

ORIGINAL RESEARCH



Characteristics and prognostic factors of HIV-positive adults in the emergency department of a university hospital in South Korea, 2013–2022

Seojun Lee¹, Chae Hyeon Lee², Young Ju Suh³, Yu Jin Lee¹, Ji Hye Kim¹, Seung Baik Han¹, Areum Durey^{1,*}

¹Department of Emergency Medicine, Inha University School of Medicine, 22332 Incheon, Republic of Korea

²The Biomedical Center, Biomedical Research Institute, Inha University Hospital, 22332 Incheon, Republic of Korea

³Department of Biomedical Sciences, Inha University School of Medicine, 22212 Incheon, Republic of Korea

***Correspondence**

areum.durey@inha.ac.kr

(Areum Durey)

Abstract

An estimated 39 million individuals globally were living with human immunodeficiency virus (HIV) at the end of 2022 with approximately 1.3 million individuals newly infected during 2022. Similarly, the number of people living with HIV (PWH) has consistently increased in Korea and the number of PWH seeking emergency care is expected to increase. This study aimed to elucidate utilization patterns of emergency department (ED) of PWH and identify key indicators that predict admission and poor prognosis. This was a single-center retrospective study of HIV-positive adult patients who visited the ED between 01 January 2013 and 31 December 2022. Data was collected at the visit level and analyzed using the generalized estimating equation method. Visits were categorized into direct hospital admissions from the ED or discharges to home to evaluate admission-associated factors. Additionally, visits in the poor prognosis group were compared with the remainder to elucidate prognostic indicators. The poor prognosis group was defined as admitted visits with intensive care unit placement, visits with in-hospital mortality, or both. Annually, an average of 8.9 per 10,000 ED visits were made by PWH, with an admission rate of 49.8%. A total of 369 ED visits corresponding to 183 PWH were included in the analysis, and 93% of them were on highly active antiretroviral therapy. Underlying chronic renal failure, presenting with fever or general weakness, supplemental oxygen administration, or ancillary department consultation in the ED increased admission odds. Ambulance use, high triage level and use of oxygen in the ED were associated with poor prognosis. Most notably, higher levels of blood urea nitrogen (BUN) or lactic acid were independent factors of poor prognosis. We hope these analytic insights from 10 years of institutional data will assist emergency physicians in providing timely informed care to HIV-infected individuals visiting the ED, ultimately leading to improved patient outcomes.

Keywords

Emergency department; HIV; Highly active antiretroviral therapy; Admission; Prognosis; South Korea

1. Introduction

An estimated 39 million individuals globally were living with HIV at the end of 2022. Although the incidence of new HIV infections has declined since 2010, approximately 1.3 million individuals still acquired HIV in 2022 [1]. Similarly, in South Korea, the number of people infected with HIV has risen consistently since the detection of the first case of HIV infection in 1985. According to a report published by the Korea Centers for Disease Control and Prevention, 19,001 cumulative confirmed cases of HIV infection had been identified in South Korea as of 2022, with an average of 1100 new diagnoses annually since 2013 [2]. The number of South Koreans diagnosed with HIV increased by 9.3 % from 975 in

2021 to 1066 in 2022.

In parallel, the prognosis of people living with HIV (PWH) has substantially improved since 1997, following the introduction of combination antiretroviral therapy (ART). Continuous advances in pharmacological HIV treatments have facilitated recommendations for earlier initiation of ART [3]. As a result, the survival and estimated life expectancy of PWH on ART now approach those of their HIV-negative counterparts residing in the same regions [4], allowing HIV infection to be regarded as a manageable chronic condition.

Accordingly, emergency department (ED) utilization by PWH is projected to rise concomitant with the aging of PWH. Indeed, comparative analyses indicate higher rates of ED use among PWH relative to HIV-negative populations [5]. An

analysis of the US National Hospital Ambulatory Medical Survey demonstrated that the rates of ED visits among PWH continue to exceed those among non-infected people (633 vs. 438 visits per 1000 people) [6]. Moreover, HIV-related ED visits reflected higher resource utilization, including longer ED stays and higher hospital admission rates [7, 8].

Therefore, this study aimed to elucidate patterns of ED utilization by PWH at a university hospital in South Korea over a 10-year period using visit-level data. Furthermore, characteristics of direct hospital admissions from the ED were compared to discharged visits to elucidate associated admission factors. Additionally, data were analyzed to identify key indicators predicting poor prognosis. We aspired to equip emergency physicians with analytic insights from 10 years of institutional data for PWH presenting to the ED.

