



Published in final edited form as:

Clin Infect Dis. 2025 November 06; 81(4): 806–814. doi:10.1093/cid/ciaf167.

Changes in the Prevalence of Non-AIDS Conditions Among Hospitalized Persons With Human Immunodeficiency Virus (HIV) in the United States and Canada, 2008–2018

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Potential conflicts of interest. J. A. C. reports consulting fees from Prime Education and Integritas Communications. J. J. E. reports grants or contracts from Gilead Sciences and ViiV Healthcare; consulting fees from Merck, ViiV Healthcare, Gilead Sciences, and AbbVie; and participation in a Data and Safety Monitoring Board (DSMB) or advisory board for Merck and TIAMED. K. A. G. reports royalties or licenses from Up-to-Date; consulting fees from Spark HealthCare, Premier HealthCare, MedEd Learning, and Harrison Consulting and MedEd Learning; and participation in a DSMB or advisory board for Shionogi and Pfizer. M. J. G. reports honoraria as an ad hoc member of HIV national advisory boards to Merck, ViiV Healthcare, and Gilead Sciences. M. Y. K. reports grants or contracts from Gilead Sciences and ViiV Healthcare, membership on the San Diego County Standards and Strategies Committee, and board membership of Being Alive. M. B. K. reports grants or contracts from AbbVie, Gilead Sciences, and ViiV Healthcare, and consulting fees from AbbVie, Gilead Sciences, and ViiV Healthcare. A. N. reports grants or contracts from Gilead Sciences and participation in a DSMB for the National Institutes of Health. All other authors report no potential conflicts. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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Abstract

Background. Hospitalization causes among persons with HIV (PWH) have shifted to non-AIDS conditions, but the complete disease profile of hospitalized PWH has not been well described. To inform hospitalization and readmission prevention efforts, we examined non-AIDS disease prevalence among PWH hospitalized in 4 US cohorts and 1 Canadian cohort.

Methods. Among PWH with ≥ 1 hospitalization from 2008 to 2018, we used log-binomial regression with generalized estimating equations to estimate trends in the annual prevalence of hepatitis B virus (HBV), hepatitis C virus (HCV), hypertension, hyperlipidemia, diabetes mellitus, chronic kidney disease (CKD) stage ≥ 3 , and multimorbidity (≥ 2 and ≥ 3 conditions), defined using longitudinal diagnosis, medication, and laboratory data.

Results. We examined 6781 hospitalized PWH who were 75% cisgender men, 40% White, and 38% Black. From 2008 to 2018, the proportion of PWH in care who had ≥ 1 hospitalization decreased from 9.6% to 6.3%. Age- and cohort-adjusted prevalence increased for hyperlipidemia (relative change per year: 3.6% [95% CI: 2.5%–4.7%]), diabetes mellitus (2.8% [1.3%–4.4%]), CKD (3.3% [1.7%–4.9%]), ≥ 2 conditions (1.3% [0.6%–2.0%]), and ≥ 3 conditions (3.0% [1.7%–4.3%]), decreased for HCV infection (–2.0% [–3.0%, –0.9%]), and remained stable for HBV infection (1.6% [–1.1%, 4.3%]) and hypertension (0.4% [–0.2%, 1.1%]).

Conclusions. Hospitalized PWH had an increasing burden of several non-AIDS conditions and multimorbidity not accounted for by aging alone. Further work is needed to understand these conditions' role in hospitalization risk among PWH. Our findings reinforce that hospital discharge planning in PWH should include efforts to ensure chronic conditions are adequately managed.

Keywords

HIV; aging; comorbidity; hypertension; hyperlipidemia

Antiretroviral therapy (ART) reduced morbidity and mortality among persons with human immunodeficiency virus (PWH) [1–3]. Yet, PWH in care in the United States and Canada have a persistently higher hospitalization burden than the general population, with a rate of 13 per 100 person-years in 2015, compared with 8–10 per 100 persons of similar age in the general population [4–6]. Hospitalization causes among PWH on ART have largely shifted from AIDS-defining to non-AIDS illnesses, particularly infectious, cardiovascular, and liver/gastrointestinal conditions [4, 7–9]. However, the current evidence on disease burden in hospitalized PWH is based on International Classification of Diseases (ICD) discharge diagnosis codes, which capture the most proximal hospitalization cause but may not reflect potential underlying contributors. Furthermore, discharge diagnoses are assigned by hospital coders for reimbursement purposes and not intended to capture conditions that are not evaluated or do not receive treatment during a hospitalization, likely leading to comorbidity prevalence underestimation. ICD coding is also subject to inaccuracies, with positive- and negative-predictive values of less than 80% for some discharge diagnoses [10–13].

