Original Article

Profile of Hospitalisation and Death in the First Year after Diagnosis of End-stage Renal Disease in a Multi-ethnic Asian Population

Boon Wee Teo,[1] *MB, BCh, FASN*, Valerie Ma,[2] *SRN*, Hui Xu,[1] *MD*, Jialiang Li,[3] *PhD*, Evan JC Lee,[1] *MRCP (UK), FRCP (Edin), FAMS*,
On behalf of the Nephrology Clinical Research Group

Abstract

Introduction: The increasing prevalence of end-stage renal disease (ESRD) is an important public health issue due to the high costs of kidney replacement therapies. We examined the impact of ethnicity and other factors in ESRD management and hospitalisation in a multi-racial Asian population in the first year after diagnosis. Materials and Methods: We analysed a prospectively collected database of 168 new ESRD patients from the National University Hospital, Singapore (NUH) in 2005. Univariate and multivariate analyses were performed to assess factors for mortality and hospitalisation. Results: Sixteen patients eventually chose conservative treatment, 102 haemodialysis, 41 peritoneal dialysis and 9 patients underwent kidney transplantation for their long-term treatment. Although more Chinese patients had dialysis plans (56.7% vs 36.8%, *P* = 0.022), many still required urgent dialysis initiation via catheters (61.3%). These dialysed patients who required urgent treatment had more admissions (3.6 vs 2.6, *P* = 0.023) and longer length of stay (9.3 days, *P* = 0.014). Approximately 40 (7.4%) admissions were related to vascular access complications (thromboses, dislodgements and infections), and 15 (2.8%) were for new tunnelled catheter insertions. Deaths were 23.8% in the first year after diagnosis and median survival was 125 days. Age, final treatment modality, type of therapy centre, history of coronary artery disease, left ventricular ejection fraction (LVEF) <50%, and having no plans for dialysis were associated with mortality. Conclusions: The care of ESRD patients requires substantial commitment of healthcare resources particularly in the first year after diagnosis. Steps to reduce urgent initiation of dialysis will help reduce resource utilisation and improve patient outcomes.

Ann Acad Med Singapore 2010;39:79-87

Key words: Dialysis, Kidney failure, Palliation

Introduction

End-stage renal disease (ESRD) is reaching epidemic proportions and is increasingly a public health issue due to the cost of providing care to these patients.[1] There are many kidney disease databases and registries tracking and studying trends in the epidemiology and care of ESRD patients.[2-4] There have also been studies looking into ESRD treatment choices, and the profile and risk factors for hospitalisation in the first year after a diagnosis of ESRD.[5-9] However, the impact of ethnicity and other factors in ESRD treatment choice and subsequent hospitalisation in a multi-racial Asian population has not been examined. Singapore does not have a nationally administered ESRD programme encompassing all treatment modalities. Instead, haemodialysis care is provided mainly by private dialysis clinics, or through voluntary welfare organisations (charities), and peritoneal dialysis is also a predominantly fee-for-service programme provided by public institutions and private practitioners. There is, however, a national deceased donor kidney transplant programme, and the care of both living and deceased donor transplant programmes are heavily subsidised by the government for citizens. Additionally, citizens who participate in the voluntary basic medical and hospitalisation insurance scheme (Medishield, with or without supplemental insurance), administered by a statutory board and private insurers, receive 50% to 100% reimbursement for ESRD treatment. We analysed the impact of ethnicity on ESRD treatment choices, and the profile and

[1] Department of Medicine, Yong Loo Lin School of Medicine, National University of Singapore, Singapore
[2] National University Hospital, Singapore
[3] Department of Statistics and Applied Probability, Duke-NUS Graduate Medical School, National University of Singapore, Singapore
Address for Correspondence: Dr Boon Wee Teo, Yong Loo Lin School of Medicine, National University of Singapore, 5 Lower Kent Ridge Road, Singapore 119074. Email: mdctbw@nus.edu.sg

risk factors for hospitalisation and death in the first year after a diagnosis of ESRD is made in an academic medical centre in Singapore.