2. Material and methods

2.1 Study design

This single-center retrospective study investigated characteristics of HIV-positive adult patients presenting to the ED of an 895-bed university hospital between 01 January 2013 and 31 December 2022. Per annual ED census data, the hospital serves approximately 60,000 patients annually. Referrals are unnecessary for ED access in South Korea, with governmental subsidization of all medical expenses for HIV care upon registration at a public health center.

Visits were categorized into direct hospital admissions from the ED or discharges to home to evaluate admission-associated factors. Additionally, visits in the poor prognosis group were compared with the remainder to evaluate prognostic indicators. The poor prognosis group was defined as admitted visits with intensive care unit (ICU) placement, visits with in-hospital mortality, or both.

2.2 Study population

Records were retrospectively reviewed for patients aged ≥ 18 years diagnosed with HIV infection who visited the ED between January 2013 and December 2022. Exclusion criteria encompassed the unawareness of positive HIV serostatus upon initial ED presentation, death prior to arrival, discharge against medical advice, and minor procedural indications including lumbar punctures, intravenous albumin-paired paracenteses, antibiotic injections, or wound dressing.

2.3 Data collection and definitions

The following variables were extracted from medical records of HIV-positive ED patients: age, sex, Korean Triage and Acuity Scale (KTAS) level, ambulance transport, reason for visit, comorbidities, duration of HIV diagnosis and highly active ART (HAART), vital sign measurements, laboratory results, supplemental oxygen necessity in the ED, ancillary department consults, ED length of stay, and cumulative ED presentations over the 10-year study period. For admitted cases, the assigned location (general ward versus ICU), hospital length of stay, and in-hospital mortality were additionally documented.

Overlapping reasons for visit were grouped with the five

most prevalent indications utilized for statistical evaluations, as follows: (1) abdominal pain and/or nausea/vomiting; (2) fever; (3) injury or poisoning; (4) general weakness or poor oral intake; and (5) skin rashes. HIV-associated variables including the most recent cluster determinant 4 (CD4) count, and HIV viral load were also collected *via* chart review. The number of years since HIV diagnosis was counted as one from the next year of HIV diagnosis.

All parameters were recorded per visit, incorporating multiple presentations by given patients over the 10-year timeframe, with total ED visits per patient also recorded. Select variables such as age, KTAS level, CD4 count, and viral load were further grouped for analytical purposes.

2.4 Statistical analyses

Data with a normal distribution were expressed as mean \pm standard deviation, whereas data with a skewed distribution were expressed as median and interquartile range (IQR). First, patients were divided into the discharge and admission groups, and the characteristics of each group were compared. Given that patients could contribute to multiple visits at different time points in our study, we used the generalized estimating equation (GEE) method with an exchangeable correlation structure to produce regression estimates when analyzing repeated measures [9]. Statistical significance was set at $p < 0.05$. Second, the poor prognosis group was compared to the remainder, and variables with a p value of < 0.10 in the simple model were candidates for the multiple models to investigate independent prognostic factors. The p value was relaxed to $p < 0.10$ to prevent exclusion of potentially meaningful clinical factors. All the statistical analyses were performed using SAS (version 9.4, SAS Institute, Cary, NC, USA).

3. Results

3.1 Overall characteristics

During the study period, a total of 369 ED visits corresponding to 183 discrete HIV-positive patients were included in the analysis. Fig. 1 depicts temporal trends in annual ED visit frequency and admission rates among HIV-positive patients over the 10-year period. An average of 8.9 per 10,000 ED visits are made by PWH annually, with an overall admission rate of 49.8%.

Baseline features of the study population's ED presentations are summarized in Tables 1 and 2. Most visits (88%) occurred among male patients, with predominant reasons for presentation encompassing abdominal pain and/or nausea/vomiting (17%), fever (13%), injury or poisoning (11%), general weakness or poor oral intake (11%), and skin rashes (5%). Suicide attempts were made in 10 visits (2.7%). Psychiatric and malignant comorbid conditions affected 33% and 21% of visits, respectively. The median interval from initial HIV diagnosis was 8 years; over 90% of cases demonstrated current HAART receipt and CD4 counts ≥ 200 cells/mL within one year of the documented visits.

