Quality of Care for HIV/AIDS and for Primary Prevention by HIV Specialists and Nonspecialists

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Abstract

The role of HIV specialists in providing primary care to persons living with HIV/AIDS is evolving, given their increased incidence of comorbidities. Multivariate logit analysis compared compliance with sentinel preventive screening tests and interventions among publicly insured Californians with and without access to HIV specialists in 2010. Quality-of-care indicators [visit frequency, CD4 and viral load (VL) assessments, influenza vaccine, tuberculosis (TB) testing, lipid profile, glucose blood test, and Pap smears for women] were related to patient characteristics and provider HIV caseload. There were 9377 adult Medicare enrollees (71% also had Medicaid coverage) and 2076 enrollees with only Medicaid coverage. Adjusted for patient characteristics, patients seeing providers with greater HIV caseloads (>50 HIV patients) were more likely to meet visit frequency guidelines in both Medicare [98%; confidence interval (CI) 97.5–98.2] and Medicaid (97%; CI 96.2–98.0), compared to 60% (CI 57.1–62.3) and 45% (CI 38.3–50.4), respectively, seeing providers without large HIV caseloads ($p < 0.001$). Patients seeing providers with larger caseloads were significantly more likely to have CD4 ($p < 0.001$), VL ($p < 0.001$), and TB testing ($p < 0.05$). A larger percentage of patients seeing large-volume Medicare providers received influenza vaccinations. Provider caseload was unrelated to lipid or glucose assessments or Pap Smears for women. Patients with access to large-volume providers were more likely to meet clinical guidelines for visits, CD4, VL, tuberculosis testing, and influenza vaccinations, and were not less likely to receive primary preventive care. Substantial insufficiencies remain in both monitoring to assess viral suppression and in preventive care.

Introduction

THE LARGE AND IMPORTANT reductions in morbidity and mortality for people living with HIV/AIDS (PLWHA), which have come about due to the widespread adoption of antiretroviral therapy (ART), have increased life expectancy for PLWHA.^{1,2} This increased longevity obligates increased attention to health problems associated with aging. When an expert panel of the HIV Medicine Association of the Infectious Diseases Society of America updated its recommended guidelines for HIV care in 2009, it noted that the improved survival of PLWHA since its 2004 recommendations enhanced the importance of screening for these non-HIV chronic diseases.³

As survival for PLWHA increases and HIV treatment continues to minimize pill burden and toxicity, medical care

for PLWHA not only needs to optimize HIV-specific treatment but also to include more primary prevention activities, particularly for the common comorbidities of aging, which PLWHA may experience at earlier ages than the general population due to immune exhaustion and chronic inflammation engendered by even well-controlled/treated HIV infection.⁴ Reflecting this need, in 2014, the Health Resources and Services Administration (HRSA) expanded its list of HIV/AIDS Care Performance Measures to include viral load (VL) monitoring, influenza immunization, and hepatitis B vaccination, in addition to the core HIV clinical performance measures (HIV VL suppression; prescription of ART, appropriate number and spacing of medical evaluations; Pneumocystis jiroveci pneumonia prophylaxis).⁵ The expanded list of performance measures also encompasses enhanced screening for conditions affecting the general population

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(e.g., annual influenza vaccination and annual fasting lipid panel for all PLWHA who are prescribed ART, not just men older than 35 years), as well as screening for health conditions that are more prevalent among PLWHA, including cervical cancer, chlamydia, gonorrhea, syphilis, hepatitis B and C, and tuberculosis (TB).^{6,7} (HRSA 2014 contains a complete list of performance measures.)

Nonetheless, the rates at which PLWHA are screened for many of these conditions are lower than screening rates in the general population, although the prevalence of these conditions among PLWHA is greater.^{8,9} For example, only 58% of HIV-positive women in Ottawa were screened for cervical CA within a 3-year period^{10,11} and only 55.6% of patients with HIV had had at least one colorectal cancer screening.⁹

It is well established that providers who treat greater numbers of HIV/AIDS patients deliver higher quality HIV treatment. HIV/AIDS patient survival,^{12–15} appropriate initiation and monitoring of ART treatment,^{13,16,17} and prescribing a medically recommended regimen of ART if any ART is prescribed, all depend on the provider's experience in treating HIV.¹⁸ HIV-specific patient volume/experience has a greater effect on HIV quality measures and HIV-specific knowledge than provider type (physician vs. mid-level provider) or specialty (infectious disease specialist vs. generalist).^{19–21}

There is conflicting evidence on whether HIV specialists are as effective as generalists in providing increasingly important primary prevention to their HIV/AIDS patients. A bill recently introduced in the California legislature (AB2372) aims to better integrate HIV treatment with primary care by requiring state-regulated health insurance plans to include HIV specialists as primary care providers for PLWHA. Although many patients have a preference for “one stop shopping” where the same provider serves as both HIV specialist and primary physician, it has been unclear whether HIV specialty providers best serve the need for primary care services that an ever-aging HIV population requires. Some studies find that although HIV specialists deliver higher quality HIV-specific care, they are less likely to conduct screening for comorbidities, including cancer.^{10,22,23} However, there is also some evidence that the most experienced HIV providers are more likely to provide preventive care and testing for HIV-related conditions.²⁴ For example, a 1995 study found that providers with the most HIV experience delivered more HIV-specific preventive screenings for co-infections and were more likely to have patients who received pneumococcal vaccination.²⁵ Koethe et al. did not find statistically significant differences between general internal medicine and infectious disease physicians in screening rates for cervical cancer among HIV-positive women.²⁶

To provide evidence on the delivery of preventive services to PLWHA, this article analyzes the impact of provider experience on the delivery of preventive services to PLWHA for a large population of PLWHA in California who were enrolled in Medicaid or Medicare in 2010.

Methods

Data

Medicare and Medicaid claims data for HIV-positive Californians were acquired through a confidential data use

agreement with the Centers for Medicare and Medicaid Services (CMS). An algorithm that required an HIV diagnosis in two outpatient claims or one inpatient claim was used to identify adult beneficiaries with strong evidence of HIV.²⁷ Our analyses included only fee-for-service Medicare and Medicaid enrollees because available data for Medicare managed care enrollees lack diagnosis fields needed to confirm HIV status. Medicaid-only beneficiaries (not dually enrolled in both Medicaid and Medicare) with visits to federally qualified health centers or rural health centers were excluded due to limited coding of procedures in these claims. To exclude persons newly diagnosed, for whom the full-year assessment of care would be inappropriate, we restricted our analyses to individuals enrolled full-year in both 2009 and 2010, with an HIV diagnosis code recorded in the claims data before 2009 (looking back to 2007–2008). We combine all Medicare beneficiaries, including “duals” into an “any Medicare” group, since Medicare is the primary payer for both and provides access to a wider range of providers than Medicaid. Any Medicare and Medicaid-only beneficiaries were analyzed separately.

Outcome variables

Eight different quality-of-care outcomes were assessed, based on recommended HIV care guidelines in 2009, which are relevant for our 2010 data.³ Use of ART has been examined previously and is not included in this analysis.¹⁸ Guidelines recommend evaluation and management (E&M) visits, and CD4 testing and VL testing occur at least twice a year, at least 3 months apart. Outpatient E&M claims were defined by CPT-4 code, and type and place of service. To allow for some flexibility, we assessed if enrollees had at least two visits, spaced at least 80 days apart in 2010, or one visit in 2010 and another in 2009 at least 80 days but not more than 365 days prior. Receipt of CD4 and VL tests was identified by procedure codes in the claims data.

Procedure and/or diagnosis codes in the 2010 claims data determined whether enrollees received each of four preventive services recommended annually for PLWHA: an influenza vaccine, TB testing (PPD or interferon gamma release assay), lipid profile, and glucose blood test. We assessed whether women received an annual cervical cancer screening.

Individual characteristics

Enrollment data provided information on age category (<30, 30–39, 40–49, 50–64, and 65+), enrollee-reported race/ethnicity (non-Hispanic white, African American, Hispanic/Latino, and other), and gender. Diagnoses of adjustment or anxiety disorders, mood disorders, schizophrenia or other psychotic disorders, or other mental health disorders were identified using the Mental Health and Substance Abuse Clinical Classifications Software.²⁸ Comorbidities were defined by examining ICD-9 diagnoses, and classified according to the Charlson Comorbidity Index,²⁹ a commonly used method of classifying comorbidities. Using this index, the number of comorbidities was determined for each individual. The Medicare analyses included an indicator for enrollment in Medicare-only vs. dual Medicare–Medicaid enrollment.

