

# Retrospective observational study examining indications for hospitalisation among haemodialysis patients at one of the Ministry of Health Hospitals in Makkah, Saudi Arabia

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## Summary

**Objectives:** To examine the indications for hospitalisations among haemodialysis patients.

**Design:** A retrospective observational study.

**Setting:** Alnoor Kidney Centre in Al Noor Specialist Hospital, Makkah City, Saudi Arabia, which is a Ministry of Health hospital.

**Participants:** Participants were prevalent patients with end-stage renal disease on regular haemodialysis in 2011, who had received haemodialysis for more than three months. Each patient was followed up retrospectively, from the first date of initiating haemodialysis to the end of 2011.

**Main outcome measures:** (i) The primary reasons for hospital admissions and (ii) risk factors that increase the number of hospital admissions and which increase length of stay in hospital.

**Results:** The primary reasons for hospital admissions associated with increases in the length of stay in hospital were diseases of the circulatory system (which increased hospital bed days by 70%; 95% CI: 11–161%;  $p$  value = 0.01 compared to all other reasons). The risk factors that increased the number of hospital admissions per patient-year at risk were increasing age (incidence rate ratio [IRR] = 1.02 per 1 year of age; 95% CI: 1.01–1.03;  $p$  value = < 0.0001); receiving haemodialysis through a catheter compared to arteriovenous fistula (IRR = 2.55; 95% CI: 1.14–4.97;  $p$  value = 0.001) and diabetes as a cause of renal disease compared to hypertension (IRR = 1.84; 95% CI: 1.29–2.63;  $p$  value = 0.001).

**Conclusion:** Indications for hospitalisation and consequences of practices related to hospitalisation for haemodialysis patients should be studied in further research to provide a comprehensive evidence-based management policy for haemodialysis patients in Saudi Arabia.

## Keywords

chronic kidney disease, end-stage renal disease, haemodialysis, hospitalisation

## Background

The high cost of hospitalisation for haemodialysis patients has become a public health concern<sup>1</sup> because an increase in the haemodialysis population together with escalating healthcare costs are not sustainable worldwide.<sup>2,3</sup> The United States Renal Data System report highlighted that the rates of hospital readmissions for end-stage renal disease (ESRD) patients are twice those in the general Medicare population.<sup>4</sup> Patients with chronic kidney disease in the late stages are often hospitalised with general medical problems, especially those patients who have reached the end-stage of renal failure and are receiving regular haemodialysis in dialysis centres. Patients on haemodialysis require more resources than patients on peritoneal dialysis or with renal graft need,<sup>5</sup> especially during the first year of dialysis treatment; these resources include vascular surgery, radiology, physician cost and hospitalisation.<sup>6</sup>

In Saudi Arabia, the incidence and prevalence of renal replacement therapy (RRT) have been increasing continuously in the last three decades with a high prevalence of co-morbid conditions.<sup>7,8</sup> The most common method for treating patients with ESRD in recent decades has been haemodialysis, which accounts for just over half of the RRT population. The Ministry of Health (MoH) in Saudi Arabia incurs the vast majority of haemodialysis care costs and provides around two-thirds of haemodialysis facilities.<sup>7</sup> Although the ESRD population accounted for only 0.08% of the total Medicare population in Saudi Arabia in 2008, the healthcare costs associated with those patients were around 3.8% of the total MoH expenditure.<sup>7</sup> Furthermore, there is a shortage in healthcare workers in Saudi Arabia including nephrologists and nurses,<sup>7,9</sup> which can influence

healthcare quality.<sup>1</sup> The British Renal Society National Renal Workforce Planning Group (2002) recommended that one whole-time equivalent renal physician is required for 75–100 patients on RRT,<sup>10</sup> while in Saudi Arabia, one consultant nephrologist will be required for 234 patients on RRT by 2015.<sup>7</sup> Furthermore, patients with ESRD who had received pre-ESRD care by nephrologists before initiating haemodialysis had a better outcome throughout haemodialysis with a reduced risk of hospitalisation and mortality compared to those patients who had not received nephrology care.<sup>11</sup> However, in Saudi Arabia, a large proportion of haemodialysis patients do not receive pre-ESRD care.<sup>12</sup>

The risk of hospitalisation increases among patients on haemodialysis due to complications of either haemodialysis or haemodialysis vascular access, with a high prevalence of co-morbid conditions, particularly diabetes<sup>13</sup> and cardiovascular diseases.<sup>14</sup> The type of vascular access used in the dialysis process makes a significant contribution to prognosis and quality of life.<sup>15,16</sup> Using a catheter at the initiation of haemodialysis or throughout the time on haemodialysis increases the risk of hospitalisation, particularly due to catheter-related infection.<sup>15</sup> Conversions from catheter to arteriovenous fistula (AVF) have lowered the risk of hospitalisation among haemodialysis patients.<sup>16,17</sup> In Saudi Arabia, there is limited research of the risk of hospitalisation among haemodialysis patients particularly that associated with vascular access practice patterns. A few studies conducted in different areas of Saudi Arabia have shown that a large proportion of new ESRD patients initiated haemodialysis treatment with a temporary catheter as a result of a late referral to nephrology care, a practice which is associated with increased morbidity and mortality<sup>12,18,19</sup> and increased costs of healthcare.