Materials and Methods

This study was approved by the Institutional Review Board. We analysed the ESRD database of the National University Hospital, Singapore. This is a prospectively collected database that includes demographic, clinical and laboratory data. The information is used primarily to place patients in dialysis, transplant or palliative care programmes. We extracted hospitalisation data from the hospital electronic records, and reviewed the discharge summaries to verify hospitalisation diagnoses and channelled the diagnoses into 7 hospitalisation categories. The categories of "haemodialysis", "peritoneal dialysis", and "transplant" reflect hospitalisations for routine care or management of complications related to these modalities. Infections of dialysis catheters (tunnelled and non-tunnelled), arterio-venous fistulae, and arterio-venous graft, exit site infections, and peritonitis are categorised here. "Dialysis/uraemia" refers to admissions for azotaemia, uraemia, fluid overload, hyperkalaemia, anorexia, failure to thrive and other clinical conditions thought to be associated with a need to start renal replacement therapy. "Non-dialysis infections" refer to hospitalisations for infections that are not related to haemodialysis vascular access or peritoneal dialysis infectious complications. "Cardiovascular or stroke" means hospitalisations for acute coronary syndromes, coronary angiograms, cardiac arrhythmias, or coronary artery bypass graft surgery, and cerebro-vascular accidents. All other diagnoses were classed under "others". The main hospitalisation diagnoses were decided by one of the authors (BWT). For eventual long-term dialysis modalities and mortality outcome, data were obtained from the Singapore Renal Registry in association with the National Registration Department of the Immigration and Checkpoint Authority. The final treatment modality is defined as the last reported treatment at 90 days after diagnosis. We included all patients with a diagnosis of ESRD in year 2005 and included hospitalisations in the year after.

Definitions

The diagnosis of ESRD is made by the attending doctors and ascertained by biochemical, clinical, histological, and/or imaging, with confirmation by the consulting nephrologist. This is then reported to the Renal Case Manager for registry inclusion. Almost all patients in our hospital with ESRD, even those who are placed on conservative care, will be referred to nephrology for assessment and counselling, and placement into a care programme. Additionally, all routine hospital laboratory blood tests showing a serum creatinine concentration of 880 µmol/L or greater are flagged for assessment. Data are collated from forms filled by the attending doctors with augmentation and clarification by the case manager for missing and ambiguous information. All information is ultimately reviewed and approved by one of the authors (EJCL) for inclusion in the database. Non-urgent treatment refers to patients: (i) who did not want or require renal replacement therapy (RRT), (ii) haemodialysis patients who dialysed via an arterio-venous fistula or graft, or (iii) peritoneal dialysis patients dialysing via an electively placed peritoneal dialysis catheter, or (iv) patients who received pre-emptive kidney transplants. Urgent dialysis refers to the need for immediate RRT by haemodialysis via a dialysis catheter. Patients with a plan for dialysis had an outpatient follow-up with the nephrologist, and had a peritoneal dialysis catheter or vascular access surgery planned. The final treatment modality and the reported treatment facility are used to classify the type of therapy centre into 3 categories. The final treatment modality and treatment facility were defined as the last treatment type and facility reported to the Singapore Renal Registry at and around 90 days after diagnosis. Patients on haemodialysis and dialysing in outpatient dialysis units of voluntary welfare organisations are placed under "Charities". Patients receiving dialysis or follow-up care in private dialysis centres, and patients on conservative treatment and kidney transplant patients seen in the NUH are classified under "Private". Patients dialysing in the "hospital-associated haemodialysis unit" are classed as such. The initial hospitalisation when ESRD was diagnosed is included in analyses unless otherwise stated.

Statistical Analysis

For some comparisons, analyses by race were performed comparing Chinese and non-Chinese patients as a group when required. Student's *t*-test, non-parametric, chi-square, Kruskal-Wallis, log-rank and Fisher's Exact tests were performed where appropriate. In examining risk factors for hospitalisation and mortality, we performed a univariate analysis on clinically plausible factors, and then included each significant factor in the multivariate analysis progressively. The factors considered in the univariate analyses included age, gender, race, aetiology of end-stage kidney failure, left ventricular ejection fraction within ± 1 year of diagnosis, final treatment modality (at 90 days), urgency of initial therapy, type of therapy centre, and the presence of co-morbid conditions (hypertension, coronary artery disease, diabetes, peripheral vascular disease, stroke). For the number of admissions in a year after diagnosis, we used Poisson regression multivariate analysis. Multiple linear regressions were used in the multivariate analysis of the length of stay. In addition, Cox proportional hazards models were constructed to examine mortality; we excluded transplant patients from these analyses as there were no deaths in this group. Significance was taken at the 0.05 level.