Provider characteristics

Each provider's caseload of publicly insured patients with HIV was assessed by counting unique HIV-positive Medicare and Medicaid enrollees seen for HIV-related care during 2010. Providers with fewer than five HIV patients were deemed non-HIV specialists. HIV-related care was defined as E&M visits with an ICD-9 diagnosis code of symptomatic (042) or asymptomatic (V08) HIV in the first diagnosis field of the claim. To demonstrate a patient's known access to an experienced HIV provider, we assigned to each beneficiary the caseload category of the highest volume provider with whom the patient had any E&M visit (not necessarily HIV related). Those with no E&M visits in 2010

fell into the lowest volume group of access to a provider with <5 HIV patients.

Statistical analysis

We estimated logistic regressions for the Medicare and Medicaid samples to relate meeting E&M guidelines to individual and provider characteristics. Logistic regression models for the seven other outcomes were fit on the sample that met the E&M guideline. Wald chi-square (χ^2) tests on the logistic regression coefficients indicate significant differences between specific categories and a reference group, holding other factors constant. Recycled predictions were

TABLE 1. SAMPLE CHARACTERISTICS AND OBSERVED PERCENTAGES OF CALIFORNIA MEDICARE AND MEDICAID PEOPLE LIVING WITH HIV/AIDS MEETING VISIT GUIDELINES IN 2010

Group	Medicare enrollees Guideline visits			Medicaid-only enrollees Guideline visits		
	n (%) in group	n (% of group)	χ^2 p Value	n (%) in group	n (% of group)	χ^2 p Value
Total	9377 (100.0)	8705 (92.8)		2076 (100.0)	1867 (89.9)	
Enrollment						
Medicare only	2727 (29.1)	2600 (95.3)	<0.001			
Dual	6650 (70.9)	6105 (91.8)				
Age						
<30	71 (0.8)	59 (83.1)	<0.001	79 (3.8)	73 (92.4)	0.55
30–39	524 (5.6)	468 (89.3)		195 (9.4)	175 (89.7)	
40–49	3173 (33.8)	2905 (91.6)		817 (39.4)	727 (89.0)	
50–65	4246 (45.3)	3987 (93.9)		975 (47.0)	884 (90.7)	
65+	1363 (14.5)	1286 (94.4)				
Gender						
Male	8427 (89.9)	7837 (93.0)	0.07	1515 (73.0)	1349 (89.0)	0.03
Female	950 (10.1)	868 (91.4)		561 (27.0)	518 (92.3)	
Race						
White	5541 (59.1)	5181 (93.5)	0.004	801 (38.6)	708 (88.4)	0.15
African American	1639 (17.5)	1520 (92.7)		685 (33.0)	625 (91.2)	
Hispanic	1797 (19.2)	1635 (91.0)		372 (17.9)	332 (89.2)	
Other	400 (4.3)	369 (92.3)		218 (10.5)	202 (92.7)	
Most experienced provider has						
50+ HIV patients	5910 (63.0)	5776 (97.7)	<0.001	1372 (66.1)	1333 (97.2)	<0.001
5–49 HIV patients	2225 (23.7)	2173 (97.7)		438 (21.1)	418 (95.4)	
<5 HIV patients	1242 (13.2)	756 (60.9)		266 (12.8)	116 (43.6)	
Comorbidities						
None	5647 (60.2)	5126 (90.8)	<0.001	1330 (64.1)	1175 (88.3)	0.005
One	2463 (26.3)	2339 (95.0)		548 (26.4)	501 (91.4)	
Two	794 (8.5)	777 (97.9)		129 (6.2)	123 (95.3)	
Three	299 (3.2)	291 (97.3)		50 (2.4)	49 (98.0)	
Four or more	174 (1.9)	172 (98.9)		19 (0.9)	19 (100.0)	
Adjustment/anxiety disorders						
No diagnosis	8840 (94.3)	8197 (92.7)	0.10	1993 (96.0)	1791 (89.9)	0.61
Diagnosis	537 (5.7)	508 (94.6)		83 (4.0)	76 (91.6)	
Mood disorders						
No diagnosis	7841 (83.6)	7245 (92.4)	<0.001	1838 (88.5)	1650 (89.8)	0.50
Diagnosis	1536 (16.4)	1460 (95.1)		238 (11.5)	217 (91.2)	
Schizophrenia/other psychosis						
No diagnosis	9024 (96.2)	8378 (92.8)	0.88	1963 (94.6)	1770 (90.2)	0.14
Diagnosis	353 (3.8)	327 (92.6)		113 (5.4)	97 (85.8)	
Other mental health disorders						
No diagnosis	9101 (97.1)	8446 (92.8)	0.51	1999 (96.3)	1802 (90.1)	0.10
Diagnosis	276 (2.9)	259 (93.8)		77 (3.7)	65 (84.4)	

For privacy reasons, cell sizes of less than 11 are not reported.

used to estimate predictive margins and 95% confidence intervals (CIs).

Results

There were 2076 PLWHA with Medicaid coverage only and 9377 enrollees with Medicare, of whom 6650 were covered by both Medicare and Medicaid (duals). Table 1 (panel 1) presents data on the percent of Medicare recipients, overall and by subgroup, meeting guidelines for number and timing of E&M visits. Seventy-one percent of Medicare recipients with HIV were dually enrolled in the Medicaid program. Medicare enrollees were predominately male (90%), with a median age of 52. Slightly more than 17% were African American, 19% Hispanic, and 59% white. For 13% of the sample, their most experienced provider had fewer than 5 publicly funded HIV cases, while 63% visited providers with a caseload of 50 or more publicly insured patients with HIV/AIDS. Forty percent of the Medicare enrollees had 1 or more comorbidities, and 13.6% had 2 or more comorbidities.

The second panel of Table 1 presents comparable data for the Medicaid sample. Similar to the Medicare sample, males predominate (73%), but median age is slightly younger (49). Thirty-three percent were African American, 18% Hispanic, and 39% white. For 13% of the sample, their most experienced provider had fewer than 5 HIV cases with Medicare or Medicaid insurance, while 66% visited providers with a caseload of 50 or more patients with HIV/AIDS. Thirty-six percent of the Medicaid enrollees had 1 or more comorbidities, and 9.5% had 2 or more comorbidities.

Table 1 shows that a large share of Medicare (93%) and Medicaid (90%) patients had guideline-compliant numbers of visits. The unadjusted percentages in the first row of Table 2 show that 89% of Medicare and 89% of Medicaid patients who had the recommended numbers of visits, received spaced CD4 testing at least twice within 2 years. Spaced VL assays were performed at least twice in 2 years for 85% of Medicare and 82% of Medicaid patients. However, smaller proportions of both populations received recommended noncore screenings and immunizations. Only 47% of Medicare and 34% of Medicaid patients received an annual flu shot. TB testing more frequently appeared in the claims for Medicaid (35%) than for Medicare enrollees (19%). Seventy-two percent of Medicare enrollees and 64% of Medicaid enrollees received a lipid panel and more than 94% in either group received a glucose test. Fewer than half of women in either program were screened for cervical cancer in 2010. Unadjusted rates of Medicare and Medicaid beneficiaries receiving guideline care within all subgroups can be found in Appendix Table 1.

Table 2 shows adjusted rates of guideline compliance based on logistic regressions that controlled for enrollee age, gender, race, provider caseload, and mental and physical comorbidities. Appendix Table 2 contains odds ratios from the logistic regressions; Appendix Table 3 contains adjusted rates of compliance by all beneficiary subgroups.

Controlling for patients' demographic and clinical characteristics, enrollees seeing only non-HIV specialists (<5 HIV patients) were significantly less likely to meet recommended levels for the core indicators. Only 60% (CI 57.1–62.3) of Medicare patients and 45% (CI 38.3–50.4) of Medicaid patients seeing only non-HIV specialists met visit guidelines,

compared to 98% (CI 97.5–98.2) of Medicare enrollees and 97% (CI 96.2–98.0) of Medicaid enrollees who had providers who treated 50 or more patients ($p < 0.001$ in both groups). Among Medicare enrollees who visited only providers with small HIV caseloads, only 78% (CI 74.6–80.5) received CD4 guideline care and 76% (CI 73.1–79.1) received guideline care for VL testing, both rates were significantly lower than the rates observed among enrollees seeing providers who treated 50 or more patients (91% [CI 89.9–91.4] and 87% [CI 85.9–87.6], respectively; $p < 0.001$ in both cases). Only 75% (CI 67.2–83.0) of Medicaid enrollees seeing only low-volume providers received CD4 tests, significantly fewer CD4 tests than those with higher volume providers (90%; CI 88.4–91.6). The difference in VL testing was not statistically significant.

