The impact of hyperkalaemia and its concurrence with cardiovascular and renal comorbidities on healthcare resource use in the UK

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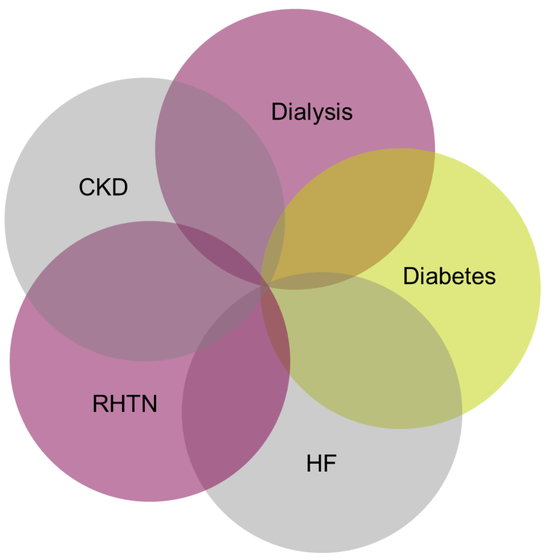
Introduction

- Hyperkalaemia (HK) is a potentially life-threatening electrolyte abnormality characterised by elevated serum potassium (sK^+) concentrations (≥5.0mmol/L)
- The risk of HK is elevated in patients with cardiovascular and renal comorbidities, with the clinical and economic burden of HK of concern to clinicians and payers alike
- In the UK, there is limited data on the impact of HK and its relationships with underlying comorbidity profiles on healthcare resource use (HRU)
- This study aimed to characterise HRU associated with hospitalisations attributed to HK in patients with cardiovascular and renal comorbidities in the UK

Methods

- A retrospective cohort analysis was conducted using primary care patient data from the Clinical Practice Research Datalink (CPRD)[1] linked to secondary care data from Hospital Episode Statistics (HES)[2]
- Eligible patients were aged ≥18 years, had linkage to HES and a prior READ or International Classification for Diseases, 10th edition (ICD-10) code for ≥1 of the following conditions (Figure 1); resistant hypertension (RHTN), heart failure (HF), diabetes, non-dialysis chronic kidney disease (CKD), dialysis-dependent CKD
- Data was collated over the study period (01 January 2008 to 30 June 2018). A five-year lookback period (2003-2007) was used to define baseline characteristics and comorbidity profiles

Figure 1 Populations within the study



- Hospital admissions relating to HK were collated, event rates and mean length of stay were calculated for each comorbidity. As patients were able to accumulate comorbidities, event rates were also calculated for increasing multi-morbidity
- HRU was estimated using mean length of hospital stay, number of hospital stays relating to HK and average cost of a mean inpatient day for severe HK event (£727)[3]
- The protocol for this study (18_213) was approved by the Independent Scientific Advisory Committee (ISAC) on 30 October 2018; a subsequent minor amendment was approved on 07 February 2019

Results

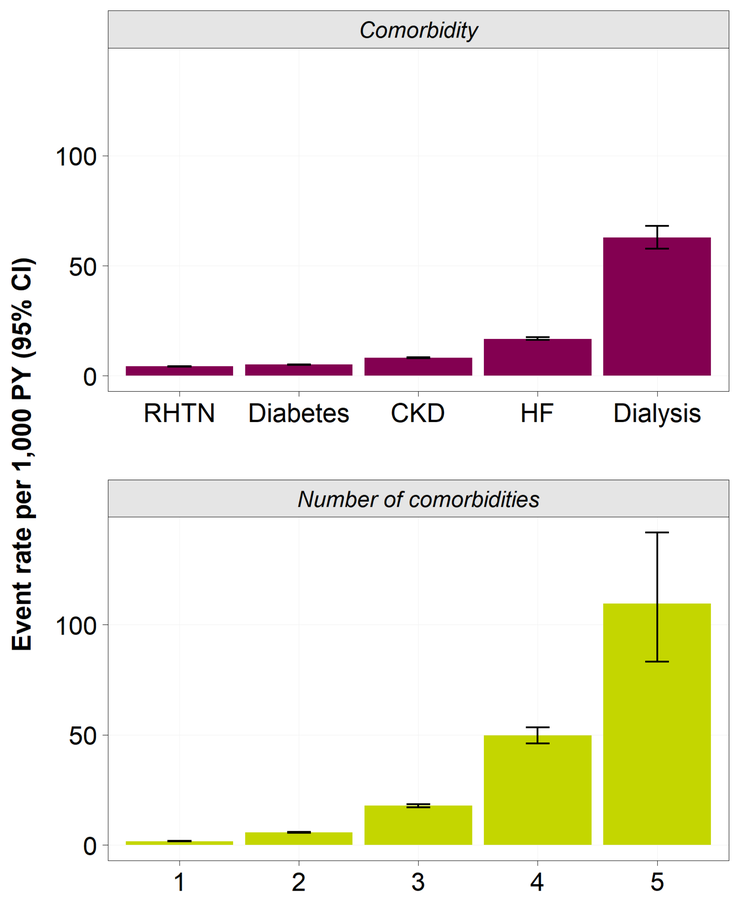
Table 1 Baseline characteristics of patients with pre-defined conditions