SPSS version 15.0 (SPSS Inc, Chicago, IL) and JMP IN 5.1 (SAS Institute, Cary, NC) were used for data analysis.

Results

There were a total of 168 patients who were diagnosed with ESRD, of whom 152 survived for more than 90 days. The demographics and baseline characteristics of these patients are shown in Table 1. The mean age was 59.2 ± 13.7 years and was not different between races (*P* = NS). Gender distribution was not different between races (*P* = NS) but diabetic nephropathy as a cause of ESRD was (*P* = 0.049); more non-Chinese (75.4%) than Chinese (55.9%) patients had diabetes as a co-morbidity (*P* = 0.0018), with Malays having the highest proportion (79.4%), followed by "Others" (71.4%), and Indians (66.7%). Complete medical history was available in 168 patients (100%) for diabetes and for hypertension, 152 (90.5%) for coronary artery disease, 99 (58.9%) for stroke and 91 (54.2%) for peripheral vascular disease. The distribution of gender, presence of hypertension, coronary artery disease, stroke or peripheral vascular disease was not different.

ESRD Treatment

Out of the 168 patients initially diagnosed, 109 (64.9%) were urgently haemodialysed via a dialysis catheter, 59 (35.1%) had elective admissions for initiation of RRT, or did not want RRT, or did not require RRT. Fifty per cent (84/168) of patients were being seen by a nephrologist in an outpatient setting and had a dialysis plan; yet 37 of these patients (44.1%) were still urgently dialysed via a dialysis catheter, although this was less than those (72/84; 85.7%) who did not have a dialysis plan (*P* <0.001). More Chinese (56.7%) patients had a plan for dialysis than non-Chinese (36.8%; *P* = 0.022) but the proportion of patients dialysed urgently were similar (61.3% vs 71.9%; *P* = NS). Sixteen patients eventually chose conservative (palliative) treatment, 102 patients selected haemodialysis, 41 received peritoneal dialysis, and 9 patients underwent kidney transplants. Kidney transplant recipients were the youngest (mean age, 41.4 ± 12.1 years), while conservatively managed patients were the oldest (mean age, 67.4 ± 11.8 years) (*P* <0.001). Forty-five patients (44.1%) were haemodialysed in private dialysis centres and the proportion of patients was similar between races (*P* = NS). Of the 16 patients on conservative management, 7 (43.8%) were urgently haemodialysed via a catheter prior to their eventual therapy decision.

Hospitalisation in the First Year

There were 544 (median, 2; IQR, 1 to 4) admissions with a total length of stay of 5244 days for all patients in the year

Table 1. Characteristics of ESRD Patients and Final Treatment Modality

n (%)	All patients 168 (100)	Conservative 16 (9.5)	Haemodialysis 102 (60.7)	Peritoneal dialysis 41 (24.4)	Transplant 9 (5.4)
Male	81 (48.2)	6 (37.5)	57 (55.9)	14 (34.2)	4 (44.4)
Diabetic	105 (62.5)	10 (62.5)	68 (66.7)	25 (61)	2 (22)
Race					
Chinese	111 (66.1)	9 (8.1)	62 (55.9)	31 (27.9)	9 (8.1)
Malay	32 (20.2)	6 (17.7)	22 (64.7)	6 (17.7)	-
Indian	9 (5.4)	1 (11.1)	8 (88.9)	-	-
Others	14 (8.3)	-	10 (71.4)	4 (28.6)	-
Hospitalisation	544 (100)	42 (7.7)	352 (64.7)	131 (24)	19 (3.5)
EF <50%	44/126 (34.9)	8 (72.7)	24 (28.6)	11 (44)	1 (16.7)
Mean age (y)	59.2 ± 13.7	67.4 ± 11.8	58.7 ± 12.9	61.3 ± 13.3	41.4 ± 12.1
20-29	5 (3)	-	3 (2.9)	1 (2.4)	1 (11.1)
30-39	9 (5.4)	-	4 (3.9)	2 (4.9)	3 (33.3)
40-49	24 (14.3)	1 (6.3)	16 (15.7)	5 (12.2)	2 (22.2)
50-59	42 (25)	2 (12.5)	29 (28.4)	9 (22)	2 (22.2)
60-69	48 (28.6)	6 (37.5)	30 (29.4)	11 (26.8)	1 (11.1)
70-79	29 (17.3)	5 (31.3)	14 (13.7)	10 (24.4)	-
80-89	11 (6.5)	2 (12.5)	6 (5.9)	3 (7.3)	-

