

Use of antiretroviral therapy in nursing home residents with HIV

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Abstract

Background: Antiretroviral therapies (ARTs) are essential HIV care. As people living with HIV age and their presence in nursing homes (NHs) increases, it is critical to evaluate the quality of HIV care. We determine the rate of ART use and examine individual- and facility-level characteristics associated with no ART use in a nationally representative long-stay NH residents with HIV.

Methods: This retrospective cohort study included all long-stay Medicare fee-for-service NH residents (2013–2016) with HIV who had a valid Minimum Data Set assessment. Residents were followed from long-stay qualification until death, Part D disenrollment, transfer from long-term care to another healthcare setting, or December 31, 2016. We identified individual and facility characteristics that were associated with non-use of ART using generalized estimating equation logistic regression.

Results: Exactly 4171 eligible HIV+ residents from 2459 NHs were included in our study. Only 36% (1507 of 4171) received any ART regimen during an average of 11.6 months of observation. Older age, females, white race, receipt of Medicare skilled nursing benefits, and some major cardiometabolic comorbidities and mental health conditions were associated with non-ART use. Rates of non-ART use did not vary significantly by residents' end-of-life status ($p = 0.21$). Residents in facilities with a higher HIV concentration [adjusted odds ratio (adjOR) 3.42; 95% confidence interval (CI) 2.13–5.48] and an AIDS unit (adjOR 2.51; 95% CI 1.92–3.30) had higher odds of using an ART.

Conclusions and Implications: The rate of ART use by HIV+ long-stay NH residents was low. Facilities' experience with HIV played an important role in ART receipt. Interventions to improve rates of ART use in NHs are urgently needed to ensure optimal health outcomes.

KEYWORDS

antiretroviral therapy, HIV, nursing home, quality of care

INTRODUCTION

HIV antiretroviral therapy (ART) is associated with reduced viral loads, improved quality of life, and survival in people living with HIV (PLWH)¹; and has been recommended to everyone with HIV regardless of CD4 counts or progression since 2013.² Owing to improved ART use, the number of aging PLWH has grown dramatically in the past decade,³ with more residing in NHs.⁴ Given their complicated healthcare needs, it is critical to evaluate the quality of HIV care delivered in NHs.

In prior work, we found that PLWH were more likely to be admitted to NHs with lower quality of care than HIV-negative persons.^{5,6} In the general population, NHs with low quality of care also experience poorer quality drug therapy and worse healthcare outcomes.⁷ However, there is limited evidence about the quality of HIV-specific care in NHs.^{8,9} We expand upon their work through investigation of a larger, national sample.

METHODS

We examined the rate of using ART regimens and characteristics associated ART non-use in a cohort of long-stay HIV-positive (HIV+) NH residents during 2013–2016. We used the 100% national Medicare Master Beneficiary Summary File (MBSF), Medicare Part D claims, the Chronic Condition Warehouse (CCW), the Minimum Data Set (MDS) version 3.0, and the Certification And Survey Provider Enhanced Reports (CASPER). The MBSF included person-level demographics, enrollment, and death data. The MDS includes more than 400 clinical characteristics.^{10,11} The CCW contains indicators of 62 chronic conditions for Medicare and Medicaid enrollees in the United States, developed using a series of algorithms typically involving outpatient, inpatient, and long-term care claims.¹² We linked these data with the CASPER database, which describes NH facility level characteristics.¹³ The Brown University IRB approved the study.

We identified NH long-stay residents with HIV using the International Classification of Diseases codes in the MDS diagnostic fields. Long stay was defined as residence in the same facility for 100 days with no more than 10 consecutive days outside the facility.¹⁴ We followed residents with HIV from the earlier date of either January 1, 2013 or the long-stay qualification date (i.e., the index date). The 100 days before the index date was defined as the baseline period. The follow-up end date was the earliest event of death, NH discharge to another setting (e.g., skilled nursing facilities [SNF], acute inpatient,

Key points

- Approximately two-thirds of people living with HIV who resided in nursing homes in the United States did not receive HIV drug therapies during an average of 12 months observation;
- Residents in nursing facilities with a higher HIV concentration and an AIDS unit had significantly higher odds of receiving HIV drug therapies.
- Evidence-based interventions that improve providers' awareness of appropriate HIV care or identify older patients who are still eligible for ART treatment are urgently needed.

Why does this paper matter?

