REUE | Original article

Clinical management of patients with hyperkalemia in Emergency Departments in Spain

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INTRODUCTION. Hyperkalemia is a common, recurrent, and potentially life-threatening electrolyte disorder that requires rapid intervention. To improve its management, the consensus document Recommendations for the Management of Hyperkalemia in Emergency Departments issued specific clinical practice guidelines.

OBJECTIVES. The primary endpoint of this study was to assess the adoption of these consensus recommendations by nephrologists and emergency physicians in Spain. Secondary endpoints were to describe the existence and degree of updating of hyperkalemia management protocols and to analyze the impact of greater knowledge of clinical practice guidelines and consensus documents on clinical practice.

MATERIALS AND METHODS. We conducted a descriptive, multicenter study based on responses to 8 questions exploring the knowledge and management of hyperkalemia among nephrologists and emergency physicians in Spain, collected across 40 meetings of the Medical Department of Diabetes & Renal Disease of AstraZeneca Spain (May 2022–June 2023).

RESULTS. Among the 451 participating clinicians, 77.5 % and 82.4 % demonstrated high knowledge of severity criteria and parameters for the rapid control of hyperkalemia. A total of 42.9 % showed high knowledge of recurrence risk, and 51.3 % reported modifying renin–angiotensin–aldosterone system inhibitor therapy in the context of hyperkalemia. Additionally, 42.1 % indicated that they established a plan for reintroduction of these agents at discharge. Furthermore, 67.1 % reported considering treatment of patients at discharge with specific potassium-lowering agents, although half stated that these were not available at their centers. Finally, greater knowledge levels were associated with improved management of hyperkalemia.

CONCLUSIONS. Adherence to consensus documents and clinical practice guidelines on hyperkalemia is heterogeneous. Knowledge of these resources is associated with better management, which may translate into reduced morbidity and mortality and decreased use of health care resources.

Keywords: Hyperkalemia. Knowledge. Management. Renin–angiotensin–aldosterone system inhibitors. Potassium binders. Protocols.

Manejo clínico de los pacientes con hiperpotasemia en urgencias en España

INTRODUCCIÓN. La hiperpotasemia es un trastorno electrolítico frecuente, recurrente y potencialmente mortal que requiere de una rápida intervención. En 2022 se publicó el documento de consenso "Recomendaciones para el manejo de la hiperpotasemia en urgencias", realizado por la Sociedad Española de Medicina de Urgencias y Emergencias, la Sociedad Española de Nefrología y la Sociedad Española de Cardiología.

OBJETIVOS. El objetivo de este trabajo fue conocer el grado de adopción de las recomendaciones de dicho documento, por parte de nefrólogos y urgenciólogos en España. Los objetivos secundarios fueron describir la existencia y grado de actualización de protocolos de manejo de hiperpotasemia.

MATERIAL Y MÉTODOS. Estudio descriptivo y multicéntrico mediante una encuesta de ocho preguntas clínicas, por parte de especialistas nefrólogos y urgenciólogos en España, en 40 reuniones presenciales realizadas por el Departamento médico de Diabetes & Enfermedad Renal de AstraZeneca España (mayo 2022-junio 2023).

RESULTADOS. De los 451 participantes, el 77,5 % y 82,4 % demostraron un alto conocimiento sobre criterios de gravedad y parámetros para el control rápido de la hiperpotasemia. Un 42,9 % mostró un alto conocimiento del riesgo de recurrencia y un 51,3 % indicó modificar la pauta de inhibidores del sistema renina-angiotensina-aldosterona ante la hiperpotasemia. El 42,1 % afirmó establecer un plan para su reintroducción al alta. Además, un 67,1 % indicó valorar el tratar a los pacientes al alta con fármacos especí-

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ficos contra la hiperpotasemia, aunque la mitad manifestó no tener acceso a estos en su centro. Finalmente, se observó que un mayor nivel de conocimiento se relacionaba con un mejor manejo de la hiperpotasemia.

CONCLUSIONES. El seguimiento de los documentos de consenso sobre la hiperpotasemia es heterogéneo. El conocimiento de estos documentos se asocia con un mejor manejo clínico lo que se podría traducir en una reducción de la morbimortalidad y del consumo de recursos sanitarios asociados.

