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Chronic health conditions in Medicare beneficiaries 65 years and older with HIV infection

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Abstract

Objectives—To examine sociodemographic factors and chronic health conditions of people living with HIV (PLWHIV/HIV+) at least 65 years old and compare their chronic disease prevalence with beneficiaries without HIV.

Design—National fee-for-service Medicare claims data (parts A and B) from 2006 to 2009 were used to create a retrospective cohort of beneficiaries at least 65 years old.

Methods—Beneficiaries with an inpatient or skilled nursing facility claim, or outpatient claims with HIV diagnosis codes were considered HIV+. HIV+ beneficiaries were compared with uninfected beneficiaries on demographic factors and on the prevalence of hypertension, hyperlipidemia, ischemic heart disease, rheumatoid arthritis/osteoarthritis, and diabetes. Odds ratios (OR), 95% confidence intervals (CIs), and *P* values were calculated. Adjustment variables included age, sex, race/ethnicity, end stage renal disease (ESRD), and dual Medicare–Medicaid enrollment. Chronic conditions were examined individually and as an index from zero to all five conditions.

Results—Of 29 060 418 eligible beneficiaries, 24 735 (0.09%) were HIV+. HIV+ beneficiaries were more likely to be Hispanic, African-American, male, and younger ($P > 0.0001$) and were 1.5–2.1 times as likely to have a chronic disease [diabetes (adjusted OR) 1.51, 95% CI (1.47, 1.55); rheumatoid arthritis/osteoarthritis 2.14, 95% CI (2.08, 2.19)], and 2.4–7 times as likely to have 1–5 comorbid chronic conditions [1 condition (adjusted OR) 2.38, 95% CI (2.21, 2.57); 5 conditions 7.07, 95% CI (6.61, 7.56)].

Conclusion—Our results show that PLWHIV at least 65 years old are at higher risk of comorbidities than other fee-for-service Medicare beneficiaries. This finding has implications for the cost and health management of PLWHIV 65 years and older.

Keywords

chronic conditions; HIV; Medicare; older

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Conflicts of interest

There are no conflicts of interest.

Introduction

Recent epidemiologic reviews of people living with HIV (PLWHIV) in the United States have indicated that those at least 50 years old represent an increasing proportion of those infected [1]. In 2011, about 36% of all PLWHIV in the United States and six territories were persons at least 50 years of age [2]. This group of PLWHIV is expanding largely because of increased length of survival after HIV infection, rather than increased numbers of infections and diagnoses [1]. Survival time for PLWHIV has increased significantly since the introduction of HAART in 1996.

Recent cohort trials have indicated that PLWHIV now have a lifespan close to that of non-HIV infected persons [3,4]. With appropriate antiretroviral management, it is expected that increasing numbers of PLWHIV will survive into older age, with some estimating that by 2020, half of all PLWHIV will be at least 50 years old [5].

Research has begun to focus on the threats to health of older PLWHIV, both those due to normal aging processes, as well as those due to their HIV infection. There is evidence that older PLWHIV experience age-related illnesses earlier in life, or in a more severe form than their non-HIV infected counterparts [6]. It is hypothesized that the greater severity and earlier onset of these diseases may be due to the changes in immunity and inflammation caused by HIV infection [5]. PLWHIV appear to be more likely to suffer from classic age-related comorbidities such as cardiovascular disease, diabetes, and renal failure than their noninfected, age-matched counterparts [7]. There are also concerns that HAART drug regimens may cause damage to the kidneys and liver in certain PLWHIV, and that drug toxicity could interact with age-related declines in organ function [8,9]. Many HAART drugs have also been associated with abnormal lipid profiles, which can increase the risk of cardiovascular diseases and diabetes [10,11]. It is also possible that PLWHIV are more prone to age-related chronic diseases due to high prevalence of harmful behaviors, such as substance abuse [12–14].

Despite recent attention on older PLWHIV, there is still the need for more specific and in-depth research in this population. In particular, although many studies have included or even focused on persons at least 50 years of age, few studies have subdivided this category further, or included substantial numbers of persons at least 65 years of age [15,16]. According to the Centers for Disease Control and Prevention in 2010, there were an estimated 35 000 PLWHIV who were at least 65 years of age, a number that will only get larger in the coming years [2]. There is a lack of knowledge about the health of PLWHIV at least 65 years old compared with that of their non-HIV infected counterparts, including their prevalence of chronic diseases. The objective of this study is to examine sociodemographic factors and chronic health conditions of PLWHIV aged 65 years and older, and to compare their chronic disease prevalence with beneficiaries without HIV.

Methods

Americans at least 65 years of age almost universally receive their health insurance coverage from Medicare. During 2006–2009, the majority (84–77%) of Medicare beneficiaries were

fee-for-service (FFS) enrollees, making FFS claims a comprehensive source to investigate the health of PLWHIV at least 65 years old [17]. Inclusion criteria for this study were as follows: enrollment in parts A and B of Medicare excluding those enrolled in a Health Maintenance Organization (Medicare Advantage/Medicare managed care programs), enrollment of 11 continuous months or more (or death) during the years 2006–2009, and age range of 65–116 (inclusive) (Fig. 1). The minimum 11-month enrollment criteria, the inclusion of data from dead beneficiaries until their date of death, and the exclusion of persons enrolled in Health Maintenance Organizations are all practices recommended by the Chronic Condition Warehouse (CCW) for determining FFS beneficiaries [18]. The upper age limit was chosen to include all beneficiaries who were plausibly alive, whereas excluding beneficiaries who were dead but did not have a confirmed death date. All data were de-identified, and each individual was assigned a unique identifier by the Centers for Medicare & Medicaid Services (CMS) prior to analysis.