Medicare patients not seeing HIV specialists had significantly lower ($p < 0.001$) rates of immunization against influenza (36%; CI 32.2–39.0) than those seeing the highest volume HIV providers (47%; CI 45.5–48.0). There were no significant differences by caseload in rates of influenza vaccination for Medicaid enrollees. Enrollees who had providers with more HIV experience were more likely to receive TB testing. Nine percent (CI 6.6–10.6) of Medicare enrollees seeing only low-volume providers, versus 22% (CI 21.0–23.2) seeing high-volume providers, received a TB test within a year ($p < 0.001$). The contrast was sharper for Medicaid enrollees: 13% (CI 6.8–19.0) of those seeing providers with fewer than 5 HIV patients and 39% (CI 36.1–41.3) of those seeing providers whose caseload was in the highest category received a TB test ($p < 0.001$). Lipid screening did not differ between patients with access to more HIV-experienced providers and those with less HIV-experienced providers, in either the Medicare or Medicaid samples. Rates of glucose testing in Medicaid patients were significantly lower ($p = 0.01$) among those seeing low-volume providers (90%; CI 84.9–95.7) versus high-volume providers (96%; CI 94.6–96.8), but we found no significant differences among Medicare patients. Female Medicaid enrollees seeing only providers with fewer than five HIV patients were significantly less likely ($p = 0.004$) to be screened for cervical cancer (19%; CI 5.4–33.2) than those with access to high-volume providers (48%; CI 43.4–53.2). Among women in Medicare, those who visited large-volume HIV providers were more likely to be screened annually for cervical cancer (44%; CI 39.9–48.1), but this number was not significantly greater than the rate among the lowest volume group (35%; CI 25.2–43.9).

Discussion

The ultimate goal of HIV treatment is viral suppression, both to maintain the health of the patient and to reduce onward transmission to sexual partners. However, even sustained viral suppression does not entirely mitigate the long-term consequences of HIV-related inflammation in the form of early senescence and end-organ disease—including but not limited to cardiovascular disease, disordered glucose metabolism, neurocognitive impairment, renal dysfunction, and some nonopportunistic malignancies.^{4,30}

The findings of this article confirm that patients whose providers included physicians with larger HIV caseloads are not only more likely to receive higher quality HIV primary care

TABLE 2. UNADJUSTED AND ADJUSTED PERCENTAGES OF CALIFORNIA MEDICARE AND MEDICAID PEOPLE LIVING WITH HIV/AIDS RECEIVING GUIDELINE CARE IN 2010 BY PROVIDER CASELOAD

	Guideline visits % (95% CI)	CD4 testing % (95% CI)	VL testing % (95% CI)	Flu shot % (95% CI)	TB test % (95% CI)	Lipid panel % (95% CI)	Glucose test % (95% CI)	Pap smear % (95% CI)
Medicare enrollees								
Unadjusted								
Total	92.8	88.5	85.3	46.8	18.5	71.9	94.9	40.3
Most experienced provider has								
50+ HIV patients	97.7	90.6	86.4	46.0	22.3	71.6	94.8	45.1
5–49 HIV patients	97.7	87.3	85.5	52.6	11.9	72.3	94.8	32.9
<5 HIV patients	60.9	76.6	75.9	36.8	8.6	73.9	96.0	31.5
Adjusted								
Most experienced provider has								
50+ HIV patients (ref.)	97.8	90.6	86.8	46.8	22.1	72.4	95.0	44.0
	(97.5–98.2)	(89.9–91.4)	(85.9–87.6)	(45.5–48.0)	(21.0–23.2)	(71.3–73.6)	(94.3–95.4)	(39.9–48.1)
5–49 HIV patients	97.4	86.9	84.4	51.0	12.3	70.6	94.5	33.7
	(96.7–98.1)	(85.5–88.3) [†]	(82.8–85.9) [†]	(48.9–53.1) [†]	(10.9–13.7) [†]	(68.6–72.5)	(93.4–95.4)	(27.4–39.9) [†]
<5 HIV patients	59.7	77.5	76.1	35.6	8.6	71.9	95.5	34.6
	(57.1–62.3) [†]	(74.6–80.5) [†]	(73.1–79.1) [†]	(32.2–39.0) [†]	(6.6–10.6) [†]	(68.6–75.1)	(93.8–97.0)	(25.2–43.9)
Medicaid enrollees								
Unadjusted								
Total	89.9	89.4	81.5	34.2	35.1	64.4	95.6	44.8
Most experienced provider has								
50+ HIV patients	97.2	89.9	80.5	34.7	38.4	63.1	95.7	47.6
5–49 HIV patients	95.4	91.9	86.6	32.8	30.9	70.1	96.7	40.6
<5 HIV patients	43.6	75.9	75.0	32.8	12.9	59.5	90.5	
Adjusted								
Most experienced provider has								
50+ HIV patients (ref.)	97.1	90.0	80.7	34.9	38.5	63.1	95.7	47.9
	(96.2–98.0)	(88.4–91.6)	(78.6–82.8)	(32.3–37.4)	(36.1–41.3)	(60.5–65.6)	(94.6–96.8)	(43.4–53.2)
5–49 HIV patients	95.5	91.6	86.2	32.5	30.5	70.2	96.7	40.1
	(93.5–97.4)	(88.9–94.3)	(82.8–89.5)*	(28.1–37.0)	(26.2–35.1) [†]	(65.8–74.5) [†]	(94.9–98.4)	(30.6–50.2)
<5 HIV patients	44.8	75.1	74.7	31.8	12.9	59.5	90.4	19.2
	(38.3–50.4) [†]	(67.2–83.0) [†]	(66.8–82.6)	(23.4–40.3)	(6.8–19.0) [†]	(50.7–68.3)	(84.9–95.7)*	(5.4–33.2) [†]

Ninety-five percent confidence intervals are provided for the regression adjusted estimates. Confidence intervals are not presented for unadjusted values because they reflect all enrollees in California in each program.

*Logit *p*-value <0.05, [†]Logit *p*-value <0.01.

CI, confidence interval; TB, tuberculosis; VL, viral load.

assessments (visits and CD4 and VL monitoring) but also^{12,14,15} were more likely to receive preventive care for conditions with greater prevalence among PLWHA (flu immunizations for Medicare patients, TB testing, cervical screening for women). Glucose testing was more frequently conducted for Medicaid patients. There were not significant differences in lipid assays.

The proportion of Medicare and Medicaid patients with HIV who achieved recommended numbers of visits is high, particularly among enrollees whose providers included HIV specialists with large HIV caseloads—98% of Medicare enrollees and 97% of Medicaid enrollees. The value of frequent visits lies in providing the opportunity to monitor HIV treatment and to conduct preventive screening for other health issues. However, even among those patients with guideline-consistent visits, the rates of core HIV-specific care (CD4 and VL testing) are less than universal, in the range of 75–92%, even among patients whose care team included HIV specialists. Rates of recommended CD4 and VL testing were lowest (75–78%) among patients whose most experienced (as measured by patient volume) providers had small caseloads. Compared to the near-universal use of ART among Medicare (87.3%) and Medicaid (96.2%) enrollees, the low levels of CD4 and VL testing suggest insufficient levels of monitoring of disease status and need for/response to ART treatment.¹⁸ Treatment guidelines note that even PLWHA who were not on ART should be routinely evaluated.⁶

Screening rates for HIV-related comorbidities were also less than optimal. Despite the high rates of ART use, lipid testing was not frequently conducted among Medicare enrollees, either those on ART (71%) or those not on ART (76%). Glucose testing was uniformly high and nearly universal (96%) across all provider sizes. Influenza immunization rates and TB testing rates were low.

Many of the comorbidities that an aging HIV/AIDS population is now experiencing fall outside of the scope of traditional HIV care and treatment, and the expertise of subspecialty-trained HIV providers. Some studies suggest that HIV specialists are uncomfortable providing treatment for other chronic diseases.^{31–33} This likely explains the finding that providers with greater HIV caseloads (>50) and infectious disease trained specialists are more likely than generalists to refer HIV patients who also have hypertension or diabetes to other specialists.³⁴ As comorbidities increase in the aging HIV population, care may increasingly be managed by teams composed of different subspecialists. However, our findings show that it is important that these teams include experienced HIV providers, because patients with access to these high-volume HIV providers were not only more likely to receive guideline-consistent HIV care but also more likely to be screened for other conditions associated with HIV, such as TB. Further, the high levels of visit frequency to HIV specialists provide them a unique opportunity to identify comorbidities and to deliver preventive services to PLWHA.