Characterizing the disease profile of hospitalized PWH is important to help health systems and policymakers allocate discharge planning resources to ensure patients receive adequate treatment and outpatient follow-up to manage chronic conditions, which could also decrease readmissions, thus improving patient outcomes and reducing healthcare costs [14]. Furthermore, evidence on chronic comorbidities among hospitalized PWH could inform efforts to improve outpatient management and prevent hospitalization. For example, PWH have high rates of cardiometabolic conditions, such as hypertension, hyperlipidemia, and diabetes, which can lead to acute cardiovascular, renal, and other illnesses when poorly controlled [15–19]. As the population of PWH continues to age and experience an increasing disease prevalence [17–20], evidence is needed to inform prevention efforts that can decrease hospitalization burden.

Using a collaboration of clinical cohorts, we examined trends in non-AIDS disease burden among hospitalized PWH, focusing on cardiometabolic conditions and viral hepatitis, which are highly prevalent among PWH, could be linked to the most common hospitalization causes in PWH, and can be targeted for postdischarge and outpatient management [4, 16–19].

METHODS

Data Source and Study Population

Data came from the North American AIDS Cohort Collaboration on Research and Design (NA-ACCORD), an HIV cohort consortium including PWH aged 18 years and older who have been linked to care, defined as 2 or more visits within 12 months [21]. Each participating cohort submits data annually to the NA-ACCORD Data Management Core, which conducts data quality control. We included 4 US clinical cohorts and 1 Canadian clinical cohort that collected the hospitalization and clinical data necessary for this study for the period 2008–2018. Data came from each site's electronic health records (EHRs). The University of North Carolina Institutional Review Board (IRB) approved this secondary data analysis.

We defined periods of HIV care from NA-ACCORD enrollment date until death, loss to follow-up (LTFU), or 31 December 2018, whichever occurred earlier. Loss to follow-up was defined as having no HIV viral load (VL) or CD4 cell count for more than 12 months. Persons with HIV returning to care, defined as having an HIV VL or CD4 count after being lost to follow-up, could contribute additional periods of HIV care. Our prior NA-ACCORD analyses estimated LTFU to be approximately 10% annually, with mortality rates of 1.4 per 100 person-years [4, 22].

For each calendar year, we included PWH with 1 or more hospitalization in that year while being in HIV care. We also examined all PWH in HIV care in a given year in the same cohorts, defined the same way, irrespective of hospitalization. In secondary analyses of disease prevalence by hospitalization reason, we examined all individual hospitalizations among PWH in care as the unit of analysis.

Health Conditions

We examined hepatitis B virus (HBV) and hepatitis C virus (HCV) infection, treated hypertension, treated hyperlipidemia, diabetes mellitus, and chronic kidney disease (CKD) stage 3 or higher, defined using validated algorithms [15, 16]. For HBV and HCV, we included any evidence of active or past infection, defined for HBV as a positive surface antigen, e antigen, or detectable DNA test, and for HCV as a positive antibody, detectable RNA, or having an HCV genotype test. Treated hypertension was defined as having a diagnosis and using an antihypertensive medication. Treated hyperlipidemia was defined as using a lipid-lowering agent (eg, statin), which may have also captured use for other indications. Diabetes was defined as meeting 1 or more of the following: (1) glycated hemoglobin (HbA1c) of 6.5% or more, (2) use of a diabetes-specific medication (eg, insulin), or (3) use of a diabetes-related medication (eg, metformin) with a diabetes diagnosis. CKD stage 3 or higher was defined as having an estimated glomerular filtration rate (eGFR) less than 60 mL/min/1.73 m² consistently for 3 or more months, based on 2 or more values. We used the older, race-based CKD-EPI equation for eGFR to align with what was used in clinical care for most of the study period [23]. For each calendar year and condition, PWH meeting the definition on 1 January of that year or any time prior were considered to have the condition. Once PWH met criteria for a condition, they were

considered to have that condition going forward, even if, for example, they discontinued treatment, or their laboratory values changed. We also examined multimorbidity, including having 2 or more and 3 or more of these conditions.

Other Measures

We identified hospitalization reason from the top-ranked discharge ICD-9 diagnosis code, categorized using Clinical Classifications Software (CCS) from the Agency for Healthcare Research and Quality (AHRQ) [24]. As in previous analyses, when ICD-10 codes were used, these were back-converted to ICD-9 prior to categorization, we modified the CCS to create an AIDS-defining illness category and assign all other infections to a non-AIDS-defining infections category [4, 8]; and if the top-ranked diagnosis code was for HIV or chronic HCV, we used the second-ranked code [25].

Covariates included age, gender, race/ethnicity, HIV risk factor, CD4 count, VL, history of AIDS-defining illness, and the cohort in which PWH were enrolled. Age and history of AIDS-defining illness were time-updated and defined as of 1 January of each year. For CD4 count and VL, we used the earliest measurement in the analysis year if available; otherwise, we used the closest measurement in the last 6 months of the prior year or first 6 months of the following year. Age and cohort were included as adjustment factors in our analyses. Other co-variables were used to describe our sample.