Inadequate antiretroviral therapy for people with HIV has implications for disease progression, impaired quality of life, and increased risk of death.

community, hospice), discontinuation of Part D coverage, or end of study (December 31, 2016). Other exclusion criteria were: residents without continuous enrollment in Medicare Part D for at least 30 days following the index date or without a valid MDS assessment during baseline.

We defined the study outcome as the use of an ART regimen at any time during the follow-up (yes vs. no). Following prior work,^{15–17} we defined an ART regimen as at least two prescription fills of at least three ingredient products (e.g., nucleoside reverse transcriptase inhibitors, non-nucleoside reverse transcriptase inhibitors, protease inhibitors, or valid ART combinations).¹⁵ We ascertained resident and facility characteristics during the baseline period, including demographic information, functional status [indicated by the performance activities of daily living¹⁸ and the cognitive functional scale¹⁹], comorbidities, the pill burden (i.e., the number of prescription drugs received), and mortality risk [indicated by the changes in health, end-stage disease and symptoms and signs (CHESS) score].²⁰ Comorbidities were selected based on known association with mortality risk in the literature (Tables 1 and S1).

We used CASPER data to identify facility characteristics that have been previously shown to be associated with quality of care for residents with HIV and general NH populations in the literature (Tables 1 and S1).^{21,22} As providers' experience with HIV care is associated with

TABLE 1 Selected baseline characteristics of the study population by ART use status during follow-up nursing home stays

Baseline characteristics ^a	ART exposure status during follow-up, n = 4171	
	Follow-up ART exposed, n = 1507	Follow-up ART unexposed, n = 2664
Age, mean (SD) years	60.3 (11.5)	67.1 (14.2)
Females, n (%)	397 (26.3)	1056 (39.2)
Race, n (%)		
Black	829 (55.0)	1145 (43.0)
White	564 (37.4)	1293 (48.5)
Hispanic	77 (5.1)	137 (5.1)
Others/unknown	37 (2.5)	89 (3.4)
Received SNF benefit, n (%)	260 (17.3)	857 (32.2)
Had dual status, n (%)	1435 (95.2)	2417 (90.7)
Cognitive impairment, n (%)		
Mild (CFS = 1)	818 (54.4)	1335 (50.2)
Moderate (CFS = 2 or 3)	641 (42.6)	1193 (44.8)
Severe (CFS = 4)	45 (3.0)	130 (4.9)
ADL, median (IQR)	13 (6–19)	16 (8–19)
CHES score, n (%)		
No health instability	968 (70.7)	1424 (62.6)
Minimal health instability	289 (21.1)	585 (25.7)
Low/moderate health instability	83 (6.1)	193 (8.5)
High/very high health instability	30 (2.2)	72 (3.2)
Comorbidities, %		
Anemia	548 (36.4)	1095 (41.1)
Atrial fibrillation/other dysrhythmias	91 (6.0)	342 (12.8)
Heart failure	145 (9.6)	525 (19.7)
Coronary artery diseases	158 (10.5)	536 (20.1)
Hypertension	956 (63.4)	2079 (78.0)

TABLE 1 (Continued)

Baseline characteristics ^a	ART exposure status during follow-up, n = 4171	
	Follow-up ART exposed, n = 1507	Follow-up ART unexposed, n = 2664
Hyperlipidemia	490 (32.5)	1080 (40.5)
Diabetes	438 (29.1)	1087 (40.8)
Renal conditions	208 (13.8)	536 (20.1)
Viral hepatitis	305 (19.7)	292 (11.0)
Anxiety	363 (24.1)	810 (30.4)
Schizophrenia	204 (13.5)	510 (19.1)
Facility characteristics		
HIV concentration, n (%)		
>20% of NH residents had HIV	139 (9.2)	35 (1.3)
≤20% of NH residents had HIV	1366 (90.8)	2626 (98.7)
Ownership, n (%)		
For profit	1196 (79.5)	2237 (84.3)
Non-profit	239 (15.9)	319 (12.0)
Government	69 (4.6)	97 (3.7)
Facility is hospital-based, n (%)		
Yes	98 (6.5)	113 (4.3)
No	1406 (93.5)	2540 (95.7)
Facility has AIDS unit, n (%)		
Yes	327 (21.7)	160 (6.0)
No	1177 (78.3)	2493 (94.0)
Percentage of residents receiving antipsychotics, mean (SD)	28.3 (18.9)	26.5 (20.0)

Note: All characteristics in Table 1 differ significantly between comparison groups; other characteristics are shown in Table S1.

