 2021.
7. The White House. National HIV/AIDS Strategy for the United States 2022–2025. The White House; **2021**. Available at: hivgov-prod-v3.s3.amazonaws.com. Accessed 2 December 2021.
8. Protection of Human Subjects, US Federal Code Title 45 Part 46. **2009**. Available at: HHS.gov. Accessed 2 December 2021.
9. Health Resources and Services Administration. HRSA Ryan White HIV/AIDS Program. Available at: hrsa.gov. Accessed 2 December 2021.
10. Centers for Disease Control and Prevention. Behavioral and clinical characteristics of persons with diagnosed HIV infection—Medical Monitoring Project US, 2019 cycle (June 2019–May 2020). HIV Surveillance Special Report 28. **2021**. Available at: https://www.cdc.gov/hiv/library/reports/hiv-surveillance.html. Accessed 2 December 2021.
11. Centers for Disease Control and Prevention. Sexually transmitted disease surveillance. **2019**. Available at: cdc.gov. Accessed 2 December 2021.
12. Fleming DT, Wasserheit JN. From epidemiological synergy to public health policy and practice: the contribution of other sexually transmitted diseases to sexual transmission of HIV infection. Sexually Transm Infect **1999**; 75:3–17.
13. Hyle EP, Scott JA, Sax PE, et al. Clinical impact and cost-effectiveness of genotype testing at human immunodeficiency virus diagnosis in the United States. Clin Infect Dis **2020**; 70:1353–63. doi:10.1093/cid/ciz372
14. Oster AM, Panneer N, Lyss SB, et al. Increasing capacity to detect clusters of rapid HIV transmission in varied populations—United States. Viruses **2021**; 13:577. doi:10.3390/v13040577
15. HIV Medicine Association. Identifying clinicians qualified to manage the longitudinal treatment of people living with HIV and resources to support quality HIV care. Available at: https://www.hivma.org/globalassets/qualified-provider-criteria-and-quality-tools-approved.pdf. Accessed 2 December 2021.
16. American Academy of HIV Medicine. HIV specialist. Available at: https://aahivm.org/hiv-specialist. Accessed 2 December 2021.
17. Weiser J, Beer L, West BT, Duke CC, Gremel GW, Skarbinski J. Qualifications, demographics, satisfaction, and future capacity of the HIV care provider workforce in the United States, 2013–2014. Clin Infect Dis **2016**; 63:966–75. doi:10.1093/cid/ciw442
18. Health Services and Resources Administration. Ryan White HIV/AIDS Program Services Report (RSR). Available at: hrsa.gov. Accessed 7 May 2022.
19. Institute for Healthcare Improvement. Initial history and physical assessment form. Available at: http://www.ihi.org/resources/Pages/Tools/InitialHistoryandPhysicalAssessmentForm.aspx. Accessed 2 December 2021.
20. Agency for Healthcare Research and Quality. Digital healthcare research, clinical decision support (CDS). Available at: ahrq.gov. Accessed 2 December 2021.
21. Leonard TC, Thaler RH, Sunstein CR. Nudge: improving decisions about health, wealth, and happiness. Const Political Econ **2008**; 19:356–60. doi:10.1007/s10602-008-9056-2
22. Nwafor O, Singh R, Collier C, DeLeon D, Osborne J, DeYoung J. Effectiveness of nudges as a tool to promote adherence to guidelines in healthcare and their organizational implications: a systematic review. Soc Sci Med **2021**; 286:114321. doi:10.1016/j.socscimed.2021.114321
23. Tcheng JE, Bakken S, Bates DW, et al. Optimizing Strategies for Clinical Decision Support: Summary of a Meeting Series. National Academy of Medicine; **2017**. Available at: nam.edu. Accessed 2 December 2021.
24. Institute for Healthcare Improvement. Embed current guidelines in the care delivery system for HIV. Available at: http://www.ihi.org/resources/Pages/Changes/EmbedCurrentGuidelinesintheCareDeliverySystem.aspx. Accessed 2 December 2021.
25. Institute for Healthcare Improvement. Provide feedback to providers on their use of care guidelines. Available at: http://www.ihi.org/resources/Pages/Changes/ProvideFeedbacktoProvidersonTheirUseofCareGuidelines.aspx. Accessed 2 December 2021.
26. Iachan R, Johnson CH, Harding RL, et al. Design and weighting methods for a nationally representative sample of HIV-infected adults receiving medical care in the United States—Medical Monitoring Project. Open AIDS J **2016**; 10:164–81.
27. Beer L, Johnson CH, Fagan JL, et al. A national behavioral and clinical surveillance system of adults with diagnosed HIV (The Medical Monitoring Project): protocol for an annual cross-sectional interview and medical record abstraction survey. JMIR Res Protoc **2019**; 8:e15453.
28. Groves RM. Nonresponse rates and nonresponse bias in household surveys. Public Opin Q **2006**; 70:646–75.