Statistical Analysis

For each calendar year, we estimated the prevalence of conditions among PWH who had 1 or more hospitalization in that year, and among all PWH in care that year. We used log-binomial regression to estimate calendar time trends in prevalence, with generalized estimating equations to account for PWH contributing to more than 1 calendar year of analysis. We included calendar year in models as a linear independent variable. We estimated trends adjusted only for cohort, and adjusted for both cohort and age, with age categorized as less than 42, 42–49, 50–57, and 58 or more years, based on the age quartiles among PWH hospitalized in 2013, the midpoint of the study period.

In a secondary analysis using individual hospitalizations as the unit of analysis, we estimated the prevalence of conditions stratified by discharge diagnosis category. This descriptive secondary analysis was conducted across all calendar years, and we did not estimate any trends in prevalence.

RESULTS

Study Sample

The 6781 PWH with 1 or more hospitalization over 2008–2018 were 75% cisgender men, 40% White, and 38% Black PWH (Table 1). From 2008 to 2018, there was a decrease in the proportion of hospitalized PWH with injection drug use as an HIV risk factor (27% to 18%) and an increase in hospitalized PWH's age (median: 47 to 54 years), CD4 count (median: 294 to 463 cells/ μ L), proportion with VL less than 200 copies/mL (47% to 79%),

and proportion with a body mass index (BMI) of 30 kg/m² or higher (18% to 26%) (Table 1, Supplementary Figure 1).

The group of all 28 381 PWH in care was 82% cisgender men and 39% White and 32% Black PWH (Table 1). The proportion of PWH in care who had 1 or more hospitalization decreased from 9.6% in 2008 to 6.3% in 2018 (Table 2). The proportion of PWH recently enrolled in NA-ACCORD also decreased over time (Supplementary Table 1).

Prevalence of Health Conditions Over Time

In unadjusted analyses among hospitalized PWH (Figure 1), prevalence estimates remained stable over time for HBV infection, decreased for HCV infection, and increased for all other conditions and multimorbidity. In 2018, the unadjusted prevalence was 6.3% (95% CI: 4.8%–7.8%) for HBV, 20.7% (18.2%–23.1%) for HCV, 49.6% (46.6%–52.6%) for treated hypertension, 38.7% (35.7%–41.6%) for treated hyperlipidemia, 20.8% (18.3%–23.2%) for diabetes mellitus, 21.0% (18.5%–23.4%) for CKD stage 3 or higher, 46.1% (43.1%–49.1%) for 2 or more conditions, and 27.9% (25.2%–30.6%) for 3 or more conditions. The 10 most frequent combinations of health conditions for PWH hospitalized with 2 or more conditions in 2018 are shown in Supplementary Table 2; treated hypertension is included in all of them, and treated hyperlipidemia in 7. Modeling analyses adjusted only for NA-ACCORD cohort showed trends similar to the unadjusted plots (Table 3). For all conditions, unadjusted prevalence was consistently higher for hospitalized PWH compared with all PWH in care (Supplementary Table 3).

In analyses adjusted for age and NA-ACCORD cohort (Table 3), the trends for HBV and HCV infection were similar to estimates adjusted only for cohort, with a relative change per year of 1.6% (95% CI: –1.1%, 4.3%) and –2.0% (–3.0%, –0.9%), respectively. However, we no longer observed an increase in treated hypertension prevalence, with a change per year of 0.4% (–0.2%, 1.1%). Trends for other conditions and multimorbidity were attenuated but similar to estimates adjusted only for cohort. The age-adjusted change per year was 3.6% (2.5%–4.7%) for treated hyperlipidemia, 2.8% (1.3%–4.4%) for diabetes, 3.3% (1.7%–4.9%) for CKD stage 3 or higher, 1.3% (0.6%–2.0%) for 2 or more conditions, and 3.0% (1.7%–4.3%) for 3 or more conditions. Calendar time trends among all PWH in care were similar to those among only hospitalized PWH (Supplementary Table 3, Table 3).

Prevalence by Reason for Hospitalization

We also examined unadjusted prevalence among a total of 18 684 hospitalizations, stratified by the 10 most frequent categories of primary discharge diagnosis (Figure 2, Supplementary Table 4). For hospitalizations in the non-AIDS infection category (26% of total hospitalizations), the most frequently occurring health condition was treated hypertension with a prevalence of 44.2%, and 40.9% had 2 or more conditions. Hospitalizations in the cardiovascular (11% of hospitalizations), renal/genitourinary (5%), and endocrine/metabolic (4%) categories had health condition distributions similar to each other, with a high prevalence of treated hypertension (65%–71%), treated hyperlipidemia (34%–51%), CKD stage 3 or higher (32%–42%), and multimorbidity (41%–51% with ≥3

conditions) (Figure 2B, 2H, and 2J). Endocrine/metabolic hospitalizations also had a 48% prevalence of diabetes.