As shown in Table 2, half of ED presentations culminated in hospital admission with a median ensuing stay of 9 days. ICU-level care was necessitated for 26 visits (7%) directly from the

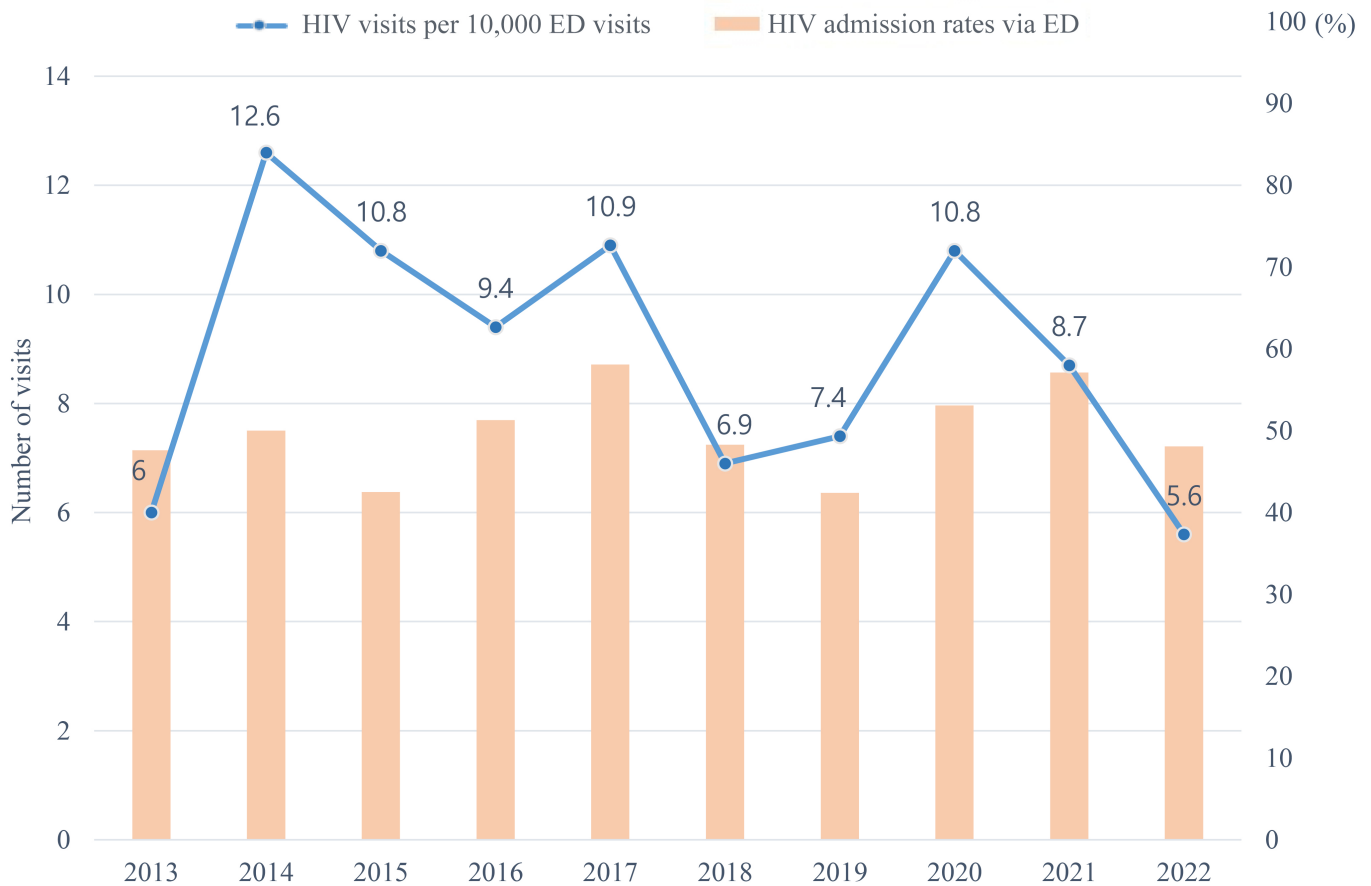


FIGURE 1. Annual changes of visit numbers of HIV-positive patient and their admission rates via ED. HIV, human immunodeficiency virus; ED, emergency department.

ED, while 18 registered in-hospital deaths amounted to a 5% visit-based mortality rate. Over the 10-year study period, the median number of ED visits per patient was 3 (range, 1–19 visits).

