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Racial Disparities in People Living with Human Immunodeficiency Virus and Upper Gastrointestinal Bleeding: A Nationwide Study (2016-2021)

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SUMMARY

Background: In the United States, approximately 1.2 million people were living with HIV (PLWH) by the end of 2021, with African Americans experiencing a higher mortality rate than American Whites (20.1 per 100,000 vs 3.1 per 100,000). Upper gastrointestinal bleeding (UGIB), though uncommon (1–14%), is a serious concern. Data on UGIB among PLWH is limited.
Methods: A retrospective cross-sectional analysis was conducted using the National Inpatient Sample database (2016-2021). PLWH with age ≥18 years with UGIB were identified using ICD-10 codes. Multivariate regression was used to determine mortality risk by adjusting for sociodemographic factors and comorbidities.
Results: Among 6,923 PLWH with UGIB requiring ICU-level care, mortality was higher in AA than AW (37.1% vs 29.9%). AA had a higher mortality risk than AW ($p<0.05$). Among those who underwent endoscopy, the mortality risk remained higher in AA compared to the AW ($p=0.1$). However, early endoscopy (<24 hours of admission) showed a lower mortality rate in AA compared to AW (41.7% vs 45.8%), but the difference was not significant after adjustment ($p>0.05$). In the AA cohort, comorbidities such as variceal gastrointestinal bleed, solid malignancy, acute coronary syndrome, acute kidney injury, sepsis, pancytopenia, and invasive ventilation independently increased the mortality risk ($p\leq0.05$).
Conclusions: African Americans with upper gastrointestinal bleeding were associated with increased mortality compared to American Whites. These findings underscore the need for equitable healthcare and targeted strategies to identify and address barriers in this population.

Keywords: HIV, bleeding, mortality, upper gastrointestinal bleeding, AIDS, African American.

INTRODUCTION

In the United States, approximately 1.2 million people were living with HIV (PLWH) by the end of 2021, as reported by the CDC [1]. HIV prevalence increased by about 20,000 people annually from 2017 to 2021 [2, 3]. Certain populations continue to be disproportionately affected, including transgender individuals, racial and ethnic minorities such as African Americans and Hispanics, and individuals with specific sexual practices, including men who have sex with men (MSM) and bisexuals [3, 4]. In 2021, African Americans (AA) accounted for 40% of newly diagnosed PLWH, while 29% were Hispanic/Latino, and 25% were American Whites (AW) [5]. Mortality in African Americans is higher at 20.1 per 100,000, compared to 5.6 per 100,000 among Hispanics/Latinos and 3.1 per 100,000 among American Whites [6].

Gastrointestinal bleeding remains relatively rare, with a reported prevalence ranging from 1% to 14% [7-9]. Upper GI bleeding (UGIB) has been shown to occur approximately three times more frequently than lower GI bleeding (LGIB) in this population (10% vs 3%) [8-10]. The causes of UGIB are complex, encompassing both HIV-related and non–HIV-related causes [8, 11]. HIV-related causes include cytomegalovirus (CMV), herpes simplex virus (HSV), Kaposi's sarcoma, GI tract lymphoma, and idiopathic esophageal ulcers. In contrast, non-HIV-related causes include peptic ulcers, gastritis, portal hypertension, and Mallory-Weiss tears [8, 10, 12]. Gastrointestinal symptoms in HIV are associated with early and profound depletion of CD4+ T cells, particularly within the gut-associated lymphoid tissue (GALT), which contributes to impairment of the mucosal immune barrier and systemic immune dysfunction [7, 13, 14]. UGIB often necessitates urgent hospitalization and close clinical monitoring [9, 10].

Although racial disparities in HIV outcomes remain a significant concern, findings have been inconsistent. For instance, a study on HCV and HIV-coinfected patients reported higher mortality rates in AW patients compared to AA patients (31% vs 15%, p=0.011) [15]. Conversely, other studies have found no significant racial or ethnic differences in HIV-related mortality or differences in the length of hospitalization [16, 17]. More recent studies include case reports detailing unique instances of Kaposi sarcoma and gastric lymphoma causing GI bleeding in PLWH [18, 19]. However, research on gastrointestinal bleeding in PLWH is limited. The existing literature describes the management of upper gastrointestinal bleeding, but it lacks generalizability. Most studies are either single-center or include predominantly patients with private insurance. Additionally, these studies do not adequately address inpatient mortality or racial disparities affecting the care received for this condition [8, 20-23].

Our study aims to evaluate the mortality associated with upper gastrointestinal bleeding in PLWH and the racial disparities affecting African Americans.

METHODS

Design, Data source and Study Population

We queried the 2016-2021 National Inpatient Sample (NIS) database for a retrospective cross-sectional study. Adults aged 18 or above admitted with an upper gastrointestinal bleed and HIV infection were included. To mitigate potential selection bias, a prespecified subpopulation analysis was performed among patients requiring ICU-level care, defined by the presence of shock, acute kidney injury requiring hemodialysis, mechanical ventilation, or vasopressor use.

The NIS was developed by the Healthcare Cost and Utilization Project (HCUP) and sponsored by the Agency for Healthcare Research and Quality (AHRQ) [24]. This project aimed to produce comprehensive data on the utilization, costs, and outcomes of inpatient care at the regional and national levels in the United States. The document consists of several elements, including patient demographics (such as age, gender, and race), diagnosis and procedure codes obtained from the International Classification of Diseases, Tenth Revision, Clinical Modification/Procedure Coding System (ICD-10-CM/PCS), indicators of severity and comorbidity, hospital characteristics, discharge status, and length of stay (LOS).