The generalizability of our findings is limited by the exclusion of PLWHA in managed care or with private insurance only. However, Medicare and Medicaid account for over half of PLWHA who are receiving care,^{35,36} minimizing the impact of this limitation. Second, the strict criteria we applied to identify PLWHA²⁷ may have yielded a sample receiving better-than-average care. Third, we could not assess the delivery of services that are recommended once in a lifetime,

such as hepatitis B vaccination. Our analysis also has a number of strengths. It is based on larger numbers of HIV-positive patients in geographically dispersed treatment settings, rather than on a small number of patients in a limited number of clinics.

It has previously been unclear whether patients whose primary care is driven by HIV specialty providers receive the preventive services that they need. Our results suggest that HIV specialists have weathered the evolution, over the past 30 years of the HIV epidemic, of HIV care from a practice largely focused on opportunistic infection management and end-of-life care, to one of highly specialized and nuanced antiretroviral management, to the current era ever-more focused on preventive care and long-term toxicity management.

Despite the near-universal use of ART in this population of publicly insured PLWHA, our results demonstrate substantial gaps in routine monitoring to assess viral suppression, even among patients with the most experienced providers. Patients with access to experienced HIV providers were as likely or more likely as others to receive routine assessments of common comorbidities, but rates at which these screens occurred were suboptimal.

Using provider education, automated EMR-based reminders, or other mechanisms to assure that primary care for PLWHA includes assessments of both HIV-specific outcomes and screening for comorbidities could have the greatest payoff among the providers with low caseloads of HIV patients. However, even the largest HIV providers are missing opportunities to provide comprehensive monitoring and preventive care for their HIV-infected patients. The large gaps that remain between actual and recommended levels of preventive services suggest that even the highest volume providers need to increase guideline fidelity of their assessments for latent TB, cervical cancer, and dyslipidemia, and administration of influenza vaccine.

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Authors' Contributions

R.J.L., K.A.D., and A.A.L. conceptualized the study. K.A.D. and J.L.G. were responsible for the statistical analysis. All authors contributed to the interpretation of the data and to the drafting and revising of the article. All authors approved the final version of the article.

Author Disclosure Statement

No competing financial interests exist.

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APPENDIX TABLE 1. OBSERVED PERCENTAGES OF CALIFORNIA MEDICARE AND MEDICAID PEOPLE LIVING WITH HIV/AIDS RECEIVING GUIDELINE HIV-SPECIFIC AND PRIMARY CARE IN 2010

Group	CD4 testing			VL testing			Flu shot			TB test			Lipid panel			Glucose test			Pap smear		
	n (% in group)	χ^2 p value		n (% in group)	χ^2 p value		n (% in group)	χ^2 p value		n (% in group)	χ^2 p value		n (% in group)	χ^2 p value		n (% in group)	χ^2 p value		n (% in group)	χ^2 p value	
Medicare enrollees																					
Total	7708 (88.5)			7423 (85.3)			4078 (46.8)			1613 (18.5)			6263 (71.9)			8260 (94.9)			350 (40.3)		
Enrollment																					
Medicare only	2357 (90.7)	<0.001		2398 (92.2)	<0.001		1452 (55.8)	<0.001		380 (14.6)	<0.001		2075 (79.8)	<0.001		2503 (96.3)	<0.001		48 (34.0)	0.10	
Dual	5351 (87.6)			5025 (82.3)			2626 (43.0)			1233 (20.2)			4188 (68.6)			5757 (94.3)			302 (41.5)		
Age																					
<30	48 (81.4)			51 (86.4)			22 (37.3)			13 (22.0)			28 (47.5)			53 (89.8)					
30-39	397 (84.8)			364 (77.8)			173 (37.0)			116 (24.8)			262 (56.0)			445 (95.1)			24 (36.9)		
40-49	2565 (88.3)	0.002		2460 (84.7)	<0.001		1201 (41.3)	<0.001		582 (20.0)	<0.001		1957 (67.4)	<0.001		2741 (94.4)	0.08		128 (49.8)	<0.001	
50-65	3576 (89.7)			3448 (86.5)			1982 (49.7)			727 (18.2)			2976 (74.6)			3786 (95.0)			153 (42.3)		
65+	1122 (87.2)			1100 (85.5)			700 (54.4)			175 (13.6)			1040 (80.9)			1235 (96.0)			36 (21.4)		
Gender																					
Male	7003 (89.4)	<0.001		6737 (86.0)	<0.001		3725 (47.5)	<0.001		1440 (18.4)	0.26		5714 (72.9)	<0.001		7465 (95.3)	<0.001		350 (40.3)		
Female	705 (81.2)			686 (79.0)			353 (40.7)			173 (19.9)			549 (63.2)			795 (91.6)					
Race																					
White	4686 (90.4)			4557 (88.0)			2578 (49.8)			878 (16.9)			3904 (75.4)			4960 (95.7)			142 (41.4)		
African American	1296 (85.3)	<0.001		1217 (80.1)	<0.001		656 (43.2)	<0.001		329 (21.6)	<0.001		968 (63.7)	<0.001		1422 (93.6)	<0.001		129 (41.3)	0.43	
Hispanic	1394 (85.3)			1337 (81.8)			656 (40.1)			343 (21.0)			1126 (68.9)			1525 (93.3)			68 (39.1)		
Other	332 (90.0)			312 (84.6)			188 (50.9)			63 (17.1)			265 (71.8)			353 (95.7)			11 (28.2)		
Most experienced provider has																					
50+ HIV patients	5233 (90.6)			4991 (86.4)			2657 (46.0)			1290 (22.3)			4134 (71.6)			5475 (94.8)			244 (45.1)		
5-49 HIV patients	1896 (87.3)	<0.001		1858 (85.5)	<0.001		1143 (52.6)	<0.001		258 (11.9)	<0.001		1570 (72.3)	0.37		2059 (94.8)	0.33		72 (32.9)	0.001	
<5 HIV patients	579 (76.6)			574 (75.9)			278 (36.8)			65 (8.6)			559 (73.9)			726 (96.0)			34 (31.5)		
Comorbidities																					
None	4543 (88.6)			4336 (84.6)			2302 (44.9)			924 (18.0)			3505 (68.4)			4790 (93.4)			209 (43.5)		
One	2090 (89.4)			2033 (86.9)			1139 (48.7)			462 (19.8)			1752 (74.9)			2247 (96.1)			84 (36.5)		
Two	693 (89.2)	<0.001		682 (87.8)	<0.001		389 (50.1)	<0.001		149 (19.2)	0.26		621 (79.9)	<0.001		764 (98.3)	<0.001		32 (35.2)	0.24	
Three	251 (86.3)			249 (85.6)			156 (53.6)			45 (15.5)			242 (83.2)			287 (98.6)			16 (42.1)		
Four or more	131 (76.2)			123 (71.5)			92 (53.5)			33 (19.2)			143 (83.1)			172 (100.0)					
Adjustment/anxiety disorders																					
No diagnosis	7255 (88.5)	0.65		6999 (85.4)	0.24		3861 (47.1)	0.06		1523 (18.6)	0.63		5898 (72.0)	0.96		7767 (94.8)	0.02		314 (39.6)	0.19	
Diagnosis	453 (89.2)			424 (83.5)			217 (42.7)			90 (17.7)			365 (71.9)			493 (97.0)			36 (47.4)		
Mood disorders																					
No diagnosis	6416 (88.6)	0.94		6203 (85.6)	0.04		3416 (47.1)	0.21		1323 (18.3)	0.15		5220 (72.0)	0.64		6864 (94.7)	0.17		280 (38.9)	0.06	
Diagnosis	1292 (88.5)			1220 (83.6)			662 (45.3)			290 (19.9)			1043 (71.4)			1396 (95.6)			70 (47.3)		
Schizophrenia/other psychosis																					
No diagnosis	7449 (88.9)	<0.001		7184 (85.7)	<0.001		3961 (47.3)	<0.001		1549 (18.5)	0.62		6046 (72.2)	0.02		7957 (95.0)	0.06		329 (39.8)	0.15	
Diagnosis	259 (79.2)			239 (73.1)			117 (35.8)			64 (19.6)			217 (66.4)			303 (92.7)			21 (51.2)		

(continued)

APPENDIX TABLE 1. (CONTINUED)