To determine which beneficiaries had HIV, we created an algorithm that used the presence of an International Classification of Diseases, Ninth Revision, Clinical Modification diagnosis code (ICD-9-CM) or diagnosis related group code (DRG) for HIV or AIDS (ICD-9-CM 42–44, V08, or 79.53; DRG 969–977 or DRG 488–490 for claims prior to September 2007). Beneficiaries were considered to have HIV if they had one inpatient, skilled nursing, or long-term care facility claim with an ICD-9-CM or DRG code indicating HIV; or two claims on different days from other therapy services (part B) or outpatient services with an ICD-9-CM or DRG code indicating HIV over the course of one year. This algorithm is similar in methodology to that used by CCW to identify beneficiaries with chronic diseases, and is also similar, but does not duplicate the method CCW recently developed to identify beneficiaries with HIV/AIDS in future data releases [19,20]. Eligible persons without indications of HIV were referred to as HIV- or non-HIV- infected.

The prevalence of the five most common chronic health conditions in the Medicare population at least 65 years of age was investigated in those with and without HIV [21]. These conditions included hypertension, hyperlipidemia, ischemic heart disease, rheumatoid arthritis/osteoarthritis, and diabetes, as defined by CCW from the presence of ICD-9-CM diagnosis, Current Procedural Terminology Fourth Edition codes, or Healthcare Common Procedure Coding System codes [19]. Beneficiaries who met each chronic condition's criteria were indicated by CCW before data analysis. These chronic condition variables are used in numerous publications from both CMS and in the general literature [21,22]. A list of the codes and specified reference periods that CCW uses to identify persons with hypertension, hyperlipidemia, ischemic heart disease, arthritis, and diabetes are included in the appendix, <http://links.lww.com/QAD/A962>.

The race/ethnicity of individuals were determined using the Research Triangle 'corrected race ethnicity' codes to allow for comparison to reports on chronic disease prevalences in Medicare issued by CMS [21]. Age was determined on the basis of birthdate and the date of enrollment, with beneficiaries only eligible for inclusion for the years when they were at least 65 years of age. Some CMS administrative variables were included in our analysis, including the original reason for qualifying in Medicare for persons enrolled before age 65 [Social Security Administration declaration of disability, end stage renal disease (ESRD), or

both disability and ESRD], current reason for Medicare enrollment (age, disability, ESRD, or both disability and ESRD), Medicaid coverage start date (historical to January 1999), and months of dual enrollment in Medicaid and Medicare. Based on administrative summaries, we also were able to determine if a beneficiary had enrolled in optional Medicare part D prescription coverage during the course of the study.

All hypothesis testing was two-tailed, and *P* values of less than 0.05 were considered significant. To examine differences in sociodemographic factors and health conditions between HIV+ beneficiaries and their HIV- counterparts, Wald χ^2 tests, Wilcoxon *Z* tests, and logistic regression modeling with odds ratios (ORs) and confidence intervals (CIs) were used. Models for chronic conditions were run both with and without adjustment for variables that are either commonly included in the chronic disease literature, or are known to affect the prevalence of chronic disease; including age, sex, and race/ethnicity, a measure of socioeconomic status, and ESRD [23–25]. In adjusted models, persons with missing values for any adjustment variables were dropped. Models examined the individual risk for each of the five chronic conditions among PLWHIV compared with non-HIV infected beneficiaries. In addition, an index was created to consider the number of comorbid chronic conditions from zero to five conditions (regardless of the combination of conditions). All statistical analyses were conducted using SAS statistical software, version 9.4 (SAS Institute Inc., Cary, North Carolina, USA).

Results

Approximately 29 million FFS Medicare beneficiaries met the inclusion criteria for the years 2006–2009. Beneficiaries had varying year of enrollment depending on when they reached 65 years of age, and on when they met FFS inclusion criteria. Out of all eligible persons, 99.7% of beneficiaries without HIV and 99.5% of beneficiaries with HIV were eligible starting on 1 January 2006 and contributed four full years of data to this study. Of the 29 060 418 eligible persons for this study, 99.9% were HIV–, and 24 735 (0.09%) were HIV+.

The median age of PLWHIV was about 5 years younger than their non-HIV infected counterparts (*P* value <0.0001). HIV+ beneficiaries were nearly twice as likely to be male, five times as likely to be African-American or Hispanic and were also more likely to live in Florida, New York, California, Texas, or New Jersey (Table 1). Beneficiaries with HIV infection were more likely to have had Medicaid coverage since 1999, OR 3.02, 95% CI (2.94, 3.10), to have had dual Medicaid and Medicare coverage for one or more months during the study, OR 3.19, 95% CI (3.11, 3.27), and to have enrolled in Medicare prescription coverage (Medicare Part D), OR 1.89, 95% CI (1.84, 1.94) than age-eligible persons without HIV infection. Beneficiaries with HIV infection were also more likely to have originally been eligible for Medicare via disability, OR 2.64, 95% CI (2.55, 2.72), ESRD, OR 6.46, 95% CI (5.18, 8.06), or both disability and ESRD, OR 5.57, 95% CI (4.22, 7.35) (Table 1). PLWHIV were also approximately five times as likely to have the current reason for Medicare enrollment be listed as ESRD, OR 4.77, 95% CI (4.03, 5.66) but were about 60% less likely to die during the time of the study, OR 0.38, 95% CI (0.36, 0.40) (Table 1), a result partially due to the younger age of HIV+ beneficiaries (data not shown).