DISCUSSION

Persons with HIV hospitalized during 2008–2018 in 5 cohorts had a high burden of non-AIDS conditions, and prevalence of treated hyperlipidemia, diabetes, CKD, and multimorbidity increased over time, even after accounting for increasing age. In 2018, close to half of hospitalized PWH had 2 or more comorbidities, with treated hypertension and treated hyperlipidemia being the most prevalent conditions.

The trends we observed are consistent with population-based studies. Among PWH in the US National Inpatient Sample (NIS), the number of chronic conditions identified in primary and secondary discharge diagnoses increased over 2005–2015 [9]. Among PWH in Illinois, the presence of anemia, hypertension, CKD, and asthma in discharge diagnoses increased over 2008–2014 [26]. Our study extends prior evidence as we defined conditions using longitudinal clinical data, which are not subject to the limitations of discharge diagnoses [10–13]. Our findings may also be more directly relevant to inform the management of PWH in care, the focus of our study. Persons with HIV who are not in care may be less likely to be evaluated for comorbidities, leading to underestimated prevalence, and likely have different hospitalization reasons and clinical profiles than those in care.

The high non-AIDS burden we observed among hospitalized PWH highlights the importance of discharge planning efforts focused on comorbidity management, including access to medications and outpatient follow-up. Treated hypertension was prevalent in almost 50% of hospitalized PWH in 2018 and may merit particular attention. Better outpatient chronic disease management could also potentially prevent hospitalizations. For example, the prevalence of hypertension, hyperlipidemia, diabetes, and CKD was particularly high in PWH hospitalized for conditions that are sensitive to the poor control of these comorbidities, such as cardiovascular and renal/genitourinary conditions. The proportion of PWH with a BMI of 30 kg/m² or higher also increased over time in our study and could have contributed to these hospitalizations. We did not examine levels of disease control (eg, blood pressure, cholesterol, or HbA1c measures). Future studies should investigate the effect of specific comorbidities, including their level of control, on hospitalization risk in PWH. Studies in PWH with more advanced disease, such as a history of myocardial infarction or cancer, may also help prevent hospitalizations in these higher risk groups.

Comorbidities may be markers of other clinical or social factors that contribute to hospitalizations. Persons with HIV with current or prior low CD4 counts may be more likely to both develop comorbidities and be hospitalized for unrelated reasons. Persons with HIV with comorbidities, including HCV, may be more likely to come from socioeconomically disadvantaged backgrounds, with fewer resources to prevent and manage diseases as outpatients. Some may also have a higher prevalence of tobacco, alcohol, or other substance use, including via injection, which can increase disease and hospitalization risk [27, 28].

Our findings also highlight multimorbidity burden among hospitalized PWH. Multimorbidity is increasing in PWH overall and projected to continue to increase [19, 29]. Complex clinical profiles with multiple conditions can complicate treatment and lead to worse outcomes, including longer hospital stays and readmission. Strategies are needed to improve the care of PWH with multimorbidity, such as coordinated or integrated care with different specialists.

Hepatitis C virus (active or past) prevalence decreased in our study among hospitalized PWH and all PWH in care, while HBV (active or past) prevalence remained stable. This may reflect improvements in primary and secondary prevention via HBV vaccination; HBV and HCV treatment, particularly with directly acting antivirals; and harm-reduction efforts for people who inject drugs. The prevalence of HBV and HCV in our study did not seem higher for PWH hospitalized due to liver/gastrointestinal conditions versus other causes. We previously reported that pancreatitis and gastrointestinal bleeds were the 2 most frequent discharge diagnoses in the liver/gastrointestinal category for PWH, which may be unrelated to viral hepatitis [4]. Hepatitis B virus remains an important concern, as 6% of hospitalized PWH and 4% of all PWH in care in 2018 had a history of HBV. However, we did not distinguish between active or past or treated or untreated HBV and HCV. Future studies should investigate hospitalizations among PWH with active HBV and HCV infections.

In our study, comorbidity burden was higher for hospitalized PWH compared with all PWH in care, but the trends over time were similar in both groups. Prior NA-ACCORD studies found an increasing prevalence in the 2000s for hypercholesterolemia, hypertension, diabetes mellitus, CKD, non-AIDS-defining cancer, and end-stage liver disease [19, 30]. Multimorbidity has also been shown to be increasing among PWH in NA-ACCORD [19, 29]. The HIV Outpatient Study (HOPS) and MACS/WIHS Combined Cohort Study (MWCCS) have shown that the prevalence of individual conditions and multimorbidity is higher in older PWH, but, to our knowledge, they have not examined trends over time [18, 31].

