

RESEARCH ON HYPOKALEMIC EVENTS BASED ON LABORATORY TEST RESULTS IN HOSPITALIZED PATIENTS AT 199 HOSPITAL, MINISTRY OF PUBLIC SECURITY

Tran Nguyen Dang Bao^{1*}, Khanh Pham Cong¹, Cuong Nguyen Duc²

¹Dong A University, Vietnam

²199 Hospital – Ministry of Public Security, Vietnam

*Corresponding author: tranndb@donga.edu.vn

(Received: June 15, 2026; Revised: July 31, 2026; Accepted: August 04, 2026)

DOI: 10.31130/ud-jst.2026.24(9).416E

Abstract - This study describes the characteristics of hypokalemic events identified through laboratory test results among hospitalized patients at 199 Hospital, Ministry of Public Security and assesses the association between medication use and hypokalemic events. A retrospective cross-sectional study was performed using serum potassium test results and electronic medical records of hospitalized patients from October to December 2024. The results showed that among 78 patients (3.4%) with hypokalemia, 60 patients were assessed as having a relationship between drug use and hypokalemic events. Most patients were female (61.5%), with a mean age of over 70. The majority had endocrine-metabolic, or cardiovascular diseases. More than 80% had at least two comorbidities, and 84.6% experienced only one episode of hypokalemia. The drug classes most frequently associated with hypokalemia were insulin, loop diuretics, and corticosteroids. Regular monitoring of serum potassium levels may facilitate early detection of hypokalemic events and optimize medication use in clinical practice.

Key words - Adverse drug reaction (ADR); hypokalemia; drug-related hypokalemia

1. Introduction

According to the Vietnamese Ministry of Health's guidelines for diagnosis and treatment in intensive care, hypokalemia is defined as a serum potassium concentration below 3.5 mmol/L [1]. Hypokalemia is a common electrolyte disorder in clinical practice and may represent one of the leading causes of life-threatening complications if not promptly recognized and appropriately managed [2]. Among the various causes of hypokalemia, drug therapy is considered a major contributor, accounting for up to 56% of hypokalemic cases among hospitalized patients [3]. Potassium disorders may result in serious complications, including cardiac arrhythmias, cardiac arrest, and neuromuscular dysfunction. Therefore, the early identification of patients requiring urgent intervention is crucial and should be based on medical history, physical examination, laboratory investigations, and electrocardiographic monitoring [4]. Despite the clinical significance of drug-induced hypokalemia, limited studies have investigated the detection of hypokalemic events through routine laboratory screening.

At 199 Hospital, Ministry of Public Security, no in-depth study on this issue has been conducted to date. Therefore, this study aimed to describe the characteristics of hypokalemic events detected through laboratory testing

and evaluate the relationship between medication use and hypokalemic events among hospitalized patients at 199 Hospital, Ministry of Public Security. The findings are expected to provide evidence for healthcare professionals to enhance awareness of laboratory-based screening, early detection, and optimization of medication use associated with hypokalemia in clinical practice.

2. Materials and methods

2.1. Study population

All serum potassium test results performed between October 1, 2024, and December 31, 2024, together with the corresponding electronic medical records of hospitalized patients who met the following eligibility criteria were included in the study.

Inclusion criteria: Patients with a serum potassium concentration < 3.5 mmol/L.

Exclusion criteria: Cases identified as pseudo-hypokalemia, patients receiving maintenance dialysis, and patients for whom medication history could not be obtained.

2.2. Methods

Study design: This was a retrospective, descriptive, non-interventional study. Data were collected from serum potassium laboratory test results and electronic medical records of hospitalized patients.

Study procedure:

Step 1: Serum potassium test results of hospitalized patients were retrieved and screened according to the predefined definition of hypokalemia. Patients meeting any exclusion criteria were excluded from the study.

Step 2: Medical record numbers were reviewed, and patient information was extracted using a standardized data collection form.

Step 3: Information on medication use was collected from inpatient medical records and outpatient prescriptions (if available) during the 30-day period preceding the hypokalemic event up to the time of event identification.