Group	CD4 testing		VL testing		Flu shot		TB test		Lipid panel		Glucose test		Pap smear	
	n (% in group)	χ^2 p value	n (% in group)	χ^2 p value	n (% in group)	χ^2 p value	n (% in group)	χ^2 p value	n (% in group)	χ^2 p value	n (% in group)	χ^2 p value	n (% in group)	χ^2 p value
Other mental health disorders														
No diagnosis	7496 (88.8)	<0.001	7229 (85.6)	<0.001	3978 (47.1)	0.007	1556 (18.4)	0.14	6092 (72.1)	0.03	8019 (94.9)	0.17	329 (39.9)	0.24
Diagnosis	212 (81.9)		194 (74.9)		100 (38.6)		57 (22.0)		171 (66.0)		241 (93.1)		21 (48.8)	
Medicaid enrollees														
Total	1670 (89.4)		1522 (81.5)		638 (34.2)		656 (35.1)		1203 (64.4)		1785 (95.6)		232 (44.8)	
Age														
<30	62 (84.9)		64 (87.7)		23 (31.5)		24 (32.9)		34 (46.6)		71 (97.3)		13 (48.1)	
30–39	154 (88.0)		141 (80.6)		54 (30.9)		66 (37.7)		110 (62.9)		166 (94.9)		32 (59.3)	
40–49	665 (91.5)	0.19	606 (83.4)	0.23	243 (33.4)	0.58	266 (36.6)	0.18	472 (64.9)	0.02	700 (96.3)	0.63	82 (45.3)	0.06
50–65	782 (88.5)		705 (79.8)		314 (35.5)		300 (33.9)		583 (66.0)		840 (95.0)		105 (41.7)	
65+														
Gender														
Male	1218 (90.3)	0.06	1100 (81.5)	0.97	461 (34.2)	0.999	476 (35.3)	0.83	904 (67.0)	<0.001	1298 (96.2)	0.04	232 (44.8)	
Female	452 (87.3)		422 (81.5)		177 (34.2)		180 (34.7)		299 (57.7)		487 (94.0)			
Race														
White	644 (91.0)		551 (77.8)		224 (31.6)		269 (38.0)		491 (69.4)		679 (95.9)		51 (39.2)	
African American	542 (86.7)	0.02	510 (81.6)	0.002	202 (32.3)	0.01	199 (31.8)	0.04	359 (57.4)	<0.001	596 (95.4)	0.81	118 (46.3)	0.53
Hispanic	306 (92.2)		286 (86.1)		135 (40.7)		126 (38.0)		215 (64.8)		319 (96.1)		39 (47.0)	
Other	178 (88.1)		175 (86.6)		77 (38.1)		62 (30.7)		138 (68.3)		191 (94.6)		24 (48.0)	
Most experienced provider has														
50+ HIV patients	1198 (89.9)		1073 (80.5)		463 (34.7)		512 (38.4)		841 (63.1)		1276 (95.7)		187 (47.6)	
5–49 HIV patients	384 (91.9)	<0.001	362 (86.6)	0.003	137 (32.8)	0.72	129 (30.9)	<0.001	293 (70.1)	0.02	404 (96.7)	0.02	39 (40.6)	0.01
<5 HIV patients	88 (75.9)		87 (75.0)		38 (32.8)		15 (12.9)		69 (59.5)		105 (90.5)			
Comorbidities														
None	1049 (89.3)		959 (81.6)		387 (32.9)		418 (35.6)		730 (62.1)		1112 (94.6)		134 (44.7)	
One	450 (89.8)		411 (82.0)		187 (37.3)		167 (33.3)		345 (68.9)		484 (96.6)		69 (44.8)	
Two	110 (89.4)	0.998	100 (81.3)	0.68	42 (34.1)	0.33	47 (38.2)	0.76	76 (61.8)	0.02	122 (99.2)	0.06	19 (50.0)	0.91
Three	44 (89.8)		36 (73.5)		18 (36.7)		16 (32.7)		37 (75.5)		48 (98.0)			
Four or more	17 (89.5)		16 (84.2)						15 (78.9)		19 (100.0)			
Adjustment/anxiety disorders														
No diagnosis	1598 (89.2)	0.13	1467 (81.9)	0.04	612 (34.2)	0.99	626 (35.0)	0.42	1156 (64.5)	0.63	1713 (95.6)	0.71	226 (45.0)	0.55
Diagnosis	72 (94.7)		55 (72.4)		26 (34.2)		30 (39.5)		47 (61.8)		72 (94.7)			
Mood disorders														
No diagnosis	1474 (89.3)	0.66	1353 (82.0)	0.14	555 (33.6)	0.18	572 (34.7)	0.24	1052 (63.8)	0.09	1576 (95.5)	0.59	213 (46.3)	0.05
Diagnosis	196 (90.3)		169 (77.9)		83 (38.2)		84 (38.7)		151 (69.6)		209 (96.3)		19 (32.8)	
Schizophrenia/other psychosis														
No diagnosis	1588 (89.7)	0.11	1442 (81.5)	0.80	601 (34.0)	0.40	621 (35.1)	0.84	1138 (64.3)	0.59	1691 (95.5)	0.52	224 (45.4)	0.19
Diagnosis	82 (84.5)		80 (82.5)		37 (38.1)		35 (36.1)		65 (67.0)		94 (96.9)			
Other mental health disorders														
No diagnosis	1615 (89.6)	0.20	1470 (81.6)	0.75	617 (34.2)	0.75	636 (35.3)	0.45	1159 (64.3)	0.58	1721 (95.5)	0.25	225 (44.9)	0.76
Diagnosis	55 (84.6)		52 (80.0)		21 (32.3)		20 (30.8)		44 (67.7)		64 (98.5)			

Sample includes all people living with HIV/AIDS who met visit guidelines in 2010, found in Table 1. For privacy reasons, cell sizes of less than 11 are not reported.
TB, tuberculosis; VL, viral load.

APPENDIX TABLE 2. LOGIT ODDS RATIOS AND CONFIDENCE INTERVALS FOR CALIFORNIA MEDICARE AND MEDICAID PEOPLE LIVING WITH HIV/AIDS RECEIVING GUIDELINE CARE IN 2010