The increasing prevalence of certain comorbidities in hospitalized PWH could have other possible contributing explanations. First, the proportion of PWH in care with 1 or more hospitalization decreased over time in our study. Prior studies reported that hospitalization incidence decreased from the early 2000s to the mid-2010s, with a shift in hospitalization causes from AIDS-defining to non-AIDS conditions [4, 8, 32]. Persons with HIV hospitalized in more recent years may thus reflect a greater proportion of patients with comorbidities that can lead to non-AIDS-related hospitalization. Second, increased efforts to screen and treat comorbidities could have led to more PWH being diagnosed, especially since some of our definitions required medication use. Third, our sample in later years might have included persons diagnosed with HIV more recently, whose comorbidity profile might have differed from PWH who entered care earlier. However, the percentage of hospitalized PWH who had enrolled in NA-ACCORD in the same year decreased over time and reached 8.1% in 2018, suggesting this would likely have played only a small role in our findings. Fourth, during our study period there was an increase in the use of integrase strand transfer inhibitor (INSTI)-based ART regimens that can increase serum creatinine, which could have led to underestimated eGFR in some PWH. Finally, changes in hospital

admission thresholds over time could have led to more PWH with comorbidities being hospitalized. This effect has been speculated to explain some hospitalization trends in the general population, including in people with diabetes [33].

Strengths and Limitations

This study included 11 years of data from 5 clinical cohorts, combining administrative hospital discharge data with longitudinal clinical data, which are rarely available together in large studies. However, our study ends in 2018. Future studies should continue to examine hospitalizations among PWH as newer data become available.

One limitation is that we only captured hospitalizations in each cohort's medical system. If there were differences in PWH hospitalized at each site versus nearby hospitals, it could have impacted our findings. We examined a limited set of comorbidities, and future studies should investigate other conditions that pose a hospitalization risk in PWH, such as anemia and chronic obstructive pulmonary disease (COPD) [34, 35]. We did not examine mental health or substance use problems, which are common among PWH, with prevalence estimates of 35% for depression and 16% for at-risk alcohol use, and associated with hospitalizations [27, 28, 36, 37]. We did not have data on insurance status or other social determinants of health, although these can also be hospitalization risk factors in PWH [28, 38]. A better understanding of how social determinants contribute to hospitalization risk in PWH with comorbidities, by reducing comorbidity control or other pathways, is needed. Future studies should also investigate the role of comorbidities in gender and racial/ethnic hospitalization disparities, as some demographic groups experience a higher burden of both comorbidities and hospitalizations [18, 22, 31].

Conclusions

Among hospitalized PWH in care in 5 cohorts, age-adjusted prevalence increased from 2008 to 2018 for several cardiometabolic conditions and multimorbidity. Further investigation of disease burden and control among hospitalized PWH can shed light on underlying contributors to hospitalization and inform prevention and care management efforts in both inpatient and outpatient settings.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments.

The authors acknowledge the contribution of the Centers for Disease Control and Prevention (CDC) to the development of this manuscript.

Financial support.

T. D.-M. has received support from the National Heart, Lung, and Blood Institute (grant number K01HL169020). This work was supported by National Institutes of Health grants U01AI069918, F31AI124794, F31DA037788, G12MD007583, K01AI093197, K01AI131895, K23EY 013707, K24AI065298, K24AI118591, K24DA000432, KL2TR000421, N01CP01004, N02CP055504, N02CP91027, P30AI027757, P30AI027763, P30AI027767, P30AI036219, P30AI050409, P30AI050410, P30AI094189, P30AI110527, P30MH62246, R01AA016893, R01DA011602, R01DA012568, R01AG053100, R24AI067039, R34DA045592, U01AA013566,

U01AA 020790, U01AI038855, U01AI038858, U01AI068634, U01AI068636, U01AI069432, U01AI069434, U01DA036297, U01DA036935, U10EY 008057, U10EY008052, U10EY008067, U01HL146192, U01HL146193, U01HL146194, U01HL146201, U01HL146202, U01HL146203, U01HL 146204, U01HL146205, U01HL146208, U01HL146240, U01HL146241, U01HL146242, U01HL146245, U01HL146333, U24AA020794, U54GM 133807, UL1RR024131, UL1TR000004, UL1TR000083, UL1TR002378, Z01CP010214, and Z01CP010176; contracts CDC-200–2006-18797 and CDC-200–2015-63931 from the Centers for Disease Control and Prevention; contract 90047713 from the Agency for Healthcare Research and Quality; contract 90051652 from the Health Resources and Services Administration; the Grady Health System; grants CBR-86906, CBR-94036, HCP-97105, and TGF-96118 from the Canadian Institutes of Health Research, Canada; the Ontario Ministry of Health and Long Term Care and the Government of Alberta, Canada. Additional support was provided by the National Institute of Allergy and Infectious Diseases (NIAID), National Cancer Institute (NCI), National Heart, Lung, and Blood Institute (NHLBI), Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), National Human Genome Research Institute (NHGRI), National Institute of Mental Health (NIMH), National Institute on Drug Abuse (NIDA), National Institute on Aging (NIA), National Institute of Dental and Craniofacial Research (NIDCR), National Institute of Neurological Disorders and Stroke (NINDS), National Institute of Nursing Research (NINR), National Institute on Alcohol Abuse and Alcoholism (NIAAA), National Institute on Deafness and Other Communication Disorders (NIDCD), and National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK).