The need for hospitalisation and increased healthcare costs are also related to severity of patients' co-morbid conditions. A study conducted in Riyadh City reported cardiovascular disease as the primary reason for hospitalisation, followed by vascular access complications and infections.<sup>20</sup> The only other Saudi study on hospitalisation conducted in Al-Madinah City reported vascular access-related problems as the primary reason, followed by infectious disease and cardiovascular disease.<sup>21</sup> Neither study reported the risk factors that might increase the rate of hospital admissions or the length of stay in hospital per patient-year on haemodialysis, which could reflect both the severity of patients' co-morbid conditions and the quality of healthcare services. Therefore, we undertook this study in one of the most active MoH hospitals in Makkah City in

Saudi Arabia. We aimed to examine the indications of hospitalisation among its haemodialysis patients, by investigating the primary reasons for hospital admissions and the risk factors associated with an increase in the rate of hospital admissions and those associated with increasing length of stay in hospital.

## Methods

### *Study design and setting*

A retrospective observational study was conducted in the Alnoor Kidney Centre (AKC) in Al Noor Specialist Hospital, which is a MoH Centre in Makkah City in the western region of Saudi Arabia.

### *Study population*

Participants were prevalent patients with ESRD on regular haemodialysis in 2011, who had received haemodialysis for more than three months. Each patient was followed up retrospectively from the day of initiating haemodialysis until the end of 2011. All patients visiting the dialysis centre who did not have a documented medical history in medical records were excluded. No patients had advanced malignancy.

A search of electronic medical records identified 418 patients with ESRD on haemodialysis in 2011. Of these, 84 were patients who were visiting the dialysis centre without a medical history, and 16 were patients who had received haemodialysis for less than three months and so were excluded.

### *Variables and data collection*

The extracted data included demographic information, date of starting dialysis, patient status throughout 2011, causes of renal disease, vascular access at first dialysis and during follow-up, co-morbid conditions, limitation in physical motion, ever received blood transfusion and hospitalisation (the main reason for admission, dates of admission and discharge). These were collected from medical records and stored in a customised Microsoft Office Access database.

### *Statistical analyses*

The total number of hospital admissions (excluding admissions on the day that haemodialysis was started) and the time on haemodialysis were calculated for each patient, and the length of stay in hospital was calculated for each hospitalisation. Admissions for less than one-night observation were

excluded from the analysis. The primary diagnoses for hospital admissions were classified using ICD-10 codes updated in 2011 and were grouped into diagnostic categories for analyses.

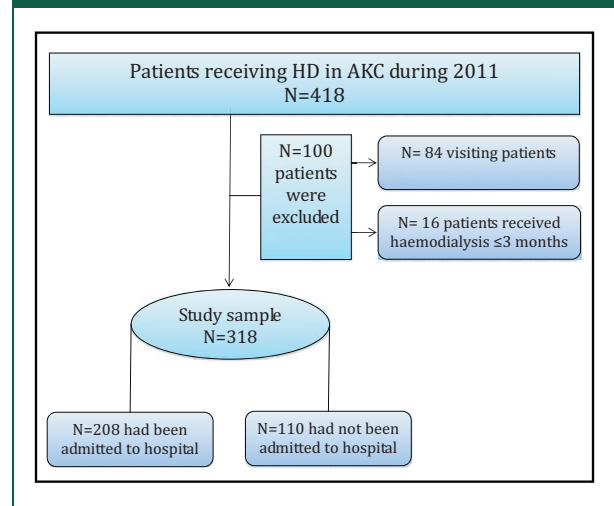
Data were analysed descriptively to describe patients' characteristics, co-morbid conditions and the distribution of the most frequent reasons for hospital admissions after starting haemodialysis in the study sample. Negative binomial regression was used among patients who were hospitalised at least once, clustered by patients, to investigate which primary reasons for hospital admissions were associated with the greatest number of hospital bed days per patient-year on haemodialysis. This is adjusted for patients' characteristics at onset of haemodialysis such as age, sex and causes of renal disease. Negative binomial regression was also used among all patients to investigate the risk factors associated with an increase in the number of hospital admissions during time on haemodialysis, clustered by patient. This estimates the incidence rate ratio (IRR) of the number of hospital admissions per patient-year at risk for vascular access type during follow-up and for causes of renal disease, adjusted for age and sex. An equivalent model was created to examine the effect of vascular access type at start of dialysis, with the same covariates. All analyses were performed using STATA 11 (StataCorp, College Station, TX, USA).