ICD-10 codes and Ethical Considerations

The NIS is a de-identified, publicly accessible database. The current investigation did not require

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approval from an institutional review board. Adults requiring ICU level of care with an ICD-10-CM code of upper gastrointestinal Bleeding and HIV infection were included [25, 26]. No predetermined sample size was calculated. ICD-10-CM/PCS codes were used to identify patients and are provided in the *supplementary Table 1*. Before accessing the NIS databases, we adhered to the AHRQ's data user agreement. The databases utilized adhere to the HIPAA (Health Insurance Portability and Accountability Act) Privacy Rule's definition of limited data sets and do not contain any explicit identifiers of patients.

Variables Assessed

Gender was delineated as male and female. Patient race was defined as American White (referent), African American, Hispanic, Asian or Pacific Islander, and Native American. Insurance status was defined by Medicare (referent), Medicaid, Private Insurance, and other/self-pay/no charge. The ICD-10 codes encompass acute kidney injury, myocardial infarction, invasive ventilation, sepsis, acute pulmonary embolism, acute respiratory failure, acute respiratory distress syndrome, acute heart failure, and vasopressor usage, AIDS-defining conditions which includes AIDS-defining cancers (Kaposi's Sarcoma, Cervical Cancer, and Non-Hodgkin's Lymphoma, Diffuse Large B-cell Lymphoma) and opportunistic infections (candidiasis, cytomegalovirus disease, chronic herpes simplex ulcers, cryptococcus, toxoplasmosis, tuberculosis, and Pneumocystis pneumonia). All other solid cancers not classified as AIDS-defining cancers were considered non-AIDS-defining cancers. Additional variables included utilization of endoscopy, tracheostomy, long-term anticoagulant use, long-term antiplatelet use, receipt of inpatient palliative care services, and hematological diatheses, including anemia, thrombocytopenia, pancytopenia, and immune thrombocytopenic purpura. To better capture bleeding severity and limit selection bias, we analyzed patients requiring ICU-level care as a prespecified subpopulation.

Outcomes

Our primary outcome of interest was to study the mortality rates and risk associated with upper gastrointestinal bleeding (UGIB) in PLWH, with a specific focus on differences based on their ICU status, as well as highlighting the racial disparities in this population. Secondary outcomes were to analyze the mortality predictors in African American patients.

Statistical analysis

We performed all statistical analyses using STATA v18. We used the strata and weights with appropriate survey commands to generate national estimates. For our descriptive analyses, we compared demographic and clinical characteristics as well as outcomes of patients using Pearson's chi-square test for categorical variables. We employed a double robust approach**,** combining inverse probability weighting combined with outcome regression, to estimate associations between risk factors and mortality. Variables found significant at $p<0.3$ were candidates for inclusion in our primary model. This enabled us to control for potential confounding factors. The models included variables that were identified as significant determinants of the outcomes according to the literature. Multivariate logistic regression and analyses were used to identify the adjusted odds ratio of the desired outcomes. All reported models were adjusted with the same variables that were identified. Statistical significance was reported if the p-value was ≤0.05.

RESULTS

Results comparing ICU and non-ICU patients

Of 39,560 PLWH with UGIB, 17.5% met the criteria for ICU admission. Multivariate regression analysis showed that the ICU cohort had higher mortality odds than the non-ICU cohort (35.7% vs 1.9%; aOR 4.6, 95% CI 3.2-6.7, $p<0.001$). Hospitalization charges for the ICU cohort had a mean cost of $75,941.3 (95% CI $41,635.3–$110,247.2, $p<0.001$), with a mean length of hospital stay of 2.9 days (95% CI 1.4–4.4, $p<0.001$). We identified that mortality was not influenced by age, gender, median income, insurance status, hospital size, or teaching status ($p>0.05$). *Table 1* shows the multivariate analysis of HIV with Upper Gastrointestinal Bleeding among ICU vs non-ICU patients.

Racial Disparities

In the ICU, African Americans (AA) (7.3%) and American Whites (AW) (7.5%) had a similar prevalence of upper gastrointestinal bleed. However, AA had higher mortality than AW (Unadjusted: 37.1%

Table 1 - Multivariate analysis of HIV with Upper Gastrointestinal Bleeding.

HIV with Upper Gastrointestinal Bleeding - ICU vs Non-ICU			
	Coefficient	*95% CI UL-LL*	*p-value*
Mortality Risk (Adjusted Odds Ratio)	4.6	3.2–6.7	<0.001
Hospitalization Charges (Dollars)	75,941.3	41,635.3–110,247.2	<0.001
Length of Hospital Stay (Days)	2.9	1.4–4.4	<0.001
Racial Disparities: African Americans vs American Whites			
Mortality Risk (Adjusted Odds Ratio)	1.5	1.1-2.1	0.01
Hospitalization Charges (Dollars)	-19,347.5	-84,293.1- 45,598.1	>0.05
Length of Hospital Stay (Days)	2.0	-2.1-6.0	>0.05

*Adjusted for factors - age, race, insurance payer, hepatic dysfunction, stroke, myocardial infarction, sepsis, acute respiratory failure, ARDS, pancytopenia, thrombocytopenia, blood transfusion, disseminated intravascular coagulation, tumors, lymphoma, kaposi sarcoma, shock, mechanical ventilation, tracheostomy, and endoscopy.

vs 29.9%, p<0.01; Adjusted: aOR 1.5, 95% CI 1.1-2.1, p=0.01). In the ICU, 17.9% received palliative care services, with AA patients receiving less palliative care than AW (15.7% vs 18.9%; OR 0.8, 95% CI 0.5-1.1, p=0.1). Variceal bleeding was associated with higher mortality than non-variceal bleeding (38.8% vs 24%). In the variceal bleeding cohort, AA were associated with a higher mortality than AW (41.2% vs 33%; OR 1.6, 95% CI 1.1-2.3, p=0.01).