Data availability.

Data from the NA-ACCORD can be accessed by submitting a Concept Sheet Proposal to NA-ACCORD, available at <https://naaccord.org/collaborate-with-us>.

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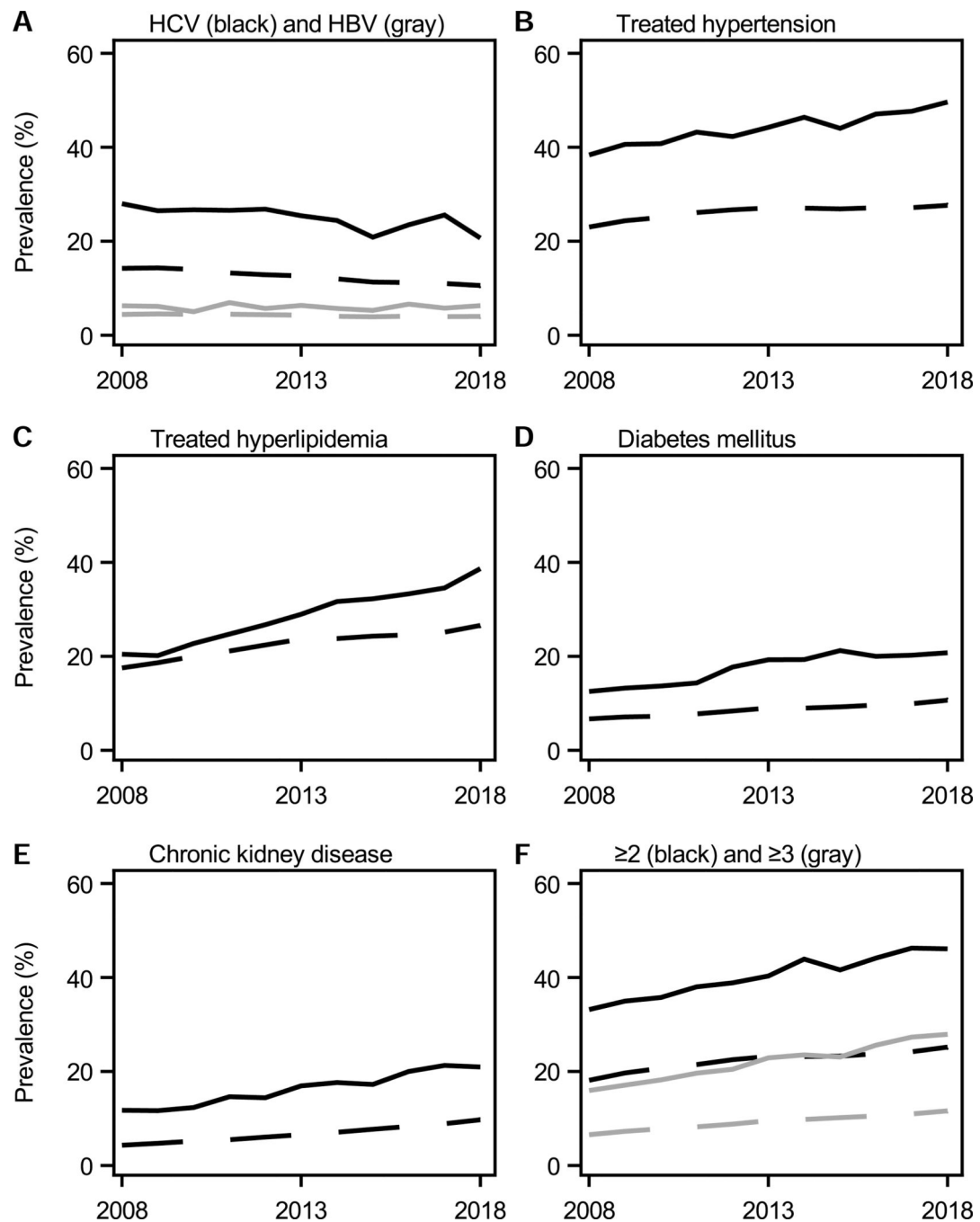


Figure 1.

A–F, Unadjusted annual prevalence (%) of health conditions among hospitalized persons with HIV (solid lines): NA-ACCORD, 2008–2018. For reference, prevalences among all 28 381 persons with HIV in care (11 000–17 000 each year) are also shown (dashed lines). Abbreviations: HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus; NA-ACCORD, North American AIDS Cohort Collaboration on Research and Design.