Palabras clave: Hiperpotasemia. Conocimiento. Manejo. Inhibidores del sistema renina-angiotensina-aldosterona. Quelantes de potasio. Protocolos.

Introduction

Hyperkalemia is a relatively common electrolyte disorder in emergency departments (EDs),[1] affecting 3% of the general population[2] and up to 50% of patients with conditions such as diabetes mellitus (DM), chronic kidney disease (CKD),[3-5] heart failure (HF),[6] or those treated with renin–angiotensin–aldosterone system inhibitors (RAASi).[7,8] It is defined as a serum potassium level (K^+) > 5,0 mEq/L[9] (or ≥ 5,5 mEq/L according to the consensus document on which this study is based[1]). In Spain, hyperkalemia shows a growing annual incidence[10] and a significant economic impact.[11] It is identified in 3–13 % of patients treated in EDs[12,13] and is associated with increased risk of admission to intensive care units, with high in-hospital mortality rates.[14] For example, in CKD, hyperkalemia is a clear predictor of in-hospital mortality.[15] Its frequency and risk of recurrence increase progressively in patients with CKD and HF,[10-16] in whom chronic hyperkalemia develops and is associated with higher morbidity and mortality.[17]

Despite the existence of consensus documents endorsed by scientific societies,[9] the management of hyperkalemia is not standardized in EDs, and there is wide variability in initial treatments.[18] RAAS inhibitors are first-line therapies in CKD and HF,[19] but their use is often modified after an acute episode of hyperkalemia, adversely affecting prognosis,[20] which is consistent with guideline recommendations to reintroduce them at hospital discharge.[1]

The consensus document of the Spanish Society of Emergency Medicine, the Spanish Society of Cardiology, and the Spanish Society of Nephrology[1] emphasized this issue and highlighted other important aspects in hyperkalemia management, such as the need for continuous cardiac monitoring in patients requiring rapid-acting therapies.[1] In addition, it recommended the use of potassium binders (cation-exchange resins, patiromer, or sodium zirconium cyclosilicate)[1,21] to prevent recurrence after an episode of severe hyperkalemia, indicating that they may be useful for rapidly reducing serum potassium when combined with other treatments. In line with these recommendations, several clinical practice guidelines advocate the use of potassium binders for the acute management of hyperkalemia, highlighting the speed of action of each agent as a determining factor in patient management.[10-22-24]

With the aim of determining the extent to which such management recommendations are applied, the primary endpoint of this study was to assess the degree of adoption of these recommendations in clinical practice by professionals involved in hyperkalemia management in Spain (nephrologists and emergency physicians). Secondarily, the study evaluated the existence and level of updating of hyperkalemia management protocols and explored the clinical impact of greater familiarity with consensus documents.

Materials and methods

Study design

We conducted a descriptive, national, multicenter study exploring the degree of adoption of the recommendations for hyperkalemia management described in the consensus document "Recommendations for the management of hyperkalemia in EDs"[1] by nephrology and emergency medicine specialists. These professionals were invited to participate voluntarily in 40 face-to-face meetings across Spain, organized and funded by the Medical Department of Diabetes & Renal Disease of AstraZeneca Spain (May 2022–June 2023).

Assessment of recommendation adoption

Eight questions were developed based on the consensus document.[1] These were individually and anonymously presented to participants via a digital platform. Responses were analyzed separately and grouped into three categories: "knowledge" (questions 1–3), "clinical management" (questions 4–6), and "other" (questions 7–8). Responses categorized as "adequate" were scored as 1, and "inadequate" as 0 (Table 1). The scores for knowledge and management dimensions were summed and classified as "low knowledge/management" when the total was 0 or 1, and "high knowledge/management" when the total was 2 or 3. Additionally, responses to questions 2, 5, and 6 were grouped as "high adoption" ("quite a lot" and "a lot") and "low adoption" ("none" and "little").

Statistical analysis

Sociodemographic characteristics of participants, their workplaces, and their responses were described using absolute frequencies and proportions.