3.2 Comparison between the admission and discharge group

Parameters exhibiting statistically significant differences between the admission and discharge cohorts appear in Table 3. Regarding comorbidities, chronic renal failure (CRF) increased the odds of admission by 17.7 times ($p = 0.001$). Additionally, patients in the admission group were more likely to present to the ED with fever, general weakness, or poor oral intake, whereas skin rashes were more common in the discharge group. Specifically, presenting with fever had a threefold increase in the odds of admission ($p = 0.001$), while presenting with skin rash had a twofold increase in the odds of discharge ($p = 0.001$) compared with other reasons for visit, except for the five main complaints. In addition, the use of oxygen and consultation with other departments increased the odds of admission by 4.3 and 4.7 times, respectively ($p = 0.0004$ and $p < 0.0001$).

3.3 Independent prognostic factors

We compared the poor prognosis group ($n = 37$), who were admitted directly to the ICU and/or died during the hospital

course, with the remainder of the visits ($n = 332$). The poor prognosis group consisted of 18 patients died during hospitalization (11 died in the ED and 7 in the ICU) and 19 visits who survived after ICU care. In a simple model analysis, the following variables were statistically significant ($p < 0.0001$) in the poor prognosis group; arrived by ambulance (odds ratio (OR) = 5.78, 95% confidence interval (CI) = 2.92–11.42), KTAS level 1, 2 over KTAS level 4, 5 (OR = 8.255, 95% CI = 4.29–428.79), and use of oxygen at ED (OR = 9.558, 95% CI = 4.49–20.34). Multiple model analysis was performed with significant variables (with a p value of < 0.10 in the simple model) only from comorbid conditions and laboratory findings (Table 4). The odds of poor prognosis were increased 1.9 and 1.6 times for a 10-unit increase in BUN and a 1-unit increase in lactic acid levels, respectively ($p = 0.0002$ and $p < 0.0001$).

4. Discussion

This study expanded beyond simply describing ED utilization profiles of PWH which distinguishes our analysis from preceding studies. We elucidated multiple variables associated with heightened admission odds from the ED including underlying chronic renal failure, presenting with fever or general weakness, supplemental oxygen administration, and ancillary department involvement. Furthermore, we uniquely sought to delineate prognostic indicators for this population in the emergency care setting. As expected, ambulance arrival, urgent

TABLE 1. Baseline characteristics of visits by HIV-positive patients presenting to the emergency department (ED) from January 2013 to December 2022.

Characteristics	Number (%)	Median (IQR)
Demographics		
Age, years		
18–29 years	46 (12)	
30–64 years	262 (71)	48 (36–58)
≥65 years	61 (17)	
Male	324 (88)	
Arrived by ambulance	99 (27)	
KTAS		
Level 1 (Resuscitation)	6 (2)	
Level 2 (Emergent)	29 (8)	
Level 3 (Urgent)	206 (56)	
Level 4 (Less urgent)	105 (28)	
Level 5 (Non-urgent)	23 (6)	
Reasons for visit		
Abdominal pain, Nausea/vomiting	61 (17)	
Fever	47 (13)	
Injury, Poisoning	41 (11)	
General weakness, Poor oral intake	40 (11)	
Skin rash	20 (5)	
Miscellaneous	160 (43)	
Comorbid conditions		
Diabetes mellitus	77 (21)	
Hypertension	65 (18)	
Cardiovascular disease	31 (8)	
Chronic renal failure	25 (7)	
Rheumatologic disease	21 (6)	
Malignancy	78 (21)	
Neurodegenerative disease	36 (10)	
Psychiatric disease	85 (33)	
HIV clinical variables		
Years since HIV diagnosis		8 (3–12)
On HAART	342 (93)	
HIV laboratory variables		
Missing data, 27		
Viral load (copies/mL)		
<200	283 (83)	
200–10 ⁵	40 (12)	
≥10 ⁵	17 (5)	
CD4 count (copies/mL)		
<200	61 (18)	
200–499	126 (37)	
≥500	153 (45)	

IQR, Interquartile range; KTAS, Korean Triage and Acuity Scale; HIV, Human immunodeficiency virus; HAART, Highly active antiretroviral therapy; CD4, Cluster determinants 4.

TABLE 2. Clinical characteristics and outcome of 369 ED visits by HIV-positive patients over the ten years.