The mean age was different between final treatment modality groups (*P* <0.001), but the mean number of admissions was not (*P* = NS). "EF < 50%" refers to left ventricular ejection fraction less than 50% by echocardiography within ± 1 year of diagnosis (only 126 patients had a study in that time period); percentage in this category refers to the number of abnormal findings over the total number of patients in that treatment modality.

after diagnosis. The mean number of hospital admissions was not different between Chinese and non-Chinese patients (3.14 ± 2.5 vs 3.44 ± 2.7; *P* = NS), nor by final treatment modality (conservative = 2.63 ± 2.9, haemodialysis = 3.45 ± 2.8, peritoneal dialysis = 3.2 ± 2.0, transplant = 2.11 ± 1.5; *P* = NS). The frequency of admissions in the year following diagnosis is shown in Figure 1. Approximately 40 (7.4%) admissions were related to vascular access complications (thromboses, dislodgements and infections), and 15 (2.8%) were for new tunnelled catheter insertions. In univariate analyses, urgency of therapy (*P* = 0.023) and type of therapy centre (*P* = 0.024) were associated with hospitalisation. Urgently dialysed patients had a mean of 3.6 ± 2.8 admissions compared to non-urgent patients (2.6 ± 1.8). There were 351 unique patient-type admissions (Fig. 2). By Poisson regression multivariate analysis, the model was significant (likelihood ratio chi-square 33.008, *P* <0.001). Patients dialysing or being managed by in-hospital associated dialysis units and private facilities had fewer admissions than charities (Incidence rate ratio: 0.39, *P* = 0.01; 0.74, *P* = 0.001, respectively). Urgently dialysed patients had 1.32 times more admissions than non-urgently treated patients (*P* = 0.05). The ratios are shown in Table 2.

The median length of stay per admission was 5 days (IQR, 3 to 10), and was not different by gender, race or final treatment modality (*P* = NS), while the median length of stay per patient was 17.5 days (IQR, 9 to 37) and was different by race (*P* = 0.044) and final treatment modality (*P* = 0.0097). When the length of stay was examined by univariate analyses, race (*P* = 0.044), final treatment modality (*P* = 0.0097), urgent dialysis (*P* <0.001) and plan for dialysis (*P* = 0.013) were significant factors. However, in the multivariate analysis by multiple linear regression, only urgent dialysis was significant and is estimated to increase the length of stay by 9.3 days (95% CI, 1.9 to 16.7; *P* = 0.014) (Table 2).

The average bill per hospitalisation was S$7944 ± 14590 (US$1 ≈ S$1.45), and the median bill was S$3957 (IQR, 2113 to 7922). Dialysed patients who need urgent treatment paid an average of S$18,381 more for all their admissions in the year after diagnosis (95% CI, S$9970 to S$26,792; *P* <0.001). The bill sizes also differed by final treatment modality, with conservatively treated patients paying the least (median, S$6951; IQR, 3361 to 23111), and haemodialysis patients paying the most (median, S$16,764; IQR, 9129 to 39372) (*P* = 0.0015). However, having a plan for dialysis did not reduce the average bill size significantly (median S$12,004; IQR, 5868 to 24545 vs S$17,322; IQR, 9908 to 35175) (*P* = NS). Bill sizes were not different by age, gender, type of therapy centre, a co-morbid condition of diabetes or coronary artery disease.