Abbreviations: SNF, skilled nursing facilities; ADL, activities of daily living; AIDS, acquired immunodeficiency syndrome; CHES, Changes in health, end-stage disease and symptoms and signs (CHES); ESRD: end-stage of renal disease. HIV, human immunodeficiency virus.

^aContinuous variables were compared using Student's *t* test; categorical variables were compared using χ^2 tests.

the quality of care PLWH received,²³ we further included facility-level indicators of HIV care experience: (1) the availability of AIDS unit, and (2) the proportion of residents with HIV calculated by dividing the number of

residents with HIV indicated by MDS or CCW by the number of residents who had at least one MDS assessment in each facility in the 3 months before the index date.

We calculated the proportions of non-ART use according to residents' end-of-life status indicated by death status during the follow-up: no death, died ≤ 180 , >180 and ≤ 365 , >365 and ≤ 730 and >730 days. We used Chi-square test to examine ART use by end-of-life status. We performed univariate analysis to examine the association between each covariate and the study outcome. Those significant covariates ($p < 0.1$) on ART use were further regressed using multivariable generalized estimation equations (GEE) with the logit link.

We conducted a supplementary analysis to examine interactions between race/ethnicity and HIV facility concentration and calculated the marginal mean adjusted rates of ART use by concentration and race/ethnicity category. We used a similar approach to examine interactions between race/ethnicity and the availability of an AIDS unit at a nursing facility.

RESULTS

Patient characteristics and ART use

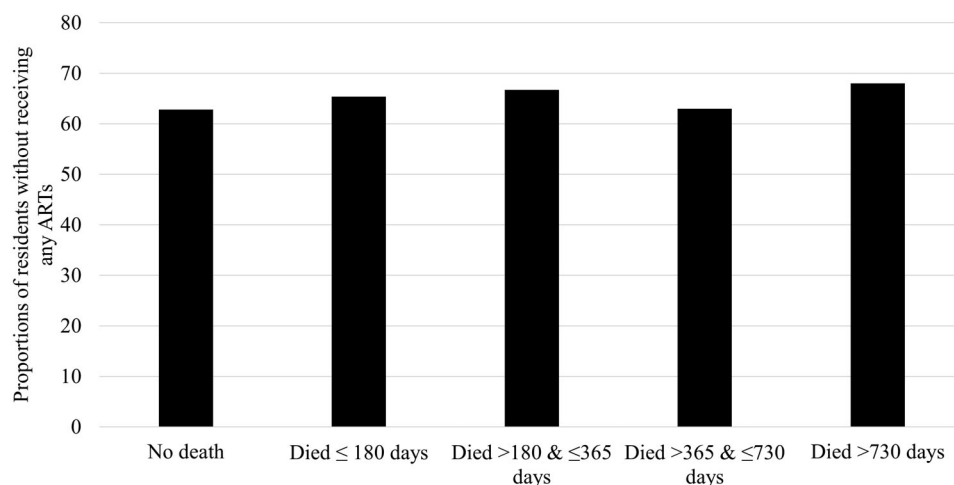
We identified 5321 eligible long-stay NH residents with HIV in 2929 NHs during the study period. Among these residents, 4171 had continuous NH stays and Medicare Part D enrollment for at least 30 days following the index date. These residents were followed for an average of 11.6

[standard deviation (SD): 11.7; range: 1–48] months. Overall, 38.1% of our study population died during the follow-up, 8.5% died within 180 days, another 9.9% died between 180 and 365 days, and 19.7% died at least 1 year after the index date. In our study cohort, only 1507 of 4171 PLWH (36.1%) received an ART regimen during the follow-up (Tables 1 and S1).

Rates of non-ART use did not differ significantly by residents' end-of-life status, with 65.4% of those who were at end-of-life (i.e., died within 180 days) versus 68.0% of those who were alive for at least 2 years did not receive ART ($p = 0.21$, Figure 1).