HIV+ beneficiaries were approximately twice as likely as those without HIV infection to have chronic condition flags indicating hypertension, hyperlipidemia, ischemic heart disease, rheumatoid arthritis/osteoarthritis, or diabetes (Table 2). Adjusted risks for these chronic conditions ranged from aOR 1.51, 95% CI (1.47, 1.55) for diabetes to aOR 2.14, 95% CI (2.08, 2.19) for rheumatoid arthritis/osteoarthritis (Table 3). Adjustment factors associated with HIV infection in multivariable models included being male, being of African-American race or Hispanic ethnicity, having ESRD, and dual eligibility for Medicaid and Medicare (Table 3). For male African-American and Hispanic beneficiaries with chronic conditions, the likelihood of HIV infection was especially elevated in comparison with that of white female beneficiaries with the same chronic condition, with aORs ranging from 8.99 to 6.33 (data not shown).

For models that examined the number of chronic diseases as an index, PLWHIV were more likely than their noninfected counterparts to have one or more chronic conditions, with increasing risks seen for each additional comorbidity. Although frequencies of having 2–4 chronic conditions were similar for persons with and without HIV, HIV+ beneficiaries were less likely to have no chronic conditions or one chronic condition (13.22 vs. 25.66%) and were more likely to have five chronic conditions (22.11 vs. 8.41%) (Table 2). Adjusted odds of having HIV infection and one or more comorbidities ranged from aOR 2.38, 95% CI (2.21, 2.57) for having one condition to aOR 7.07, 95% CI (6.61, 7.56) for having all five chronic conditions (Table 4). Adjustment factors that were significant in each of the five individual models of chronic conditions remained significant in the model that considered the number of chronic conditions as an index. Male African-American and Hispanic beneficiaries were more than three times as likely to have HIV for each level of the chronic condition index as compared with white women with the same number of chronic conditions (data not shown).

Discussion

The current study found that age-eligible PLWHIV in Medicare were more likely to be of Hispanic ethnicity, African-American race, male sex, and younger than other age eligible Medicare beneficiaries. Beneficiaries with HIV infection were more likely to have originally enrolled in Medicare under disability benefits, to have been previously enrolled in Medicaid (since 1999), and to have been dually enrolled in Medicaid and Medicare. Beneficiaries with HIV infection were also more likely than those without HIV infection to have one or more of the five most common chronic health conditions, increasing the complexity of their medical issues, care, and likelihood of ill health after age 65.

Increasing numbers of PLWHIV will use Medicare as their primary source of insurance as survival of HIV-positive persons extends to 50 or more years postinfection [3,4]. Although historically Medicaid has been a major source of health insurance for PLWHIV, Medicaid is only responsible for insurance costs after all other third-party insurance payers, including Medicare, are billed for services [26]. As greater numbers of PLWHIV enter Medicare as age-eligible beneficiaries, the majority of their care costs will shift from Medicaid to Medicare [27]. This is important given that costs for HIV care are considerable, even without the additional costs seen when multiple chronic conditions are also considered. Cost

estimates of living with HIV in the United States range considerably depending on demographic and HIV-related factors; but estimates using 2005 and 2006 data range from \$10 000 to \$40 000 per year [28,29]. Costs associated with multiple chronic health problems are also high. Data from 2005 Medicare expenditure costs indicate that the annual costs for Medicare beneficiaries with one chronic condition are \$7172, and for beneficiaries with three or more chronic conditions \$32 498 [30].

The current study adds to the growing body of literature on older PLWHIV in the United States. Historically, PLWHIV have entered the Medicare health system as younger persons eligible for Medicare via social security disability benefits. However, with the aging HIV-positive patient population, HIV providers in the Medicare network will have to prepare for patients with different medical needs, including a higher likelihood of chronic comorbid health conditions. Similarly, chronic disease practitioners who serve in the Medicare network, such as cardiologists and endocrinologists, should be aware that their Medicare patients may be receiving treatment for HIV infection. Greater collaboration between infectious disease and chronic disease practitioners will be needed to ensure the appropriate medical management of these patients including complex medication regimens [31,32].

The current study is the first and largest one to the authors' knowledge to examine chronic conditions among PLWHIV who are exclusively 65 years of age or older. Previous studies have examined frequencies of chronic conditions among PLWHIV at least 50 years of age, but few of these studies have included large numbers of participants 65 years and older [33–37]. This study is in agreement with many previous studies that have found higher prevalence of disease, or increased risk for cardiovascular diseases, arthritis, and diabetes among persons with HIV, both among those at least 50 years of age and those not focused on older persons with HIV [7,11,38].

The current study identified 24 735 FFS Medicare beneficiaries who were at least 65 years old with HIV infection, which represents 78% of the total number of PLWHIV at least 65 years of age identified in the Centers for Disease Control and Prevention National surveillance data for 2009 [2]. The discrepancy between the number of PLWHIV identified in this study and in surveillance reports is likely due to the exclusion in this study of beneficiaries enrolled in Health Maintenance Organizations. During the years 2006–2009, 16–23% of all Medicare beneficiaries were members of Medicare Advantage/managed care plans [17].