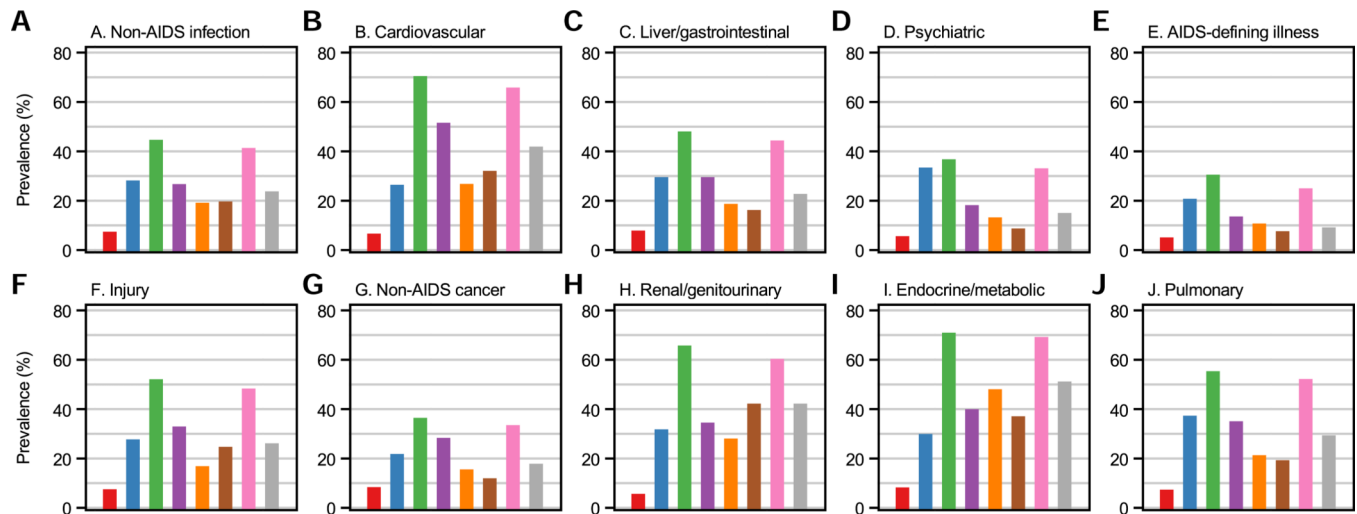


Figure 2.

A–J, Unadjusted prevalence of non-AIDS health conditions stratified by the 10 most frequent categories of primary hospital discharge diagnosis: NA-ACCORD, 2008–2018.

Displayed from left to right within each panel are the prevalence of HBV infection (red), HCV infection (blue), treated hypertension (green), treated hyperlipidemia (purple), diabetes mellitus (orange), chronic kidney disease stage ≥ 3 (brown), ≥ 2 conditions (pink), and ≥ 3 conditions (gray). Abbreviations: HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus; NA-ACCORD, North American AIDS Cohort Collaboration on Research and Design.

Table 1.

Characteristics of Persons With HIV in 5 Cohorts of the North American AIDS Cohort Collaboration on Research and Design (NA-ACCORD), 2008–2018

Characteristic ^a	Hospitalized Persons With HIV			All Persons With HIV in Care		
	All (n = 6781)	2008 (n = 1022)	2018 (n = 1050)	All (n = 28 381)	2008 (n = 10 615)	2018 (n = 16 794)
Gender						
Cisgender men	5109 (75%)	726 (71%)	793 (76%)	23 277 (82%)	8655 (82%)	13 622 (81%)
Cisgender women	1602 (24%)	283 (28%)	242 (23%)	4885 (17%)	1890 (18%)	3049 (18%)
Transgender persons	70 (1%)	13 (1%)	15 (1%)	219 (1%)	70 (1%)	123 (1%)
Race/ethnicity						
White	2704 (40%)	387 (38%)	401 (38%)	11 132 (39%)	4698 (44%)	6444 (38%)
Black	2573 (38%)	430 (42%)	437 (42%)	9154 (32%)	3154 (30%)	5639 (34%)
Hispanic	918 (14%)	111 (11%)	153 (15%)	4780 (17%)	1583 (15%)	2994 (18%)
Other or missing	586 (9%)	94 (9%)	59 (6%)	3315 (12%)	1180 (11%)	1717 (10%)
Age, y	48 (40, 56)	47 (40, 54)	54 (45, 61)	43 (34, 51)	45 (38, 51)	50 (39, 58)
HIV acquisition risk factor						
Men who have sex with men	2997 (44%)	364 (36%)	452 (43%)	15 503 (55%)	5722 (54%)	9106 (54%)
Injection drug use	1251 (18%)	276 (27%)	188 (18%)	3385 (12%)	1510 (14%)	1755 (10%)
Heterosexual, other, or missing	2533 (37%)	382 (37%)	410 (39%)	9493 (33%)	3383 (32%)	5933 (35%)
CD4 count, cells/ μ L	404 (191, 630)	294 (109, 510)	463 (246, 725)	457 (273, 660)	440 (279, 623)	634 (436, 857)
HIV RNA <200 copies/mL	4073 (61%)	478 (47%)	813 (79%)	14 392 (54%)	6238 (63%)	13 611 (88%)
History of AIDS-defining illness	1893 (28%)	430 (42%)	406 (39%)	3663 (13%)	2772 (26%)	3667 (22%)
Body mass index ^b kg/m ²						
<18.5 kg/m ²	295 (5%)	54 (6%)	52 (5%)	637 (2%)	202 (2%)	234 (2%)
18.5–24.9 kg/m ²	2636 (41%)	424 (45%)	362 (36%)	10 887 (42%)	3979 (42%)	5036 (33%)
25.0–29.9 kg/m ²	2101 (33%)	300 (32%)	337 (33%)	9525 (36%)	3534 (37%)	5794 (38%)
$\geq$ 30.0 kg/m ²	1421 (22%)	173 (18%)	266 (26%)	5156 (20%)	1779 (19%)	4357 (28%)
Cohort enrollment year	2008 (2003, 2012)	2004 (2000, 2007)	2011 (2005, 2015)	2010 (2006, 2015)	2004 (2001, 2007)	2012 (2007, 2016)
Enrolled in US-based cohort	5991 (88%)	915 (90%)	934 (89%)	25 596 (90%)	9395 (89%)	14 832 (88%)