Multivariable models of ART use

In the multivariable model, older age, females, white race, and specific comorbidities (heart failure, diabetes, anxiety disorder, schizophrenia) were associated with lower odds of ART use. For instance, 65+ versus <65 years: adjusted odds ratio (adjOR) 0.55; 95% CI 0.47–0.64; females vs. males: adjOR 0.66; 95% CI 0.56–0.77; white vs. black: adjOR 0.61; 95% CI 0.52–0.72; receiving vs. not-receiving skilled nursing benefits at baseline (adjOR 0.41; 95% CI 0.34–0.50); presence vs. absence of coronary artery disease: adjOR 0.64; 95% CI 0.52–0.80; and schizophrenia: adjOR 0.46; 95% CI 0.37–0.57. For facility characteristics, facilities with higher HIV concentration and those with AIDS unit were associated with greater odds of ART use (facilities with higher vs. lower HIV concentration: adjOR 3.42; 95% CI 2.13–5.48; facilities with vs. without AIDS unit: adjOR 2.51; 95% CI 1.92–3.30, Figure 2).



Non-ART use	1,622	231	275	298	238
Total n of residents	2,583	353	412	473	350

FIGURE 1 Proportions of non-ART use by end-of-life status during the follow-up

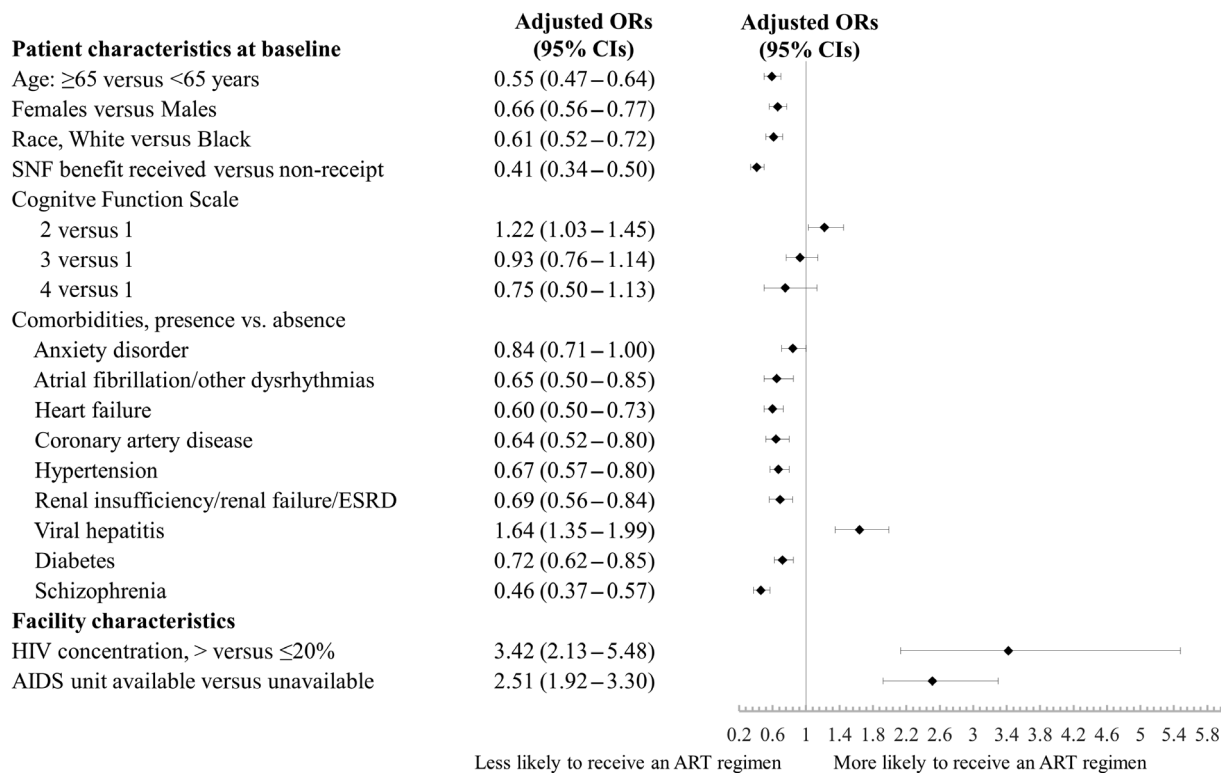


FIGURE 2 Association between baseline characteristics and ART use in long-stay residents with HIV: Findings from a multivariable generalized estimation equations model. *Characteristics that were not associated with ART use significantly in the final model were not included in the figure

In our supplemental analysis, the interaction between NH HIV concentration and race was not statistically significant (Tables S2 and S3).

