

Hyperkalemia in Heart Failure Hospitalizations: An Underreported Contributor to Poor Outcomes and Higher Costs in Brazil

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Abstract

Hyperkalemia is associated with poor prognosis in heart failure (HF), but its reporting in administrative data is likely suboptimal.

The aim was to evaluate the frequency and impact of hyperkalemia ICD coding during HF hospitalizations in Brazil.

We analyzed 3,551,738 HF hospitalizations from the DATASUS database (2008–2024). ICD codes were used to identify hyperkalemia. Logistic and Cox regression analyses assessed associations between comorbidities, outcomes, and resource utilization.

Only 491 hospitalizations (0.014%) were coded for hyperkalemia. These patients were older (mean 70.3 vs. 66.6 years) and had higher rates of chronic kidney disease, diabetes, and cardiovascular disease. Hyperkalemia was associated with increased in-hospital mortality (25% vs. 10%), ICU admissions (17% vs. 11%), dialysis (11% vs. 1%), and longer ICU stays (9.45 vs. 5.36 days). Average costs were 59% higher (2,402 vs. 1,512 BRL).

Hyperkalemia is severely underreported in Brazilian HF hospitalizations, despite being a clear marker of clinical severity and higher resource use. Improved awareness and coding may support better outcomes and planning.

Introduction

Heart failure (HF) hospitalizations remain a major clinical and economic challenge in Brazil. Hyperkalemia, often driven by comorbid conditions such as chronic kidney disease

(CKD) and diabetes, is an independent risk factor for adverse HF outcomes.^{1,2} However, in administrative datasets like DATASUS, hyperkalemia may be severely underreported, limiting our understanding of its impact.

This study aimed to assess the prevalence of hyperkalemia coding among patients hospitalized for HF in Brazil and to evaluate the clinical outcomes and healthcare resource utilization associated with this condition using national administrative data.

Methods

We included all hospitalizations coded for HF using ICD-10 codes I50, I50.0, I50.1, and I50.9 in the DATASUS Hospital Information System between January 2008 and February 2024 (Appendix). Hyperkalemia was identified using the ICD-10 code E875. Comorbidities and clinical events (e.g., diabetes, CKD, dialysis, acute kidney injury, acute myocardial infarction, and stroke) were identified using all relevant ICD and procedure codes to maximize diagnostic sensitivity. Continuous variables were summarized as means and standard deviations or medians and interquartile ranges, depending on distribution, while categorical variables were reported as absolute numbers and percentages. The prevalence of hyperkalemia was calculated by dividing the number of hyperkalemia-coded hospitalizations by the total number of HF hospitalizations. Logistic regression was used to evaluate associations between hyperkalemia and clinical covariates, with results expressed as odds ratios (OR) and 95% confidence intervals. Outcomes included in-hospital mortality, ICU admission, dialysis requirement, length of stay, and hospitalization cost. Time-to-event outcomes (30-day mortality and time to hospital discharge) were analyzed using Kaplan–Meier curves, compared with the log-rank test, and further assessed using Cox proportional hazards models adjusted for established risk factors. Patients hospitalized for more than 30 days were censored in both survival analyses.

Results

A total of 3,551,738 hospitalizations with a HF diagnosis were identified from January 2008 to February

Keywords

Heart Failure; Hyperkalemia; International Classification of Diseases; Hospitalization

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Brief Communication

Central Illustration: Hyperkalemia in Heart Failure Hospitalizations: An Underreported Contributor to Poor Outcomes and Higher Costs in Brazil



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IC sem hipercalemia	IC com hipercalemia
Mean age: 68 anos	Mean age: 68 anos
Lower prevalence of comorbidities	Higher prevalence of comorbidities
Average cost: BRL\$ 1512	Average cost: BRL\$ 2401 (+59%)
ICU: 11%	ICU: 17%
Dialysis: 01%	Dialysis: 11%
ICU stay: 9 days	ICU stay: 14 days
Crude mortality: 10%	Crude mortality: 25%

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Underreporting and Impact of Hyperkalemia in Heart Failure Hospitalizations (Brazil, 2008–2024).

2024. Of these, only 491 (0.014%) had an ICD code for hyperkalemia, suggesting substantial underreporting. As shown in Table 1, patients with hyperkalemia were older (mean age 70.3 vs. 66.6 years) and had a higher prevalence of comorbidities such as diabetes, CKD and cardiovascular disease (CVD).