Category	Guideline visits OR (95% CI)	CD4 testing OR (95% CI)	VL testing OR (95% CI)	Flu shot OR (95% CI)	TB test OR (95% CI)	Lipid panel OR (95% CI)	Glucose test OR (95% CI)	Pap smear OR (95% CI)
Medicare enrollees								
Enrollment group								
Dual vs. Medicare only	0.57 (0.45–0.73)	0.82 (0.69–0.97)	0.42 (0.35–0.50)	0.70 (0.63–0.78)	1.20 (1.04–1.37)	0.68 (0.60–0.76)	0.71 (0.55–0.90)	0.98 (0.64–1.49)
Age								
30–39 vs. <30	1.81 (0.76–4.34)	1.24 (0.61–2.54)	0.51 (0.23–1.12)	0.96 (0.54–1.68)	1.24 (0.64–2.39)	1.23 (0.71–2.14)	1.85 (0.71–4.80)	0.40 (0.13–1.25)
40–49 vs. <30	2.40 (1.05–5.45)	1.56 (0.79–3.07)	0.71 (0.33–1.52)	1.05 (0.61–1.79)	0.99 (0.53–1.86)	1.78 (1.05–3.01)	1.35 (0.57–3.24)	0.72 (0.26–2.03)
50–64 vs. <30	2.97 (1.31–6.77)	1.72 (0.87–3.38)	0.71 (0.33–1.52)	1.34 (0.78–2.29)	0.92 (0.49–1.72)	2.27 (1.34–3.84)	1.30 (0.54–3.11)	0.56 (0.20–1.57)
65+ vs. <30	3.79 (1.61–8.93)	1.45 (0.72–2.90)	0.57 (0.27–1.25)	1.49 (0.86–2.57)	0.73 (0.38–1.39)	2.90 (1.69–4.99)	1.46 (0.59–3.63)	0.22 (0.07–0.64)
Gender								
Female vs. male	0.93 (0.69–1.25)	0.61 (0.50–0.74)	0.78 (0.65–0.94)	0.83 (0.72–0.96)	1.07 (0.89–1.28)	0.72 (0.61–0.84)	0.57 (0.44–0.75)	
Race								
African American vs. white	0.89 (0.68–1.16)	0.72 (0.60–0.86)	0.68 (0.58–0.80)	0.87 (0.77–0.99)	1.24 (1.06–1.44)	0.65 (0.57–0.74)	0.71 (0.55–0.91)	0.93 (0.66–1.30)
Hispanic vs. white	0.89 (0.70–1.13)	0.67 (0.56–0.79)	0.73 (0.62–0.85)	0.75 (0.67–0.84)	1.23 (1.06–1.42)	0.80 (0.71–0.91)	0.65 (0.51–0.83)	0.92 (0.62–1.36)
Other vs. white	0.82 (0.52–1.30)	0.98 (0.69–1.41)	0.75 (0.56–1.01)	1.08 (0.87–1.34)	1.01 (0.76–1.34)	0.87 (0.68–1.10)	1.01 (0.60–1.71)	0.66 (0.31–1.42)
Most experienced provider has								
5–49 HIV patients	0.85 (0.61–1.17)	0.68 (0.58–0.80)	0.82 (0.71–0.95)	1.19 (1.08–1.32)	0.49 (0.42–0.57)	0.91 (0.81–1.02)	0.91 (0.72–1.14)	0.63 (0.45–0.89)
vs. 50+ HIV patients								
<5 HIV patients vs. 50+ HIV patients	0.03 (0.02–0.03)	0.35 (0.29–0.42)	0.47 (0.39–0.57)	0.62 (0.53–0.73)	0.33 (0.25–0.43)	0.97 (0.81–1.16)	1.12 (0.76–1.66)	0.66 (0.41–1.06)
Comorbidities								
One vs. none	2.39 (1.89–3.03)	1.14 (0.97–1.34)	1.30 (1.12–1.51)	1.16 (1.05–1.28)	1.18 (1.04–1.35)	1.34 (1.20–1.51)	1.77 (1.39–2.25)	0.74 (0.53–1.05)
Two vs. none	7.84 (4.64–13.23)	1.25 (0.97–1.61)	1.57 (1.24–1.98)	1.26 (1.07–1.47)	1.20 (0.98–1.46)	1.86 (1.54–2.25)	4.44 (2.53–7.79)	0.88 (0.53–1.46)
Three vs. none	6.81 (3.19–14.52)	1.01 (0.71–1.45)	1.40 (0.99–1.99)	1.47 (1.15–1.87)	0.95 (0.68–1.33)	2.36 (1.71–3.24)	5.56 (2.05–15.10)	1.29 (0.63–2.65)
Four or more vs. none	22.66 (5.43–94.64)	0.59 (0.40–0.86)	0.64 (0.45–0.92)	1.59 (1.16–2.18)	1.32 (0.89–1.97)	2.39 (1.58–3.61)		0.80 (0.34–1.89)
Mental health diagnoses								
Adjustment/ anxiety diagnosis vs. none	1.23 (0.77–1.95)	1.23 (0.91–1.68)	1.02 (0.79–1.32)	0.91 (0.75–1.10)	0.88 (0.69–1.13)	1.02 (0.83–1.27)	1.79 (1.05–3.07)	1.09 (0.66–1.81)
Mood disorder diagnosis vs. none	1.58 (1.16–2.15)	1.04 (0.86–1.26)	0.97 (0.82–1.14)	1.03 (0.91–1.16)	1.04 (0.89–1.21)	1.02 (0.89–1.17)	1.17 (0.88–1.56)	1.17 (0.79–1.74)
Schizophrenia diagnosis vs. none	1.05 (0.63–1.75)	0.53 (0.40–0.71)	0.58 (0.45–0.76)	0.73 (0.58–0.93)	0.97 (0.73–1.30)	0.90 (0.70–1.15)	0.63 (0.40–0.99)	1.28 (0.66–2.48)

(continued)

APPENDIX TABLE 2. (CONTINUED)

Category	Guideline visits OR (95% CI)	CD4 testing OR (95% CI)	VL testing OR (95% CI)	Flu shot OR (95% CI)	TB test OR (95% CI)	Lipid panel OR (95% CI)	Glucose test OR (95% CI)	Pap smear OR (95% CI)
Other mental health diagnosis vs. none	0.72 (0.39–1.30)	0.62 (0.44–0.88)	0.55 (0.41–0.75)	0.72 (0.55–0.94)	1.22 (0.89–1.66)	0.69 (0.52–0.90)	0.59 (0.35–0.98)	1.70 (0.87–3.33)
Medicaid enrollees								
Age								
30–39 vs. <30	0.51 (0.16–1.62)	1.29 (0.58–2.88)	0.62 (0.28–1.38)	0.99 (0.54–1.79)	1.16 (0.64–2.09)	1.92 (1.09–3.38)	0.53 (0.11–2.52)	1.66 (0.62–4.41)
40–49 vs. <30	0.53 (0.19–1.50)	1.75 (0.86–3.56)	0.77 (0.37–1.60)	1.13 (0.67–1.91)	1.07 (0.63–1.81)	2.01 (1.22–3.30)	0.67 (0.15–2.92)	0.80 (0.34–1.89)
50–64 vs. <30	0.72 (0.26–2.02)	1.29 (0.65–2.59)	0.61 (0.29–1.25)	1.24 (0.74–2.09)	0.97 (0.58–1.64)	2.08 (1.27–3.40)	0.45 (0.11–1.93)	0.71 (0.31–1.64)
65+ vs. <30	0.56 (0.06–4.85)	1.77 (0.19–16.73)	0.41 (0.07–2.41)	2.18 (0.49–9.60)		1.41 (0.32–6.22)		
Gender								
Female vs. male	1.22 (0.79–1.90)	0.80 (0.57–1.11)	0.97 (0.74–1.28)	1.00 (0.80–1.25)	1.02 (0.82–1.27)	0.73 (0.59–0.91)	0.59 (0.37–0.95)	
Race								
African American vs. white	1.40 (0.90–2.19)	0.71 (0.49–1.01)	1.26 (0.95–1.67)	1.02 (0.80–1.30)	0.76 (0.60–0.96)	0.63 (0.49–0.79)	0.93 (0.53–1.60)	1.38 (0.89–2.16)
Hispanic vs. white	1.30 (0.79–2.15)	1.26 (0.78–2.05)	1.71 (1.19–2.46)	1.51 (1.14–1.98)	1.06 (0.81–1.40)	0.83 (0.63–1.10)	1.06 (0.54–2.10)	1.71 (0.95–3.09)
Other vs. white	1.99 (1.01–3.91)	0.80 (0.48–1.33)	1.83 (1.17–2.87)	1.35 (0.97–1.87)	0.74 (0.53–1.04)	0.99 (0.71–1.40)	0.77 (0.37–1.59)	1.39 (0.69–2.78)
Most experienced provider has								
5–49 HIV patients	0.63 (0.36–1.09)	1.22 (0.82–1.82)	1.50 (1.09–2.06)	0.90 (0.71–1.14)	0.70 (0.55–0.88)	1.39 (1.09–1.78)	1.31 (0.71–2.38)	0.72 (0.45–1.15)
vs. 50+ HIV patients								
<5 HIV patients vs. 50+ HIV patients	0.02 (0.01–0.03)	0.33 (0.21–0.53)	0.70 (0.45–1.10)	0.87 (0.58–1.31)	0.23 (0.13–0.41)	0.86 (0.58–1.27)	0.42 (0.21–0.83)	0.25 (0.10–0.63)
Comorbidities								
One vs. none	1.36 (0.88–2.09)	1.17 (0.82–1.67)	1.06 (0.80–1.40)	1.20 (0.96–1.50)	0.95 (0.75–1.19)	1.41 (1.12–1.77)	1.78 (1.02–3.11)	1.04 (0.69–1.58)
Two vs. none	3.17 (1.17–8.56)	1.11 (0.60–2.06)	1.06 (0.65–1.72)	1.04 (0.70–1.55)	1.16 (0.78–1.72)	1.03 (0.70–1.53)	7.60 (1.04–55.64)	1.27 (0.63–2.55)
Three vs. none	2.25 (0.28–18.06)	1.10 (0.42–2.87)	0.67 (0.34–1.30)	1.07 (0.59–1.96)	0.81 (0.43–1.50)	1.96 (1.00–3.83)	3.00 (0.40–22.39)	0.97 (0.35–2.73)
Four or more vs. none		1.30 (0.29–5.83)	1.32 (0.38–4.64)	0.53 (0.17–1.62)	1.41 (0.55–3.60)	2.59 (0.84–7.95)		0.76 (0.18–3.27)
Mental health diagnoses								
Adjustment/ anxiety diagnosis vs. none	1.76 (0.67–4.63)	2.30 (0.82–6.48)	0.67 (0.39–1.14)	0.95 (0.58–1.56)	1.15 (0.71–1.88)	0.78 (0.47–1.27)	0.79 (0.27–2.30)	0.83 (0.28–2.47)
Mood disorder diagnosis vs. none	1.44 (0.77–2.68)	1.13 (0.68–1.86)	0.85 (0.59–1.22)	1.25 (0.92–1.70)	1.15 (0.85–1.57)	1.31 (0.95–1.80)	1.15 (0.53–2.48)	0.50 (0.27–0.93)
Schizophrenia diagnosis vs. none	0.63 (0.30–1.34)	0.68 (0.37–1.26)	1.19 (0.67–2.10)	1.22 (0.78–1.91)	1.09 (0.69–1.72)	1.11 (0.70–1.76)	1.19 (0.35–3.96)	0.49 (0.20–1.22)
Other mental health diagnosis vs. none	0.82 (0.34–1.97)	0.68 (0.32–1.46)	0.93 (0.48–1.81)	0.78 (0.44–1.38)	0.70 (0.39–1.24)	1.08 (0.61–1.91)	2.55 (0.33–19.56)	1.01 (0.34–3.03)

Cells are blank where sample sizes were too small to estimate odds ratios. CI, confidence interval; OR, odds ratio; TB, tuberculosis; VL, viral load.

