Received: 24 November 2023 | Revised: 17 January 2024 | Accepted: 7 February 2024

DOI: 10.1111/nep.14281

REVIEW ARTICLE

NEPHROLOGY WILEY

Consensus statement on the management of hyperkalaemia—An Asia–Pacific perspective

Desmond Y. H. Yap[1] | Ronald C. W. Ma[2] | Emmanuel C. K. Wong[3] | Matthew S. H. Tsui[4] | Esther Y. T. Yu[5] | Vivien Yu[6] | Cheuk Chun Szeto[7] | Wing Fai Pang[7] | Hung Fat Tse[3] | David C. W. Siu[3] | Kathryn C. B. Tan[8] | Walter W. C. Chen[9] | Chiu Leong Li[10] | Wei Chen[11] | Tak Mao Chan[1]

[1]Division of Nephrology, Department of Medicine, University of Hong Kong, Hong Kong SAR, China

[2]Division of Endocrinology and Diabetes, Department of Medicine and Therapeutics, The Chinese University of Hong Kong, Hong Kong SAR, China

[3]Cardiology Division, Department of Medicine, University of Hong Kong, Hong Kong SAR, China

[4]Department of Accident and Emergency, Queen Mary Hospital, Hong Kong SAR, China

[5]Department of Family Medicine and Primary Care, University of Hong Kong, Hong Kong SAR, China

[6]Department of Dietetics, Queen Mary Hospital, Hong Kong SAR, China

[7]Division of Nephrology, Department of Medicine and Therapeutics, The Chinese University of Hong Kong, Hong Kong SAR, China

[8]Endocrinology and Metabolism Division, Department of Medicine, University of Hong Kong, Hong Kong SAR, China

[9]Division of Cardiology, Virtus Medical Group, Hong Kong SAR, China

[10]Division of Nephrology, Centro Hospitalar Conde de São Januário, Macau SAR, China

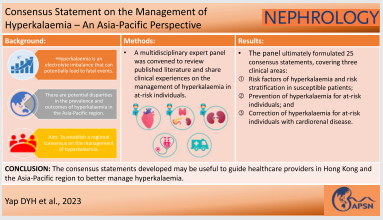
[11]Department of Nephrology, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou, China

Correspondence
Desmond Y. H. Yap, Department of Medicine, University of Hong Kong, Queen Mary Hospital, 102 Pokfulam Road, Hong Kong SAR, China.
Email: desmondy@hku.hk

Abstract

Hyperkalaemia is an electrolyte imbalance that impairs muscle function and myocardial excitability, and can potentially lead to fatal arrhythmias and sudden cardiac death. The prevalence of hyperkalaemia is estimated to be 6%–7% worldwide and 7%–10% in Asia. Hyperkalaemia frequently affects patients with chronic kidney disease, heart failure, and diabetes mellitus, particularly those receiving treatment with renin-angiotensin-aldosterone system (RAAS) inhibitors. Both hyperkalaemia and interruption of RAAS inhibitor therapy are associated with increased risks for cardiovascular events, hospitalisations, and death, highlighting a clinical dilemma in high-risk patients. Conventional potassium-binding resins are widely used for the treatment of hyperkalaemia; however, caveats such as the unpalatable taste and the risk of gastrointestinal side effects limit their chronic use. Recent evidence suggests that, with a rapid onset of action and improved gastrointestinal tolerability, novel oral potassium binders (e.g., patiromer and sodium zirconium cyclosilicate) are alternative treatment options for both acute and chronic hyperkalaemia. To optimise the care for patients with hyperkalaemia in the Asia–Pacific region, a multidisciplinary expert panel was convened to review published literature, share clinical experiences, and ultimately

formulate 25 consensus statements, covering three clinical areas: (i) risk factors of hyperkalaemia and risk stratification in susceptible patients; (ii) prevention of hyperkalaemia for at-risk individuals; and (iii) correction of hyperkalaemia for at-risk individuals with cardiorenal disease. These statements were expected to serve as useful guidance in the management of hyperkalaemia for health care providers in the region.



KEYWORDS
chronic kidney disease, diabetes, heart failure, potassium, renin-angiotensin-aldosterone system

Summary at a glance

To optimise the care for patients with hyperkalaemia in the Asia–Pacific region, a multidisciplinary expert panel was convened to review published literature, share clinical experiences, and ultimately formulate a set of consensus statements.

1 | INTRODUCTION

1.1 | Epidemiology of hyperkalaemia

Hyperkalaemia is an electrolyte imbalance that impairs muscle function and myocardial excitability, and can potentially cause life-threatening arrhythmias and sudden cardiac death.[1,2] Data from a systematic review and meta-analysis showed that the worldwide prevalence of hyperkalaemia (by any definition/threshold) is 6.3% (95% confidence interval [CI], 5.8%–6.8%), with marked differences across continents (Table 1).[3] The prevalence of hyperkalaemia in Asia (10.4%) is approximately double that in Europe (5.9%) and North America (5.0%), possibly because of a higher proportion of inpatients included in Asian studies (28% vs. 13% and 18%, respectively).[3]

TABLE 1 Prevalence of hyperkalaemia (by any definition/threshold) across different continents.[3]

Continent	Prevalence of hyperkalaemia (%)
Africa	21.8
Asia	10.4
Australasia	10.1
Europe	5.9
North America	5.0
South America	13.4

The Asian Sudden Cardiac Death in Heart Failure (ASIAN-HF) registry showed that 7.0% (356/5054) of patients with heart failure across 11 Asian countries/regions have hyperkalaemia (serum potassium >5.0 mmol/L).[4] Geographical differences in the prevalence of hyperkalaemia (Table 2) are independent of differences in comorbidities, renal function and medications for heart failure, and might be attributable to varied health care systems or local clinical practices.[4]

TABLE 2 Percentage of patients with hyperkalaemia (serum potassium >5.0 mmol/L) per country/region in the ASIAN-HF registry.[4]

Country/region	Percentage category
India	>10%
Thailand	
China	5%–10%
Japan	
Malaysia	
South Korea	
Hong Kong	<5%
Indonesia	
Philippines	
Singapore	
Taiwan	

For the general population, dietary potassium supplies appear to be optimal in most countries (Figure 1), although there are variations between different localities.[5] In this context, populations in the Asia–Pacific region appear to have higher dietary potassium levels compared with other regions. Roots and tubers were found to offer the largest dietary source of potassium (80%) across different parts of Asia, and plant-based foods contributed far higher proportions of dietary potassium than animal-based foods.

Hyperkalaemia is a common and important problem in patients with cardiac and renal diseases (Figure 2).[3] Furthermore, the medications used to manage these predisposing conditions also increase the risk of hyperkalaemia. One recent retrospective study in Hong Kong showed that the prevalence of hyperkalaemia is high (28%) among people who receive treatment with renin-angiotensin-aldosterone system (RAAS) inhibitors.[6] Another study showed that >50% of patients with diabetes mellitus (DM) and advanced chronic kidney disease (CKD) experienced at least one episode of hyperkalaemia during a median follow-up of 3.6 years, with a higher cumulative incidence in those who continued to receive RAAS inhibitors (59.4% vs. 51.1% in those who discontinued).[7] Notably, the presence of hyperkalaemia is significantly associated with unfavourable clinical outcomes, including major cardiovascular events, deterioration of renal function and higher mortality (Table 3).[6,8–11]

1.2 | Purpose of the consensus

In view of the differences in clinical epidemiology of predisposing diseases and diets, one might expect disparities in the prevalence and outcomes of hyperkalaemia in the Asia–Pacific region. Because there was no consensus in this area in the management of hyperkalaemia, a multidisciplinary expert panel was convened to review the risk factors of hyperkalaemia and strategies to treat and prevent the condition in at-risk individuals. The consensus statements developed during this review exercise may be useful to guide health care providers in Hong Kong and the Asia–Pacific region to better manage hyperkalaemia.