Step 4: Characteristics of hypokalemic events were identified and recorded based on laboratory test results among hospitalized patients at 199 Hospital, Ministry of Public Security.

2.3. Data analysis

Microsoft Excel was used for data management, statistical analysis, and data processing. Descriptive statistical methods were applied to summarize the study data. Continuous variables are presented as mean ± standard deviation (SD), while categorical variables are expressed as frequencies and percentages.

3. Results

3.1. Patient characteristics

Between October 1, 2024, and December 31, 2024, a total of 2,304 serum potassium tests from hospitalized patients were screened, corresponding to 1,591 inpatients admitted to 199 Hospital, Ministry of Public Security. Following the screening process, 78 patients (3.4%) were included for causality assessment between suspected medications and hypokalemic events. The baseline characteristics of the study population are presented in Table 1.

Table 1. Characteristics of the study population

Characteristic	N = 78 (100%)
Age and Sex	
Female (n, %)	48 (61.5)
Male (n, %)	30 (38.5)
Mean age ± SD (years)	70 (± 13.8)
Primary diagnosis	
Endocrine, nutritional and metabolic diseases (E00 – E90) (n, %)	24 (30.8)
Diseases of the circulatory system (I00 – I99) (n, %)	18 (23.1)
Diseases of the respiratory system (J00 – J99) (n, %)	13 (16.7)
Other disease categories (n, %)	23 (29.4)
Comorbidity status	
No comorbidity (n, %)	2 (2.6)
One comorbidity (n, %)	13 (16.7)
Two comorbidities (n, %)	36 (46.2)
More than two comorbidities (n, %)	27 (34.5)

The study population was predominantly female (61.5%), with a mean age of 70.0 ± 13.8 years. Endocrine, nutritional, and metabolic diseases were the most common primary diagnoses (30.8%). More than 80% of patients had at least two comorbidities.

3.2. Characteristics of hypokalemic events

The characteristics of hypokalemic events observed in the study population are presented in Table 2.

Most patients experienced only one hypokalemic episode (84.6%). Hypokalemia was more frequently identified at hospital admission (56.4%) than during hospitalization (43.6%). The majority of events were classified as mild in severity (75.3%), while no life-threatening events were recorded. Renal impairment (eGFR < 60 mL/min/1.73 m²) was identified in 16 episodes (17.2%). More than half of the events lacked concurrent serum creatinine measurements, preventing assessment of renal function.

Table 2. Characteristics of hypokalemic events

Characteristic	N = 78 (100%)
Timing of event occurrence	
At hospital admission (n, %)	44 (56.4)
During hospitalization (n, %)	34 (43.6)
Number of hypokalemic episodes per patient	
One episode (n, %)	66 (84.6)
Two episodes (n, %)	9 (11.5)
More than two episodes (n, %)	3 (3.9)
Severity of hypokalemic events according to CTCAE (n = 93 episodes)* [5]	
Mild (n, %)	70 (89.7)
Moderate (n, %)	22 (28.2)
Severe (n, %)	1 (1.3)
Life-threatening (n, %)	0 (0.0)
Renal function at the time of hypokalemic events according to KDIGO 2024 (n = 93 episodes)* [6]	
Normal (≥ 90 mL/phút/1.73m ²) (n, %)	9 (9.7)
Mildly decreased (60 – 89 mL/phút/1.73m ²) (n, %)	19 (20.4)
Moderately decreased (30 – 59 mL/phút/1.73m ²) (n, %)	11 (11.8)
Severely decreased (15 – 29 mL/phút/1.73m ²) (n, %)	4 (4.3)
Kidney failure (< 15mL/phút/1.73m ²) (n, %)	1 (1.1)
Unknown** (n, %)	49 (52.7)

* Recurrent hypokalemic events in a subgroup of patients led to a total of 93 episodes among 78 patients.

**No serum creatinine result was available at the time of the hypokalemic event.

3.3. Management of hypokalemic events

The number of patients receiving treatment and the management strategies used for hypokalemic events are presented in Table 3.