Regional disparities were evident, with 93% of hyperkalemia-coded cases concentrated in the Southeast region. This distribution likely reflects not only a true geographic variability but also disparities in coding practices within the national database (DATASUS). Previous evaluations of DATASUS have demonstrated heterogeneity in the quality and completeness of diagnostic coding across different Brazilian regions, often influenced by resource availability, local training, and administrative priorities. The apparent concentration of cases in the Southeast may, at least in part, represent underreporting in other regions rather than a true epidemiological difference, and this limitation must be considered when interpreting our results.

Figure 1 displays a forest plot from logistic regression, identifying CKD, diabetes, CVD, and older age as strong predictors of hyperkalemia ICD coding. These findings

Table 1 – Characteristics of the population stratified by the presence of an ICD coding report for hyperkalemia

Variable	Overall	Hyperkalemia	No hyperkalemia
n	3,551,738	491	3,551,247
Age (years)	66.6±16.4	70.3±14.0	66.6±16.4
Age > 65 years	58.3%	67.4%	58.3%
Female	48.5%	48.9%	48.5%
Race (White)	37.0%	42.8%	37.0%
Region			
South	22%	2%	22%
Southeast	42%	93%	42%
Midwest	7%	1%	7%
Northeast	23%	4%	23%
North	5%	0%	5%

Brief Communication

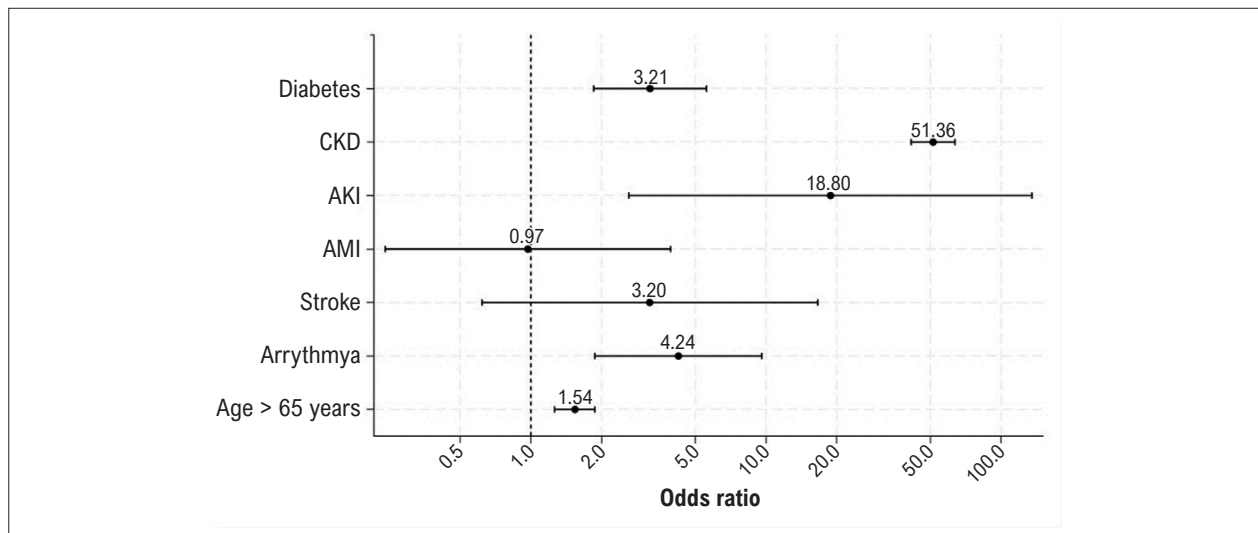


Figure 1 – Forest plot of the risk factors associated with hyperkalemia. CKD: chronic kidney disease; AKI: acute kidney injury; AMI: acute myocardial infarction.

reinforce the association between hyperkalemia and established HF risk factors.

Clinical outcomes were notably worse in the hyperkalemia group. As detailed in Table 2, in-hospital mortality was significantly higher (25% vs. 10%). ICU admission occurred in 17% of hyperkalemic patients compared to 11% in non-hyperkalemic patients. The proportion requiring dialysis was over tenfold higher (11% vs. 1%).

Kaplan-Meier analysis in Figure 2A demonstrates a clear survival disadvantage in hyperkalemic patients. Figure 2B shows prolonged hospital stays in the hyperkalemia group. Median length of stay was 6 days (IQR 3–12) for hyperkalemic patients versus 4 days (IQR 3–8) for those without hyperkalemia.