To determine whether the participating specialists constituted an adequate sample, a post hoc statistical power calculation was performed for the primary association objective between the "knowledge" and "clinical management" dimensions. The sample size achieved a statistical power of 99 %. Calculations assumed an alpha value of 5 % and 2 degrees of freedom. For the post hoc sample

Table 1. Facilitating questions

Category / Dimension	Facilitating question	Response options	Level of knowledge/ adoption[1]
Knowledge	1. In your experience, what percentage of patients with HF and/ or CKD experience a second episode of hyperkalemia?	10-20 % 20-30 % 30-40 % 40-50 %	Low knowledge Low knowledge High knowledge Low knowledge
Knowledge	2. In your setting, do you use the consensus severity classification criteria?[†]	Not at all Little Quite a lot A lot	Low knowledge Low knowledge High knowledge High knowledge
Knowledge	3. What determines the urgency of your intervention in the management of hyperkalemia?	ECG Potassium levels Clinical condition The previous 3	Low knowledge Low knowledge Low knowledge High knowledge
Clinical management	4. In what proportion of cases do you modify RAAS inhibitor therapy?	Do not modify 25 % 50 % 75 % Always	High adoption High adoption Low adoption Low adoption Low adoption
Clinical management	5. If you modify it, do you establish a plan for reintroduction or titration?	Not at all Little Quite a lot A lot	Low adoption Low adoption High adoption High adoption
Clinical management	6. Do you consider prescribing anti-hyperkalemia agents at discharge?	Not at all Little Quite a lot A lot	Low adoption Low adoption High adoption High adoption
Other	7. Which service do you propose for patient follow-up?	PC Cardiology Nephrology None Other	Not applicable
Other	8. In your hospital, do you have access to the new treatments for hyperkalemia?	No Yes	Not applicable

PC: Primary Care; ECG: electrocardiogram; CKD: chronic kidney disease; HF: heart failure; RAASi: renin–angiotensin–aldosterone system inhibitors.

size calculation, an 80 % statistical power and a 5 % alpha value were assumed. GPower software (version 3.1.9.7) was used for these estimates (Appendix 2: https://www.reue.org/extra/art36.pdf).

Results

A total of 451 clinicians from the specialties of nephrology and emergency medicine participated in this initiative (Table 2 and Appendix 3: https://www.reue.org/extra/art36.pdf).

Knowledge and clinical management of professionals

A high level of knowledge regarding the recurrence of hyperkalemia episodes was reported by 42.9 % of professionals (Figure 1A), and 82.4 % demonstrated high knowledge of the criteria used to classify episode severity (Figure 1B). Regarding the factors determining the urgency of intervention, 77.5 % indicated that the ECG, serum potassium level, and the patient's clinical status were all important (Figure 1C). A total of 51.3 % reported modifying RAAS inhibitor (RAASi) therapy in 50 % or more of hyperkalemia cases (Figure 1D), whereas only 42.1 % stated that they established a plan for reintroduction or dose titration at discharge (Figure 1E). A total of 67.1 % reported considering the use of new potassium binders for hyperkalemia management at discharge (Figure 1F), while 50.9 % indicated that such agents were not available in their hospitals (Figure 1G). Regarding follow-up after discharge, 52.7 % believed that patients should be followed by primary care, whereas 38.8 %, 1.7 %, and 6.1 % considered that follow-up should be performed by nephrology, cardiology, or other services, respectively (Figure 1H). Finally, the combined analysis of the knowledge dimension (questions 1–3) and clinical management dimension (questions 4–6) showed that 51.9 % of participants had high knowledge (Figure 1I), while 68.7 % demonstrated low clinical management (Figure 1J).