Table 3. Management of hypokalemic events

Characteristic	N = 78 (100%)
Patients receiving treatment	
Oral potassium supplementation (n, %)	56 (71.8)
Intravenous potassium supplementation (n, %)	22 (28.2)
Potassium-sparing diuretics (n, %)	5 (6.4)
Combined magnesium and potassium supplementation (n, %)	1 (1.3)
No documented management	
Mild hypokalemia (n, %)	14 (87.5)
Poor prognosis/discharged or transferred before follow-up testing (n, %)	2 (12.5)

Overall, 62 patients (79.5%) received treatment for hypokalemia. The most common management strategies were oral potassium supplementation (71.8%) and intravenous potassium supplementation (28.2%). Among the 16 patients (20.5%) without documented management, 14 (87.5%) had mild hypokalemia, while 2 (12.5%) had a poor prognosis and were discharged or transferred before subsequent serum potassium measurements could be obtained. All patients who

underwent follow-up serum potassium testing achieved normalization of potassium levels at discharge (serum potassium > 3.5 mmol/L).

3.4. Causality assessment of drug–hypokalemia associations

Among the 880 medications used by the 78 patients, 321 medications (36.5%) were excluded from causality assessment, including medications used to manage hypokalemic events and medications that were continued after discontinuation of the corrective treatment. Consequently, causality assessment using the WHO–UMC system [7] was performed on 559 drug–event pairs (63.5%). The results are presented in Table 4.

Table 4. Results of causality assessment according to the WHO–UMC system

Causality category	Drug–event pairs (N = 559, 100%)	Number of patients* (N = 78, 100%)
Certain (n, %)	0 (0.0)	0 (0.0)
Probable/Likely (n, %)	66 (11.8)	32 (41.0)
Possible (n, %)	100 (17.9)	52 (66.7)
Unlikely (n, %)	393 (70.3)	70 (89.7)
Unclassified (n, %)	0 (0.0)	0 (0.0)
Unclassifiable (n, %)	0 (0.0)	0 (0.0)
Total imputed causal (Probable/Likely + Possible)	166 (29.7)	60 (76.9)**

* A single patient could receive multiple concurrent medications assigned to different causality categories.

** The total number of patients with at least one causal medication (classified as Probable/Likely or Possible).

A total of 166 drug–event pairs (29.7%), corresponding to 60 (76.9%) patients, were assessed as having a causal relationship with hypokalemic events. Of these, 66 drug–event pairs (11.8%) were classified as probable/likely and 100 (17.9%) as possible. No drug–event pair met the criteria for the certain category.

3.5. Suspected drugs associated with hypokalemic events

Suspected drugs associated with hypokalemic events in 60 patients were classified according to their pharmacological groups based on the World Health Organization Anatomical Therapeutic Chemical (ATC) classification system [8]. The results are presented in Figure 1.

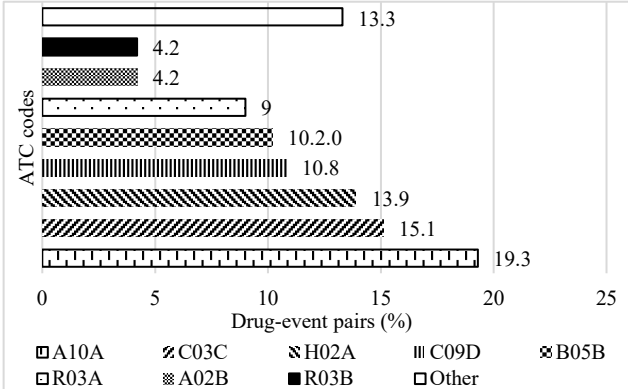


Figure 1. Classification of suspected drugs associated with hypokalemic events according to ATC codes

Insulins and analogues were the most frequently implicated drug class (19.3%), followed by loop high-ceiling diuretics (15.1%) and corticosteroids for systemic use, plain (13.9%).

4. Discussion

During the study period from October 1, 2024, to December 31, 2024, a total of 78 patients (3.4%) were included in the study among 1,591 inpatients who underwent serum potassium testing at 199 Hospital, Ministry of Public Security. Patients with hypokalemia were predominantly elderly, with a mean age of 70.0 ± 13.8 years, and were mainly female (61.5%). These findings are consistent with those reported by P.T.T. Hang and B. Song et al., in which female patients accounted for the majority of hypokalemia cases and the mean age of affected patients was 66.0 ± 15.1 years and over 65 years, respectively [9], [3]. This observation suggests that hypokalemia is more common among older adults and women, which may be explained by the lower muscle mass and reduced exchangeable potassium stores in females compared with males [10].