2 | RISK FACTORS OF HYPERKALAEMIA AND RISK STRATIFICATION IN SUSCEPTIBLE PATIENTS

2.1 | Statement 1

CKD, heart failure and DM are important risk factors for hyperkalaemia.[7,12,13]

CKD, heart failure and DM are different diseases with shared pathophysiological pathways that can potentially lead to common comorbidities, including hyperkalaemia.[13] A registry-based cohort study conducted in Hong Kong showed that, among patients with T2DM and significant renal impairment (estimated glomerular filtration rate [eGFR] < 30 mL/min/1.73 m^2) who received RAAS inhibitors within 6 months, 50%–60% experienced at least one episode of hyperkalaemia (serum potassium ≥5.5 mmol/L).[7] Another observational study conducted in the US showed that patients with heart

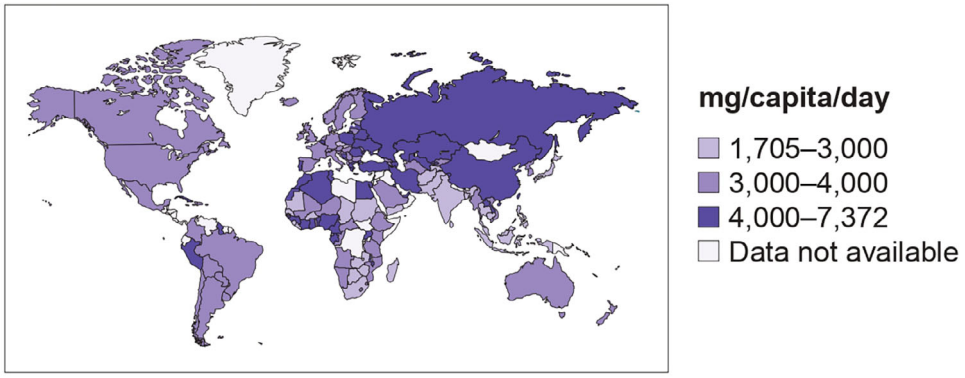


FIGURE 1 National levels of dietary supplies of potassium worldwide in 2017.[5]

End-stage renal disease	Non-dialysis-dependent chronic kidney disease	Diabetes mellitus	Heart failure	Acute kidney injury
33.3%	14.6%	8.4%	8.6%	25.7%

FIGURE 2 Pooled prevalence of hyperkalaemia (defined as serum potassium >5.0 mmol/L) by comorbidity.[3] Comorbidities were not mutually exclusive.

TABLE 3 Potential impact of hyperkalaemia on cardiorenal outcomes and all-cause mortality in a variety of settings.

	Yap et al[6]	Mclean et al[8]	Núñez et al[9]	Kovesdy et al[10]	Aldahl et al[11]
Setting	Teaching hospital/ tertiary referral centre, Hong Kong	Grampian, United Kingdom	Acute HF registry from a single centre	Meta-analysis of 27 international cohorts	Danish National registries
Study participants	14 206 patients with or without hyperkalaemia on RAAS inhibitors	302 630 people with ≥1 blood test	2642 patients consecutively discharged after admission for acutely decompensated HF	1 217 986 participants (general populations and people with high CV risk or CKD)	19 549 patients with HF on loop diuretics and RAAS inhibitors
Outcome measures					
Major cardiovascular event	Incidence, 7.8% versus 3.0%; $p < .001$	Adjusted HR (hyperkalaemia vs. no hyperkalaemia), 1.4–1.8[a]	NA	NA	NA
Deterioration of eGFR	2.8 ± 6.0 mL/min/year versus 1.3 ± 4.3 mL/min/year; $p < .001$	NA	NA	NA	NA
End-stage renal disease	Incidence, 6.2% versus 0.7%; $p < .001$	NA	NA	Adjusted HR (serum potassium 5.5 vs. 4.2 mmol/L), ~1.50	NA
Kidney failure	NA	Adjusted HR (hyperkalaemia vs. no hyperkalaemia), 2.0–17.0[a]	NA	NA	NA
All-cause mortality	Incidence, 25.5% versus 6.2%; $p < .001$	Adjusted HR (hyperkalaemia vs. no hyperkalaemia), 1.5–2.3[a]	HR (hyperkalaemia vs. normokalaemia), 1.55; $p = .011$	Adjusted HR (serum potassium 5.5 vs. 4.2 mmol/L), 1.22	Adjusted HR (serum potassium 5.6–7.4 vs. 4.2–4.4 mmol/L), 3.31

Abbreviations: CV, cardiovascular; CKD, chronic kidney disease; HR, hazard ratio; HF, heart failure; RAAS, renin-angiotensin-aldosterone system.
[a]Depends on the estimated glomerular filtration rate (eGFR).[8]

failure, CKD and DM had higher all-cause mortality rates per index potassium (range: 2.5–8.0 mmol/L) compared with control populations (22%, 16.6% and 6.6%, respectively, vs. 1.2%).[12] It also revealed that all-cause mortality was significantly elevated for every 0.1 mmol/L change in serum potassium <4.0 or ≥5.0 mmol/L, which represented a U-shaped relationship.[12] Recent clinical trials and international guidelines have defined hyperkalaemia as a serum potassium level of >5.0 mmol/L. More details on the definition of hyperkalaemia were discussed in Statement 5.

2.2 | Statement 2

Common medications that are frequently associated with hyperkalaemia include RAAS inhibitors, potassium-sparing diuretics, non-steroidal anti-inflammatory drugs (NSAIDs), beta-blockers and trimethoprim.[14–16]

These medications potentially increase the risk for hyperkalaemia, mainly by inhibiting the release of renin from juxtaglomerular cells, inhibiting the release of aldosterone from the adrenal gland or blocking sodium channel blockers in the epithelium of the kidney collecting duct.[14,15] One recent retrospective study in Hong Kong showed that the prevalence of hyperkalaemia is high (28%) among people who receive treatment with RAAS blockade.[6] In the FIDELIO-DKD trial, treatment with a mineralocorticoid receptor antagonist was shown to be an independent risk factor for hyperkalaemia; with a median follow-up of 2.6 years, 21.4% of patients with CKD and type 2 DM who received the treatment had hyperkalaemia, compared with 9.2% in the placebo group.[16]

2.3 | Statement 3

Hyperkalaemia is a major limiting factor for the dosing of RAAS inhibitor therapy in patients with CKD, heart failure, or DM.[17]

Because RAAS inhibitors may increase serum potassium levels, RAAS inhibitor-induced hyperkalaemia often limits the optimal use of these drugs, thereby offsetting their clinical benefits.[17]

2.4 | Statement 4

Dose interruptions of RAAS inhibitors due to treatment-related hyperkalaemia are associated with adverse cardiorenal outcomes, disease progression and increased mortality.[7,18,19]

2.5 | Statement 5

RAAS inhibitors should be continued for cardiorenal benefits as far as possible when managing mild-to-moderate hyperkalaemia in patients with CKD, heart failure, or DM.[20,21]