Table 2. Professional practice location of specialists involved in the management of hyperkalemia in Spain

Autonomous Community	N = 451 n (%)
Andalusia	101 (22.4)
Aragon	17 (3.8)
Principality of Asturias	15 (3.3)
Cantabria	15 (3.3)
Castile–La Mancha	24 (5.3)
Castile and León	31 (6.9)
Catalonia	93 (20.7)
Valencian Community	46 (10.2)
Extremadura	24 (5.3)
Balearic Islands	9 (2.0)
Community of Madrid	53 (11.7)
Chartered Community of Navarre	23 (5.1)

Attitudes of professionals toward modification of RAASi therapy in patients with hyperkalemia

The analysis across Autonomous Communities of the strategy followed in patients on RAASi who developed hyperkalemia showed that approximately half of respondents (48 ± 14.5 %) modified treatment. Castilla y León was the region with the lowest modification rate (< 20 %), whereas the Valencian Community showed the highest (≈ 70 %) (Figure 2A). The proportion of professionals who established a plan for RAASi reintroduction or titration at discharge was lower (35.8 ± 23.4 %) (Figure 2B). Notably, professionals from Aragón and the Balearic Islands reported no such practice (0 %), in contrast to the high proportion observed in Extremadura (76.5 %).

Existence and degree of updating of hyperkalemia management protocols

A total of 85.3 % of professionals reported the absence of hyperkalemia management protocols in their institutions, and 14.7 % indicated that such protocols existed but were outdated (Table 3).