There are several limitations to this work. The time period of the study was restricted to the most recent available data for persons with dual Medicare–Medicaid benefits, which at the time of analysis was 2009. It is important to note that Medicare claims data are reimbursement based and contain only information for provided health services. Therefore, information on some demographic factors of interest (education level, income), results of clinical tests (viral load tests, CD4⁺ T-cell tests), and other patient history information (e.g. diet, exercise, and presence of risk behaviors such as smoking) were not available. This study also developed a novel algorithm for FFS Medicare beneficiaries with HIV. This algorithm was based on early formulations of the CCW other chronic or potentially disabling condition HIV flag. The CCW has recently finalized their HIV flag, but it has not

yet been retrospectively applied to historic data [20]. Whereas the codes used to define HIV + beneficiaries in this article and those used in the CCW algorithm are the same, there are slight differences between the algorithm in this article and that developed by the CCW. The number of claims needed for the CCW algorithm is two for all claim types except for inpatient, whereas this article considered one claim sufficient for all but outpatient and other therapy (part B) claims. Similarly, the CCW algorithm uses a 2-year retrospective period, whereas this article used a single year retrospective period. It is possible that the shorter retrospective period used in this article will underestimate the number of HIV+ beneficiaries in comparison with the algorithm used by CCW. In contrast, the fewer claims used in this article as compared with the CCW criteria may result in an overestimation of HIV+ beneficiaries.

This paper used CCW algorithms to determine who had chronic conditions. These algorithms are commonly used in the analysis of Medicare data but are known to be less sensitive in identifying diseases than the clinical medical record [39]. Some studies have indicated that the CCW algorithms are likely to underestimate chronic illnesses, especially those that may not require frequent medical care [40]. It is also possible that a higher proportion of chronic conditions that ordinarily do not require frequent medical care would be diagnosed among individuals with HIV who are adherent to care and regularly encounter medical professionals. In addition, astute healthcare personnel may have preferentially screened HIV-positive beneficiaries for particular chronic conditions known to be associated with long-term HIV infection and antiretroviral treatment, such as diabetes and cardiovascular diseases, leading to increased diagnosis of some chronic conditions among PLWHIV. Prevalence of both HIV and chronic conditions was measured in this article, not incidence. The temporal relationship between HIV infection and chronic conditions cannot be determined because of the lack of original clinical diagnosis dates. Survivor bias is likely to have affected the available Medicare beneficiary population, both those with and without HIV. Medicare prescription drug plans were only introduced in 2006 (part D), and not all beneficiaries in this study had prescription drug information available to researchers. This includes a lack of information on HAART, which is likely to influence chronic condition prevalence for HIV+ beneficiaries. Beneficiaries who had HIV infection and part D Medicare drug coverage will be explored in depth in a future analysis.

In conclusion, this is the first and largest study of PLWHIV at least 65 years old. Using an original data source, our results show that this population is at significantly higher risk of comorbidities than other non-HIV infected Medicare beneficiaries. Medicare data represent a rich source of information to create HIV-positive cohorts with information on multiple chronic conditions that affect older PLWHIV.

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References

1. Centers for Disease Control and Prevention. Diagnoses of HIV infection among adults aged 50 years and older in the United States and dependent areas, 2007–2010. 2013
2. Centers for Disease Control and Prevention. HIV surveillance report, 2011. 2013. Available from: <http://www.cdc.gov/hiv/topics/surveillance/resources/reports/>. [Accessed May 29, 2014]
3. Samji H, Cescon A, Hogg RS, Modur SP, Althoff KN, Buchacz K, et al. Closing the gap: increases in life expectancy among treated HIV-positive individuals in the United States and Canada. *PLoS One*. 2013; 8:e81355. [PubMed: 24367482]
4. Patterson S, Cescon A, Samji H, Chan K, Zhang W, Raboud J, et al. Life expectancy of HIV-positive individuals on combination antiretroviral therapy in Canada. *BMC Infect Dis*. 2015; 15:274. [PubMed: 26183704]
5. Brooks JT, Buchacz K, Gebo KA, Mermin J. HIV infection and older Americans: the public health perspective. *Am J Public Health*. 2012; 102:1516–1526. [PubMed: 22698038]
6. Deeks SG, Phillips AN. HIV infection, antiretroviral treatment, ageing, and non-AIDS related morbidity. *Bmj*. 2009; 338:a3172. [PubMed: 19171560]
7. Guaraldi G, Orlando G, Zona S, Menozzi M, Carli F, Garlassi E, et al. Premature age-related comorbidities among HIV-infected persons compared with the general population. *Clin Infect Dis*. 2011; 53:1120–1126. [PubMed: 21998278]
8. Scarpino M, Pinzone MR, Di Rosa M, Madeddu G, Foca E, Martellotta F, et al. Kidney disease in HIV-infected patients. *Eur Rev Med Pharmacol Sci*. 2013; 17:2660–2667. [PubMed: 24142615]
9. Falade-Nwulia O, Thio CL. Liver disease, HIV and aging. *Sex health*. 2011; 8:512–520. [PubMed: 22127037]
10. Giannarelli C, Klein RS, Badimon JJ. Cardiovascular implications of HIV-induced dyslipidemia. *Atherosclerosis*. 2011; 219:384–389. [PubMed: 21722900]
11. Lake JE, Currier JS. Metabolic disease in HIV infection. *Lancet Infect Dis*. 2013; 13:964–975. [PubMed: 24156897]
12. Mdodo R, Frazier EL, Dube SR, Mattson CL, Sutton MY, Brooks JT, et al. Cigarette smoking prevalence among adults with HIV compared with the general adult population in the United States: cross-sectional surveys. *Ann Intern Med*. 2015; 162:335–344. [PubMed: 25732274]
13. Freiberg MS, Kraemer KL. Focus on the heart: alcohol consumption, HIV infection, and cardiovascular disease. *Alcohol Res Health*. 2010; 33:237–246. [PubMed: 23584065]
14. Kumar S, Rao PS, Earla R, Kumar A. Drug-drug interactions between antiretroviral therapies and drugs of abuse in HIV systems. *Expert Opin Drug Metab Toxicol*. 2015; 11:343–355. [PubMed: 25539046]
15. Emlet CA, Tozay S, Raveis VH. ‘I’m not going to die from the AIDS’: resilience in aging with HIV disease. *Gerontologist*. 2011; 51:101–111. [PubMed: 20650948]
16. Nguyen N, Holodniy M. HIV infection in the elderly. *Clin Interv Aging*. 2008; 3:453–472. [PubMed: 18982916]
17. K Davis, CS.; Bhandari, F. Medicare: 50 years of ensuring coverage and care. New York, NY: Commonwealth Fund; 2015.
18. Chronic Condition Data Warehouse. CCW technical guidance: getting started with CMS Medicare administrative research files. 2016. Available from: <https://www.ccwdata.org/web/guest/technical-guidance-documentation>. [Accessed January 25, 2016]
19. Chronic Condition Data Warehouse. Condition categories. 2015. Available from: <https://www.ccwdata.org/web/guest/condition-categories>. [Accessed September 3, 2015]
20. Chronic Condition Data Warehouse. Other chronic or potentially disabling conditions. 2015. Available from: <https://www.ccwdata.org/web/guest/condition-categories>. [Accessed November 10, 2015]
21. Centers for Medicare & Medicaid Services. Chronic conditions among Medicare beneficiaries. Baltimore, MD: Chartbook; 2012.