Remark: Serum potassium levels of 5.0–5.4, 5.5–5.9 and ≥6.0 mmol/L can be considered as mild, moderate and severe hyperkalaemia, respectively.[20]

A registry-based cohort study conducted in Hong Kong showed that 17% (1766/10400) of patients with T2DM discontinued treatment with RAAS inhibitors within 6 months, and were associated with higher risks of major adverse cardiovascular events (MACEs), heart failure and end-stage renal disease (hazard ratios of 1.27 [95% CI, 1.08–1.49], 1.85 [1.53–2.25] and 1.30 [1.17–1.43], respectively) compared with those who continued to receive RAAS inhibitors.[7] Real-world evidence from Western populations has consistently demonstrated that suboptimal dosing or discontinuation of RAAS inhibitors is associated with higher risks of MACEs, CKD, heart failure and all-cause mortality among patients with CKD or heart failure.[18,19]

Other international clinical consensuses also suggested that RAAS inhibitors should be continued as far as possible in patients with cardiorenal disease who experience de novo RAAS inhibitor-induced hyperkalaemia.[20,21] The clinical dilemma is that both hyperkalaemia and discontinuation of RAAS inhibitors are associated with increased risks for cardiovascular events, hospitalisations and death in patients with DM, CKD, or heart failure[22]; however, recent randomized trials showed that optimal control of hyperkalaemia, with novel oral potassium binders (patiromer and sodium zirconium cyclosilicate [SZC]), is a well-tolerated and effective approach to allow continuation of RAAS inhibitor treatment and subsequent clinical benefits.[23,24]

These studies enrolled patients with baseline serum potassium ≥5.1 mmol/L,[23,24] which was consistent with the definition of hyperkalaemia endorsed by the Canadian Cardiovascular Society Heart Failure Companion and the European Society of Cardiology, that is serum potassium levels of 5.0–5.4, 5.5–5.9 and ≥6.0 mmol/L as mild, moderate and severe hyperkalaemia, respectively.[20,21] The phase III randomized placebo-controlled HARMONIZE-Global trial demonstrated the efficacy and safety of SZC in patients with baseline serum potassium ≥5.1 mmol/L, 85% (227/267) of whom were from Japan, South Korea and Taiwan.[24] These results suggest that a serum potassium level of ≥5.1 mmol/L can be considered as a threshold for treatment initiation in Asian patients. Presented at the National Kidney Foundation Spring Clinical Meetings 2023, the real-world REVOLUTIONIZE I study similarly used serum potassium >5.0 mmol/L to define hyperkalaemia and investigated the recurrence of the condition among patients who received dietary counselling.[25] There were 59% (1209/2048) of patients with serum potassium from >5.0 to <5.5 mmol/L.[25] Overall, most patients with CKD Stage 3 or 4 and hyperkalaemia experienced recurrent and chronic hyperkalaemia even after dietary counselling, with more frequent and rapid episodes observed in those with more recurrences, highlighting the need for long-term anti-hyperkalaemia therapy in addition to dietary counselling.[25]

3 | PREVENTION OF HYPERKALAEMIA FOR AT-RISK INDIVIDUALS

Figure 3 summarises the following Statements 6 to 12.

3.1 | Statement 6

After initiation and up-titration of treatment with RAAS inhibitors, serum potassium levels should be measured within 1–2 weeks in high-risk patients with DM, CKD, or heart failure.[27–29]

3.2 | Statement 7

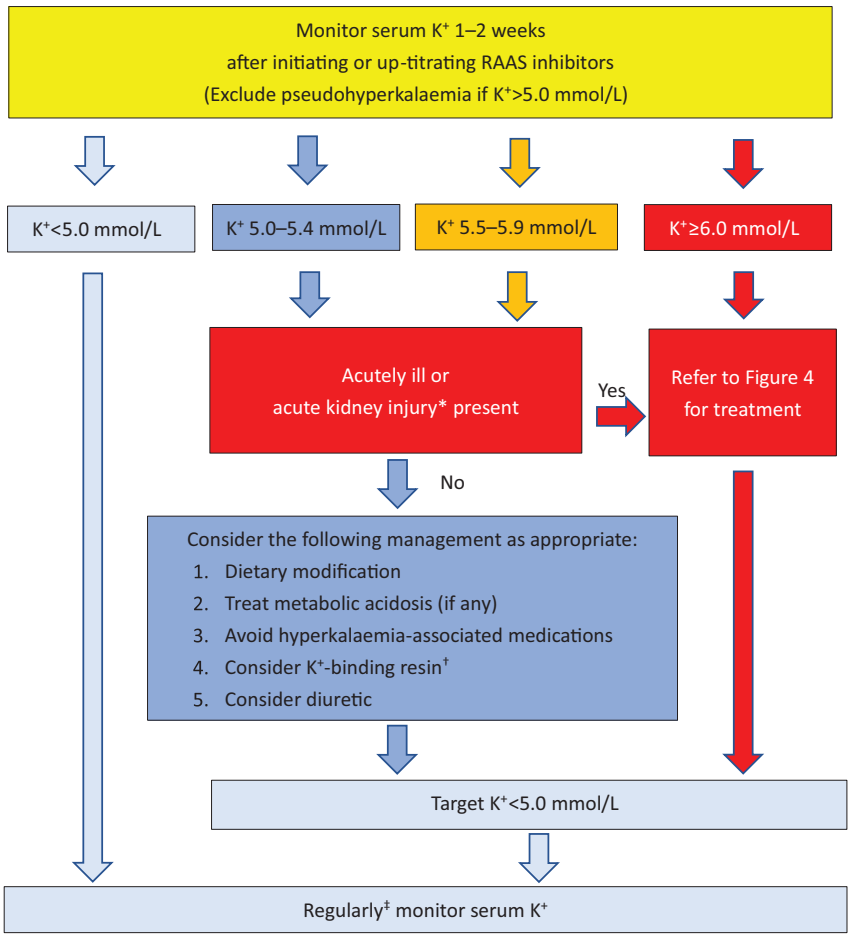
Serum potassium levels should be monitored regularly in high-risk patients who are receiving RAAS inhibitors.[30]

3.3 | Statement 8

More frequent monitoring should be considered in patients with multiple risk factors, for example presence of mild hyperkalaemia at baseline,[11] concomitant use of medications that can increase potassium,[30,31] and treatment with intermittent haemodialysis.[32]

The requirements and schedules of hyperkalaemia monitoring in patients receiving RAAS inhibitors have been proposed in various international guidelines and expert consensuses.[27–32] Serum potassium measurement within 1–2 weeks of starting or dose-escalating RAAS inhibitors is generally recommended for patients with CKD, DM or heart failure. Acute hyperkalaemia should be treated according to the algorithm shown in Figure 4. For chronic or transient hyperkalaemia, several measures, including dietary modification, treatment of metabolic acidosis (if any), avoidance of hyperkalaemia-associated medications and use of potassium-binding resin or diuretic therapy, can be considered (Figure 3).

Regular monitoring of serum potassium levels is recommended for all patients receiving RAAS inhibitors. Notably, the monitoring schedule should be individualised based on patient comorbidities and concomitant medications. Real-world data from routine clinical practice in the USA revealed that patients who received RAAS inhibitors were generally tested for hyperkalaemia no less than once annually, with more frequent monitoring (no less than 3 times annually) in those with an eGFR <30 mL/min/1.73 m^2.[33,34] Additionally, detection of hyperkalaemia was increased with frequency of testing.[33,34]



*Acute kidney injury is an abrupt (≤48 hours) reduction in renal function based on an elevated serum creatinine level, a reduced urine output, the need for dialysis, or a combination of these factors.[26]

†Sodium zirconium cyclosilicate and patiromer are available options; the choice depends on local access and resources.