APPENDIX TABLE 3. ADJUSTED PERCENTAGES OF CALIFORNIA MEDICARE AND MEDICAID PEOPLE LIVING WITH HIV/AIDS RECEIVING GUIDELINE CARE IN 2010 BY PATIENT CHARACTERISTICS

Category	Guideline visits % (95% CI)	CD4 testing % (95% CI)	VL testing % (95% CI)	Flu shot % (95% CI)	TB test % (95% CI)	Lipid panel % (95% CI)	Glucose test % (95% CI)	Pap smear % (95% CI)
Medicare enrollees								
Enrollment group								
Medicare only (ref.)	94.6 (93.8–95.4)	89.9 (88.7–91.2)	91.8 (90.7–92.9)	52.9 (50.9–54.9)	16.6 (15.1–18.2)	77.2 (75.5–79.0)	96.0 (95.1–96.7)	40.7 (32.0–49.5)
Dual	92.2 (91.6–92.7) [†]	88.0 (87.2–88.8) [*]	82.7 (81.7–83.6) [†]	44.3 (43.0–45.5) [†]	19.2 (18.2–20.2) [*]	69.9 (68.8–71.1) [†]	94.5 (93.8–94.9) [†]	40.2 (36.8–43.7)
Age								
<30 (ref.)	87.0 (81.2–92.9)	83.3 (74.4–92.2)	89.4 (82.5–96.3)	41.9 (29.2–54.6)	19.6 (10.0–29.1)	56.1 (43.7–68.5)	93.2 (87.6–98.5)	56.7 (32.5–80.9)
30–39	90.8 (88.9–92.7)	86.0 (83.0–89.0)	81.6 (78.4–84.8)	40.9 (36.3–45.4)	23.1 (19.3–26.8)	61.0 (56.7–65.3)	96.2 (94.5–97.7)	35.1 (23.6–46.5)
40–49	92.3 (91.5–93.0) [*]	88.4 (87.3–89.6)	85.8 (84.6–87.1)	43.0 (41.2–44.8)	19.4 (18.0–20.9)	69.1 (67.4–70.8) [*]	94.9 (94.0–95.5)	48.8 (42.6–54.9)
50–64	93.3 (92.6–93.9) [†]	89.4 (88.4–90.3)	85.9 (84.8–86.9)	48.9 (47.4–50.4)	18.3 (17.1–19.5)	73.9 (72.5–75.3) [†]	94.7 (93.8–95.3)	42.5 (37.4–47.6)
65+	94.3 (93.2–95.4) [†]	87.7 (85.8–89.5)	83.2 (81.0–85.4)	51.5 (48.7–54.3)	15.1 (13.0–17.2)	78.2 (75.8–80.6) [†]	95.2 (93.8–96.4)	22.6 (15.8–29.3) [†]
Gender								
Male (ref.)	92.9 (92.4–93.3)	89.2 (88.5–89.9)	85.6 (84.9–86.4)	47.3 (46.2–48.4)	18.4 (17.6–19.3)	72.7 (71.7–73.6)	95.2 (94.6–95.6)	
Female	92.5 (91.2–93.9)	83.6 (81.2–86.0) [†]	82.4 (80.1–84.8) [†]	42.8 (39.5–46.2) [*]	19.4 (16.8–22.0)	65.9 (62.8–69.0) [†]	92.0 (90.0–93.7) [†]	
Race								
White (ref.)	93.1 (92.5–93.7)	90.0 (89.1–90.8)	87.1 (86.2–88.1)	48.6 (47.2–50.0)	17.4 (16.3–18.4)	74.4 (73.2–75.6)	95.6 (94.9–96.1)	41.7 (36.5–46.9)
African American	92.6 (91.5–93.6)	86.6 (85.0–88.3) [†]	82.3 (80.5–84.2) [†]	45.4 (42.8–47.9) [*]	20.5 (18.5–22.5) [†]	65.8 (63.4–68.1) [†]	93.9 (92.6–95.0) [†]	40.0 (34.7–45.4)
Hispanic	92.5 (91.6–93.5)	85.9 (84.2–87.5) [†]	83.3 (81.5–85.0) [†]	41.8 (39.4–44.2) [†]	20.4 (18.5–22.4) [†]	70.2 (68.0–72.4) [†]	93.5 (92.1–94.5) [†]	39.8 (32.6–46.9)
Other	92.2 (90.0–94.3)	89.8 (86.8–92.9)	83.7 (79.9–87.5)	50.5 (45.5–55.5)	17.5 (13.6–21.3)	71.7 (67.2–76.2)	95.7 (93.5–97.7)	32.6 (17.4–47.8)
Comorbidities								
None (ref.)	90.6 (89.9–91.2)	88.1 (87.2–89.0)	83.9 (82.9–85.0)	44.9 (43.5–46.2)	17.6 (16.6–18.6)	68.6 (67.3–69.9)	93.3 (92.7–94.0)	42.3 (37.9–46.6)
One	94.8 (94.0–95.5) [†]	89.4 (88.2–90.7)	87.1 (85.7–88.4) [†]	48.5 (46.5–50.5) [†]	20.1 (18.5–21.7) [†]	74.4 (72.6–76.2) [†]	96.1 (95.3–96.9) [†]	35.7 (29.7–41.7)
Two	98.0 (97.1–98.9) [†]	90.2 (88.3–92.2)	89.0 (86.9–91.1) [†]	50.4 (46.9–53.8) [†]	20.2 (17.4–23.1)	79.9 (77.1–82.7) [†]	98.4 (97.5–99.3) [†]	39.4 (29.2–49.7)
Three	97.7 (96.3–99.2) [†]	88.3 (84.8–91.8)	87.9 (84.4–91.3)	54.1 (48.4–59.8) [†]	16.9 (12.4–21.3)	83.4 (79.1–87.6) [†]	98.7 (97.5–100.0) [†]	48.2 (32.3–64.2)
Four or more	99.3 (98.2–100.0) [†]	81.7 (76.4–87.0) [†]	77.4 (71.6–83.2) [*]	56.1 (48.7–63.4) [†]	21.9 (15.4–28.4)	83.6 (78.1–89.0) [†]	100.0	37.2 (18.8–55.6)
Adjustment/anxiety								
No diagnosis (ref.)	92.8 (92.3–93.2)	88.4 (87.7–89.1)	85.3 (84.5–86.0)	47.0 (45.9–48.0)	18.6 (17.8–19.5)	71.9 (71.0–72.9)	94.8 (94.2–95.1)	40.1 (36.8–43.5)
Diagnosis	93.7 (91.8–95.6)	90.3 (87.8–92.9)	85.5 (82.5–88.5)	44.7 (40.2–49.1)	16.8 (13.6–20.1)	72.4 (68.5–76.3)	97.0 (95.4–98.5) [*]	42.1 (31.2–53.0)
Mood disorders								
No diagnosis (ref.)	92.5 (92.0–93.0)	88.5 (87.7–89.2)	85.3 (84.5–86.2)	46.7 (45.6–47.9)	18.4 (17.5–19.3)	71.9 (70.9–72.9)	94.8 (94.1–95.2)	39.7 (36.1–43.2)
Diagnosis	94.5 (93.4–95.6) [†]	88.9 (87.2–90.5)	84.9 (83.1–86.8)	47.4 (44.8–50.1)	19.0 (16.9–21.0)	72.3 (69.9–74.6)	95.5 (94.2–96.5)	43.3 (35.1–51.4)
Schizophrenia								
No diagnosis (ref.)	92.8 (92.4–93.3)	88.9 (88.2–89.5)	85.6 (84.9–86.4)	47.1 (46.1–48.2)	18.5 (17.7–19.4)	72.0 (71.1–73.0)	95.0 (94.4–95.4)	40.0 (36.8–43.3)
Diagnosis	93.1 (90.8–95.3)	81.2 (77.1–85.4) [†]	78.0 (73.7–82.2) [†]	39.7 (34.3–45.2) [*]	18.2 (14.0–22.3)	69.9 (65.1–74.8)	92.4 (89.2–95.3) [*]	45.7 (30.8–60.6)
Other mental health disorders								
No diagnosis (ref.)	92.9 (92.4–93.3)	88.7 (88.1–89.4)	85.5 (84.8–86.3)	47.1 (46.0–48.1)	18.4 (17.6–19.3)	72.2 (71.2–73.1)	95.0 (94.4–95.3)	39.7 (36.5–43.0)
Diagnosis	91.2 (88.1–94.4)	83.3 (78.8–87.8) [†]	77.0 (72.0–82.0) [†]	39.3 (33.3–45.3) [*]	21.5 (16.5–26.5)	64.4 (58.6–70.3) [†]	91.8 (87.9–95.4) [*]	52.0 (36.9–67.1)
Medicaid enrollees								
Age								
<30 (ref.)	92.4 (87.5–97.1)	85.7 (77.9–93.6)	86.7 (78.6–94.7)	30.8 (20.3–41.4)	34.6 (23.6–45.7)	48.5 (37.0–59.9)	97.5 (94.1–100.0)	49.8 (30.8–68.8)
30–39	88.8 (85.1–92.3)	88.5 (83.9–93.1)	80.3 (74.3–86.2)	30.6 (23.7–37.4)	38.0 (30.8–45.2)	63.9 (56.9–70.9) [*]	95.4 (92.4–98.3)	61.7 (48.7–74.6)
40–49	89.0 (87.2–90.6)	91.2 (89.1–93.3)	83.4 (70.7–86.1)	33.5 (30.0–36.9)	36.1 (32.7–39.6)	64.9 (61.4–68.3) [†]	96.4 (95.0–97.7)	44.7 (37.4–51.8)
50–64	90.7 (89.2–92.1)	88.5 (86.4–90.6)	79.9 (77.3–82.5)	35.6 (32.4–38.8)	34.1 (31.0–37.2)	65.6 (62.5–68.7) [†]	94.7 (93.2–96.2)	41.6 (35.5–47.6)
65+	89.3 (77.6–100.0)	91.3 (74.6–100.0)	73.2 (72.1–100.0)	49.1 (14.5–83.6)	0.0	56.8 (23.4–90.2)	100.0	0.0
Gender								
Male (ref.)	89.7 (88.4–90.8)	90.1 (88.5–91.7)	81.6 (79.6–83.7)	34.2 (31.6–36.7)	35.0 (32.6–37.7)	66.4 (63.9–68.9)	96.3 (95.2–97.2)	
Female	90.8 (88.6–92.8)	87.9 (85.2–90.7)	81.2 (77.8–84.6)	34.2 (30.0–38.3)	35.5 (31.4–39.8)	59.4 (55.2–63.7) [†]	93.9 (91.6–95.9) [*]	