## Results

### Patients' characteristics

Of our 318 patients, 208 patients on regular haemodialysis were hospitalised at least once in Al Noor Specialist Hospital, and 110 patients did not have any reported hospitalisation there (Figure 1). The median period of haemodialysis care (period of follow-up) was 4.3 years up to the end of 2011 (25%, 75% percentiles: 2.4, 8.7), and around 8.2% of patients (26/318) had received haemodialysis for one year or under. Of the study population, 58.2% were male, and 93.7% were Saudis. The mean age at onset of dialysis was 45.6 ( $\pm$  standard deviation [SD]=16.9) years. The dominant cause of renal disease in the study sample was hypertensive nephropathy (58.8%), followed by diabetic nephropathy (23.9%) and glomerulonephritis (4.1%). Haemodialysis was initiated through a catheter in over 80% of patients; only slightly over 7% initiated haemodialysis through an AVF. However, most patients who started with the catheter switched to AVF, so that 95% were using AVF by the end of 2011. The prevalence of co-morbid conditions was

**Figure 1.** Recruitment of study participants. HD: haemodialysis, AKC: Alnoor kidney centre.



high, particularly diabetes (24.8%) and hypertension (75.2%), hepatitis B (8.5%) and hepatitis C (47.5%) (Table 1). In 2011, 25 (7.9%) patients in the study sample died, and 10 patients underwent renal transplantation although eight of them rejected the transplants. The predominant causes of death were cardiovascular disease (7 patients) and sepsis (7 patients), followed by cerebrovascular accident (2 patients), cardiac arrest (2 patients), with unknown cause of death in the remaining seven patients.

### Primary reasons for hospital admissions and length of stay in hospital

There were 486 recorded hospital admissions among 208 haemodialysis patients in the study sample. The length of stay in hospital ranged between one and 80 days per hospital admission with a median of three days per admission (25%, 75% percentiles: 2, 6). The most frequent reasons for hospitalisation throughout the follow-up period in the study sample were diseases of the genitourinary system (40.1%), diseases of the circulatory system (22.6%) and vascular access (19.5%), followed by overall infectious diseases (9%) (Table 2).

*Reasons for the greatest number of hospital bed days per patient-year on haemodialysis among patients who were hospitalised.* The adjusted ratios of mean number of bed days in hospital per patient-year on haemodialysis show that hospital admissions for diseases of the circulatory system increased the number of hospital bed days per patient-year on haemodialysis by 70% compared to other reasons for hospital admissions.

**Table 1.** Characteristics of study participants.

Patient characteristics	Outcome (N = 318 patients)
Demographics	
Mean age in years (SD)	45.6 ( $\pm$ 16.9)
Male (%)	185 (58.18)
Saudi (%)	298 (93.7)
Access type at start of dialysis (%)	
AVF	23 (7.23)
AVG	7 (2.2)
Catheter	255 (80.19)
PD	1 (0.31)
Missing	32 (10.06)
Access type during follow-up (%)	
AVF	302 (94.97)
AVG	4 (1.26)
Catheter	12 (3.77)
Period of haemodialysis (years)	
Median (25%, 75% percentiles)	4.3 (2.4, 8.7)
Cause of renal disease (%)	
Diabetes	76 (23.9)
Glomerulonephritis	13 (4.09)
Hypertension	187 (58.81)
Other	42 (13.21)
Co-morbid conditions (%)	
Diabetes	79 (24.8)
Hypertension	239 (75.2)
Ischaemic heart disease	27 (8.5)
Congestive heart failure	20 (6.3)
Cerebrovascular disease	10 (3.1)
Peripheral vascular disease	8 (2.5)
Pulmonary disease	22 (6.9)
Neurologic disease	11 (3.5)

(continued)

**Table 1.** Continued.

Patient characteristics	Outcome (N = 318 patients)
Gastrointestinal bleeding	3 (0.9)
Hepatitis B virus	27 (8.5)
Hepatitis C virus	151 (47.5)
Catheter-related infection	10 (3.14)
Limitation in physical motion (%)	132 (41.51)
Ever received blood transfusion (%)	73 (23)

AVF: arteriovenous fistula; AVG: arteriovenous graft; PD: peritoneal dialysis.