‡More frequent monitoring can be considered in patients with chronic kidney disease stage 3–5 (not on dialysis) or heart failure.

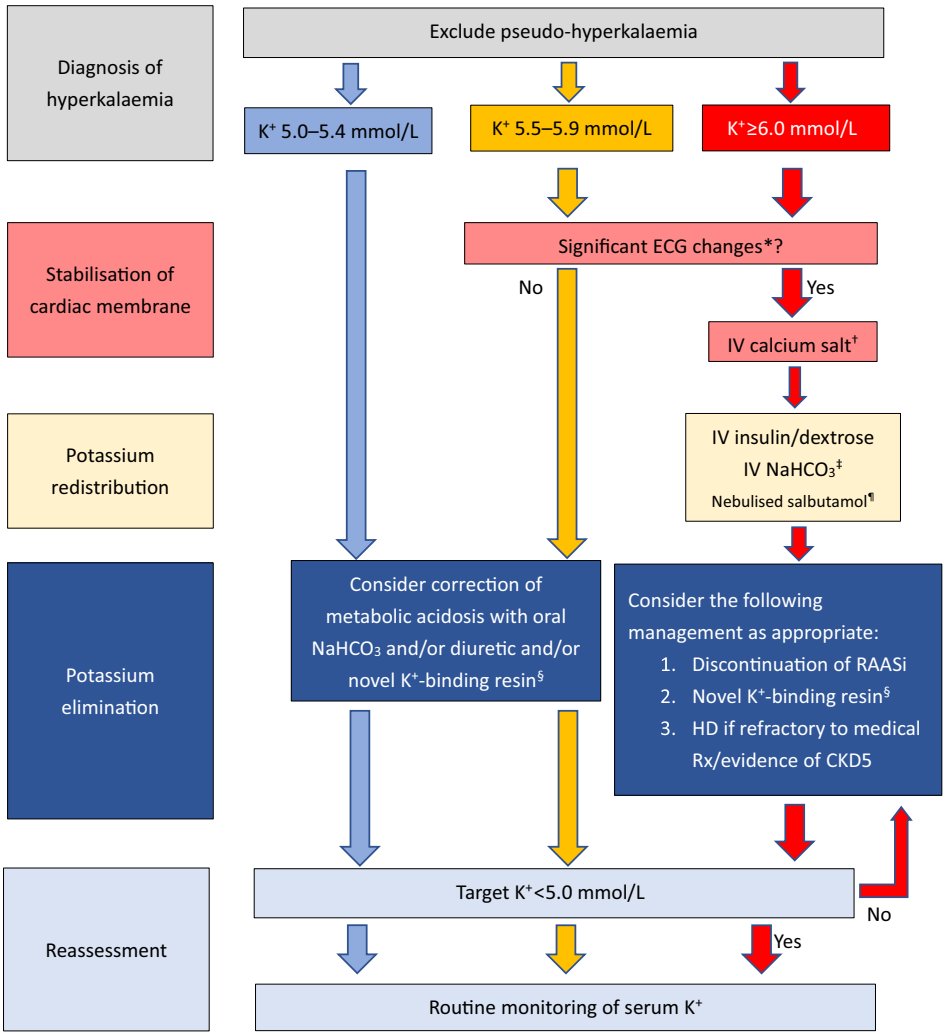
FIGURE 3 Suggested algorithm for monitoring serum potassium and preventing hyperkalaemia in high-risk patients who are receiving renin-angiotensin-aldosterone system (RAAS) inhibitors.

3.4 | Statement 9

Alternative preventive measures (Tables 4 and 5) should be considered in high-risk patients with prior hyperkalaemia, before de-escalating or discontinuing RAAS inhibitors.[21,27,30,31,35,36]

3.5 | Statement 10

Dietary modification (e.g., low-potassium diets [Table 5] and avoidance of potassium-containing salt substitutes) can serve as a non-pharmacological preventive measure against hyperkalaemia in high-risk patients.[37]



*ECG changes (e.g. arrhythmia, prolonged QRS, ST/T wave changes, etc.) are uncommon when serum K^+ is in the range of 5.5–5.9 mmol/L.

†Calcium gluconate is preferred over calcium chloride, except for patients with haemodynamic instability or cardiac arrest.

‡Can be considered in patients with metabolic acidosis.

¶Can be considered to reduce the risk of hypoglycaemia.

§Sodium zirconium cyclosilicate (SZC) and patiromer are available options; the choice depends on local access and resources. Sodium/calcium polystyrene sulfonate can be a short-term treatment option for mild-to-moderate hyperkalaemia if novel K^+-binding resins are not available.

CKD5 = stage 5 chronic kidney disease; ECG = electrocardiography; HD = haemodialysis; IV = intravenous; RAASi = renin-angiotensin-aldosterone system inhibitor.

FIGURE 4 Suggested treatment algorithm for acute hyperkalaemia.

TABLE 4 Pros and cons of preventive measures against hyperkalaemia.

Preventive measure	Advantage	Disadvantage
Low-potassium diet (Table 5)	• Low cost • No medications required	• Poor patient compliance[27,31] • May deprive patients of the health benefits of plant/fibre-based diets[35,36]
Avoiding potassium-containing salt substitutes	• Low cost • No medications required	• May affect palatability of diets (given that avoidance of salt remains necessary in most patients)
Avoiding hyperkalaemia-associated medications (e.g., NSAIDs, potassium-sparing diuretics)	• Low cost • No additional medications required	• May limit the choice of treatment in patients indicated for these medications
Loop/thiazide diuretics	• Can treat concomitant hypertension or hypervolemia[21,30]	• Potential side effects include volume depletion and gout • Potential for drug–drug interactions[31]
Approved potassium binders (e.g., SZC)	• Can lower potassium without discontinuation or alterations of RAAS inhibitors[21,30] • May prevent adjustments of diets or concomitant medications[21]	• Potential side effects include gastrointestinal upset (albeit the risk is much lower than sodium/calcium polystyrene sulfonate)[23,41]

Abbreviations: NSAID, non-steroidal anti-inflammatory drug; RAAS, renin-angiotensin-aldosterone system; SZC, sodium zirconium cyclosilicate.

Both pharmacological and non-pharmacological approaches can be used to reduce the risk of hyperkalaemia in patients who are receiving RAAS inhibitors. Pharmacological approaches include loop/thiazide diuretics and novel oral potassium binders (Table 4), both of which are effective in reducing serum potassium levels directly.[21,30,31] Non-pharmacological approaches focus on dietary and lifestyle modifications, such as avoiding high-potassium diets (Table 5), potassium-containing salt substitutes and hyperkalaemia-associated medications (e.g., NSAIDs and potassium-sparing diuretics).[27,31,35–37] Notably, the risks and benefits should be considered before initiating these measures (Table 4).