22. Chi MJ, Lee CY, Wu SC. The prevalence of chronic conditions and medical expenditures of the elderly by chronic condition indicator (CCI). *Arch Gerontol Geriatr.* 2011; 52:284–289. [PubMed: 20452688]
23. Horowitz B, Miskulin D, Zager P. Epidemiology of hypertension in CKD. *Adv Chronic Kidney Dis.* 2015; 22:88–95. [PubMed: 25704344]
24. Jones DW, Chambless LE, Folsom AR, Heiss G, Hutchinson RG, Sharrett AR, et al. Risk factors for coronary heart disease in African Americans: the atherosclerosis risk in communities study, 1987–1997. *Arch Intern Med.* 2002; 162:2565–2571. [PubMed: 12456228]
25. Gaskin DJ, Thorpe RJ Jr, McGinty EE, Bower K, Rohde C, Young JH, et al. Disparities in diabetes: the nexus of race, poverty, and place. *Am J Public Health.* 2014; 104:2147–2155. [PubMed: 24228660]
26. Centers for Medicare & Medicaid Services. Third party liability in the Medicaid program. Baltimore, MD: US Department of Health and Human Services; 2007. Deficit reduction act important facts for state policymakers.
27. Foote SM, Hogan C. Disability profile and healthcare costs of Medicare beneficiaries under age sixty-five. *Health Aff (Millwood).* 2001; 20:242–253. [PubMed: 11816665]
28. Schackman BR, Gebo KA, Walensky RP, Losina E, Muccio T, Sax PE, et al. The lifetime cost of current human immunodeficiency virus care in the United States. *Med Care.* 2006; 44:990–997. [PubMed: 17063130]
29. Gebo KA, Fleishman JA, Conviser R, Hellinger J, Hellinger FJ, Josephs JS, et al. Contemporary costs of HIV healthcare in the HAART era. *AIDS.* 2010; 24:2705–2715. [PubMed: 20859193]
30. Schneider KM, O'Donnell BE, Dean D. Prevalence of multiple chronic conditions in the United States' Medicare population. *Health Qual Life Outcomes.* 2009; 7:82. [PubMed: 19737412]
31. Greene M, Justice AC, Lampiris HW, Valcour V. Management of human immunodeficiency virus infection in advanced age. *JAMA.* 2013; 309:1397–1405. [PubMed: 23549585]
32. Holtzman C, Armon C, Tedaldi E, Chmiel JS, Buchacz K, Wood K, et al. Polypharmacy and risk of antiretroviral drug interactions among the aging HIV-infected population. *J Gen Intern Med.* 2013; 28:1302–1310. [PubMed: 23605401]
33. Patel R, Moore T, Cooper V, McArdle C, Perry N, Cheek E, et al. An observational study of comorbidity and healthcare utilisation among HIV-positive patients aged 50 years and over. *Int J STD AIDS.* 2016; 27:628–637. [PubMed: 26068965]
34. Buchacz K, Baker RK, Palella FJ Jr, Shaw L, Patel P, Lichtenstein KA, et al. Disparities in prevalence of key chronic diseases by gender and race/ethnicity among antiretroviral-treated HIV-infected adults in the US. *Antivir Ther.* 2013; 18:65–75. [PubMed: 23111762]
35. Oursler KK, Goulet JL, Crystal S, Justice AC, Crothers K, Butt AA, et al. Association of age and comorbidity with physical function in HIV-infected and uninfected patients: results from the Veterans Aging Cohort Study. *AIDS Patient Care STDS.* 2011; 25:13–20. [PubMed: 21214375]
36. Rodriguez-Penney AT, Iudicello JE, Riggs PK, Doyle K, Ellis RJ, Letendre SL, et al. Comorbidities in persons infected with HIV: increased burden with older age and negative effects on health-related quality of life. *AIDS Patient Care STDS.* 2013; 27:5–16. [PubMed: 23305257]
37. Hasse B, Ledergerber B, Furrer H, Battegay M, Hirschel B, Cavassini M, et al. Morbidity and aging in HIV-infected persons: the Swiss HIV cohort study. *Clin Infect Dis.* 2011; 53:1130–1139. [PubMed: 21998280]
38. Kebodeaux CD, Wilson AG, Smith DL, Vouri SM. A review of cardiovascular and renal function monitoring: a consideration of older adults with HIV. *HIV/AIDS (Auckland, NZ).* 2013; 5:263–274.
39. Romano PS, Roos LL, Luft HS, Jollis JG, Doliszny K. A comparison of administrative versus clinical data: coronary artery bypass surgery as an example. *Ischemic Heart Disease Patient Outcomes Research Team. J Clin Epidemiol.* 1994; 47:249–260. [PubMed: 8138835]
40. Gorina Y, Kramarow EA. Identifying chronic conditions in Medicare claims data: evaluating the Chronic Condition Data Warehouse algorithm. *Health Serv Res.* 2011; 46:1610–1627. [PubMed: 21649659]