Hospitalisations for diseases of the genitourinary system, for diseases of the nervous system, for trauma/injury and for vascular access creation all resulted in lower mean hospital days per person-year on dialysis, compared to other reasons for hospitalisation. Note that vascular access procedures are usually required for haemodialysis patients during the first year of dialysis if the patient had haemodialysis initiated with a catheter (Table 2). There was a proportional relationship between the number of hospital bed days per patient-year on haemodialysis and patient age for all reasons for admission, and the adjusted rate of length of stay in hospital per patient-year at risk increased by around 2% per a year increase in patient age. Sex and causes of renal disease did not have any significant effect on the length of stay in hospital for any disease (Table 3).

*Factors that increase the risk of hospital admissions per patient-year on haemodialysis.* The number of admissions for 318 patients in the study sample ranged between 0 and 17 admissions per patient during the follow-up period, with median of one hospital admission per patient (25%, 75% percentiles: 0, 2). The risk factors at baseline analysis, which might be associated with an increase in the number of admissions per patient-year on haemodialysis, were investigated. We found that the expected rate of hospital admissions increased by 2% per patient-year at risk per one year increase in age, while there was no significant effect for sex on the rate of admissions. Patients who received haemodialysis through a catheter during the follow-up period, rather than via AVF, showed a 2.55-fold increase in the rate of hospital admissions per patient-year on dialysis (adjusted for age, sex and causes of renal disease). Patients who had ESRD because of glomerulonephritis or diabetic

**Table 2.** Distribution of hospital admissions by diagnostic categories, and the ratio of the mean number of hospital bed days per patient-year on dialysis for each cause of hospital admission in turn, compared to all other disease groups combined.

The main diagnosis for hospitalisation	Frequency (%) (N = 486 admissions)	Unadjusted ratios of mean number of bed days per patient-year at risk (95% CIs)	p value	Adjusted ratios of mean number of bed days per patient-year at risk (95% CIs)*	p value
Anaemia	8 (1.65)	0.74 (0.39–1.43)	0.38	0.92 (0.57–1.49)	0.75
Diseases of the circulatory system	110 (22.63)	1.62 (0.97–2.71)	0.07	1.70 (1.11–2.61)	0.01
Diseases not of the circulatory system	–	1	–	1	–
Hypertensive disease	45 (9.26)	1.53 (0.73–3.24)	0.26	1.76 (0.97–3.21)	0.06
Ischaemic heart disease	31 (6.38)	2.05 (0.70–6.07)	0.19	2.07 (0.90–4.77)	0.09
Other forms of heart disease	19 (3.91)	1.66 (0.78–3.52)	0.19	1.56 (0.81–3.02)	0.18
Cerebrovascular disease	9 (1.85)	0.79 (0.30–2.10)	0.64	0.66 (0.30–1.46)	0.31
Vascular disease	6 (1.23)	1.27 (0.69–2.32)	0.44	1.50 (0.83–2.70)	0.17
Diseases of the digestive system	27 (5.56)	0.98 (0.58–1.66)	0.94	0.95 (0.59–1.55)	0.85
Diseases of the genitourinary system	195 (40.12)	0.69 (0.51–0.95)	0.02	0.71 (0.54–0.94)	0.02
Diseases of the musculoskeletal system	7 (1.44)	1.78 (0.53–5.98)	0.35	2.51 (0.58–10.93)	0.22
Diseases of the nervous system	9 (1.85)	0.65 (0.35–1.22)	0.18	0.49 (0.27–0.86)	0.01
Diseases of the respiratory system	15 (3.09)	0.70 (0.30–1.61)	0.4	0.63 (0.29–1.40)	0.26
Endocrine and metabolic diseases	36 (7.41)	0.94 (0.44–2.01)	0.88	0.87 (0.51–1.47)	0.6
Non-endocrine, non-metabolic disease	–	1	–	1	–
Diabetes mellitus	3 (0.62)	0.53 (0.27–1.04)	0.06	0.50 (0.26–0.98)	0.04
Disorders of endocrine glands	8 (1.65)	0.41 (0.24–0.70)	0.001	0.36 (0.21–0.63)	<0.0001
Metabolic disorders	25 (5.14)	1.20 (0.51–2.85)	0.68	0.11 (0.62–2.01)	0.72

(continued)



Table 2. Continued.