DISCUSSION

In this national cohort, nearly two-thirds of long-stay NH residents with HIV did not receive an ART regimen during an average observation period of 1 year. High rates of non-ART use put patients at risk for decline in immune function, progression of clinical disease, and premature death. It also increases the risk of HIV transmission to others. Our findings show that the care of long-stay NH residents does not align with national treatment guidelines that recommend ART for everyone with HIV.^{2,24} The rate of non-use of ART in our study cohort (~64%) was much higher than the rates reported previously (21% ~ 36%).^{8,9} Several differences in study methods may explain these discrepancies. First, in the two previous studies, concurrent ART use was used to define the study population; we used only diagnosis codes to avoid biasing our study sample toward those with ART use. Second, the previous studies defined ART use as any ART prescription. In contrast, we counted only valid ART regimens as constituting ART use. Note that when one of the

previous papers examined only “preferred” ART regimens, their findings were very similar to ours.⁹ Additionally, the one previous study that looked only at long-stay residents, making it directly comparable to our study, included only 694 patients,⁸ as compared with 4171 PLWH in our study.

Older age, females, white race, receiving Medicare skilled nursing benefits, and aging-related comorbidities such as cardiovascular conditions and mental health conditions (anxiety and schizophrenia) were associated with not-receiving ART during NH stays. Being in a facility with higher HIV concentrations or an AIDS unit was associated with higher odds of ART use. These findings suggest that low rates of ART use may be partially due to inexperience in HIV care in some facilities and/or providers. Provider education about HIV care may be a productive focus of interventions to improve ART use in HIV+ residents.

We observed that receiving care under the Medicare skilled nursing benefit at baseline was a strong predictor of non-ART use during NH stays, which confirms previous evidence.⁸ People who are admitted to short-term SNF for post-acute care are typically covered by Medicare Part A. When covered by Part A, NHs receive a risk-adjusted per diem rate, which may create an incentive not to prescribe expensive medications such as ART. However, once an individual makes the transition from

SNF to long-term care, and has medication coverage through Medicare Part D, this disincentive is no longer present. One explanation for our findings is that patients may be discharged from the hospital with an ART, but the ART is not continued during the SNF stay during Medicare Part A coverage, and when the patient subsequently transfers to long-term care and resumes Part D coverage, providers continue the medication regimen that they were on during the SNF stay, missing the ART. This is speculation on our part given that we cannot observe ART (or any other drug) use immediately before the start of an NH long-term stay. Further studies that include pre-hospital, hospital, and SNF medication use data are essential to better understand the roots of the low rates of ART use that we observed.

We do not believe our findings can be explained by PLWH being severely ill or near death, which could prompt providers to discontinue ART, because we controlled for hospice use and our findings showed that the distribution of non-ART use was similar by end-of-life status during the follow-up. It is possible that some patients had pharmacological contraindications for ART use, for example, those who received statin treatment,²⁵ but we think that this is an unlikely explanation for our finding. Mental health conditions (e.g., anxiety and schizophrenia), which were relatively common in our sample, have been associated with poor adherence to ART,^{26,27} but it is unclear how this would happen in an NH setting where medications are administered by patients by nursing staff.

We observed that white residents had a lower likelihood of receiving an ART use compared with black residents. Although this runs counter to prior community-based studies,^{28,29} it is consistent with another NH study.⁸ Although we hypothesized whites were more likely to reside in facilities with low HIV experience, our supplementary analyses did not support this explanation. Further studies are needed to identify other factors contributing to the low use of ART in NH residents.

There are several study limitations. We did not have access to clinical information such as viral loads and CD4⁺ cell counts. However, ART has been universally recommended for the treatment of HIV since 2013,² so based on this, all or most PLWH in NHs should be receiving ART. We also do not have access to patient preferences, though we doubt that the majority of long-stay PLWH were offered and declined ART. Finally, our analyses tested associations, and the relationships that we demonstrated may not be causal.

In conclusion, nearly two-thirds of the PLWH in NHs across the United States did not receive ART during an average follow-up of 12 months, a serious deficit in the quality of HIV care in NHs, which could impair people's quality of life and result in complications and progression.

Evidence-based interventions that improve providers' awareness of appropriate HIV care or identify older patients who are still eligible for ART treatment are urgently needed. Our findings also raise broader questions about appropriate access to specialty care for persons in NHs.

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I have listed everyone who contributed significantly to this research work.

CONFLICT OF INTEREST

All co-authors reported no conflict of interest for this research work.