TABLE 5 Foods that contain low or high potassium content.[37]

Food category	Low potassium content	High potassium content
Fruits	Pear, blueberry, red apple and green apple	Durian, banana, kiwifruit, mandarin orange, guava, nectarine, grapefruit, strawberry and peach
Vegetables	String bean, melon, zucchini, Chinese kale, cabbage, bean sprout and cauliflower	Lotus root, pumpkin, wolfberry leaves and spinach
Others	Rice, noodles, pasta and bread (not whole grains)	Salt substitutes, bean, soy products, sugar syrup, nuts, dairy products, dried fruits and whole grain product

3.6 | Statement 11

Significant metabolic acidosis should be treated to reduce the risk of hyperkalaemia.[38–40]

Metabolic acidosis precipitates hyperkalaemia by enhancing movement of intracellular potassium into the extracellular fluid, resulting in an increased serum potassium level relative to total body stores. Treatment of acidosis with sodium bicarbonate promotes intracellular uptake of potassium by activating the sodium–hydrogen exchange and sodium–potassium pump, thereby reducing the risk of hyperkalaemia.

3.7 | Statement 12

Approved oral potassium binders can serve as an effective preventive measure in patients with a history of RAAS inhibitor-induced hyperkalaemia.[17,21,23,41]

Remark: SZC and patiromer are available options; the choice depends on local access and resources.

The efficacy and safety of SZC and patiromer for the treatment of hyperkalaemia have been demonstrated in phase III randomised controlled trials.[23,41] The HARMONIZE trial demonstrated that SZC 10 g three times daily reduced the mean serum potassium level

among patients with hyperkalaemia (serum potassium ≥5.1 mmol/L) from 5.6 mmol/L at baseline to 4.5 mmol/L at 48 h; compared with placebo (5.1 mmol/L), all three doses of SZC resulted in significantly lower mean serum potassium levels during days 8–29 (4.8, 4.5 and 4.4 mmol/L for 5, 10 and 15 g, respectively; all $p < .001$).[41] Weir et al. reported that, among patients with CKD who were receiving RAAS inhibitors and had hyperkalaemia (serum potassium level, 5.1 to <6.5 mmol/L), patiromer treatment was associated with a significant reduction in serum potassium levels (mean change from baseline to week 4, −1.01 mmol/L; $p < .001$) and, as compared with placebo, a significant decrease in the recurrence rate of hyperkalaemia (15% vs. 60% at week 8; $p < .001$).[23] The most common adverse effects with SZC and patiromer were oedema and constipation, respectively.[23,41] Several international expert panels have reached a consensus that, for patients with cardiorenal disease and hyperkalaemia, treatment with SZC or patiromer (depending on the country-specific approval status) can be initiated to optimise RAAS inhibitor therapy.[17,21]

Compared with SZC and patiromer, conventional potassium-binding resins, such as sodium polystyrene sulfonate (SPS) and calcium polystyrene sulfonate (CPS), have several barriers to their long-term use in an outpatient setting. The unpalatable taste, risk of gastrointestinal side effects and potential impact on the absorption of oral comedications (including RAAS inhibitors) may affect patient adherence.[42–44] A large-scale real-world study conducted in Japan revealed that approximately 60% of patients with hyperkalaemia discontinued treatment with CPS or SPS within 1 year.[45] These agents may also be associated with serious adverse effects, such as bowel necrosis, electrolyte disturbances, systemic alkalosis, fluid overload and aspiration.[44] Long-term (>1 year) data on the efficacy of SPS and CPS were mostly derived from retrospective studies with small sample sizes.[46] In contrast, the long-term efficacy of SZC was demonstrated in a phase III prospective trial. A group of 751 outpatients with serum potassium ≥5.1 mmol/L had a mean serum potassium of 4.7 mmol/L (95% CI, 4.6 to 4.7) after 12 months of SZC treatment (mean time, 286 days; mean daily dose, 7.2 g).[47] Researchers proposed that, in contrast to SPS, SZC is not a polymer and does not absorb water or swell in the gastrointestinal tract; therefore, it is not expected to cause the gastrointestinal side effects that are commonly associated with SPS and other nonspecific organic polymers.[48] However, there remains a lack of randomied controlled trials to compare conventional and novel oral potassium binders in terms of efficacy and safety.

Sodium-glucose cotransporter 2 (SGLT2) inhibitors are a newer class of oral glucose-lowering agent that offer additional benefits in reducing the risks of heart failure and CKD among patients with and without T2DM. Based on post hoc analyses of phase III randomised trials,[49–51] among patients already on RAAS inhibitors, add-on treatment with SGLT2 inhibitors may facilitate the use of lower doses of RAAS inhibitors, thereby reducing the risk of hyperkalaemia[16] while preserving cardiorenal benefits. Notably, this hypothesis warrants further investigation.

4 | CORRECTION OF HYPERKALAEMIA FOR AT-RISK INDIVIDUALS WITH CARDIORENAL DISEASE

Figure 4 summarises the following Statements 13 to 25.

4.1 | General principle

4.1.1 | Statement 13

> Pseudo-hyperkalaemia should be excluded before treatment initiation.[40,52]
>
> *Remark*: Pseudo-hyperkalaemia is defined as an increase in serum potassium while plasma potassium is normal, and is associated with CKD stage ≥3 and delayed laboratory processing time.[52]

Pseudo- or false hyperkalaemia can be quite common in the outpatient setting. A study conducted in Singapore showed that, among outpatients in public primary care clinics, the prevalence of pseudo-hyperkalaemia (defined as index potassium level >5.5 mmol/L, but repeat potassium level ≤5.5 mmol/L within 8 days) can be as high as 86.4%, with delayed laboratory processing time being a key risk factor for false hyperkalaemia.[52] Clinical guidelines consistently recommend that pseudo-hyperkalaemia should be properly excluded before consideration of treatment.[40]

4.1.2 | Statement 14

> Treatment of acute hyperkalaemia is guided by the severity (serum potassium level) and electrocardiographic (ECG) changes.[27,28,38–40,53,54]

4.1.3 | Statement 15

A stepwise approach that involves stabilisation of cardiac membrane, potassium redistribution and elimination of potassium should be adopted in the treatment of acute hyperkalaemia.[28,40,55]

Criteria and approaches for the treatment of acute hyperkalaemia have been proposed in various international clinical practice guidelines and expert consensuses.[27,28,38–40,53–55] Acute hyperkalaemia can be defined as a sudden, rapid increase in serum potassium levels. A serum potassium level ≥5.5 mmol/L with significant ECG changes is a life-threatening emergency that requires prompt treatment to stabilise the cardiac membrane and thereby prevent cardiac toxicity and arrhythmia. The next step is to reduce serum potassium levels by facilitating the movement of extracellular potassium into muscle cells. Subsequently, elimination of potassium should be enhanced with potassium-binding resins or haemodialysis in patients who are refractory to medical treatment or have stage 5 CKD. Discontinuation of RAAS inhibitor treatment can also be considered.

4.2 | STABILISATION OF THE CARDIAC MEMBRANE

4.2.1 | Statement 16

Treatment with intravenous calcium is indicated only for hyperkalaemic patients with significant ECG changes.[38,39,54,56]

4.2.2 | Statement 17

Calcium gluconate is preferred over calcium chloride, except for patients with haemodynamic instability or cardiac arrest.[38,56]

Remark: Calcium gluconate is associated with a lower risk of tissue necrosis in the event of extravasation.