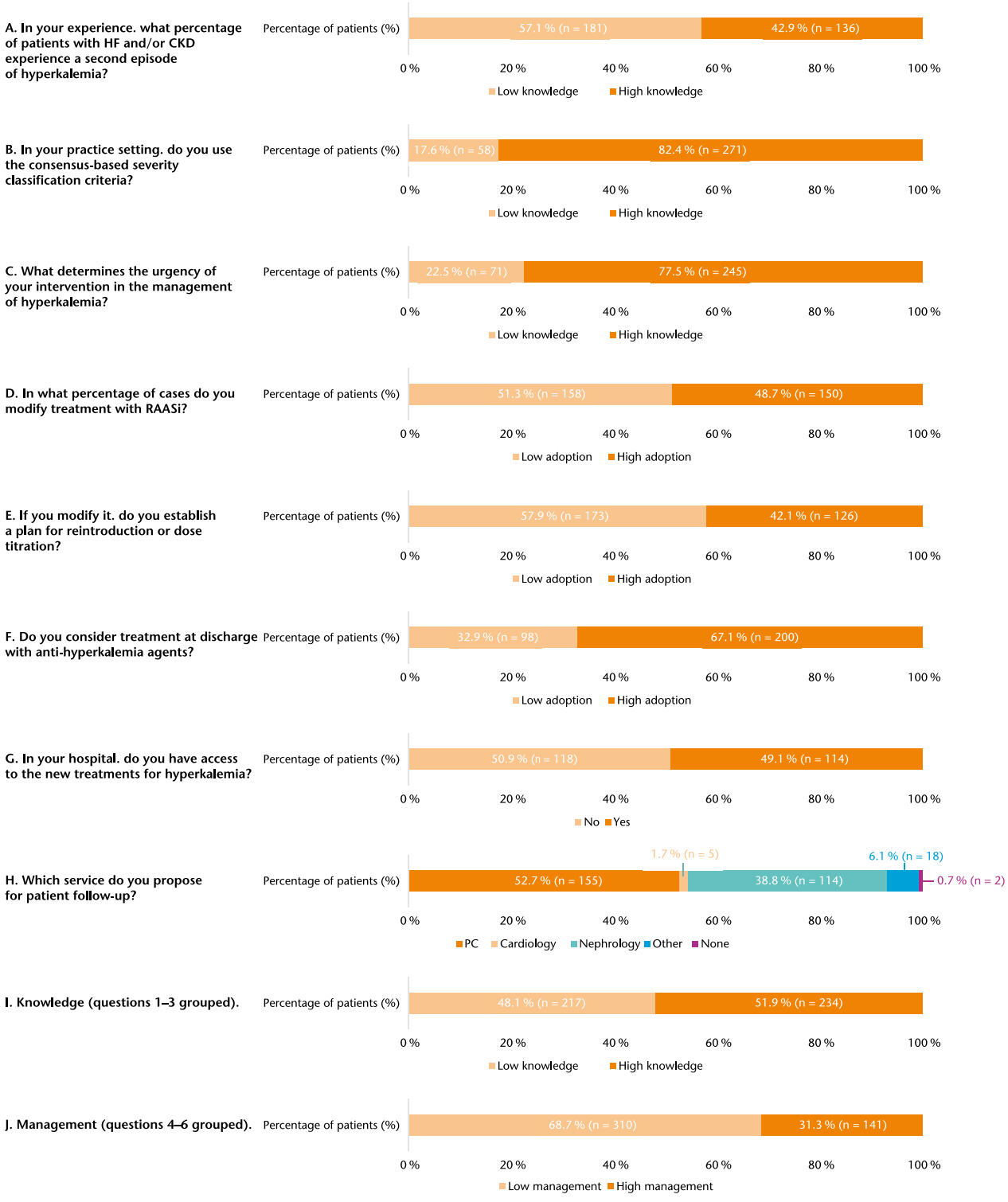

Figure 1. Grouped responses to the questions regarding the consensus document.
PC: Primary Care; CKD: chronic kidney disease; HF: heart failure; RAASi: renin–angiotensin–aldosterone system inhibitors.

Relationship between knowledge of hyperkalemia and its management

When evaluating the relationship between knowledge and management, among participants classified as having high management (n = 141), 68.1 % also demonstrated high knowledge of the disorder. In contrast, among those with low management (n = 310), most showed low knowledge of hyperkalemia (55.5 %). Thus, a clear association between knowledge and management was observed: professionals with a higher level of knowledge tended to deliver better clinical management of patients, and vice versa.

Table 3. Characteristics of the participants' workplaces

	N (%)
Type of hospital	
Primary hospital (district/community)	151 (36.3)
Secondary hospital (specialized, without kidney transplant program)	118 (28.4)
Tertiary hospital (with kidney transplant program)	147 (35.3)
Not reported	35
Existence of a hyperkalemia management protocol	
No	355 (85.3)
Yes, but not updated	61 (14.7)
Not reported	35
Protocol coordinated with the emergency department	
No	229 (63.8)
Yes	130 (36.2)
Not reported	92

Discussion

This study describes the level of knowledge and the clinical management of hyperkalemia by specialists in nephrology and emergency medicine in relation to the document "Recommendations for the Management of Hyperkalemia in the Emergency Department".[1] The results revealed that a high proportion of professionals demonstrated a good level of knowledge regarding this electrolyte disorder, the need for rapid intervention upon its occurrence, and the criteria for classifying its severity (serum potassium level, ECG, and clinical presentation). In addition, respondents indicated that primary care physicians should be the main professionals responsible for the follow-up of patients with hyperkalemia, which is consistent with the structure of our health care system for chronic hyperkalemia follow-up,[3-8] despite the fact that up to 35 % of patients with hyperkalemia are admitted for cardiac-related causes.[25] This finding aligns with recommendations that cardiologists should also participate in this follow-up.[9]

The professionals' knowledge on the proportion of patients who experience a second episode of hyperkalemia was consistent with previous studies,[10] whereas the tendency to modify therapies based on RAAS inhibitor use deviated from recommended practices advocating maintenance of chronic treatment in patients with CKD.[7-9] These responses, together with those concerning the establishment of a plan for reintroduction or titration of these drugs at discharge, showed marked variability across Autonomous Communities, which may be attributable to the lack of updated management protocols at the hospital or regional level.[26,27]

New potassium binders such as patiromer and sodium zirconium cyclosilicate improve potassium control while allowing maintenance of optimal RAAS inhibitor dosing, thereby helping prevent the morbidity and mortality associated with their withdrawal or dose reduction.[28] The use of these binders is also recommended in acute hyperkalemia, particularly those with a rapid onset of action.[9,22,24,29] In agreement with these recommendations, most participants reported considering treatment with potassium-binding agents. Whether this truly reflects real-world clinical practice remains to be determined, as no comparable studies were found in the literature.