Among PLWH with upper gastrointestinal bleeding, unadjusted mortality rates were 39.5% in Hispanic patients, 50.0% in Asian or Pacific Islander patients, and 31.4% in those classified as other races.

AIDS-defining conditions that included opportunistic infections and AIDS defining cancers (Non-Hodgkin Lymphoma, Diffuse Large B-cell Lymphoma, Cervical Cancer, and Kaposi Sarcoma) had a 40.7% ICU mortality, with higher mortality in AA than AW (45.1% vs 30%). However, the difference was marginally significant after adjustment (OR=1.8, 95% CI 1-3.3, p=0.05). AIDS-defining cancers had a 50.5% ICU mortality rate, and mortality did not differ between AA and AW (47% vs 50%, p>0.05). Sepsis was associated with a 45.6% ICU mortality, with higher mortality in AA compared to AW (48.5% vs 39.7%; OR 1.5, 95% CI 1.01-2.3, p<0.05). Racial disparities did not alter mortality in immune thrombocytopenic purpura, or patients treated with long-term antiplatelet or anticoagulation therapy (p>0.05).

Procedures and Timing of Intervention

Patients who underwent endoscopy had lower mortality than those who did not (Unadjusted:

Table 2 - Clinical Outcomes and Mortality Rates Among American Whites and African Americans.

Variables	*African Americans (%)*	*American Whites (%)*	*p-value*	*Mortality in African Americans (%)*	*Mortality in American Whites (%)*	*p-value*
Age over 60	32.3	33.5	0.3919	36	27.1	0.0698
Females	32.7	15.1	<0.001*	34.2	45	0.0811
Palliative Care	15.7	18.9	0.1067	67.6	64	0.1697
Gastrointestinal Comorbidities						
Variceal GI Bleed	75.4	70.5	0.1841	41.2	33	0.0078*
Non-Variceal GI Bleed	24.6	29.5	0.1841	24.3	22.4	0.5622
Hepatic Dysfunction	17.2	21.7	0.0211*	55.1	54.1	0.937
Cardiovascular Comorbidities						
Stroke	3.2	4.5	0.5376	31.8	61.1	0.1887
Myocardial Infarction	8.7	10.1	0.6508	41.7	25.6	0.3355

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Variables	*African Americans (%)*	*American Whites (%)*	*p-value*	*Mortality in African Americans (%)*	*Mortality in American Whites (%)*	*p-value*
Arrhythmia	12.4	11.6	0.4801	41.2	35.6	0.1961
Acute Heart Failure	14.4	11.8	0.0233*	41.4	27.7	0.45
Cardiac Vascular Graft	9.0	9.1	0.0899	24.2	11.1	0.0182*
Other Comorbidities						
Acute Respiratory Failure	58.3	59.5	0.0596*	46.9	34.8	0.0126*
Metabolic Encephalopathy	22.5	17.6	0.4909	41.3	40.6	0.6258
Acute Kidney Injury	67.3	64.5	0.0091*	40	34.4	0.0409*
Hemodialysis	35.9	11.3	<0.001*	26.7	22.7	0.5687
Infectious Processes						
Sepsis	51.6	47.9	0.3593	48.5	39.7	0.0105*
Infective Endocarditis	<5	<5	0.3707	40.9	50	0.6715
AIDS Defining Conditions	28.3	25.2	0.001*	45.1	30	0.055*
Hematological Comorbidities						
Acute Pulmonary Embolism	5.2	<5	0.4198	47.2	40	0.1886
Anemia	54.5	36.0	<0.0001*	34.7	29.6	0.0176*
Long-term Anticoagulant Use	4.7	6.3	0.6817	31.3	12	0.1179
Long-term Antiplatelet Use	6.1	5.8	0.8266	19.1	13	0.2958
Immune Thrombocytopenic Purpura	<5	<5	0.0331*	18.2	<5	0.062
Thrombocytopenia	25.3	23.4	0.3458	46	32.3	0.1035
Pancytopenia	9.7	7.8	0.2194	53.7	25.8	0.0328*
ICU-related Complications						
Cardiopulmonary resuscitation	13.2	10.6	0.0451*	67	64.3	0.6208
Disseminated intravascular coagulation	7.1	7.8	0.1657	63.3	71	0.5842
ARDS	<5	<5	0.0471	64.3	46.2	0.0938
Invasive Ventilation	58.7	60.7	0.0215*	49.5	36.9	0.0017*
Tracheostomy	8.3	5.3	0.0398*	28.1	23.8	0.9066
Cardiogenic Shock	5.8	6.3	0.7131	47.5	32	0.4617
Hypovolemic Shock	12.2	16.9	0.2162	21.4	22.7	0.1307
Vasopressor Use	19.0	17.4	0.2543	41.2	34.8	0.3881
Blood Transfusion	39.1	32.8	<0.001*	38.3	32.6	0.2319

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Variables	African Americans (%)	American Whites (%)	p-value	Mortality in African Americans (%)	Mortality in American Whites (%)	p-value
Interventions						
Endoscopy	28.1	31.2	0.6649	23.3	16.4	0.1723
Angiography	<5	<5	0.2461	12.5	9.1	0.8628
Variceal Ligation	14.1	18.1	0.2589	27.8	22.2	0.6435
Radical Embolization	<5	<5	0.8534	12.5	20	0.8518
Malignancies						
AIDS Defining Cancers	7.1	5	0.023*	46.9	50	0.642
Leukemia	<5	<5	0.7141	36.8	58.3	0.1783
Lymphoma	5.4	<5	0.0164*	43.2	50	0.4477
Hodgkin Lymphoma	<5	<5	0.04	-	-	-
Solid Malignancy	14.4	10.1	0.3766	53.5	27.5	0.0073*
Urogenital Cancer	<5	<5	0.8593	-	-	-
Kaposi Sarcoma	<5	<5	0.2747	55.6	55.6	0.4695
Diffuse Large B-cell Lymphoma	<5	<5	0.0395	57.1	25	0.6078
Non-Hodgkin Lymphoma	<5	<5	0.0646	45.2	45.5	0.7167
Liver Cancer	<5	<5	0.0986	83.3	66.7	0.6453
Pancreatic Cancer	<5	<5	0.8178	80	<5	0.053
Anal Cancer	<5	<5	0.9767	25	<5	0.565
Cervical Cancer	<5	<5	0.9795	-	-	-
Stomach Cancer	<5	<5	0.9271	50	50	0.637