The main diagnosis for hospitalisation	Frequency (%) (N = 486 admissions)	Unadjusted ratios of mean number of bed days per patient-year at risk (95% CIs)	p value	Adjusted ratios of mean number of bed days per patient-year at risk (95% CIs)*	p value
Miscellaneous	7 (1.44)	0.44 (0.14–1.38)	0.16	0.39 (0.14–1.06)	0.07
Overall infectious diseases	44 (9.05)	1.13 (0.68–1.87)	0.65	1.06 (0.72–1.57)	0.76
Non-infectious diseases	–	–	–	–	–
Sepsis	7 (1.44)	0.96 (0.35–2.62)	0.94	0.95 (0.43–2.07)	0.9
Infections of the skin and subcutaneous tissue	13 (2.67)	1.54 (0.57–4.18)	0.4	1.12 (0.61–2.07)	0.7
Infectious arthropathies	4 (0.82)	0.91 (0.50–1.65)	0.75	1.16 (0.50–2.71)	0.73
Respiratory infectious diseases	17 (3.5)	1.10 (0.36–3.36)	0.87	0.96 (0.47–1.98)	0.92
Viral infection	3 (0.62)	1.05 (0.33–3.35)	0.94	1.36 (0.58–3.21)	0.48
Other infectious diseases	3 (0.62)	0.93 (0.49–1.77)	0.83	0.87 (0.46–1.68)	0.69
Trauma- or injury-related condition	3 (0.62)	0.31 (0.22–0.44)	<0.0001	0.26 (0.14–0.49)	<0.0001
Vascular access	95 (19.55)	0.70 (0.48–1.01)	0.06	0.70 (0.51–0.97)	0.03
Non-vascular access causes	–	–	–	–	–
Complications	22 (4.53)	1.08 (0.51–2.31)	0.84	0.91 (0.52–1.58)	0.74
Creation	72 (14.81)	0.61 (0.43–0.87)	0.007	0.64 (0.45–0.91)	0.01

CIs: confidence intervals.

\*Adjusted for age, sex, and causes of renal disease.

**Table 3.** Adjusted ratio of the mean number of hospital bed days per patient-year on dialysis by patient characteristics at baseline.

Predictors	Anaemia	Diseases of the circulatory system	Diseases of the digestive system	Diseases of the genitourinary system	Diseases of the musculoskeletal system	Diseases of the nervous system	Diseases of the respiratory system	Endocrine and metabolic diseases	Vascular access	Overall infectious diseases	Miscellaneous	Trauma- or injury-related condition
Ratios of mean number of hospital bed days per patient-year on dialysis (95% CIs)												
Age												
Per year	1.02 (1.01-1.04)	1.02 (1.01-1.03)	1.02 (1.01-1.04)	1.02 (1.01-1.03)	1.02 (1.01-1.03)	1.02 (1.01-1.04)	1.02 (1.01-1.04)	1.02 (1.01-1.04)	1.02 (1.01-1.04)	1.02 (1.01-1.04)	1.02 (1.01-1.04)	1.02 (1.01-1.04)
Sex												
Female	1	1	1	1	1	1	1	1	1	1	1	1
Male	0.91 (0.65-1.28)	0.92 (0.67-1.27)	0.91 (0.65-1.28)	0.95 (0.68-1.34)	0.95 (0.68-1.34)	0.90 (0.64-1.27)	0.91 (0.64-1.27)	0.90 (0.64-1.27)	0.93 (0.66-1.30)	0.91 (0.65-1.28)	0.91 (0.65-1.28)	0.91 (0.65-1.28)
Cause of renal disease												
Hypertension	1	1	1	1	1	1	1	1	1	1	1	1
Glomerulonephritis	1.5 (0.50-3.84)	1.51 (0.54-4.26)	1.51 (0.59-3.84)	1.51 (0.60-3.83)	1.51 (0.60-3.83)	1.52 (0.60-3.81)	1.57 (0.60-4.09)	1.50 (0.59-3.81)	1.52 (0.63-3.66)	1.51 (0.60-3.76)	1.52 (0.60-3.83)	1.51 (0.59-3.84)
Diabetes	1.36 (0.87-2.13)	1.40 (0.94-2.10)	1.36 (0.87-2.13)	1.40 (0.92-2.14)	1.40 (0.92-2.14)	1.37 (0.87-2.15)	1.38 (0.88-2.17)	1.35 (0.86-2.11)	1.38 (0.89-2.13)	1.36 (0.86-2.16)	1.38 (0.88-2.17)	1.37 (0.88-2.15)
Others	1.44 (0.92-2.27)	1.33 (0.87-2.04)	1.44 (0.92-2.27)	1.38 (0.89-2.14)	1.38 (0.89-2.14)	1.44 (0.92-2.26)	1.45 (0.93-2.28)	1.45 (0.92-2.28)	1.42 (0.91-2.22)	1.44 (0.92-2.27)	1.46 (0.93-2.29)	1.46 (0.93-2.30)

CIs: confidence intervals.  
Data are analysed separately for each reason for hospital admissions in turn.

nephropathy also showed an increase in the rate of admissions by 2.28-fold and 1.84-fold, respectively (adjusted for age, sex and access type during follow-up), compared to those patients who had ESRD because of hypertensive nephropathy. Using a catheter at initiation of haemodialysis tends to increase the risk of hospital admission by 62% per patient-year at risk (adjusted for age, sex and cause of renal disease), although this relation was not statistically significant (Table 4).