Deaths

There were 40/168 (23.8%) deaths in the first year after diagnosis, with 16/40 (40%) deaths occurring within 90 days (conservative = 5, haemodialysis = 7, peritoneal dialysis = 4). The median survival was 125 days (IQR, 76 to 247). Proportionately more deaths occurred in the conservatively treated group (11/16, 68.8%) than in patients on peritoneal dialysis (9/41, 22%) or haemodialysis (20/102, 19.6%); there were no deaths in patients who received kidney transplants (*P* <0.001). Deaths were not different by race or gender (*P* = NS), but 80% (4/5) of patients dialysing with the high-risk, hospital-associated dialysis centre died. Figure 3 shows the probabilities of death by final treatment modality, and type of therapy centre. By Kaplan-Meier analysis, age (*P* <0.001), final treatment modality (*P* <0.001), type of therapy centre (*P* <0.001), a history of coronary artery disease (*P* = 0.0074), left ventricular ejection fraction less than 50% (*P* <0.001), and having no plan for dialysis (*P* = 0.044) were associated with mortality. We constructed 4 Cox models to examine these factors. The model containing age, gender and race was significant (*P* <0.001), with age remaining a significant factor (HR, 1.06; 95% CI, 1.03 to 1.09; *P* <0.001). When examining therapy related factors in a model, final treatment modality (*P* <0.001), centre of therapy (*P* <0.001), and plans for dialysis (*P* = 0.030) were significant (*P* <0.001). The model containing cardiac history and cardiac assessment was significant (*P* <0.0019), but only left ventricular ejection fraction above 50% was significant (HR, 0.67; 95% CI, 0.43 to 1.00; *P* = 0.05). We then put all significant factors into the fourth model with the standard adjusters, whereby plan for dialysis became non-significant. The final model was constructed that included all significant factors from the fourth model and the standard adjusters. This model was significant (*P* <0.001), and the hazard risk ratios are shown in Table 3.

Discussion

Our study is the first comprehensive examination of the profile of hospitalisation and death in the first year after diagnosis of ESRD in a multi-ethnic Asian population. Comparisons with other registries and studies are difficult because data are not collected in the same fashion. Our data captured all newly diagnosed ESRD patients but the United States Renal Data System (USRDS) captures data for patients who survived more than 90 days on dialysis, with less complete data for the first 90 days. Published Asian-centric papers in the English language on this aspect, and readily available via computerised scientific databases are limited. Moreover, differences in practice patterns and changes in practice over time also affect comparability. For example, it is acceptable for patients to be admitted for health education and lifestyle changes in Japan, but this would not be possible in Singapore. Patients receiving dialysis in

Table 2. Univariate and Multivariate Analyses for Hospitalisation

(a) Frequency of admissions

Factor	**Multivariate analysis**			
(*P* value) (Univariate analysis)	**Incidence rate ratio**	**Lower 95% CI**	**Upper 95% CI**	***P* value**
Age (*P* = NS)	1.006	1	1.01	NS
Gender (If male) (*P* = NS)	1	0.84	1.19	NS
Race (*P* = NS)				NS
Chinese	1	-	-	-
Malay	2.59	0.89	1.35	NS
Indian	0.74	0.47	1.15	NS
Others	1.24	1.09	1.66	NS
Therapy centre (*P* = 0.024)				<0.001
Charities	1	-	-	-
Private	0.74	0.62	0.87	0.001
Hospital-associated Haemodialysis unit	0.39	0.19	0.80	0.01
Urgency of therapy (If urgent) (*P* <0.001)	1.32	1.09	1.59	0.05

(b) Length of stay (days)

Factor (*P* value) (Univariate analysis)	**Median stay (IQR) (days)**	**Scaled estimate (days)**	**Estimate plot**	***P* value (multivariate analysis)**
Intercept		31.4		<0.0001
Age (*P* = NS)		7.6		NS
Race (*P* = 0.044)				NS
Chinese	15 (9-31)	-10.4		0.048
Indian	21 (17-86)	11.2		NS
Malay	22 (12-51)	-2.8		NS
Others	27 (13-80)	2.0		NS
Gender (*P* = NS)				
Female	16 (9-33)	0.5		NS
Male	21 (10-38)	-0.5		NS
Modality (*P* = 0.0097)				NS
Conservative	12 (7-31)	-5.0		NS
Haemodialysis	19 (11-44)	6.1		NS
Peritoneal dialysis	19 (8-29)	2.6		NS
Transplant	9 (4-15)	-3.6		NS
Plan for dialysis (*P* = 0.013)				
None	20 (12-42)	-2.2		NS
Planned	15 (8-31)	2.2		NS
Urgency of therapy (*P* <0.001)				
Non-urgent	10 (6-24)	-9.3		0.014
Urgently dialysed	21 (13-49)	9.3		0.014

Table 2. Contd.

Continuous factors centred by mean, scaled by range/2

These tables show the factors that were significant for (a) hospital admissions and (b) length of stay. For both multivariate analyses, we included age, gender and race as standard adjusters, regardless of significance in univariate analyses.