Characteristics	Number (%)	Median (IQR)
Vital signs on presentation		
SBP, mmHg		130 (117–149)
DBP, mmHg		80 (70–90)
PR, beats/min		88 (76–105)
RR, breaths/min		18 (18–18)
Body temperature, °C		36.7 (36.3–37.2)
Saturation, %		98 (96–98)
Laboratory findings		
Complete blood cell counts		
Leukocyte count, ×10 ⁹ cells/mL		7780 (5695–10,582)
Hemoglobin, g/dL		13.9 (11.9–14.9)
Platelet, ×10 ³ /μL		215 (170–264)
Other laboratory findings		
Glucose, mg/dL		114 (99–149)
Blood urea nitrogen, mg/dL		14.5 (10.7–20.0)
Creatinine, mg/dL		0.93 (0.79–1.14)
CRP, mg/dL		0.7 (0.1–4.9)
HCO ₃ ⁻ , mmol/L		22.7 (20.0–24.7)
Lactic acid, mmol/L		1.7 (1.1–2.5)
Courses in ED		
Use of oxygen at ED	47 (13)	
Consultation with other departments	250 (68)	
Length of ED stay (min)		207 (133–314)
Number of ED visits during the study period		3 (1–5)
Admission characteristics		
Admitted	186 (50)	
ICU admission directly from ED	26 (7)	
Hospital days (n = 186)		9 (5–18)
In-hospital mortality	18 (5)	

IQR, Interquartile range; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; PR, Pulse rate; RR, Respiratory rate; ED, Emergency department; ICU, Intensive care unit.

triage acuity, and oxygen needs were associated with poor prognosis. Notably, incremental elevations in BUN or lactic acid each were independent factors for poor prognosis.

Studies worldwide have investigated ED utilization patterns among HIV-positive adults with descriptions of demographic and HIV disease-specific variables [5–9]. For example, a 2019 Belgian study retrospectively reviewed 1026 patients, finding trauma-related discharge diagnoses most prevalent overall at 30% [10]. Some analyses have explored predictors of ED use frequency in HIV-positive cohorts, and Venkat *et al.* [11] identified levels of income and a viral load were significantly related to ED utilization in the United States. In a cross-sectional survey by the HIV Research Network, ED use was also associated with Medicaid insurance, high levels of pain, current or former illicit drug use, social alcohol use, and female gender [12]. However, per our literature review no existing

investigations have elucidated prognostic outcomes particular to HIV-infected ED patients.

Our results for HIV disease control markers aligned with previously published South Korean national data. Cho *et al.* [13] evaluated the proportion of PWH receiving ART among all PWH using the Korean National Health Insurance between 2006 and 2015. The proportion of PWH who received ART increased from 55.4% in 2006 to 87.6%. Correspondingly, Choi *et al.* [14] reported a viral load suppression rate exceeding 90% among a 2019 national HIV cohort. The likewise high levels of virologic control observed herein likely explain the absence of significant relationships between HIV-related variables (such as years since HIV diagnosis, HARRT-taking, viral loads, and CD4 counts) and admission likelihood or prognosis. Restricting our analysis only to patients aware of their positive HIV serostatus at the ED visit may have further diluted any

TABLE 3. Comparison of the admission and discharge groups among visits of patients with HIV presenting to the ED.