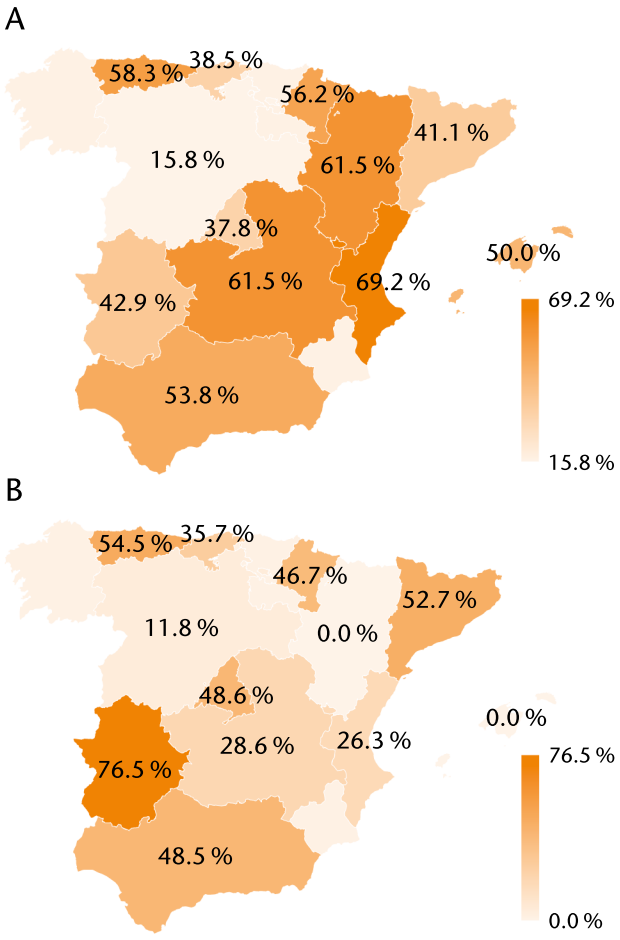

Figure 2. Detailed analysis by Autonomous Community. A: Professionals who modified RAAS inhibitor therapy in patients with hyperkalemia. B: Detailed analysis across Autonomous Community of the establishment of a plan to reintroduce or titrate RAAS inhibitor therapy at discharge (Autonomous Communities shown in light orange represent those with no participants; the orange gradient indicates the percentage of participants in each Community).

Moreover, the direct association between specialists' knowledge and the quality of hyperkalemia management underscores the importance of continuing education and regular knowledge updates among health professionals.[30] It is also essential to ensure that all professionals have access to clinical practice guidelines and tools that facilitate interdisciplinary collaboration, which is critical for appropriate management of this electrolyte disorder.[22]

This study has several limitations. The survey questions were not psychometrically validated, although they were developed based on evidence from the consensus document by Álvarez-Rodríguez *et al.*[1] Additional limitations include the inherent subjectivity of participant responses. Therefore, observational studies evaluating the real-world implementation of recommendations would be valuable. Selection bias due to voluntary participation and social desirability bias cannot be excluded, as these may have skewed the sample toward professionals more interested in the topic and encouraged responses portraying a favorable

image. Demographic variables such as age and years of professional experience were not collected and may have influenced result interpretation. Furthermore, the study design evaluated hyperkalemia management jointly among nephrology and emergency medicine specialists, providing a comprehensive view of practice in Spain; however, separate analyses by specialty could have identified important differences and merit future investigation. The study also excluded cardiology, internal medicine, and primary care professionals, despite their key roles in post-discharge follow-up.

Among the strengths of the study is the participation of a large number of professionals from diverse regions, ensuring robust and generalizable findings, further supported by post hoc sample size analysis.

Conclusions

There is a clear need to disseminate, raise awareness of, and improve adherence to recommendations for hyperkalemia management outlined in consensus documents and clinical practice guidelines,[1,26] particularly regarding professional knowledge and its correlation with appropriate clinical management. It is also essential to update and harmonize management protocols and ensure access to effective therapies such as new potassium binders for both chronic and acute hyperkalemia control.

Consensus documents recommend the use of potassium binders to prevent recurrence following acute hyperkalemia episodes, prioritizing those with rapid onset of action.[9,22,24,29]

Improved knowledge and adoption of these recommendations could reduce the incidence of severe hyperkalemia episodes, decrease associated in-hospital morbidity and mortality, enhance patient quality of life, and reduce both direct and indirect costs and health care resource utilization related to this condition.

ARTICLE INFORMATION

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ADDENDUM

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