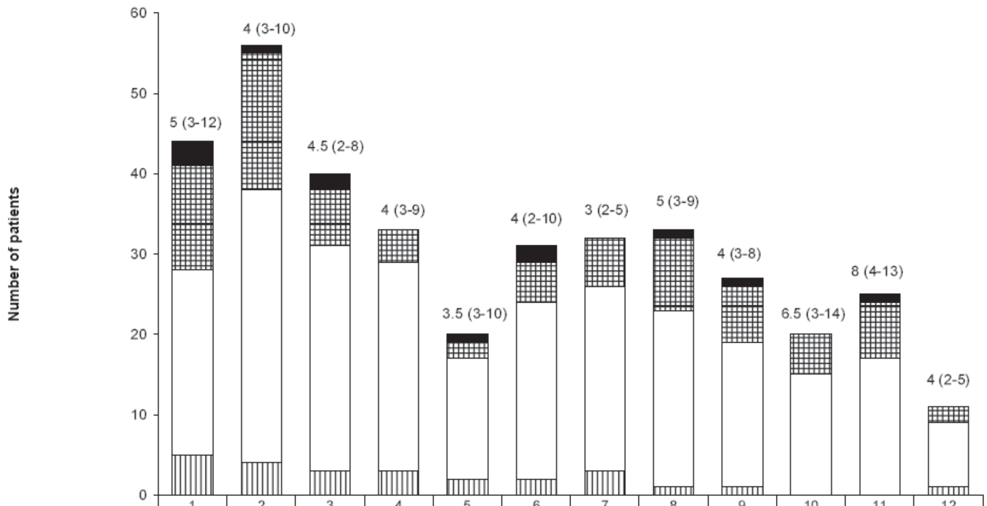
(a) We used Poisson regression analysis for the number of admissions in a year after diagnosis, and added all significant factors from univariate analysis into the model. The model was significant (Likelihood ratio chi-square 33.008, *P* <0.001); with therapy centre and urgency of therapy remaining significant.

(b) We used multivariate analysis by multiple linear regression for length of stay, and added all significant factors from univariate analysis into the model. The overall model was significant ($P = 0.048$, $R^2 = 0.11$), with urgent dialysis as the only factor that is estimated to increase length of stay by 9.3 days (95% CI, 1.9 to 16.7; $P = 0.014$). Chinese patients stayed 10.4 days ($P = 0.048$) less than the mean although race as a whole was not significant.

Table 3. Cox Regression Analysis of Risk Factors for Death

Factor	Hazard ratio (95% CI)	*P*
Age (per year increase)	1.03 (0.99 to 1.07)	NS
Female	0.71 (0.46 to 1.06)	NS
Race		NS
Chinese	0.76 (0.40 to 1.79)	
Indian	2.29 (0.68 to 6.87)	
Malay	1.54 (0.70 to 3.80)	
Ejection fraction >50%	0.64 (0.42 to 0.97)	0.036
Type of therapy centre		<0.001
Charities	0.17 (0.07 to 0.42)	
Private	0.57 (0.28 to 1.18)	
Final treatment modality		0.042
Conservative	2.29 (1.16 to 4.45)	
Haemodialysis	0.59 (0.33 to 1.05)	

We constructed 4 Cox models to examine grouping factors that were significant by Kaplan-Meier analysis. Model 1 of the standard adjusters (age, gender, and race) was significant (*P* <0.001), with age remaining a significant factor (HR 1.06; 95% CI, 1.03 to 1.09; *P* <0.001). Model 2 of therapy related factors was significant (*P* <0.001) [final treatment modality (*P* <0.001), type of therapy centre (*P* <0.001), and plans for dialysis (*P* = 0.030)]. Model 3 (coronary artery disease history and ejection fraction assessment) was significant (*P* <0.0019); but only left ventricular ejection fraction more than 50% was significant (HR 0.67; 95% CI, 0.43 to 1.00; *P* = 0.05). We then put all significant factors into the fourth model with the standard adjusters, where the plan for dialysis became non-significant. The final model was constructed that included all significant factors from the fourth model and the standard adjusters and the results are shown in the table above. The reference groups include male, "other" race, peritoneal dialysis, hospital-associated haemodialysis unit, ejection fraction <50% within ± 1 year of diagnosis of ESRD.