Most patients with hypokalemia had endocrine, nutritional, and metabolic disorders (30.8%) and presented with two or more comorbidities (80.7%). These findings are comparable to those reported by J. Bhargava et al., in which diabetes mellitus and ischemic heart disease were among the predominant underlying conditions [11]. However, compared with the study by P.T.T. Hang, where circulatory system diseases accounted for the majority of cases (90.1%) and most patients had one to two comorbidities (83.9%) [9], notable differences were observed. These discrepancies may be attributed to variations in patient demographics and disease patterns across healthcare settings. 199 Hospital, Ministry of Public Security is a first-class hospital with multiple inpatient specialties, and most admitted patients are elderly individuals with multiple chronic conditions who often seek medical care only after developing symptoms. In contrast, the study conducted by P.T.T. Hang was performed at a cardiovascular institute, making the predominance of circulatory diseases in that population expected.

Hypokalemia was most frequently identified at the time of hospital admission (56.4%). This proportion differs from that reported by P.T.T. Hang, in which 83.9% of hypokalemia cases occurred during hospitalization [9]. These findings suggest that hypokalemia may have been present before hospitalization but remained undetected until serum potassium testing was performed during hospital admission or inpatient care. Routine laboratory monitoring therefore plays an important role in the early detection of hypokalemic events, particularly in patients receiving medications or presenting with clinical conditions associated with an increased risk of potassium imbalance.

Most patients (79.5%) received interventions for hypokalemia, and all patients who underwent repeat potassium testing after treatment achieved normal serum

potassium concentrations. Sixteen patients (20.5%) did not receive specific treatment because their hypokalemia was mild and did not require correction. In addition, two patients had a poor prognosis and were discharged before follow-up potassium measurements were obtained. Among patients with subsequent potassium assessments, all achieved serum potassium levels above 3.5 mmol/L prior to discharge.

Oral potassium chloride supplementation was the most commonly used intervention (71.8%), consistent with previous studies [9], [10], [11]. This approach is considered appropriate because potassium chloride, whether administered orally or intravenously, is generally the preferred formulation for potassium replacement. Compared with other potassium salts, it more effectively corrects potassium deficits and concomitant metabolic alkalosis [12].

Following identification of hypokalemic events, the relationship between medication use and hypokalemia was evaluated using the WHO–UMC causality assessment system [7]. Most drug–event pairs were classified as “unlikely” (70.3%), followed by “possible” (17.9%) and “probable/likely” (11.8%) and no cases were categorized as “certain”. This finding reflects the retrospective nature of the study, in which important information required for causality assessment, such as dechallenge and rechallenge data, is often unavailable. Furthermore, hypokalemia is a multifactorial clinical condition that may result from underlying diseases, endocrine disorders, nutritional factors, or concomitant therapies. Consequently, determining the precise contribution of individual drugs is challenging, leading to a high proportion of cases being classified as “unlikely”. Similar findings have been reported in previous studies, where most adverse drug reactions were categorized as “possible” or “probable”, whereas “certain” cases were uncommon.

Among the medications assessed as having a possible or probable relationship with hypokalemic events, insulin and its analogues accounted for the highest proportion (19.3%), followed by loop diuretics (15.1%) and corticosteroids for systemic use, plain (13.9%). The observed distribution may be attributed to differences in patient characteristics and disease patterns across healthcare settings. In our study, the relatively high proportion of patients receiving insulin was likely related to the fact that the study population consisted predominantly of patients with diabetes mellitus or hyperglycemia requiring glycemic control [12].

From a pharmacological perspective, insulin has long been recognized as a medication that may contribute to hypokalemia by promoting intracellular potassium shift, thereby reducing serum potassium concentrations. Meanwhile, loop diuretics increase renal potassium excretion and consequently elevate the risk of hypokalemia. In patients receiving these agents without concomitant potassium supplementation, mild-to-moderate hypokalemia is frequently observed [13].