Variable	RHTN (N = 183,627)	CKD (N = 174,929)	Diabetes (N = 168,177)	HF (N = 54,861)	Dialysis (N = 3,095)
Patient demographics					
Age (years)	68.06 (12.23)	73.92 (11.41)	64.12 (13.79)	75.95 (11.48)	64.77 (14.17)
Female	99,557 (54.22%)	101,948 (58.28%)	75,850 (45.10%)	26,181 (47.72%)	1,170 (37.80%)
Current smoker	152,237 (82.91%)	149,738 (85.6%)	131,052 (77.93%)	46,002 (83.85%)	2,515 (81.26%)
Serum K+ (mmol/L)	4.38 (0.48)	4.50 (0.50)	4.45 (0.47)	4.47 (0.51)	4.69 (0.70)
BMI (kg/m2)	29.63 (6.21)	28.20 (5.86)	31.01 (6.68)	28.29 (6.68)	28.58 (6.74)
SBP (mmHg)	143.85 (17.17)	135.83 (17.60)	136.16 (16.38)	131.55 (19.27)	136.46 (21.37)
DBP (mmHg)	79.52 (11.08)	75.27 (10.39)	77.57 (10.34)	73.64 (11.41)	74.12 (12.59)
Baseline medication usage					
Beta blockers	53,431 (29.10%)	55,447 (31.7%)	40,984 (24.37%)	29,313 (53.43%)	1,243 (40.16%)
Bronchodilators	31,103 (16.94%)	28,099 (16.06%)	25,104 (14.93%)	15,235 (27.77%)	547 (17.67%)
Calcium channel blockers	118,924 (64.76%)	56,254 (32.16%)	50,388 (29.96%)	14,670 (26.74%)	1,498 (48.40%)
Diuretics	105,047 (57.21%)	83,502 (47.73%)	55,542 (33.03%)	43,503 (79.30%)	1,489 (48.11%)
Insulin	9,057 (4.93%)	9,138 (5.22%)	23,054 (13.71%)	3,892 (7.09%)	615 (19.87%)

Continuous denoted as mean (SD), categorical denotes as N (%)
CKD: chronic kidney disease; DBP: diastolic blood pressure; eGFR: estimated glomerular filtration rate; HF: heart failure; RHTN: resistant hypertension; SBP: systolic blood pressure; SD: standard deviation;

- 536,678 unique patients were eligible for the study, 34.2%, 32.6% and 31.3% of the population had pre-existing RHTN, CKD and diabetes, respectively (Table 1)
- Patients with HF and CKD were older (mean age 76.0 years [standard deviation:11.5] and 73.9 years [11.4] respectively)
- Over half of the RHTN population received calcium channel blockers and diuretics. Almost 80% of HF patients received diuretics
- No significant differences in length of stay were observed between comorbidities (range 15.2-17.6 days) (Table 3)

Figure 2 HK specific hospitalisation event rates stratified by comorbidity and multi-morbidity



- Patients with pre-existing dialysis had the highest (62.7 [95% confidence interval: 57.7-68.0]) event rate per 1,000 patient years [PYs]. RHTN and diabetes had the lowest event rates (4.3 [4.2-4.4] and 5.1 [5.0-5.3] respectively) (Figure 2)
- Multiple comorbidities were associated with increasing event rates ranging from 1.8 [1.7-1.8] (one comorbidity) to 109.7 [83.3-141.8] (five comorbidities) per 1,000 PYs

Table 3 Length of stay and resource use per comorbidity

Comorbidity	Mean length of stay [95% CI] (days)	Total resource use over cohort follow-up
RHTN	16.56 (15.82 - 17.30)	£49,745,644
CKD	17.02 (16.42 - 17.63)	£76,567,466
Diabetes	17.21 (16.37 - 18.05)	£52,186,176
HF	17.58 (16.71 - 18.44)	£32,245,605
Dialysis	15.21 (13.08 - 17.34)	£6,490,852

CI: confidence interval; CKD: chronic kidney disease; HF: heart failure; RHTN: resistant hypertension

- Total resource use was highest in the CKD population (£76,587,466), followed by diabetes (£52,186,176), RHTN (£49,745,644) and HF (£32,245,605) (Table 3)
- Dialysis was associated with the smallest total resource use (£6,490,852) (Table 3) despite a significantly higher event rate compared to other populations (Figure 2) due to the relatively small size of the population

Conclusions

- Understanding relationships between risk and experience/accumulation of comorbidities may help treat/prevent HK, reducing HRU
- When considering preventative resourcing strategies for HK, consideration should be given to comorbidity specific and multi-morbidity event rates and the relative size of the population. From a total budgetary perspective, populations with significant total resource use should also be considered (whether it be UK or other health systems)

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