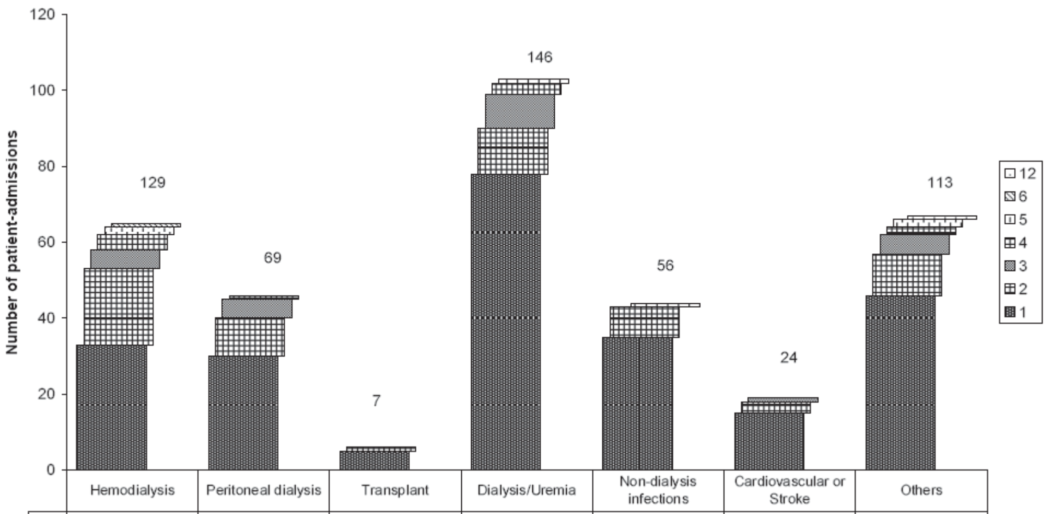
	1	2	3	4	5	6	7	8	9	10	11	12
Transplant	3	1	2	0	1	2	0	1	1	0	1	0
Peritoneal dialysis	13	17	7	4	2	5	6	9	7	5	7	2
Hemodialysis	23	34	28	26	15	22	23	22	18	15	17	8
Conservative	5	4	3	3	2	2	3	1	1	0	0	1

Months from diagnosis

Conservative · Hemodialysis · Peritoneal dialysis · Transplant

Fig. 1. Frequency of admissions in year after diagnosis by final treatment modality

The total number of admissions after the diagnosis of ESRD are 544. This figure excludes admissions during the month of diagnosis (172/544 = 31.6%). The numbers at the top of the bars indicate the median length of stay in that month with the inter-quartile range in parentheses.



	Hemodialysis	Peritoneal dialysis	Transplant	Dialysis/Uremia	Non-dialysis infections	Cardiovascular or Stroke	Others
12							1
6	1						
5	2			1	1		2
4	4	1		3			2
3	5	5		9		1	5
2	20	10	1	12	8	3	11
1	33	30	5	78	35	15	46

Type of admission

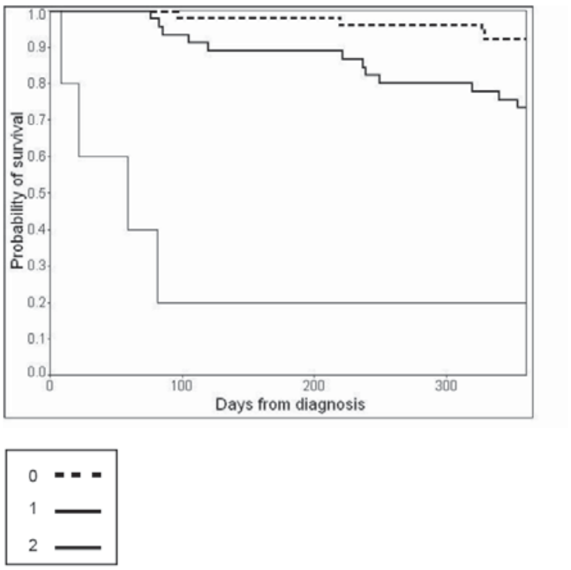
Fig. 2. Profile of admissions.