5. Conclusion

This study provides an initial description of the characteristics of hypokalemia among hospitalized patients at 199 Hospital, Ministry of Public Security based on laboratory data. Causality assessment using the WHO–UMC scale identified a considerable proportion of drug–event pairs as “possible” or “probable/likely,” suggesting a potential contribution of medications to the development of hypokalemia in this population. These findings highlight the importance of medication surveillance and routine electrolyte monitoring in clinical practice to improve patient safety and optimize treatment outcomes.

Acknowledgements: This research was funded by Dong A University.

REFERENCES

- [1] Ministry of Health, “*Guidelines for diagnosis and management in intensive care*”, Decision No. 1493/QĐ-BYT, Hanoi, Vietnam, 2015, pp. 185-193 (in Vietnamese).
- [2] Y. Fan *et al.*, “Potassium levels and the risk of all-cause and cardiovascular mortality among patients with cardiovascular diseases: a meta-analysis of cohort studies”, *Nutrition Journal*, vol. 23, no. 1, pp. 88, 2024, doi: 10.1186/s12937-023-00888-z.
- [3] B. Song, L. Liu, S. Dong, and S. Wang, “Drug-induced hypokalemia: an analytical study based on real-world drug monitoring data”, *Expert Opinion on Drug Safety*, vol. 25, no. 5, pp. 847-855, 2025, doi: 10.1080/14740338.2025.2468861.
- [4] M. J. Kim, C. Valerio, and G. K. Knobloch, “Potassium Disorders: Hypokalemia and Hyperkalemia”, *American Family Physician*, vol. 107, no. 1, pp. 59-70, 2023.
- [5] National Cancer Institute (NCI), “*Common Terminology Criteria for Adverse Events (CTCAE)*”, United States National Institutes of Health (NIH), v6.0, 2025.
- [6] Kidney Disease: Improving Global Outcomes (KDIGO), “KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease”, *Kidney inter.*, vol. 105, no. 4S, April 2024. doi: 10.1016/j.kint.2023.10.018.
- [7] World Health Organization, “The WHO-UMC causality assessment system”, *Uppsala Monitoring Centre*. 2017, [Online]. Available: <https://www.who.int/docs/default-source/medicines/pharmacovigilance/whocausality-assessment.pdf> [Accessed June 11, 2026].
- [8] Norwegian Institute of Public Health (NIPH), “ATC/DDD Index 2026”, January 20, 2026. [Online]. Available: https://atcddd.fhi.no/atc_ddd_index/ [Accessed June 11, 2026].
- [9] P.T.T. Hang, “*Screening for drug-related dyskalemia events through laboratory test results at the Vietnam National Heart Institute, Bach Mai Hospital*”, Bachelor thesis, Hanoi University of Pharmacy, 2019 (in Vietnamese).
- [10] H. K. Jensen, M. Brabrand, P. J. Vinholt, J. Hallas, and A. T. Lassen, “Hypokalemia in acute medical patients: risk factors and prognosis”, *The American Journal of Medicine*, vol. 128, no. 1, pp. 60-67, 2015.
- [11] J. Bhargava and S. Viswanathan, “Incidence, Risk Factors and Prognosis of Hypokalaemia in Patients with Normokalaemia at Hospital Admission”, *Indian Journal of Endocrinology and Metabolism*, vol. 27, no. 6, pp. 537-543, 2024. doi: 10.4103/ijem.ijem_159_23.
- [12] L. C. Ring, K. G. Nishide, and E. B. Rangel, “Hypokalemia in Diabetes Mellitus Setting”, *Medicina*, vol. 58, no. 3, pp. 431, 2022, doi: 10.3390/medicina58030431
- [13] M. M. Alosaimi, M. N. Alazwari, A. Alotaibi, and M. E. Alotaibi, “Hypokalemia: Pathophysiology, Diagnosis, and Management”, *Journal of Surgery*, vol. 10, no. 16, 2025, doi: 10.29011/2575-9760.011511.