*denotes significant p-value.
Legend: GI- Gastrointestinal, AIDS- Acquired immunodeficiency syndrome, ARDS- Acute Respiratory Distress Syndrome

22.3% vs 77.8%). In this cohort who underwent the intervention, mortality was higher in AA than AW (Unadjusted: 23.3% vs 16.4%; Adjusted aOR 1.6, 95% CI 0.8-3.1, p=0.1). Based on the procedure timing (<24 hours), mortality was lower in AA than in AW (41.7% vs 45.8%, p<0.05). However, after multivariable adjustment, early endoscopy (<24 hours) was not independently associated with mortality, and no significant difference in mortality by race was observed (p> 0.05). *Table 2* shows the Clinical Outcomes and Mortality Rates Among American Whites and African Americans.

Predictors of Mortality in African American Patients with Upper Gastrointestinal Bleeding

Multivariate analysis was performed to determine the predictors of mortality in African Americans. Several factors emerged as statistically significant with a p≤0.05. Pancytopenia (OR=2.1), cardiogenic shock (OR=2.2), non-AIDS cancer (OR=2.5), sepsis (OR=2.7), acute respiratory failure (OR=2.1), ARDS (OR=4.4), invasive ventilation (OR=3.2), and variceal gastrointestinal bleeding (OR=1.7) were associated with an increased risk of mortality. Thrombocytopenia was also linked to higher mortality, showing borderline significance (p=0.067). Conversely, tracheostomy (p<0.001) and endoscopy (p=0.01) were associated with a decreased risk of mortality. Other variables, including age over 60, female gender, insurance status, cardiac and vascular grafts, and AIDS-defining cancers, were not significantly associated with mortality (p>0.05). *Table 3* shows the predictors of mortality in African Americans with Upper Gastrointestinal Bleeding.

Table 3 - Predictors of Mortality in African Americans with Upper Gastrointestinal Bleeding (UGIB).

Variable	*Odds Ratio (OR)*	*95% Confidence Interval*	*p-value*
Age > 60 years	1.3	0.8 – 1.9	0.282
Female	0.9	0.6 – 1.3	0.595
Insurance (Medicare as Ref)			
Medicaid	1.2	0.8 – 1.9	0.33
Private	1.4	0.8 – 2.5	0.25
Self-pay	2.1	0.7 – 6.0	0.186
Other	0.9	0.4 – 1.4	0.971
Unknown	1.3	0.4 – 4.9	0.66
Pancytopenia	2.1	1.2 – 3.9	*0.015*
Thrombocytopenia	1.5	1.0 – 2.2	0.067
Cardiogenic Shock	2.2	1.0 – 4.9	*0.048*
Cardiac and Vascular Graft	0.7	0.3 – 1.4	0.273
AIDS-defining Cancer	1.5	0.8 – 3.0	0.247
Non-AIDS Cancer	2.5	1.3 – 4.5	*0.004*
Sepsis	2.7	1.8 – 3.9	*<0.001*
Acute Respiratory Failure	2.1	1.3 – 3.3	*0.002*
ARDS	4.4	1.6 – 11.7	*0.003*
Invasive Ventilation	3.2	2.1 – 5.1	*<0.001*
Tracheostomy	0.3	0.1 – 0.6	*<0.001*
Variceal GI Bleed	1.7	1.1 – 2.8	*0.028*
Endoscopy	0.6	0.4 – 0.9	*0.018*

Legend: AIDS- Acquired immunodeficiency syndrome, ARDS- Acute Respiratory Distress Syndrome, GI- Gastrointestinal. AIDS-defining cancers include Kaposi's Sarcoma, Cervical Cancer, Non-Hodgkin Lymphoma, and Diffuse Large B-cell Lymphoma. Non-AIDS cancers include all other solid cancers not classified as AIDS-defining cancers.

DISCUSSION

To our knowledge, this is the first large-scale analysis on racial disparities affecting mortality in PLWH with upper gastrointestinal bleeding. The patients that required ICU level of care were associated with a higher mortality, increased hospitalization costs, and prolonged hospital stays compared to the non-ICU cohort ($p<0.001$). In the ICU cohort, African American (AA) patients were associated with higher mortality than American White (AW) patients ($p<0.01$). AA patients were associated with no difference in hospitalization costs and length of hospitalization compared to AW. ICU patients tend to have organ failure and a poorer prognosis with HIV [27]. PLWH with CD4 counts $<200/mm^3$ are at increased risk for AIDS-associated complications, which may further worsen outcomes [28].