Considering the risk of soft tissue injuries, intravenous calcium should be reserved for patients with significant ECG changes, which include arrhythmia, prolonged QRS and ST/T wave changes.[56] These conditions necessitate stabilisation of myocytes to prevent cardiac complications of hyperkalaemia. Although no randomised trials have compared calcium chloride and calcium gluconate for the treatment of hyperkalaemia, calcium gluconate is associated with a lower risk of tissue necrosis in the event of extravasation, and is thus a preferred treatment over calcium chloride, except for patients with haemodynamic instability or cardiac arrest.[38,56]

4.3 | REDISTRIBUTION OF POTASSIUM

4.3.1 | Statement 18

Intravenous insulin/dextrose is effective for shifting serum potassium intracellularly.[40,57]

4.3.2 | Statement 19

Add-on intravenous sodium bicarbonate can be considered in hyperkalaemia patients with metabolic acidosis.[38–40]

4.3.3 | Statement 20

In patients at high risk of hypoglycaemia, add-on nebulised salbutamol may be considered for potassium redistribution.[39,40]

Data from systematic reviews have demonstrated that intravenous insulin/dextrose is the standard of care for acute hyperkalaemia.[40,57] As mentioned in Statement 11, although not indicated for hyperkalaemia, treatment of metabolic acidosis with sodium bicarbonate remains an important means to redistribute serum potassium.[38–40] In the clinical setting in Hong Kong, the use of nebulised salbutamol in

acute hyperkalaemia is not a common practice; however, according to international guidelines, it remains a worthwhile option for hyperkalaemic patients at risk of hypoglycaemia (i.e. pre-treatment blood glucose level <7.0 mmol/L) to reduce serum potassium while preserving normoglycaemia.[39,40]

4.4 | ELIMINATION OF POTASSIUM

4.4.1 | Statement 21

The routine use of SPS in the management of hyperkalaemia, especially when treatment duration is prolonged, is not advisable.[58,59]

Remark: SPS is associated with potential harm and lack of efficacy.

4.4.2 | Statement 22

Novel oral potassium-binding resins can serve as an effective treatment for acute hyperkalaemia.[23,41]

Remark 1. SZC and patiromer are viable options, with the choice depending on availability. For example, in Hong Kong, only SZC is registered.

Remark 2. SZC is associated with a far lower risk of gastrointestinal upset compared with SPS.

Remark 3. SPS/CPS can be a short-term treatment option for mild-to-moderate hyperkalaemia if novel oral potassium-binding resins are not available.

Recent studies demonstrated that the efficacy and safety of SPS in treating hyperkalaemia may be unfavourable. A real-world study of patients with mild hyperkalaemia revealed that SPS had a minimal treatment effect, with the potential for gastrointestinal adverse events.[58] Additionally, a systematic review that focused on gastrointestinal safety of SPS showed that the agent is associated with fatal gastrointestinal injury, regardless of the concomitant use of sorbitol.[59] The current evidence does not support the routine use of SPS. Instead, based on their established efficacy and safety, novel oral potassium-binding resins should be considered to eliminate serum potassium, as described in Statement 12.[23,41] Furthermore, pooled data from clinical trials showed that SZC was associated with a low incidence (2.9%; 5/170) of gastrointestinal disorders.[41]

CPS is a widely available oral potassium-binding agent. However, the onset of action is unpredictable and possibly longer than 4 h, which restricts the use of CPS for the treatment of acute, severe hyperkalaemia.[60] CPS may be considered in patients with mild or moderate hyperkalaemia (with no or mild ECG changes) where a slower reduction in serum potassium is acceptable.[61,62] In contrast, SZC has a rapid onset of action (within 1 h) and offers a greater potassium-lowering effect with increasing severity of hyperkalaemia.[41] The phase III randomied HARMONIZE trial revealed that patients with serum potassium ≥5.1 mmol/L achieved normokalaemia with a median time of 2.2 h after SZC treatment.[41] Although SZC lowered the serum potassium by 1.1 mmol/L within 48 h in the overall study population, the reduction was increased to 1.5 mmol/L within 48 h in patients with serum potassium >6.0 mmol/L.[41] These data support the use of SZC for the treatment of acute hyperkalaemia.

4.4.3 | Statement 23

Add-on loop or thiazide diuretics can be considered to facilitate potassium elimination in hyperkalaemic patients.[38,39]

Remark: Add-on loop or thiazide diuretics can be used to treat concomitant hypervolaemia or hypertension.

4.4.4 | Statement 24

Haemodialysis can be considered to eliminate serum potassium in patients who have severe hyperkalaemia (especially in those with stage 5 CKD) or are refractory to medical therapies.[63–65]

4.4.5 | Statement 25

In patients with acute hyperkalaemia, serum potassium levels should be reassessed 2–4 h after administration of potassium-lowering therapies.[38,39]

Remark: The aim is to verify the achievement of normokalaemia (serum potassium <5.0 mmol/L).

Loop or thiazide diuretics facilitate renal potassium excretion and are particularly helpful for hyperkalaemic patients with concomitant hypervolaemia or hypertension; however, they are not recommended as monotherapy for hyperkalaemia.[38,39] Haemodialysis should be considered to normalise serum potassium levels to reduce the risk of fatal arrhythmia in hyperkalaemic patients who have end-stage renal disease or inadequate response to other treatments.[63,64] Real-world evidence showed that haemodialysis was the only treatment approach that normalised the median serum potassium level within 4 h among patients with hyperkalaemia in the emergency setting.[65] Other guidelines generally recommend re-assessment of serum potassium levels 2–4 h after treatment to verify the achievement of normokalaemia (serum potassium <5.0 mmol/L), followed by routine monitoring.[38,39]

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing interests.

ORCID

Desmond Y. H. Yap https://orcid.org/0000-0001-8179-8293
Cheuk Chun Szeto https://orcid.org/0000-0002-8898-8505
Tak Mao Chan https://orcid.org/0000-0002-3495-4051