Table 2 – Hospitalization events and clinical outcomes from 2008 to 2023

	Hyperkalemia	No Hyperkalemia	p-value
Days in the hospital stay (median, IQR)*	6 (3;12)	4 (IQR: 3;8)	<0.001
Need for ICU (%)**	17	11	<0.001
Days in the ICU (median, IQR)*	14 (9;25)	9 (IQR: 9;16)	<0.001
Need for dialysis (%)**	11	1	<0.001
Mortality rate (%)**	25	10	<0.001

* Mann–Whitney U test; ** Chi-square test. HK: hyperkalemia; ICU: intensive care unit; IQR: interquartile range

Resource use was markedly increased in the hyperkalemia group. Table 3 shows that the mean hospitalization cost was 2,401 BRL for hyperkalemic patients, 59% higher than the 1,512 BRL for patients without hyperkalemia. ICU costs averaged 6,215 BRL compared to 3,774 BRL. ICU length of stay was also longer: median 14 days versus 9 days.

Our analysis also revealed a strong association between hyperkalemia and ESKD, which likely contributes to the poor clinical outcomes observed. Previous studies have reported hyperkalemia prevalence rates exceeding 30% in patients with ESKD and nearly 15% in those undergoing dialysis. As such, the increase in in-hospital mortality and ICU resource use seen among hyperkalemia-coded patients may partly reflect the severity of underlying kidney dysfunction rather than hyperkalemia alone. This underscores the need for cautious interpretation and the importance of accounting for renal disease severity in future analyses.³⁻⁵

These results collectively illustrate that while hyperkalemia reporting is rare, it identifies a subgroup of HF patients at much higher clinical economic risk and economic burden (Central Illustration). Finally, the recent introduction of sodium zirconium cyclosilicate in Brazil, already approved for incorporation into the public health system, will be especially important in patients with HF, given their high risk of hyperkalemia due to a high prevalence of concomitant CKD and the need for therapies that, while essential for reducing morbidity and mortality, are associated with increased potassium levels as an adverse effect.

Author Contributions

Conception and design of the research: Pecoits-Filho R, Montenegro C, Moraes TP; Acquisition of data and Statistical analysis: Longato M; Analysis and interpretation of the