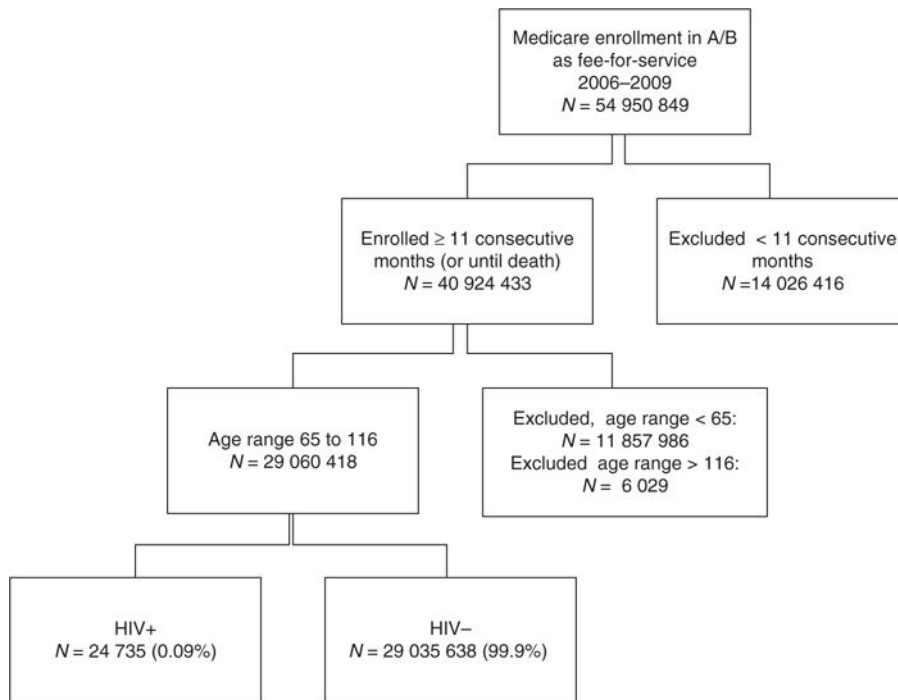


Fig. 1. Inclusion criteria and number of eligible beneficiaries in Medicare 2006–2009
 *HIV+ beneficiaries were those with International Classification of Diseases, Ninth Revision, Clinical Medication, or diagnosis related group codes with a diagnosis of HIV, HIV– were beneficiaries without these codes.

Table 1

Demographics and Medicare coverage in beneficiaries at least 65 years old with and without HIV infection^a, 2006–2009.

| Sociodemographic factors (N = 29 060 418) | HIV– median (SD) or number (%) | HIV+ median (SD) or number (%) | HIV+ vs. HIV– OR (95% CI) | Wilcoxon Z P value or Wald χ^2 P value |
|---|--------------------------------|--------------------------------|---------------------------|---|
| Age | 75.2 (+7.7) | 71.1 (+6.3) | NA | <0.0001 |
| Sex | | | | |
| Unknown | 16 (0%) | 0 (0%) | NA | NA |
| Male ^b | 12 203 017 (42.2%) | 14 419 (58.3%) | 1.93 (1.88, 1.98) | <0.0001 |
| Female ^b | 16 832 650 (58.0%) | 10 316 (41.7%) | Reference | Reference |
| Race/ethnicity | | | | |
| Unknown | 29 196 (0.1%) | 9 (0%) | 0.57 (0.30, 1.03) | 0.10 |
| Non-Hispanic white | 24 321 073 (83.8%) | 13 068 (52.8%) | Reference | Reference |
| African-American | 2240 959 (7.7%) | 6492 (26.3%) | 5.39 (5.23, 5.56) | <0.0001 |
| Other | 154 649 (0.5%) | 137 (0.6%) | 1.65 (1.39, 1.95) | <0.0001 |
| Asian/Pacific Islander | 627 525 (2.2%) | 338 (1.4%) | 0.99 (0.89, 1.10) | 0.96 |
| Hispanic | 1556 497 (5.4%) | 4634 (18.7%) | 5.51 (5.33, 5.70) | <0.0001 |
| Native American | 105 784 (0.4%) | 57 (0.2%) | 1.00 (0.90, 1.12) | 0.98 |
| State of residence | | | | |
| Any other state | 20 048 783 (69.0%) | 11 668 (47.2%) | Reference | Reference |
| Florida | 2068 065 (7.1%) | 5402 (21.8%) | 4.49 (4.34, 4.63) | <0.0001 |
| New York | 1738 310 (6.0%) | 2443 (9.9%) | 2.40 (2.30, 2.51) | <0.0001 |
| California | 23 525 562 (8.1%) | 2432 (9.8%) | 1.78 (1.71, 1.86) | <0.0001 |
| Texas | 1911 494 (6.6%) | 1443 (5.8%) | 1.30 (1.23, 1.37) | <0.0001 |
| New Jersey | 932 094 (3.2%) | 1347 (5.5%) | 2.48 (2.35, 2.63) | <0.0001 |
| Died during study | 6879 447 (23.7%) | 2606 (10.5%) | 0.38 (0.36, 0.40) | <0.0001 |
| Ever had Medicaid coverage ^c | 6216 824 (21.4%) | 11 164 (45.1%) | 3.02 (2.94, 3.10) | <0.0001 |
| Had dual coverage ^d | 5394 511 (18.6%) | 10 418 (42.1%) | 3.19 (3.11, 3.27) | <0.0001 |
| Had Medicare part D coverage | 15 483 704 (53.3%) | 16 898 (68.3%) | 1.89 (1.84, 1.94) | <0.0001 |
| Original Medicare category | | | | |
| Old age/survivors insurance | 26 762 008 (92.2%) | 20 150 (81.5%) | Reference | Reference |
| Disability insurance benefits | 2245 503 (7.7%) | 4456 (18.0%) | 2.64 (2.55, 2.72) | <0.0001 |
| ESRD | 16 243 (0.1%) | 79 (0.3%) | 6.46 (5.18, 8.06) | <0.0001 |
| Both disability and renal | 11 929 (0.0%) | 50 (0.2%) | 5.57 (4.22, 7.35) | <0.0001 |
| Current Medicare category | | | | |
| Old age/survivors insurance | 28 995 402 (99.9%) | 24 594 (99.4%) | Reference | Reference |
| Disability insurance benefits | 7078 (0%) | 7 (0%) | 1.17 (0.56, 2.45) | 0.68 |
| ESRD | 33 091 (0.1%) | 134 (0.5%) | 4.77 (4.03, 5.66) | <0.0001 |
| Both disability and renal | 112 (0%) | 0 (0%) | NA | 0.89 |