Data are presented as n (%) or median (IQR). Shown are PWH in care who had at least 1 hospitalization (left) and all PWH in care (right), overall and at the beginning and end of the study period.

Abbreviations: HIV, human immunodeficiency virus; IQR, interquartile range; PWH, persons with HIV.

^a Characteristics were measured on 1 January of the calendar of the first hospitalization in the study period for the first column and on 1 January of the relevant year for the second and third columns.

^b Body mass index values were missing for 328, 71, 33, 2176, 1121, and 1373 PWH across columns.

Table 2.

Number and Proportion of Persons With HIV in Care Who Had 1 or More Hospitalization by Calendar Year in 5 Cohorts of the North American AIDS Cohort Collaboration on Research and Design (NA-ACCORD), 2008–2018

Calendar Year	Hospitalized PWH	All PWH in Care	Percentage of PWH in Care With ≥ 1 Hospitalization
2008	1022	10 615	9.6%
2009	1012	11 227	9.0%
2010	1038	11 977	8.7%
2011	1039	12 709	8.2%
2012	1055	13 282	7.9%
2013	1074	13 691	7.8%
2014	1020	14 322	7.1%
2015	1079	14 930	7.2%
2016	1090	15 703	6.9%
2017	1146	16 372	7.0%
2018	1050	16 794	6.3%

Abbreviations: HIV, human immunodeficiency virus; PWH, persons with HIV.

Table 3. Calendar Time Trends in the Prevalence of Chronic Non-AIDS Conditions Among Hospitalized Persons With HIV in 5 Cohorts of the North American AIDS Cohort Collaboration on Research and Design (NA-ACCORD), 2008–2018

Condition	Unadjusted Prevalence (95% CI)		Relative Change per Year (95% CI)	
	2008	2018	Adjusted for NA-ACCORD Cohort ^a	Adjusted for Age and Cohort ^b
HBV infection	6.3% (4.8%, 7.7%)	6.3% (4.8%, 7.8%)	1.2% (−1.5%, 3.9%)	1.6% (−1.1%, 4.3%)
HCV infection	28.0% (25.2%, 30.7%)	20.7% (18.2%, 23.1%)	−0.8% (−1.9%, 0.2%)	−2.0% (−3.0%, −0.9%)
Hypertension	38.4% (35.4%, 41.3%)	49.6% (46.6%, 52.6%)	2.8% (2.1%, 3.5%)	0.4% (−0.2%, 1.1%)
Hyperlipidemia	20.5% (18.0%, 22.9%)	38.7% (35.7%, 41.6%)	6.7% (5.5%, 7.8%)	3.6% (2.5%, 4.7%)
Diabetes mellitus	12.5% (10.5%, 14.6%)	20.8% (18.3%, 23.2%)	6.1% (4.5%, 7.7%)	2.8% (1.3%, 4.4%)
CKD stage ≥3	11.7% (9.8%, 13.7%)	21.0% (18.5%, 23.4%)	7.4% (5.7%, 9.1%)	3.3% (1.7%, 4.9%)
Two or more conditions	33.2% (30.3%, 36.1%)	46.1% (43.1%, 49.1%)	4.0% (3.2%, 4.8%)	1.3% (0.6%, 2.0%)
Three or more conditions	15.9% (13.7%, 18.2%)	27.9% (25.2%, 30.6%)	6.7% (5.3%, 8.1%)	3.0% (1.7%, 4.3%)

Abbreviations: CKD, chronic kidney disease; HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus.

^a Estimates and 95% CIs were obtained from separate log-binomial regression models, including only NA-ACCORD cohort as a covariate, with generalized estimating equations to account for patients contributing to more than 1 calendar year of analysis.

^b Estimates and 95% CIs were obtained from separate log-binomial regression models, including age (categorized as <42, 42–49, 50–57, and ≥58 y) and NA-ACCORD cohort as covariates, with generalized estimating equations.