Sharbatji *et al.* reported that patients with variceal bleeding had a significantly higher mortality rate compared to those with nonvariceal bleeding (6.6% *vs.* 1.8%) [29]. Similarly, our study showed that AA patients experienced higher mortality rates with variceal bleeding compared to nonvariceal bleeding. This finding may be attributed to the increasing prevalence of chronic liver disease among PLWH. Notably, PLWH are approximately six times more likely to be affected by hepatitis C virus (HCV) than HIV-negative individuals, and HIV-HCV coinfection is associated with an accelerated progression to chronic hepatitis [30, 31]. If left untreated, this progression frequently leads to end-stage liver disease and portal hypertension, substantially increasing the risk of variceal formation and bleeding [30, 31]. Additional contributing factors include hepatitis B co-infection, alcohol use, nonalcoholic fatty liver disease, and medica-

tion-induced hepatotoxicity [32]. While no specific guidelines are dedicated to managing upper gastrointestinal bleeding in PLWH, their care generally follows standard protocols. This includes initial fluid resuscitation and hemodynamic stabilization followed by early endoscopic evaluation (<24 hr) [8, 11], as outlined in the ACG Clinical Guideline for Upper Gastrointestinal and Ulcer Bleeding and the ASGE Guidelines for Endoscopic Management of Nonvariceal Upper GI Bleeding [33, 34]. Early and effective control of upper gastrointestinal bleeding becomes critically important in improving outcomes [4, 35]. Undergoing endoscopy was associated with decreased overall mortality ($p<0.05$). However, mortality remained higher among AA compared to AW (23.3% *vs.* 16.4%). Prior studies have demonstrated that undergoing endoscopy and receiving early endoscopic evaluation within 24 hours were associated with reduced in-hospital mortality among AA patients [36-38]. Consistent with these findings, early endoscopy (<24 hours) was found to have a lower mortality in AA than AW. Racial disparities were not associated with mortality after adjustment for sociodemographic factors and comorbidities. This may be attributed to the smaller samples. We examined other interventions such as variceal ligation and radical embolizations; however, these findings were insignificant due to limited samples.

Palliative care utilization was lower among AA patients compared to AW patients (15.7% *vs.* 18.9%). AA patients often face both individual and structural barriers to care, including limited healthcare literacy and access, which have been associated with poorer outcomes [37, 39-41]. Early discussions around goals of care and the incorporation of palliative strategies may help alleviate the clinical burden in this population. In AA patients, the presence of pancytopenia, cardiogenic shock, sepsis, Acute Respiratory Distress Syndrome (ARDS), and the need for invasive mechanical ventilation were independently associated with a higher mortality ($p<0.05$). These factors have been independently linked to adverse outcomes in HIV-infected patients in previous studies [42-45]. A multidisciplinary approach with individualized treatment planning is essential to improving outcomes in AA patients.

Limitations of our study include the absence of detailed clinical information on HIV disease status, such as CD4 count, viral load, antiretroviral therapy, and compliance. We were unable to account for biological factors related to immune function and viral suppression that may influence clinical outcomes. We could not evaluate the exact cause of UGIB or the severity. The database also lacks information on laboratory values and antimicrobials used. Data on code status, 30-day mortality, long-term outcomes, and readmission rates were unavailable. Patients' self-reported racial data recorded in clinical settings may not always accurately reflect the patient's true background and may incompletely capture the impact of systemic barriers to care. Moreover, the retrospective design limits our ability to adjust for unmeasured confounders, particularly those related to healthcare access and treatment availability.

CONCLUSIONS

In people living with HIV (PLWH) presenting with upper gastrointestinal bleeding, African American patients had 1.5 times higher odds of mortality compared to American White patients. Independent predictors of increased mortality included pancytopenia, cardiogenic shock, sepsis, ARDS, and the need for endoscopy. These findings highlight the importance of a multidisciplinary care approach and underscore the need for expanded palliative care services to support individualized treatment planning. Addressing racial disparities and social determinants of health may facilitate earlier recognition of complications and help reduce mortality in this high-risk population.

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Conflict of interest
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Author contributions
D.B.R. was involved in study conceptualisation, methodology, data collection, writing original article and reviewing. N.Y. was involved in critical review of analysis, reviewing and editing. B.P.S. was involved in study conceptualisation, data analysis, critical analysis of results and reviewing of manuscript. F.M.S., M.M., H.P.S., D.D.M., N.N.A., J.P., U.A.M., K.S.K.S., A.E., K.B. were involved in

writing the original article. R.T. was involved in critical reviewing and editing, study conceptualisation and supervision. R.D. was involved in critical reviewing and editing and supervision.

Data availability statement
All data used in this study are publicly available through the Healthcare Cost and Utilization Project (HCUP) databases, accessible at: https://hcup-us.ahrq.gov/databases.jsp.

Ethics approval statement
Not Applicable.

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Supplementary Table 1 - List of ICD-10-CM and ICD-10-PCS codes used for patient identification in the study cohort.