CI, confidence interval; ESRD, end stage renal disease; OR, odds ratio.

^aHIV+ beneficiaries were those with ICD-9-CM, or DRG codes with a diagnosis of HIV, HIV– were beneficiaries without these codes.

^bThere were individuals whose sex response differed from their gender response, and two individuals whose sex and gender were both unknown.

^cHad a Medicaid coverage start date (historical to 1999).

^dDual coverage was defined as having Medicaid and Medicare coverage for one or more months 2006–2009.

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Table 2

Prevalence and unadjusted odds ratios for each of the five chronic conditions and for the number of chronic conditions as an index in Medicare beneficiaries at least 65 years old with and without HIV infection^a.

| Chronic condition ^b (N = 29 060 418) | HIV- number (%) | HIV+ number (%) | HIV+ vs. HIV- OR (95% CI) |
|---|--------------------|-----------------|---------------------------|
| Hypertension | 21 460 895 (73.9%) | 21 146 (85.5%) | 2.08 (2.00, 2.15) |
| Hyperlipidemia | 17 039 249 (58.7%) | 17 759 (71.8%) | 1.79 (1.74, 1.84) |
| Ischemic heart disease | 13 476 065 (46.4%) | 15 190 (601.4%) | 1.84 (1.79, 1.89) |
| Rheumatoid/osteoarthritis | 12 310 604 (42.4%) | 14 277 (57.7%) | 1.86 (1.81, 1.90) |
| Diabetes | 9249 614 (31.9%) | 12 181 (49.3%) | 2.08 (2.02, 2.13) |
| Number of chronic conditions ^c | | | |
| 0 | 3646 397 (12.6%) | 1030 (4.2%) | Reference |
| 1 | 3803 118 (13.1%) | 2241 (9.1%) | 2.09 (1.93, 2.25) |
| 2 | 5883 662 (20.3%) | 3760 (15.2%) | 2.26 (2.11, 2.42) |
| 3 | 7282 313 (25.1%) | 5493 (22.2%) | 2.67 (2.50, 2.85) |
| 4 | 5981 919 (20.6%) | 6742 (27.3%) | 3.99 (3.74, 4.26) |
| 5 | 2438 274 (8.4%) | 5469 (22.1%) | 7.94 (7.43, 8.49) |

CI, confidence interval; OR, odds ratio.

^aHIV+ beneficiaries were those with ICD-9-CM, or DRG codes with a diagnosis of HIV, HIV- were beneficiaries without these codes.

^bChronic health conditions were defined by ICD-9-CM, diagnosis or procedure codes, or HCPCS codes.

^cThe number of chronic diseases as an index (regardless of the combination of conditions).

Table 3

Adjusted odds ratios for five chronic conditions in Medicare beneficiaries at least 65 years old with HIV infection^a.