## Discussion

This study gives an overview of the primary reasons and indications for hospitalisation among ESRD

patients on haemodialysis in one of the most active MoH hospitals, which may reflect the severity of patients' co-morbid conditions or the quality of healthcare practices. The length of stay in hospital usually reflects the severity of illness and underlying patient health status. This study shows that cardiovascular diseases had the highest impact on hospital bed days, among patients who are ever hospitalised. This increases hospital bed days per patient-year on haemodialysis by 70% compared to other reasons for hospital admission. While the most prevalent co-morbid conditions were diabetes and hypertension, which are strongly associated with an increased risk of developing cardiovascular disease, which may often occur before ESRD.<sup>22,23</sup> This probably reflects

**Table 4.** Incidence rate ratio (IRR) of number of hospital admissions per patient-year on dialysis.

Predictors	Unadjusted IRR (95% CIs) (N = 318 patients)		*Adjusted IRR (95% CIs) (N = 286 patients)		†Adjusted IRR (95% CIs) (N = 318 patients)	
		p value		p value		p value
Age						
Per year of age	1.02 (1.01–1.03)	0.001	1.02 (1.01–1.03)	<0.0001	1.02 (1.01–1.03)	<0.0001
Sex						
Female	1	–	1	–	1	–
Male	1.16 (0.84–1.60)	0.37	1.23 (0.90–1.67)	0.19	1.17 (0.88–1.56)	0.29
Access type at first dialysis						
AVF	1	–	1	–	–	–
AVG	1.46 (0.42–5.09)	0.55	1.19 (0.37–3.80)	0.77	–	–
Catheter	1.84 (0.97–3.48)	0.06	1.62 (0.90–2.90)	0.11	–	–
PD	0.42 (0.03–5.03)	0.49	0.61 (0.06–6.29)	0.68	–	–
Access type during follow-up						
AVF	1	–	–	–	1	–
AVG	1.23 (0.27–5.55)	0.78	–	–	0.77 (0.18–3.27)	0.72
Catheter	2.93 (1.36–6.33)	0.006	–	–	2.55 (1.26–4.97)	0.009
Causes of renal disease						
Hypertension	1	–	1	–	1	–
Glomerulonephritis	2.04 (0.96–4.36)	0.6	2.20 (1.09–4.44)	0.03	2.28 (1.14–4.55)	0.02
Diabetes	2.50 (1.75–3.58)	<0.0001	2 (1.38–2.88)	<0.0001	1.84 (1.29–2.63)	0.001
Other	0.95 (0.61–1.49)	0.84	1.04 (0.66–1.65)	0.85	1.05 (0.68–1.62)	0.81

CI: confidence intervals; AVF: arteriovenous fistula; AVG: arteriovenous graft; PD: peritoneal dialysis.

\*Adjusted for age, sex, access type at start of dialysis, and cause of renal disease.

†Adjusted for age, sex, access type during follow-up, and cause of renal disease.



poor management or lack of early detection of chronic diseases. Furthermore, this study found that an increase in one year of a patient's age, which is an unmodifiable risk factor, had a significant effect in increasing the length of stay in hospital and the rate of admissions by 2% per patient-year on haemodialysis. Both diabetes and glomerulonephritis as causes of renal disease, and using a catheter as access point for haemodialysis, increased the rate of hospital admissions. In this study, only 7% of haemodialysis patients commenced dialysis with AVF, while the NKF/KDOQI and the Renal Association guidelines for vascular access have recommended that 65% of all incident haemodialysis patients should initiate dialysis with AVF.<sup>24,25</sup> Although the vast majority of the study population commenced haemodialysis with a catheter as a result of late referral to nephrology care, most of them had converted to AVF, which reduced risk of vascular access complications, especially infections, hence lowering risk of hospitalisation. This study demonstrated that patients who had used a catheter throughout the follow-up period showed a 2.5-fold increase in the rate of hospital admissions compared to those who had used AVF. Therefore, the high prevalence of hospital admissions due to vascular access throughout haemodialysis was mainly attributed to creating AVF as a permanent vascular access rather than vascular access complications. This study demonstrates that the goals of vascular access placement for the NKF/KDOQI and The Renal Association guidelines<sup>24,25</sup> have been achieved in AKC, whereas the prevalent functional AVF placement rate was around 95% of patients in AKC in 2011, which is higher than the recommended goal of over 65% in NKF KDOQI and 85% in the Renal Association. However, according to the Saudi Centre for Organ Transplantation data report in 2011, the prevalent functional AVF placement rate in all centres in Saudi Arabia was 71% of patients,<sup>8</sup> which is lower than the rate in AKC. This indicates the differences in haemodialysis practices and outcomes between healthcare centres, suggesting diversity in competencies and training between healthcare institutions and/or inequality in allocating relevant healthcare resources between healthcare centres in Saudi Arabia.<sup>7</sup>