Solid Malignancy	C000 C001 C002 C003 C004 C005 C006 C008 C009 C01 C020 C021 C022 C023 C024 C028 C029 C030 C031 C039 C040 C041 C048 C049 C050 C051 C052 C058 C059 C060 C061 C062 C0680 C0689 C069 C07 C080 C081 C089 C090 C091 C098 C099 C100 C101 C102 C103 C104 C108 C109 C110 C111 C112 C113 C118 C119 C12 C130 C131 C132 C138 C139 C140 C142 C148 C153 C154 C155 C158 C159 C160 C161 C162 C163 C164 C165 C166 C168 C169 C170 C171 C172 C173 C178 C179 C180 C181 C182 C183 C184 C185 C186 C187 C188 C189 C19 C20 C210 C211 C212 C218 C220 C221 C222 C223 C224 C227 C228 C229 C23 C240 C241 C248 C249 C250 C251 C252 C253 C254 C257 C258 C259 C260 C261 C269 C300 C301 C310 C311 C312 C313 C318 C319 C320 C321 C322 C323 C328 C329 C33 C3400 C3401 C3402 C3410 C3411 C3412 C342 C3430 C3431 C3432 C3480 C3481 C3482 C3490 C3491 C3492 C37 C380 C381 C382 C383 C384 C388 C390 C399 C4000 C4001 C4002 C4010 C4011 C4012 C4020 C4021 C4022 C4030 C4031 C4032 C4080 C4081 C4082 C4090 C4091 C4092 C410 C411 C412 C413 C414 C419 C430 C4310 C4311 C43111 C43112 C4312 C43121 C43122 C4320 C4321 C4322 C4330 C4331 C4339 C434 C4351 C4352 C4359 C4360 C4361 C4362 C4370 C4371 C4372 C438 C439 C4400 C4401 C4402 C4409 C44101 C44102 C441021 C441022 C44109 C441091 C441092 C44111 C44112 C441121 C441122 C44119 C441191 C441192 C44121 C44122 C441221 C441222 C44129 C441291 C441292 C44131 C441321 C441322 C441391 C441392 C44191 C44192 C441921 C441922 C44199 C441991 C441992 C44201 C44202 C44209 C44211 C44212 C44219 C44221 C44222 C44229 C44291 C44292 C44299 C44300 C44301 C44309 C44310 C44311 C44319 C44320 C44321 C44329 C44390 C44391 C44399 C4440 C4441 C4442 C4449 C44500 C44501 C44509 C44510 C44511 C44519 C44520 C44521 C44529 C44590 C44591 C44599 C44601 C44602 C44609 C44611 C44612 C44619 C44621 C44622 C44629 C44691 C44692 C44699 C44701 C44702 C44709 C44711 C44712 C44719 C44721 C44722 C44729 C44791 C44792 C44799 C4480 C4481 C4482 C4489 C4490 C4491 C4492 C4499 C450 C451 C452 C457 C459 C460 C461 C462 C463 C464 C4650 C4651 C4652 C467 C469 C470 C4710 C4711 C4712 C4720 C4721 C4722 C473 C474 C475 C476 C478 C479 C480 C481 C482 C488 C490 C4910 C4911 C4912 C4920 C4921 C4922 C493 C494 C495 C496 C498 C499 C49A0 C49A1 C49A2 C49A3 C49A4 C49A5 C49A9 C4A0 C4A10 C4A11 C4A111 C4A112 C4A12 C4A121 C4A122 C4A20 C4A21 C4A22 C4A30 C4A31 C4A39 C4A4 C4A51 C4A52 C4A59 C4A60 C4A61 C4A62 C4A70 C4A71 C4A72 C4A8 C4A9 C50011 C50012 C50019 C50021 C50022 C50029 C50111 C50112 C50119 C50121 C50122 C50129 C50211 C50212 C50219 C50221 C50222 C50229 C50311 C50312 C50319 C50321 C50322 C50329 C50411 C50412 C50419 C50421 C50422 C50429 C50511 C50512 C50519 C50521 C50522 C50529 C50611 C50612 C50619 C50621 C50622 C50629 C50811 C50812 C50819 C50821 C50822 C50829 C50911 C50912 C50919 C50921 C50922 C50929 C510 C511 C512 C518 C519 C52 C530 C531 C538 C539 C540 C541 C542 C543 C548 C549 C55 C561 C562 C569 C5700 C5701 C5702 C5710 C5711 C5712 C5720 C5721 C5722 C573 C574 C577 C578 C579 C58 C600 C601 C602 C608 C609 C61 C6200 C6201 C6202 C6210 C6211 C6212 C6290 C6291 C6292 C6300 C6301 C6302 C6310 C6311 C6312 C632 C637 C638 C639 C641 C642 C649 C651 C652 C659 C661 C662 C669 C670 C671 C672 C673 C674 C675 C676 C677 C678 C679 C680 C681 C688 C689 C6900 C6901 C6902 C6910 C6911 C6912 C6920 C6921 C6922 C6930 C6931 C6932 C6940 C6941 C6942 C6950 C6951 C6952 C6960 C6961 C6962 C6980 C6981 C6982 C6990 C6991 C6992 C700 C701 C709 C710 C711 C712 C713 C714 C715 C716 C717 C718 C719 C720 C721 C7220 C7221 C7222 C7230 C7231 C7232 C7240 C7241 C7242 C7250 C7259 C729 C73 C7400 C7401 C7402 C7410 C7411 C7412 C7490 C7491 C7492 C750 C751 C752 C753 C754 C755 C758 C759 C760 C761 C762 C763 C7640 C7641 C7642 C7650 C7651 C7652 C768 C770 C771 C772 C773 C774 C775 C778 C779 C7800 C7801 C7802 C781 C782 C7830 C7839 C784 C785 C786 C787 C7880 C7889 C7900 C7901 C7902 C7910 C7911 C7919 C792 C7931 C7932 C7940 C7949 C7951 C7952 C7960 C7961 C7962 C7970 C7971 C7972 C7981 C7982 C7989 C799 C7A00 C7A010 C7A011 C7A012 C7A019 C7A020 C7A021 C7A022 C7A023 C7A024 C7A025 C7A026 C7A029 C7A090 C7A091 C7A092 C7A093 C7A094 C7A095 C7A096 C7A098 C7A1 C7A8 C800 C801 C802