Characteristics	Discharge group (n = 183)	Admission group (n = 186)	β	SE	Exp(β) (95% CI)	p value
Demographics						
Age, no (%)						
18–29 years	35 (19)	11 (6)	-0.800	0.344	0.449 (0.228–0.882)	0.020
30–64 years	120 (66)	140 (75)			reference	
Male	152 (83)	172 (92)	0.840	0.425	2.318 (91.007–5.333)	0.047
Arrived by ambulance	33 (18)	66 (35)	0.705	0.257	2.025 (1.222–3.357)	0.006
KTAS group						
Level 1, 2 (Resuscitation, Emergent)	9 (26)	26 (74)	1.765	0.402	5.844 (2.655–12.864)	
Level 3 (Urgent)	74 (40)	132 (71)	1.436	0.264	4.203 (2.508–7.044)	<0.0001
Level 4, 5 (Less urgent, Non urgent)	100 (55)	28 (15)			reference	<0.0001
Reason for visit group						
Abdominal pain, Nausea/vomiting	27 (15)	34 (18)	0.590	0.283	1.805 (1.036–3.144)	0.037
Fever	12 (7)	35 (19)	1.104	0.344	3.017 (1.537–5.923)	0.001
General weakness, Poor oral intake	8 (4)	32(17)	1.062	0.326	2.893 (1.525–5.489)	0.001
Skin rash	19 (10)	2 (1)	-0.719	0.353	0.487 (0.243–0.973)	0.041
Others	88 (48)	71 (38)			reference	
Comorbid conditions						
Hypertension	21 (11)	44 (24)	0.670	0.314	1.954 (1.054–3.622)	0.033
Chronic renal failure	1 (1)	24 (13)	2.932	0.907	17.781 (3.173–111.141)	0.001
Vital signs on presentation						
DBP, mmHg	80 (76–93)	78 (68–89)	-0.018	0.006	0.981 (0.968–0.994)	0.006
RR, breaths/min	18 (18–18)	18 (18–20)	0.176	0.048	1.191 (1.084–1.312)	0.0003
Saturation, %	98 (97–99)	97 (95–98)	-0.290	0.071	0.748 (0.650–0.860)	<0.0001
Laboratory findings						
Leukocyte count, $\times 10^9$ cells/mL	7390 (5940–9620)	8015 (5420–11,430)	0.0001	0.000	1.000 (1.000–1.000)	0.042
Blood urea nitrogen, mg/dL	12.5 (9.75–16.15)	16.1 (11.6–23.6)	0.079	0.020	1.083 (1.041–1.126)	<0.0001
Creatinine, mg/dL	0.93 \pm 0.23	0.96 (0.79–1.22)	0.937	0.312	2.533 (1.384–4.709)	0.002
CRP, mg/dL	0.26 (0.07–1.03)	3.11 (0.26–9.96)	0.270	0.043	1.310 (1.203–1.427)	<0.0001
Courses in ED						
Use of oxygen at ED	7 (4)	40 (22)	1.471	0.417	4.356 (1.920–9.881)	0.0004
Consultation to other departments	88 (49)	162 (88)	1.552	0.233	4.720 (2.984–7.466)	<0.0001

SE, Standard error; CI, Confidence interval; KTAS, Korean triage and acuity scale; DBP, Diastolic blood pressure; RR, Respiratory rate; CRP, C-reactive protein; ED, Emergency department.

TABLE 4. Poor prognostic factors were identified by comparing the poor prognostic group (those who were admitted directly to the intensive care unit and died during the hospital course) with the rest of the ED visits of HIV-positive patients.

Characteristics	Simple model		Multiple model	
	Exp(β) (95% CI)	<i>p</i> value	Exp(β) (95% CI)	<i>p</i> value
Comorbid conditions				
Diabetes	2.679 (1.168–6.142)	0.019		
Hypertension	3.986 (1.814–8.758)	0.0006		
Chronic renal failure	2.329 (0.761–7.132)	0.138		
Laboratory findings				
Glucose, mg/dL	1.003 (1.000–1.005)	0.020		
Blood urea nitrogen, mg/dL			1.069 (1.032–1.106)	0.0002
Creatinine, mg/dL	1.187 (1.072–1.315)	0.001		
CRP, mg/dL			1.059 (1.004–1.121)	0.048
HCO ₃ ⁻ , mmol/L	0.885 (0.814–0.961)	0.004		
Lactic acid, mmol/L			1.613 (1.289–2.018)	<0.0001

CI, Confidence interval; CRP, C-reactive protein.

potential associations attributable to disease severity.

One of the primary limitations of our study was that it was conducted at a single healthcare institution, which may not fully represent the broader population of HIV-infected individuals seeking emergency care. Variations in patient demographics, healthcare practices, and resource availability across institutions could have influenced the findings. Therefore, caution should be exercised when generalizing these results to the entire population.

Additionally, we conducted our analysis based on a sample size of 369 visits, which could be considered relatively small. Particularly, only 37 visits were included in the poor prognosis group, which may have affected the reliability and precision of the results. Further multicenter studies on ED utilization by PWH should be conducted with a larger sample size to ensure a more comprehensive understanding and reliable analytical results.

5. Conclusions

In summary, this study identified underlying chronic renal failure, presenting with fever or general weakness/poor oral intake, supplemental oxygen necessity, and ancillary department consultation as factors related to hospital admission from the ED in HIV patients. Ambulance transport, high KTAS level and use of oxygen in the ED presaged poorer prognosis, along with elevations in serum BUN or lactic acid. We hope these data will assist emergency physicians in providing timely informed care to HIV-infected individuals visiting the ED, ultimately leading to improved patient outcomes.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

JHK and SBH—designed the research study. YJL—performed the research. CHL, YJS and SL—analyzed the data. AD and SL—wrote the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Institutional Review Board of Inha University Hospital, Incheon, South Korea (IRB no. 2023-04-031), and was conducted in accordance with the Declaration of Helsinki. The need for informed consent was waived due to the retrospective nature of this study.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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