The potential limitations of this study were that the study was conducted retrospectively at a single centre for prevalent patients in 2011 due to time limitations for collecting data and a lack of national health information systems in Saudi Arabia. Therefore, it was not possible to examine the trend in the annual rate of hospitalisation by calendar year. Important data for many patients were missing, such as clinical and laboratory measurements at start of

dialysis and the time at which all co-morbid conditions were diagnosed, limiting which variables were available for analyses. Around one-third of the study sample (who all came to AKC for dialysis) did not have any reported hospitalisation in Al Noor Specialist Hospital. Some of them (and some patients hospitalised also in Al Noor) may have been hospitalised in another hospital such as a private hospital, with others not needing hospitalisation. These issues could affect the precision of the results, as could any accuracy in hospital admissions data records. There may on occasion be inappropriate hospitalisation in the governmental hospitals in Saudi Arabia, which does not fully reflect patients' health conditions, mostly because there was nobody able to look after the patients outside hospital,<sup>26</sup> particularly for elderly patients, who require more care than younger patients, as demonstrated in this study by the strong association of the increased length of stay in hospital and admissions rate that we found with increasing patient age, might also reflect the severity of patients' co-morbid conditions disease.

This study reveals that the most frequent reasons for hospital admission among haemodialysis patients were cardiovascular disease, particularly hypertension and coronary artery disease, creation of vascular access via AVF after starting dialysis, infectious diseases particularly respiratory infectious disease and endocrine and metabolic disorders. Increased age, diabetes as a cause of renal disease and using a catheter as access point for haemodialysis have a significant effect in increasing the rate for hospital admissions per patient-year on haemodialysis. These indications for hospital admissions provide evidence for public health administrators and healthcare providers in Saudi Arabia to develop multidisciplinary strategies for improving pre-ESRD nephrology care practice and the quality of healthcare management for patients with multiple chronic diseases and their complications, patients' health behaviours and awareness about their illness. These strategies would be valuable in the future to improve healthcare outcomes and reduce hospital utilisation and the cost of haemodialysis care.

## Conclusion

This study suggests that early detection and effective management for patients with high risks to cardiovascular disease, such as diabetic and hypertensive patients, could reduce the risk of hospitalisation even before the onset of haemodialysis. Pre-ESRD nephrology care practice should be modified to reduce the rate of initiating dialysis with catheters as this is associated with an increased rate of hospital admission among haemodialysis patients. Health

information systems must be developed in Saudi Arabia to allow further multicentre studies that include other key data such as clinical and laboratory measurements, and details of healthcare providers' specialist services; and the outcomes of hospitalisation for haemodialysis patients. This would help to provide comprehensive evidence-based guidance on the clinical management of haemodialysis patients in Saudi Arabia.

#### Declarations

**Competing interests:** None declared

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**Ethical approval:** Data were obtained after applying for ethical approval from the Ministry of Health and General Directorate of Health Affairs in Makkah in 2011.

**Guarantor:** AH

**Contributorship:** AH designed study, created electronic database for data collection, collected data, performed statistical analyses and drafted the manuscript. AM contributed in study design, coordination of the study, edited and reviewed the manuscript critically. HW contributed in statistical analyses and interpretation, edited and reviewed the manuscript critically.