Cervix cancer	C530 C531 C538 C539
Breast Cancer	C500, C5001, C50011, C50012, C50019, C5002, C50021, C50022, C50029, C501, C5011, C50111, C50112, C50119, C5012, C50121, C50122, C50129, C502, C5021, C50211, C50212, C50219, C5022, C50221, C50222, C50229, C503, C5031, C50311, C50312, C50319, C5032, C50321, C50322, C50329, C504, C5041, C50411, C50412, C50419, C5042, C50421, C50422, C50429, C505, C5051, C50511, C50512, C50519, C5052, C50521, C50522, C50529, C506, C5061, C50611, C50612, C50619, C5062, C50621, C50622, C50629, C508, C5081, C50811, C50812, C50819, C5082, C50821, C50822, C50829, C509, C5091, C50911, C50912, C50919, C5092, C50921, C50922, C50929
Lung Cancer	C340, C3400, C3401, C3402, C341, C3410, C3411, C3412, C342, C343, C3430, C3431, C3432, C348, C3480, C3481, C3482, C349, C3490, C3491, C3492
Anal Cancer	C210 C211 C212 C218
Colon Cancer	C180 C181 C182 C183 C184 C185 C186 C187 C188 C189
Upper GI bleed	K2931 K2931 K2941 K2951 K2961 K2971 K2981 K2991 K2981 K226 K264 K266 K270 K272 K274 K276 K280 K282 K284 K286 K2901 K2211 K250 K252 K254 K256 K260 K262 K921 K922 K920 I8501 I8511 K31811
Lower GI bleed	K5793 K5791 K5781 K5753 K5751 K5741 K5733 K5731 K5721 K5713 K5711 K5701 K5521 K51411 K51511 K921
Intracranial Hemorrhage	I6000 I6001 I6002 I6010 I6011 I6012 I602 I6030 I6031 I6032 I604 I6050 I6051 I6052 I606 I607 I608 I609 I610 I611 I612 I613 I614 I615 I616 I618 I619 I6200 I6201 I6202 I6203 I621 I629
Hematuria	R3121 R3129 R319 R310
Hypovolemic shock	R571
Acute pulmonary embolism	0072 0880 0881 0882 0883 O888 I2782 I2601 I2602 I2609 I2690 I2692 I2699 T790 T790XXA T790XXD T790XXS T791 T791XXA T791XXD T791XXS T800 T800XXA T800XXD T800XXS T82817 T82818
Stomach cancer	C160 C161 C162 C163 C164 C165 C166 C168 C169
Liver cancer	C220 C221 C222 C223 C224 C227 C228 C229
Lymphoma	C8194 C8195 C8196 C8197 C8198 C8199 C8190 C8191 C8192 C8193 C8170 C8171 C8172 C8173 C8174 C8175 C8176 C8177 C8178 C8179 C8140 C8141 C8142 C8143 C8144 C8145 C8146 C8147 C8148 C8149 C8130 C8131 C8132 C8133 C8134 C8135 C8136 C8137 C8138 C8139 C8120 C8121 C8122 C8123 C8110 C8111 C8112 C8113 C8114 C8115 C8116 C8117 C8118 C8119 C8100 C8101 C8102 C8103 C8104 C8105 C8106 C8107 C8108 C8109 C8293 C8294 C8295 C8296 C8297 C8298 C8299 C8290 C8291 C8292 C8284 C8285 C8286 C8287 C8288 C8289 C8280 C8281 C8282 C8283 C8260 C8261 C8262 C8263 C8264 C8265 C8266 C8267 C8268 C8269 C8254 C8255 C8256 C8257 C8258 C8259 C8250 C8251 C8252 C8253 C8243 C8244 C8245 C8246 C8247 C8248 C8249 C8240 C8241 C8242 C8233 C8234 C8235 C8236 C8237 C8238 C8239 C8230 C8231 C8232 C8224 C8225 C8226 C8227 C8228 C8229 C8220 C8221 C8222 C8223 C8210 C8211 C8212 C8213 C8214 C8215 C8216 C8217 C8218 C8219 C8200 C8201 C8202 C8203 C8204 C8205 C8206 C8207 C8208 C8209 C8390 C8391 C8392 C8393 C8394 C8395 C8396 C8397 C8398 C8399 C8380 C8381 C8382 C8383 C8384 C8385 C8386 C8386 C8387 C8388 C8389 C8372 C8373 C8374 C8375 C8376 C8377 C8378 C8379 C8370 C8371 C8372 C8354 C8355 C8356 C8357 C8358 C8359 C8350 C8351 C8352 C8353 C8333 C8334 C8335 C8336 C8337 C8338 C8339 