AUTHOR CONTRIBUTIONS

Ira B. Wilson and Tingting Zhang obtained funding. Ira B. Wilson obtained data use agreement and Ira B. Wilson approval. Tingting Zhang drafted this manuscript. Tingting Zhang and Yoojin Lee analyzed the data. All authors participated in the design of this study, review and interpretation of the findings, and participated in the comprehensive review of this manuscript.

SPONSOR'S ROLE

Sponsors did not participate in the design, methods, data analysis, or preparation of the paper.

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REFERENCES

1. Erb P, Battegay M, Zimmerli W, Rickenbach M, Egger M. Effect of antiretroviral therapy on viral load, CD4 cell count, and progression to acquired immunodeficiency syndrome in a community human immunodeficiency virus-infected cohort. Swiss HIV cohort study. *Arch Intern Med*. 2000; 160(8):1134-1140.
2. Thompson MA, Aberg JA, Hoy JF, et al. Antiretroviral treatment of adult HIV infection: 2012 recommendations of the International Antiviral Society-USA panel. *JAMA*. 2012;308(4): 387-402. doi:10.1001/jama.2012.7961
3. Centers for Disease Control and Prevention. Estimated HIV incidence and prevalence in the United States, 2010–2016. HIV surveillance supplemental report 2019;24(No. 1). <http://www.cdc.gov/hiv/library/reports/hiv-surveillance.html>. Published February 2019. Accessed 04-25-2020.
4. Miller SC, Cai S, Daiello LA, Shireman TI, Wilson IB. Nursing home residents by human immunodeficiency virus status: characteristics, dementia diagnoses, and antipsychotic use. *J Am Geriatr Soc*. 2019;67(7):1353-1360. doi:10.1111/jgs.15949
5. Meyers DJ, Wilson IB, Lee Y, Cai S, Miller SC, Rahman M. The quality of nursing homes that serve patients with human immunodeficiency virus. *J Am Geriatr Soc*. 2019;67(12):2615-2621. doi:10.1111/jgs.16155