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#### References

1. Kshirsagar AV, Hogan SL, Mandelkehr L and Falk RJ. Length of stay and costs for hospitalized hemodialysis patients: nephrologists versus internists. *J Am Soc Nephrol* 2000; 11: 1526–1533.
2. Lee H, Manns B, Taub K, Ghali WA, Dean S, Johnson D, et al. Cost analysis of ongoing care of patients with end-stage renal disease: the impact of dialysis modality and dialysis access. *Am J Kidney Dis* 2002; 40: 611–622.
3. Thamer M, Ray NF, Fehrenbach SN, Richard C and Kimmel PL. Relative risk and economic consequences of inpatient care among patients with renal failure. *J Am Soc Nephrol* 1996; 7: 751–762.
4. Collins AJ, Foley RN, Chavers B, Gilbertson D, Herzog C, Johansen K, et al. US renal data system 2011 annual data report. *Am J Kidney Dis* 2011; 59: A7.
5. Chui BK, Manns B, Pannu N, Dong J, Wiebe N, Jindal K, et al. Health care costs of peritoneal dialysis technique failure and dialysis modality switching. *Am J Kidney Dis* 2012; 61: 104–111.
6. Manns B, Tonelli M, Yilmaz S, Lee H, Laupland K, Klarenbach S, et al. Establishment and maintenance of vascular access in incident hemodialysis patients: a prospective cost analysis. *J Am Soc Nephrol* 2005; 16: 201–209.
7. Al-Sayyari AA and Shaheen FA. End stage chronic kidney disease in Saudi Arabia. A rapidly changing scene. *Saudi Med J* 2011; 32: 339–346.
8. Saudi Centre for Organ Transplantation, Annual Report 2011, <http://scot.org.sa/en/en/annual-report-national-data/2011.html> (accessed July 2013).
9. Almalki M, Fitzgerald G and Clark M. Health care system in Saudi Arabia: an overview. *East Mediterr Health J* 2011; 17: 784–793.
10. Royal College of Physicians. Consultant physicians working with patients, revised 5th edition (online update). London: RCP, 2013, [https://www.rcplondon.ac.uk/sites/default/files/consultant\\_physicians\\_revised\\_5th\\_ed\\_full\\_text\\_final.pdf](https://www.rcplondon.ac.uk/sites/default/files/consultant_physicians_revised_5th_ed_full_text_final.pdf).
11. Wei S-Y, Chang Y-Y, Mau L-W, Lin M-Y, Chiu H-C, Tsai J-C, et al. Chronic kidney disease care program improves quality of pre-end-stage renal disease care and reduces medical costs. *Nephrology* 2010; 15: 108–115.
12. Hassanien A, Majeed A, Watt H and Basri N. Review of pre end-stage renal disease care in the western region in Saudi Arabia. *J Diab Res Clin Metabol* 2013; 2: 12.
13. Joyce AT, Iacoviello JM, Nag S, Sajjan S, Jilinskaia E, Throop D, et al. End-stage renal disease-associated managed care costs among patients with and without diabetes. *Diab Care* 2004; 27: 2829–2835.
14. Rostand SG. Coronary heart disease in chronic renal insufficiency: some management considerations. *J Am Soc Nephrol* 2000; 11: 1948–1956.
15. Ng LJ, Chen F, Pisoni RL, Krishnan M, Mapes D, Keen M, et al. Hospitalization risks related to vascular access type among incident US hemodialysis patients. *Nephrol Dial Transplant* 2011; 26: 3659–3666.
16. Pisoni RL, Arrington CJ, Albert JM, Ethier J, Kimata N, Krishnan M, et al. Facility hemodialysis vascular access use and mortality in countries participating in DOPPS: an instrumental variable analysis. *Am J Kidney Dis* 2009; 53: 475–491.
17. Lacson E, Wang W, Lazarus JM and Hakim RM. Change in vascular access and hospitalization risk in long-term hemodialysis patients. *Clin J Am Soc Nephrol* 2010; 5: 1996–2003.
18. Saeed Abdulrahman I, Al-Mueilo SH, Bokhary HA, Ladipo GOA and Al-Rubaish A. A prospective study of hemodialysis access-related bacterial infections. *J Infect Chemother* 2002; 8: 242–246.
19. El-Saed A, Sayyari A, Hejaili F, Sallah M, Dagunton N and Balkhy H. Higher access-associated bacteremia but less hospitalization among Saudi compared with US hemodialysis outpatients. *Semin Dial* 2011; 24: 460–465.
20. Al Wakeel JS, Mitwalli AH, Al Mohaya S, Abu-Aisha H, Tarif N, Malik GH, et al. Morbidity and mortality in ESRD patients on dialysis. *Saudi J Kidney Dis Transpl* 2002; 13: 473–477.

21. Osman MA. Morbidity and mortality in ESRD patients on regular hemodialysis: a single center experience. *Saudi J Kidney Dis Transpl* 2005; 16: 336–341.
22. Hage FG, Venkataraman R, Zoghbi GJ, Perry GJ, DeMattos AM and Iskandrian AE. The scope of coronary heart disease in patients with chronic kidney disease. *J Am Coll Cardiol* 2009; 53: 2129–2140.
23. Sarnak MJ, Levey AS, Schoolwerth AC, Coresh J, Culleton B, Hamm LL, et al. Kidney disease as a risk factor for development of cardiovascular disease: a statement from the American Heart Association Councils on Kidney in Cardiovascular Disease, High Blood Pressure Research, Clinical Cardiology, and Epidemiology and Prevention. *Circulation* 2003; 108: 2154–2169.
24. Vascular Access Work Group. Clinical practice guidelines for vascular access. *Am J Kidney Dis* 2006; 48: 248–273.
25. Flucka R and Kumwenda M. Renal association clinical practice guideline on vascular access for haemodialysis. *Nephron Clin Pract* 2011; 118: 225–240.
26. Al-Omar BA, Al-Assaf AF, Al-Aiban KM, Kalash KK and Javed F. Factors influencing inappropriate hospitalization in Riyadh, Saudi Arabia: physicians' perspectives. *East Mediterr Health J* 2006; 12: 195–206.