REFERENCES

1. Crawford AH. Hyperkalemia: recognition and management of a critical electrolyte disturbance. *J Infus Nurs*. 2014;37:167-175. doi:10.1097/nan.0000000000000036
2. Brueske B, Sidhu MS, Schulman-Marcus J, Kashani KB, Barsness GW, Jentzer JC. Hyperkalemia is associated with increased mortality among unselected cardiac intensive care unit patients. *J Am Heart Assoc*. 2019;8:e011814. doi:10.1161/jaha.118.011814
3. 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*. 2022;15:727-737. doi:10.1093/ckj/sfab243
4. Beusekamp JC, Teng TK, Tay WT, et al. Potassium abnormalities in patients with heart failure from 11 Asian regions: insights from the ASIAN-HF registry. *Eur J Heart Fail*. 2020;22:751-754. doi:10.1002/ejhf.1640
5. Kumssa DB, Joy EJM, Broadley MR. Global trends (1961–2017) in human dietary potassium supplies. *Nutrients*. 2021;13:1369. doi:10.3390/nu13041369
6. Yap D, So BYF, Lee PCH, Hai JSH, Chan DTM. Hyperkalaemia in patients receiving renin-angiotensin-aldosterone system blockade: clinical epidemiology and outcomes [Abstract]. *J Am Soc Nephrol*. 2022;33:472.
7. Yang A, Shi M, Lau ESH, et al. Clinical outcomes following discontinuation of renin-angiotensin-system inhibitors in patients with type 2 diabetes and advanced chronic kidney disease: a prospective cohort study. *EClinicalMedicine*. 2023;55:101751. doi:10.1016/j.eclinm.2022.101751
8. McLean A, Nath M, Sawhney S. Population epidemiology of hyperkalemia: cardiac and kidney long-term health outcomes. *Am J Kidney Dis*. 2022;79:527-538.e1. doi:10.1053/j.ajkd.2021.07.008
9. Núñez J, Bayés-Genís A, Zannad F, et al. Long-term potassium monitoring and dynamics in heart failure and risk of mortality. *Circulation*. 2018;137:1320-1330. doi:10.1161/circulationaha.117.030576
10. Kovesdy CP, Matsushita K, Sang Y, et al. Serum potassium and adverse outcomes across the range of kidney function: a CKD prognosis consortium meta-analysis. *Eur Heart J*. 2018;39:1535-1542. doi:10.1093/eurheartj/ehy100
11. Aldahl M, Jensen AC, Davidsen L, et al. Associations of serum potassium levels with mortality in chronic heart failure patients. *Eur Heart J*. 2017;38:2890-2896. doi:10.1093/eurheartj/ehx460
12. Collins AJ, Pitt B, Reaven N, et al. Association of serum potassium with all-cause mortality in patients with and without heart failure, chronic kidney disease, and/or diabetes. *Am J Nephrol*. 2017;46:213-221. doi:10.1159/000479802
13. Lawson CA, Seidu S, Zaccardi F, et al. Outcome trends in people with heart failure, type 2 diabetes mellitus and chronic kidney disease in the UK over twenty years. *EClinicalMedicine*. 2021;32:100739. doi:10.1016/j.eclinm.2021.100739
14. Palmer BF, Clegg DJ. Physiology and pathophysiology of potassium homeostasis: Core curriculum 2019. *Am J Kidney Dis*. 2019;74:682-695. doi:10.1053/j.ajkd.2019.03.427
15. Hollander-Rodriguez JC, Calvert JF Jr. Hyperkalemia. *Am Fam Physician*. 2006;73:283-290.
16. Agarwal R, Joseph A, Anker SD, et al. Hyperkalemia risk with finerenone: results from the FIDELIO-DKD trial. *J Am Soc Nephrol*. 2022;33:225-237. doi:10.1681/asn.2021070942
17. Rosano GMC, Tamargo J, Kjeldsen KP, et al. Expert consensus document on the management of hyperkalaemia in patients with cardiovascular disease treated with renin angiotensin aldosterone system inhibitors: coordinated by the working group on cardiovascular pharmacotherapy of the European Society of Cardiology. *Eur. Heart J.: Cardiovasc. Pharmacother*. 2018;4:180-188. doi:10.1093/ehjcvp/pvy015
18. Linde C, Bakhai A, Furuland H, et al. Real-world associations of renin-angiotensin-aldosterone system inhibitor dose, hyperkalemia, and adverse clinical outcomes in a cohort of patients with new-onset chronic kidney disease or heart failure in the United Kingdom. *J Am Heart Assoc*. 2019;8:e012655. doi:10.1161/jaha.119.012655
19. Leon SJ, Whitlock R, Rigatto C, et al. Hyperkalemia-related discontinuation of renin-angiotensin-aldosterone system inhibitors and clinical outcomes in CKD: a population-based cohort study. *Am J Kidney Dis*. 2022;80:164-173.e1. doi:10.1053/j.ajkd.2022.01.002
20. Howlett JG, Chan M, Ezekowitz JA, et al. The Canadian cardiovascular society heart failure companion: bridging guidelines to your practice. *Can J Cardiol*. 2016;32:296-310. doi:10.1016/j.cjca.2015.06.019
21. Burton JO, Coats AJS, Kovesdy CP, et al. An international Delphi consensus regarding best practice recommendations for hyperkalaemia across the cardiorenal spectrum. *Eur J Heart Fail*. 2022;24:1467-1477. doi:10.1002/ejhf.2612
22. Hundemer GL, Sood MM. Hyperkalemia with RAAS inhibition: mechanism, clinical significance, and management. *Pharmacol Res*. 2021;172:105835. doi:10.1016/j.phrs.2021.105835
23. Weir MR, Bakris GL, Bushinsky DA, et al. Patiromer in patients with kidney disease and hyperkalemia receiving RAAS inhibitors. *N Engl J Med*. 2015;372:211-221. doi:10.1056/NEJMoa1410853