(continued)

APPENDIX TABLE 3. (CONTINUED)

Category	Guideline visits % (95% CI)	CD4 testing % (95% CI)	VL testing % (95% CI)	Flu shot % (95% CI)	TB test % (95% CI)	Lipid panel % (95% CI)	Glucose test % (95% CI)	Pap smear % (95% CI)
Race								
White (ref.)	88.6 (86.7–90.3)	90.5 (88.3–92.7)	78.0 (74.9–81.1)	31.6 (28.2–35.1)	37.7 (34.3–41.4)	68.7 (65.3–72.2)	95.8 (94.2–97.3)	38.4 (30.5–47.0)
African American	90.6 (88.6–92.4)	87.2 (84.6–89.8)	81.7 (78.6–84.8)	32.1 (28.4–35.8) [†]	31.5 (28.0–35.3)*	58.1 (54.2–62.0) [†]	95.5 (93.8–97.1)	45.9 (40.2–52.3)
Hispanic	90.2 (87.8–92.4)	92.3 (89.4–95.1)	85.8 (72.0–89.6) [†]	41.0 (35.7–46.3) [†]	39.1 (34.0–44.6)	64.7 (59.6–69.9)	96.0 (93.8–98.1)	50.9 (40.3–62.3)
Other	92.4 (89.3–95.3)*	88.5 (84.1–92.8)	86.6 (71.9–91.3) [†]	38.3 (31.6–45.1)	31.1 (24.8–37.6)	68.6 (62.2–74.9)	94.6 (91.5–97.7)	46.0 (32.5–60.3)
Comorbidities								
None (ref.)	89.1 (87.7–90.3)	88.9 (87.1–90.7)	81.4 (79.1–83.6)	33.1 (30.4–35.8)	35.3 (32.7–38.2)	61.8 (59.0–64.6)	94.5 (93.1–95.8)	44.2 (39.0–50.1)
One	90.8 (88.8–92.8)	90.4 (87.8–92.9)	82.2 (78.9–85.6)	37.2 (33.0–41.5)	34.1 (30.1–38.4)	69.3 (65.3–73.3) [†]	96.8 (95.3–98.3)*	45.2 (37.7–53.3)
Two	94.7 (91.0–98.4)*	89.9 (84.8–95.1)	82.2 (75.6–88.8)	34.0 (25.7–42.4)	38.6 (30.2–47.4)	62.6 (54.1–71.0)	99.2 (97.7–100.0)*	49.7 (34.6–65.6)
Three	93.3 (84.0–100.0)	89.8 (81.4–98.2)	74.6 (72.7–86.6)	34.6 (21.4–47.8)	30.6 (18.2–43.4)	75.7 (63.8–87.5)	98.1 (94.3–100.0)	43.6 (20.4–67.4)
Four or more	100.0	91.2 (79.6–100.0)	85.2 (79.7–100.0)	20.8 (2.6–39.0)	43.2 (21.3–65.5)	80.3 (63.1–97.6)	100.0	38.0 (6.0–70.6)
Adjustment/anxiety								
No diagnosis (ref.)	89.8 (88.6–90.8)	89.2 (87.8–90.6)	81.8 (70.0–83.6)	34.2 (32.0–36.4)	35.0 (33.0–37.3)	64.7 (62.5–66.8)	95.7 (94.6–96.5)	44.9 (41.0–49.5)
Diagnosis	92.7 (88.2–97.1)	94.9 (90.1–99.8)	75.1 (75.6–84.7)	33.1 (22.4–43.8)	38.2 (27.3–49.4)	58.9 (47.7–70.2)	94.6 (89.2–99.8)	40.7 (16.3–65.6)
Mood disorders								
No diagnosis (ref.)	89.7 (88.5–90.7)	89.3 (87.9–90.8)	81.8 (70.0–83.7)	33.6 (31.3–35.9)	34.8 (32.6–37.2)	63.8 (61.5–66.1)	95.5 (94.5–96.5)	46.6 (42.4–51.4)
Diagnosis	91.7 (88.6–94.6)	90.4 (86.4–94.4)	79.3 (73.9–84.7)	38.7 (32.0–45.4)	38.0 (31.5–44.7)	69.5 (63.3–75.7)	96.1 (93.3–98.8)	31.1 (19.4–43.3)*
Schizophrenia								
No diagnosis (ref.)	90.1 (88.9–91.1)	89.7 (88.3–91.1)	81.4 (79.6–83.2)	33.9 (31.7–36.1)	35.0 (33.0–37.4)	64.3 (62.1–66.5)	95.6 (94.6–96.5)	45.6 (41.6–50.3)
Diagnosis	87.3 (82.2–92.1)	85.7 (78.6–92.7)	83.8 (76.4–91.2)	38.5 (28.3–48.6)	36.9 (27.0–47.1)	66.5 (56.8–76.3)	96.2 (91.9–100.0)	29.7 (12.0–47.9)
Other mental health disorders								
No diagnosis (ref.)	90.0 (88.8–91.0)	89.6 (88.2–91.0)	81.6 (79.8–83.3)	34.4 (32.2–36.5)	35.4 (33.4–37.8)	64.4 (62.2–66.6)	95.5 (94.5–96.4)	44.8 (40.9–49.4)
Diagnosis	88.8 (83.5–94.0)	85.6 (76.8–94.4)	80.5 (70.4–90.5)	29.1 (17.8–40.4)	27.8 (16.8–39.1)	66.1 (54.1–78.2)	98.2 (94.5–100.0)	45.0 (20.1–70.7)

*Logit *p*-value <0.05, [†]Logit *p*-value <0.01.

CI, confidence interval; TB, tuberculosis; VL, viral load.