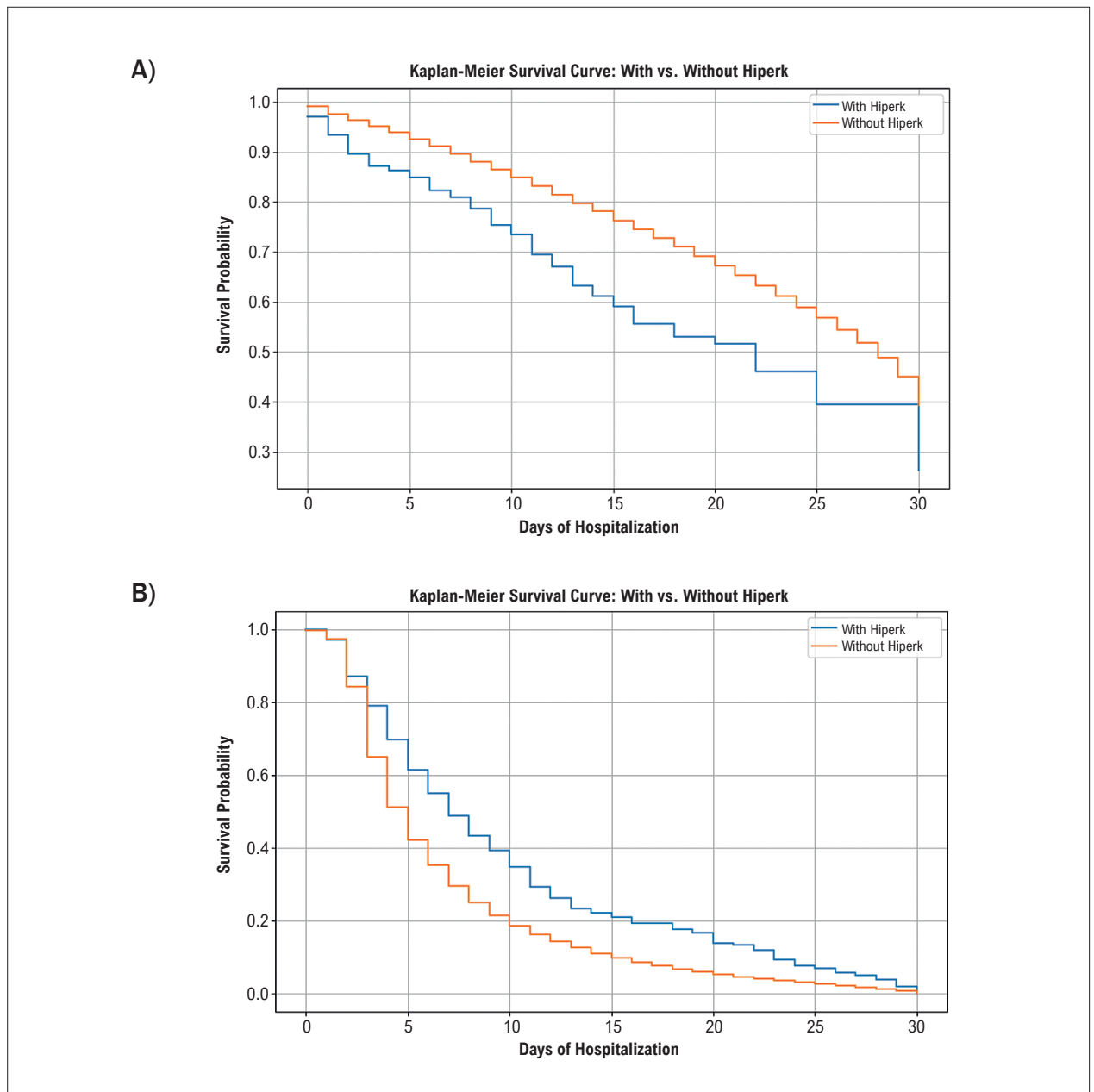


Figure 2 – A) Kaplan-Meier survival curves (Cox adjusted) of patients with hyperkalemia versus those without. $p < 0.001$. B) Kaplan-Meier length of hospitalization (Cox adjusted) of patients with hyperkalemia versus those without.

data: Pecoits-Filho R, Segre N, Rego T, Moraes TP Montenegro C; Obtaining financing and Writing of the manuscript: Pecoits-Filho R; Critical revision of the manuscript for intellectual content: Pecoits-Filho R, Rocha PT, Costa MC, Schwartzmann P, Moura LAZ, Segre N, Rego T, Montenegro C, Moraes TP.

Potential Conflict of Interest

Roberto Pecoits-Filho: Akebia, Ardelix, AstraZeneca, Bayer, Boehringer Ingelheim, CSL Vifor, Fresenius Medical Care, GSK, Lilly, Novo Nordisk, Otsuka, Vantive. Pedro Tulio Rocha:

Table 3 – Analysis of Healthcare Costs in Patients With Versus Without

	Hyperkalemia	No Hyperkalemia	p-value
Mean cost (BRL)	2,401	1,512	< 0.001
Mean cost ICU (BRL)	6,215	3,774	< 0.001

Statistical method: t-test. *BRL: Brazilian reais.

Brief Communication

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

Use of Artificial Intelligence

The authors did not use any artificial intelligence tools in the development of this work.

Availability of Research Data

The content is available at the link: <https://datasus.saude.gov.br/acesso-a-informacao/>

References

1. Humphrey T, Davids MR, Chothia MY, Pecoits-Filho R, Pollock C, James G. How Common is Hyperkalaemia? A Systematic Review and Meta-Analysis of the Prevalence and Incidence of Hyperkalaemia Reported in Observational Studies. *Clin Kidney J.* 2021;15(4):727-37. doi: 10.1093/ckj/sfab243.
2. Ferreira JP, Claggett BL, Liu J, Desai AS, Pfeffer MA, Anand IS, et al. Serum Potassium and Outcomes in Heart Failure with Preserved Ejection Fraction: A Post-Hoc Analysis of the PARAGON-HF Trial. *Eur J Heart Fail.* 2021;23(5):776-84. doi: 10.1002/ejhf.2134.
3. Kohsaka S, Okami S, Kanda E, Kashihara N, Yajima T. Cardiovascular and Renal Outcomes Associated with Hyperkalemia in Chronic Kidney Disease: A Hospital-Based Cohort Study. *Mayo Clin Proc Innov Qual Outcomes.* 2021;5(2):274-85. doi: 10.1016/j.mayocpiqo.2020.10.001.
4. McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M, et al. 2021 ESC Guidelines for the Diagnosis and Treatment of Acute and Chronic Heart Failure. *Eur Heart J.* 2021;42(36):3599-726. doi: 10.1093/eurheartj/ehab368.
5. Pitt B, Bakris GL. New Potassium Binders for the Treatment of Hyperkalemia: Current Data and Opportunities for the Future. *Hypertension.* 2015;66(4):731-8. doi: 10.1161/HYPERTENSIONAHA.115.04889.

*Supplemental Materials

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