6. Olivieri-Mui B, McGuire J, Griffith J, Cahill S, Briesacher B. Assessing the quality of human immunodeficiency virus care in nursing homes. *J Am Geriatr Soc* Jun 2020;68(6):1226–1234. doi:10.1111/jgs.16359
7. Cioltan H, Alshehri S, Howe C, et al. Variation in use of antipsychotic medications in nursing homes in the United States: a systematic review. *BMC Geriatr*. 2017;17(1):32. doi:10.1186/s12877-017-0428-1
8. Olivieri-Mui BL, Koethe B, Briesacher B. Economic barriers to antiretroviral therapy in nursing homes. *J Am Geriatr Soc*. 2020;68(4):777–782. doi:10.1111/jgs.16288
9. Olivieri-Mui B, McGuire J, Cahill S, Griffith J, Briesacher B. People living with HIV in U.S. nursing homes in the fourth decade of the epidemic. *J Assoc Nurses AIDS Care*. 2019;30(1):20–34. doi:10.1097/JNC.0000000000000033
10. Mor V, Angelelli J, Jones R, Roy J, Moore T, Morris J. Interrater reliability of nursing home quality indicators in the U.S. *BMC Health Serv Res*. 2003;3(1):20. doi:10.1186/1472-6963-3-20
11. Mor V, Intrator O, Unruh MA, Cai S. Temporal and geographic variation in the validity and internal consistency of the nursing home resident assessment minimum data set 2.0. *BMC Health Serv Res*. 2011;11:78. doi:10.1186/1472-6963-11-78
12. Centers for Medicare and Medicaid Services (CMS). Chronic Conditions Data Warehouse (online) <https://www.ccwdata.org/web/guest/home> Accessed April 27, 2020.
13. Feng Z, Katz PR, Intrator O, Karuza J, Mor V. Physician and nurse staffing in nursing homes: the role and limitations of the online survey certification and reporting (OSCAR) system. *J Am Med Dir Assoc*. 2005;6(1):27–33. doi:10.1016/j.jamda.2004.12.008
14. Berry SD, Zullo AR, Lee Y, et al. Fracture risk assessment in long-term care (FRAiL): development and validation of a prediction model. *J Gerontol A Biol Sci Med Sci*. 2018;73(6):763–769. doi:10.1093/gerona/glx147
15. Youn B, Shireman TI, Lee Y, et al. Ten-year trends in antiretroviral therapy persistence among US Medicaid beneficiaries. *Aids*. 2017;31(12):1697–1707. doi:10.1097/QAD.0000000000001541
16. Youn B, Shireman TI, Lee Y, Galarraga O, Wilson IB. Trends in medication adherence in HIV patients in the US, 2001 to 2012: an observational cohort study. *J Int AIDS Soc* Aug 2019; 22(8):e25382. doi:10.1002/jia2.25382
17. Zhang T, Wilson IB, Youn B, Lee Y, Shireman TI. Factors associated with antiretroviral therapy reinitiation in medicaid recipients with human immunodeficiency virus. *J Infect Dis*. 2020;221(10):1607–1611. doi:10.1093/infdis/jiz666
18. Morris JN, Fries BE, Morris SA. Scaling ADLs within the MDS. *J Gerontol A Biol Sci Med Sci*. 1999;54(11):M546–M553. doi:10.1093/gerona/54.11.m546
19. Thomas KS, Dosa D, Wysocki A, Mor V. The minimum data set 3.0 cognitive function scale. *Med Care*. 2017;55(9):e68–e72. doi:10.1097/MLR.0000000000000334
20. Ogarek JA, McCreedy EM, Thomas KS, Teno JM, Gozalo PL. Minimum data set changes in health, end-stage disease and symptoms and signs scale: a revised measure to predict mortality in nursing home residents. *J Am Geriatr Soc*. 2018;66(5):976–981. doi:10.1111/jgs.15305
21. Collier E, Harrington C. Staffing characteristics, turnover rates, and quality of resident care in nursing facilities. *Res Gerontol Nurs*. 2008;1(3):157–170. doi:10.3928/00220124-20091301-03
22. Shippee TP, Henning-Smith C, Kane RL, Lewis T. Resident- and facility-level predictors of quality of life in long-term care. *Gerontologist*. 2015;55(4):643–655. doi:10.1093/geront/gnt148
23. Landovitz RJ, Desmond KA, Gildner JL, Leibowitz AA. Quality of care for HIV/AIDS and for primary prevention by HIV specialists and nonspecialists. *AIDS Patient Care STDS*. 2016;30(9):395–408. doi:10.1089/apc.2016.0170
24. Panel on Antiretroviral Guidelines for Adults and Adolescents. Guidelines for the Use of Antiretroviral Agents in Adults and Adolescents with HIV. Department of Health and Human Services. Available at <https://clinicalinfo.hiv.gov/sites/default/files/guidelines/documents/AdultandAdolescentGL.pdf>. Accessed September-9-2021.
25. Chuck SK, Penzak SR. Risk-benefit of HMG-CoA reductase inhibitors in the treatment of HIV protease inhibitor-related hyperlipidaemia. *Expert Opin Drug Saf*. 2002;1(1):5–17. doi:10.1517/14740338.1.1.5
26. Wykowski J, Kemp CG, Velloza J, Rao D, Drain PK. Associations between anxiety and adherence to antiretroviral medications in low- and middle-income countries: a systematic review and meta-analysis. *AIDS Behav*. 2019;23(8):2059–2071. doi:10.1007/s10461-018-02390-8
27. Springer SA, Dushaj A, Azar MM. The impact of DSM-IV mental disorders on adherence to combination antiretroviral therapy among adult persons living with HIV/AIDS: a systematic review. *AIDS Behav*. 2012;16(8):2119–2143. doi:10.1007/s10461-012-0212-3
28. Simoni JM, Huh D, Wilson IB, et al. Racial/ethnic disparities in ART adherence in the United States: findings from the MACH14 study. *J Acquir Immune Defic Syndr*. 2012;60(5):466–472. doi:10.1097/QAI.0b013e31825db0bd
29. Kong MC, Nahata MC, Lacombe VA, Seiber EE, Balkrishnan R. Association between race, depression, and antiretroviral therapy adherence in a low-income population with HIV infection. *J Gen Intern Med*. 2012;27(9):1159–1164. doi:10.1007/s11606-012-2043-3

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

Table S1. Additional baseline characteristics of study population by ART use status during follow-up nursing home stays

Table S2. Marginal mean adjusted rates of ART use by nursing facility HIV concentration and race/ethnicity category

Table S3. Marginal mean adjusted rates of ART use by nursing facility AIDS unit availability and race/ethnicity category

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