| HIV+ vs. HIV- (N = 29 060 402) | Hypertension aOR ^b (95% CI) Wald χ^2 P value | Hyperlipidemia aOR ^b (95% CI) Wald χ^2 P value | Ischemic heart disease aOR ^b (95% CI) Wald χ^2 P value | Rheumatoid/osteoarthritis aOR ^b (95% CI) Wald χ^2 P value | Diabetes aOR ^b (95% CI) Wald χ^2 P value |
|---------------------------------|--|--|--|---|--|
| Chronic conditions ^c | 2.01 (1.94, 2.09) <0.0001 | 1.81 (1.76, 1.86) <0.0001 | 1.82 (1.77, 1.86) <0.0001 | 2.14 (2.08, 2.19) <0.0001 | 1.51 (1.47, 1.55) <0.0001 |
| Sex | | | | | |
| Male | 2.05 (2.00, 2.11) <0.0001 | 2.06 (2.01, 2.12) <0.0001 | 1.90 (1.85, 1.95) <0.0001 | 2.24 (2.18, 2.30) <0.0001 | 1.98 (1.93, 2.04) <0.0001 |
| Female | Reference | Reference | Reference | Reference | Reference |
| Age (for each year younger) | 0.94 (0.93, 0.94) <0.0001 | 0.94 (0.94, 0.94) <0.0001 | 0.93 (0.93, 0.94) <0.0001 | 0.93 (0.93, 0.94) <0.0001 | 0.94 (0.94, 0.94) <0.0001 |
| Race/ethnicity | | | | | |
| Unknown race | 0.74 (0.39, 1.43) 0.40 | 0.75 (0.39, 1.45) 0.40 | 0.74 (0.39, 1.43) 0.38 | 0.76 (0.39, 1.46) 0.41 | 0.72 (0.37, 1.38) 0.3 |
| Non-Hispanic white | Reference | Reference | Reference | Reference | Reference |
| African-American | 3.75 (3.64, 3.87) <0.0001 | 4.06 (3.93, 4.19) <0.0001 | 4.00 (3.88, 4.13) <0.0001 | 3.99 (3.87, 4.12) <0.0001 | 3.72 (3.61, 3.84) <0.0001 |
| Other race | 1.16 (0.98, 1.37) 0.08 | 1.14 (0.97, 1.35) 0.12 | 1.17 (0.99, 1.39) 0.07 | 1.20 (1.02, 1.42) 0.03 | 1.11 (0.94, 1.32) 0.2 |
| Asian/Pacific Islander | 0.62 (0.55, 0.69) <0.0001 | 0.60 (0.53, 0.66) <0.0001 | 0.65 (0.58, 0.72) <0.0001 | 0.64 (0.57, 0.72) <0.0001 | 0.60 (0.54, 0.67) <0.0001 |
| Hispanic | 3.56 (3.44, 3.69) <0.0001 | 3.52 (3.39, 3.65) <0.0001 | 3.58 (3.45, 3.71) <0.0001 | 3.53 (3.41, 3.66) <0.0001 | 3.34 (3.23, 3.50) <0.0001 |
| Native American | 0.68 (0.52, 0.88) 0.004 | 0.72 (0.55, 0.93) 0.013 | 0.70 (0.54, 0.91) 0.008 | 0.69 (0.52, 0.89) <0.0001 | 0.65 (0.50, 0.84) <0.001 |
| Had dual coverage | 2.50 (2.42, 2.57) <0.0001 | 2.68 (2.61, 2.76) <0.0001 | 2.44 (2.37, 2.51) <0.0001 | 2.47 (2.40, 2.54) <0.0001 | 2.50 (2.43, 2.60) <0.0001 |
| ESRD | 1.58 (1.36, 1.85) <0.0001 | 1.72 (1.47, 2.01) <0.0001 | 1.46 (1.25, 1.70) <0.0001 | 1.78 (1.52, 2.08) <0.0001 | 1.54 (1.32, 1.80) <0.0001 |

CI, confidence interval; ESRD, end stage renal disease; aOR, adjusted odds ratio.

^aHIV+ beneficiaries were those with ICD-9-CM, or DRG codes with a diagnosis of HIV, HIV – were beneficiaries without these codes.

^bAdjusted odds ratios (aOR).

^cChronic health conditions were defined by ICD-9-CM, diagnosis or procedure codes, or HCPCS codes.

Table 4

Adjusted odds ratios for the number of chronic conditions as an index among Medicare beneficiaries at least 65 years old with HIV infection^a.

| HIV+ vs. HIV- (N = 29 060 402) | aOR (95% CI) | Wald χ^2 Pvalue |
|---|-------------------|----------------------|
| Number of chronic conditions ^b | | |
| 0 | Reference | Reference |
| 1 | 2.38 (2.21, 2.57) | <0.0001 |
| 2 | 2.63 (2.46, 2.83) | <0.0001 |
| 3 | 2.98 (2.46, 2.83) | <0.0001 |
| 4 | 4.13 (3.87,4.41) | <0.0001 |
| 5 | 7.07 (6.61, 7.56) | <0.0001 |
| Sex | | |
| Male | 2.11 (2.06, 2.17) | <0.0001 |
| Female | Reference | Reference |
| Age (for each year younger) | 0.94 (0.93, 0.94) | <0.0001 |
| Race/ethnicity | | |
| Unknown race | 0.77 (0.40, 1.48) | 0.43 |
| Non-Hispanic white | Reference | Reference |
| African-American | 3.86 (3.75, 4.00) | <0.0001 |
| Other race | 1.16 (0.98, 1.37) | 0.09 |
| Asian/Pacific Islander | 0.62 (0.60, 0.70) | 0.18 |
| Hispanic | 3.41 (3.29, 3.54) | <0.0001 |
| Native American | 0.70 (0.54, 0.91) | 0.007 |
| Had dual coverage | 2.31 (2.24, 2.38) | <0.0001 |
| ESRD | 1.44 (1.23, 1.68) | <0.0001 |

CI, confidence interval; ESRD, end stage renal disease; aOR, adjusted odds ratio.

^aHIV+ beneficiaries were those with ICD-9-CM, or DRG codes with a diagnosis of HIV, HIV- were beneficiaries without these codes.

^bChronic health conditions were defined by ICD-9-CM, diagnosis or procedure codes, or HCPCS codes.