24. Zannad F, Hsu BG, Maeda Y, et al. Efficacy and safety of sodium zirconium cyclosilicate for hyperkalaemia: the randomized, placebo-controlled HARMONIZE-global study. *ESC Heart Fail*. 2020;7:54-64. doi:10.1002/ehf2.12561
25. Rowan CG, Agiro A, Chan KA, et al. Recurrence of hyperkalemia following dietary counseling: REVOLUTIONIZE I real-world evidence study. Poster #296 Presented at National Kidney Foundation Spring Clinical Meetings 2023, Austin, TX, USA, April 11–15 2023.
26. Rahman M, Shad F, Smith MC. Acute kidney injury: a guide to diagnosis and management. *Am Fam Physician*. 2012;86:631-639.
27. Palmer BF, Carrero JJ, Clegg DJ, et al. Clinical management of hyperkalemia. *Mayo Clin Proc*. 2021;96:744-762. doi:10.1016/j.mayocp.2020.06.014
28. Campbell P, McKeveney P, Donegan K, Ataliotis C, Patton C, Mullan R. Practical guidance for the use of potassium binders in the management of hyperkalaemia in patients with heart failure and/or chronic kidney disease. *Br J Hosp Med (Lond)*. 2021;82:1-11. doi:10.12968/hmed.2021.0215
29. Bianchi S, Aucella F, De Nicola L, Genovesi S, Paoletti E, Regolisti G. Management of hyperkalemia in patients with kidney disease: a position paper endorsed by the Italian Society of Nephrology. *J Nephrol*. 2019;32:499-516. doi:10.1007/s40620-019-00617-y
30. Almenar Bonet L, González-Franco Á. Consensus on the management of hyperkalemia in patients with heart failure: recommendations from the SEC-SEMI. *Rev Clin Esp*. 2022;222:235-240. doi:10.1016/j.rceng.2020.11.012
31. Kumar R, Kanev L, Woods SD, Brenner M, Smith B. Managing hyperkalemia in high-risk patients in long-term care. *Am J Manag Care*. 2017;23:S27-S36.
32. Fishbane S, Charytan DM, Chertow GM, et al. Consensus-based recommendations for the management of hyperkalemia in the hemodialysis setting. *J Ren Nutr*. 2022;32:e1-e14. doi:10.1053/j.jrn.2021.06.003
33. Chang AR, Sang Y, Leddy J, et al. Antihypertensive medications and the prevalence of hyperkalemia in a large health system. *Hypertension*. 2016;67:1181-1188. doi:10.1161/hypertensionaha.116.07363
34. Luo J, Brunelli SM, Jensen DE, Yang A. Association between serum potassium and outcomes in patients with reduced kidney function. *Clin J Am Soc Nephrol*. 2016;11:90-100. doi:10.2215/cjn.01730215
35. Carrero JJ, González-Ortiz A, Avesani CM, et al. Plant-based diets to manage the risks and complications of chronic kidney disease. *Nat Rev Nephrol*. 2020;16:525-542. doi:10.1038/s41581-020-0297-2
36. Sumida K, Lau WL, Kovesdy CP, Kalantar-Zadeh K, Kalantar-Zadeh K. Microbiome modulation as a novel therapeutic approach in chronic kidney disease. *Curr Opin Nephrol Hypertens*. 2021;30:75-84. doi:10.1097/mnh.0000000000000661
37. Hospital Authority. COC – grade (dietetics). Low potassium diet. 2020 Accessed on 11 Aug 2023 https://www3.ha.org.hk/dic/files/sdn_26.pdf.
38. Rafique Z, Peacock F, Armstead T, et al. Hyperkalemia management in the emergency department: an expert panel consensus. *J Am Coll Emerg Physicians Open*. 2021;2:e12572. doi:10.1002/emp2.12572
39. Wu Y, Fu YY, Zhu HD, Xu J, Walline JH. Treatment of hyperkalemic emergencies. *World J Emerg Med*. 2022;13:232-236. doi:10.5847/wjem.j.1920-8642.2022.054
40. Alfonzo A, Harrison A, Baines R, Chu A, Mann S, MacRury M. Renal Association Clinical Practice Guidelines – Treatment of Acute Hyperkalaemia in Adults. 2020 Accessed on 4 May 2023 https://ukkidney.org/sites/renal.org/files/RENAL%20ASSOCIATION%20HYPERKALAEMIA%20GUIDELINE%20-%20JULY%202022%20V2_0.pdf.
41. Kosiborod M, Rasmussen HS, Lavin P, et al. Effect of sodium zirconium cyclosilicate on potassium lowering for 28 days among outpatients with hyperkalemia: the HARMONIZE randomized clinical trial. *JAMA*. 2014;312:2223-2233. doi:10.1001/jama.2014.15688
42. Zann V, McDermott J, Jacobs JW, et al. Palatability and physical properties of potassium-binding resin RDX7675: comparison with sodium polystyrene sulfonate. *Drug des Devel Ther*. 2017;11:2663-2673. doi:10.2147/dddt.S143461
43. Chaaban A, Abouchacra S, Gebran N, et al. Potassium binders in hemodialysis patients: a friend or foe? *Ren Fail*. 2013;35:185-188. doi:10.3109/0886022x.2012.745118
44. Aronson JK, ed. Polystyrene sulfonates. *Meyler's Side Effects of Drugs*. 16th ed. Elsevier; 2016:868-871.
45. Kashihara N, Kohsaka S, Kanda E, Okami S, Yajima T. Hyperkalemia in real-world patients under continuous medical care in Japan. *Kidney Int Rep*. 2019;4:1248-1260. doi:10.1016/j.ekir.2019.05.018
46. Wong SWS, Zhang G, Norman P, Welihinda H, Wijeratne DT. Polysulfonate resins in hyperkalemia: a systematic review. *Can J Kidney Health Dis*. 2020;7:2054358120965838. doi:10.1177/2054358120965838
47. Spinowitz BS, Fishbane S, Pergola PE, et al. Sodium zirconium cyclosilicate among individuals with hyperkalemia: a 12-month phase 3 study. *Clin J Am Soc Nephrol*. 2019;14:798-809. doi:10.2215/cjn.12651018
48. Stavros F, Yang A, Leon A, Nuttall M, Rasmussen HS. Characterization of structure and function of ZS-9, a K+ selective ion trap. *PLoS One*. 2014;9:e114686. doi:10.1371/journal.pone.0114686
49. Neuen BL, Oshima M, Perkovic V, et al. Effects of canagliflozin on serum potassium in people with diabetes and chronic kidney disease: the CREDENCE trial. *Eur Heart J*. 2021;42:4891-4901. doi:10.1093/eurheartj/ehab497
50. Shen L, Kristensen SL, Bengtsson O, et al. Dapagliflozin in HFrEF patients treated with mineralocorticoid receptor antagonists: an analysis of DAPA-HF. *JACC Heart Fail*. 2021;9:254-264. doi:10.1016/j.jchf.2020.11.009
51. Palmer BF, Clegg DJ. Managing hyperkalemia to enable guideline-recommended dosing of renin-angiotensin-aldosterone system inhibitors. *Am J Kidney Dis*. 2022;80:158-160. doi:10.1053/j.ajkd.2022.02.012
52. Boo AYY, Koh YLE, Hu PL, Tan NC. Prevalence and factors associated with false hyperkalaemia in Asians in primary care: a cross-sectional study (the unlysed hyperkalaemia-the unseen burden (UHUB) study). *BMJ Open*. 2020;10:e033755. doi:10.1136/bmjopen-2019-033755
53. Rafique Z, Weir MR, Onuigbo M, et al. Expert panel recommendations for the identification and management of hyperkalemia and role of patiromer in patients with chronic kidney disease and heart failure. *J Manag Care Spec Pharm*. 2017;23:S10-S19. doi:10.18553/jmcp.2017.23.4-a.s10
54. Wang AY. Optimally managing hyperkalemia in patients with cardiorenal syndrome. *Nephrol Dial Transplant*. 2019;34:iii36-iii44. doi:10.1093/ndt/gfz225
55. Clase CM, Carrero JJ, Ellison DH, et al. Potassium homeostasis and management of dyskalemia in kidney diseases: conclusions from a kidney disease: improving global outcomes (KDIGO) controversies conference. *Kidney Int*. 2020;97:42-61. doi:10.1016/j.kint.2019.09.018
56. Gupta AA, Self M, Mueller M, Wardi G, Tainter C. Dispelling myths and misconceptions about the treatment of acute hyperkalemia. *Am J Emerg Med*. 2022;52:85-91. doi:10.1016/j.ajem.2021.11.030
57. Batterink J, Cessford TA, Taylor RA. Pharmacological interventions for the acute management of hyperkalaemia in adults. *Cochrane Database Syst Rev*. 2015;10:CD010344. doi:10.1002/14651858.CD010344.pub2
58. Batterink J, Lin J, Au-Yeung SH, Cessford T. Effectiveness of sodium polystyrene sulfonate for short-term treatment of hyperkalemia. *Can J Hosp Pharm*. 2015;68:296-303. doi:10.4212/cjhp.v68i4.1469
59. Harel Z, Harel S, Shah PS, Wald R, Perl J, Bell CM. Gastrointestinal adverse events with sodium polystyrene sulfonate (kayexalate) use: a

systematic review. *Am J Med*. 2013;126(264):9-24. doi:10.1016/j.amjmed.2012.08.016
60. Gruy-Kapral C, Emmett M, Santa Ana CA, Porter JL, Fordtran JS, Fine KD. Effect of single dose resin-cathartic therapy on serum potassium concentration in patients with end-stage renal disease. *J Am Soc Nephrol*. 1998;9:1924-1930. doi:10.1681/asn.V9101924
61. Kamel KS, Schreiber M. Asking the question again: are cation exchange resins effective for the treatment of hyperkalemia? *Nephrol Dial Transplant*. 2012;27:4294-4297. doi:10.1093/ndt/gfs293
62. Nasir K, Ahmad A. Treatment of hyperkalemia in patients with chronic kidney disease: a comparison of calcium polystyrene sulphonate and sodium polystyrene sulphonate. *J Ayub Med Coll Abbottabad*. 2014;26:455-458.
63. Pirklbauer M. Hemodialysis treatment in patients with severe electrolyte disorders: management of hyperkalemia and hyponatremia. *Hemodial Int*. 2020;24:282-289. doi:10.1111/hdi.12845
64. Palmer BF, Clegg DJ. Hyperkalemia across the continuum of kidney function. *Clin J Am Soc Nephrol*. 2018;13:155-157. doi:10.2215/cjn.09340817
65. Peacock WF, Rafique Z, Clark CL, et al. Real world evidence for treatment of hyperkalemia in the emergency department (REVEAL-ED): a multicenter, prospective, observational study. *J Emerg Med*. 2018;55:741-750. doi:10.1016/j.jemermed.2018.09.007

How to cite this article: Yap DYH, Ma RCW, Wong ECK, et al. Consensus statement on the management of hyperkalaemia—An Asia–Pacific perspective. *Nephrology*. 2024;1-14. doi:10.1111/nep.14281