C8330 C8331 C8332 C8333 C8310 C8311 C8312 C8313 C8314 C8315 C8316 C8317 C8318 C8319 C8303 C8304 C8305 C8306 C8307 C8308 C8309 C8300 C8301 C8302 C84Z4 C84Z5 C84Z6 C8427 C8428 C8429 C84Z0 C84Z1 C8422 C84Z3 C84Z4 C84A0 C84A1 C84A2 C84A3 C84A4 C84A5 C84A6 C84A7 C84A8 C84A9 C8490 C8491 C8492 C8493 C8494 C8495 C8496 C8497 C8498 C8499 C8474 C8475 C8476 C8477 C8478 C8479 C8470 C8471 C8472 C8473 C8474 C8460 C8461 C8462 C8463 C8464 C8465 C8466 C8467 C8468 C8469 C8440 C8441 C8442 C8443 C8444 C8445 C8446 C8447 C8448 C8449 C8410 C8411 C8412 C8413 C8414 C8415 C8416 C8417 C8418 C8419 C8400 C8401 C8402 C8403 C8404 C8405 C8406 C8407 C8408 C8409 C8594 C8595 C8596 C8597 C8598 C8599 C8590 C8591 C8592 C8593 C8594 C8585 C8586 C8587 C8588 C8589 C8580 C8581 C8582 C8583 C8584 C8524 C8525 C8526 C8527 C8528 C8529 C8520 C8521 C8522 C8523 C8513 C8514 C8515 C8516 C8517 C8518 C8519 C8510 C8511 C8512 C8513 C860 C861 C862 C863 C864 C865 C866 C880 C882 C883 C884 C888 C889
Pancreatic cancer	C250 C251 C252 C253 C254 C257 C258 C259
Diffuse large B cell lymphoma	C8332 C8333 C8334 C8335 C8336 C8337 C8338 C8339 C833 C8330 C8331 C8332
Hodgkin lymphoma	C8194 C8195 C8196 C8197 C8198 C8199 C8190 C8191 C8192 C8193 C8170 C8171 C8172 C8173 C8174 C8175 C8176 C8177 C8178 C8179 C8140 C8141 C8142 C8143 C8144 C8145 C8146 C8147 C8148 C8149 C8130 C8131 C8132 C8133 C8134 C8135 C8136 C8137 C8138 C8139 C8120 C8121 C8122 C8123 C8110 C8111 C8112 C8113 C8114 C8115 C8116 C8117 C8118 C8119 C8100 C8101 C8102 C8103 C8104 C8105 C8106 C8107 C8108 C8109
HIV	B9735 098711 098712 098713 098719 09872 09873 Z21 B20
Endoscopy	0D953ZX 0D983ZX 0D9A4ZX ODB54ZX ODB87ZX ODBA4ZX 0D954ZX 0D984ZX OD9A7ZX ODB57ZX ODB88ZX ODBA7ZX 0D957ZX 0D987ZX OD9B3ZX ODB58ZX ODB83ZX ODBA8ZX 0D958ZX 0D993ZX 0D9B4ZX ODB63ZX ODB93ZX ODBB3ZX 0D963ZX 0D994ZX OD9B7ZX ODB64ZX ODB94ZX ODBB4ZX 0D964ZX 0D997ZX 0D9B8ZX ODB67ZX ODB97ZX ODBB7ZX 0D967ZX 0D998ZX OD9C8ZX ODB68ZX ODB98ZX ODBB8ZX 0D968ZX 0D9A3ZX ODB53ZX ODB84ZX ODBA3ZX ODBC8ZX ODJ08ZZ 0DJ68ZZ 0DD58ZX 0DD68ZX 0DD98ZX 0DB58ZX 0DB68ZX 0DB98ZX 0DDC8ZX 0DDB8ZX 0DDA8ZX 0DD88ZX 0DBC8 06L34CZ 0D518ZZ 0D528ZZ 0D538ZZ 0D548ZZ 0D558ZZ 0W3P8ZZ 3E0G8TZ 0D568ZZ 0D578ZZ 0D598ZZ 0DQ98ZZ 0DQ68ZZ 0DQ78ZZ 0DL58ZZ 0DL68ZZ 0DL98ZZ 0DLA8ZZ 0DLB8ZZ 0DTB8ZZ 0DJD8ZZ 0D9E8ZX 0D9H8ZX 0D9N8ZX 0DBE8ZX 0DBH8ZX 0DBN8ZX 0DDE8ZX 0DDH8ZX 0DDN8ZX 0DBP8ZZ 0DBQ8ZZ 0DJD3ZZ 0DJD4ZZ 0DJD7ZZ 0DBF8ZX 0DBG8ZX 0DBK8ZX 0DBL8ZX 0DBM8ZX 0D5E8ZZ 0D5F8ZZ 0D5G8ZZ 0D5H8ZZ 0D5K8ZZ 0D5L8ZZ 0D5M8ZZ 0D5N8ZZ 0D5P8ZZ 0DLH8ZZ 0D5Q8ZZ 0DLP8ZZ 0DLQ8ZZ 0DQH8ZZ 0DQQ8ZZ 0DTH8ZZ 0DTP8ZZ 0DTQ8ZZ 0DJ07ZZ 0D588ZZ 0D5A8ZZ 0D718ZZ 0D728ZZ 0D738ZZ 0D748ZZ 0D758ZZ 0D768ZZ 0D778ZZ 0D788ZZ 0D798ZZ 0D7A8ZZ 0D718DZ 0D728DZ 0D738DZ 0D748DZ 0D758DZ 0D768DZ 0D778DZ 0D788DZ 0D798DZ 0D7A8DZ 0D9180Z 0D918ZX 0D918ZZ 0D9280Z 0D928ZX 0D928ZZ 0D9380Z 0D938ZX 0D938ZZ 0D9480Z 0D948ZX 0D948ZZ 0D9580Z 0D958ZZ 0D9680Z 0D968ZX 0D968ZZ 0D9780Z 0D978ZX 0D978ZZ 0D9880Z 0D988ZX 0D988ZZ 0D9980Z 0D998ZZ 0D9A80Z 0D9A8ZX 0D9A8ZZ 0DB18ZX 0DB18ZZ 0DB28ZX 0DB28ZZ 0DB38ZX 0DB38ZZ 0DB48ZX 0DB48ZZ 0DB58ZZ 0DB68ZZ 0DB78ZZ 0DB88ZZ 0DB98ZZ 0DBA8ZZ 0DC18ZZ 0DC28ZZ 0DC38ZZ 0DC48ZZ 0DC58ZZ 0DC68ZZ 0DC78ZZ 0DC88ZZ 0DC98ZZ 0DCA8ZZ
Angiography	B4040ZZ B414OZZ B4041ZZ B4141ZZ B404YZZ B414YZZ B40BOZZ B41BOZZ B40B1ZZ B41B1ZZ B4OBYZZ B41BYZZ
Variceal ligation	06L30ZZ 0D554ZZ 0D518ZZ 0D528ZZ 0D538ZZ 0D548ZZ 0D558ZZ 0D568ZZ 0W3P8ZZ 3E0G8TZ 0DQ78ZZ 0DQ68ZZ 0DQ28ZZ 0DQ38ZZ 0DQ58ZZ 0DQ48ZZ 06L38CZ 06L34CZ 06L38ZZ 3E0G8GC 06L28CZ 06L28ZZ
Radical embolization	04L23DZ
Kaposi sarcoma	C4652 C467 C469 C460 C461 C462 C463 C464 C465 C4650 C4651