This figure shows the types of admissions in the year after diagnosis. The table and legend show the number of unique patients and the number of times they were admitted for the same reason (patient-admissions). The numbers at the top of the columns reflect the total number of admissions for that type of hospitalisation. Altogether there were 351 unique patient-type admissions out of 544 admissions. The admissions include hospitalisation for which the diagnosis of ESRD was made. Haemodialysis, peritoneal dialysis and transplant refers to hospitalisation for the management of routine care or complications related to those modalities. Admissions for peritoneal dialysis or kidney transplant complications needing haemodialysis via a tunnelled dialysis catheter is reflected in the "Haemodialysis" or "Dialysis/Uraemia" columns. Dialysis/Uraemia refers to admissions for fluid overload, uncontrolled hypertension, and/or uremic symptoms requiring dialysis. Cardiovascular refers to admissions for acute coronary syndromes, coronary artery bypass graft surgery, or coronary artery disease-related management or complications. Stroke refers to admissions for cerebro-vascular accidents. Hospitalisation for other reasons includes admissions for vascular access creation.

private practice are not reflected in Hong Kong's report.[5] Our study patients were also treated after the promulgation and propagation of clinical practice guidelines, especially with regard to adequacy of dialysis.[10-12] Regardless, it may be helpful to compare for insights that may potentially improve the delivery of care to the newly diagnosed ESRD patient.

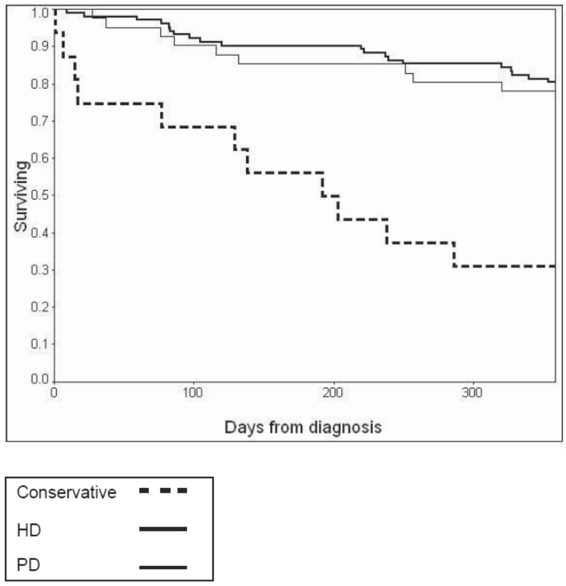
The care of ESRD patients requires substantial commitment of healthcare resources particularly in the first year after diagnosis. Patients who needed dialysis urgently consumed more resources. Although many patients had plans for dialysis, a substantial proportion still required urgent initiation of RRT; and it is unclear if impediments to plan implementation or late plan formulation (or late nephrologist consultation) were the cause of this. Anecdotally, patients in Singapore are less accepting of a diagnosis of ESRD, and thus, less prepared to make early definitive management decisions. Whether this is due to inadequate counselling in overcoming disease denial, or if financial concerns propagate this behaviour, or if this can truly be ascribed to cultural reasons remains to be investigated in depth. Regardless of the increased economic costs, urgent dialysis was also associated with more morbidity (increased number of admissions and longer duration of hospitalisation) similar to previous reports.[13,14] The use of dialysis catheters in urgently treated patients may in part be associated with the increased morbidity. This is because dialysing through catheters requires more medications and longer haemodialysis times to achieve the same clinical performance measures associated with better clinical outcomes.[15] We speculate that poorer dialysis delivered via tunnelled dialysis catheters may be a reason why urgently dialysed patients do worse in the first year, accounting for the large number of admissions associated with inadequate dialysis (Fig. 2). Clearly, steps to reduce urgent initiation of dialysis will help reduce resource utilisation and improve patient outcomes. Therefore, identifying barriers to elective initiation of RRT or early decision on conservative or palliative treatment need to be investigated in a future study.

The pattern of hospitalisation is similar to a previously reported series, being highest in the first 3 months of diagnosis and declining thereafter.[13] The average number of admissions is similar, but the mean length of stay per patient is slightly higher (median 17.5 versus 13 days); but such data may be difficult to compare due to the influence of physician practice, resources and reimbursement policies. In



0 = Charities
1 = Private
2 = Hospital-associated outpatient unit
Log-Rank test *P* <0.001

Fig. 3a. Probability of survival in haemodialysis patients by type of therapy centre.
Fig. 3. Kaplan-Meier plots of survival in the first year.



Log-Rank *P* <0.001

Fig. 3b. Probability of survival in all patients by final treatment modality (excluding transplant).

our context, the lack of suitable outpatient dialysis facilities able to handle new dialysis patients who are more sick, and/or assisted transport may increase the length of stay. Because our institution trained new peritoneal dialysis patients in an inpatient setting (this is currently no longer so if outpatient training is possible), the length of stay was not different by final treatment modality, in contra-distinction to some previous studies.[6,7,9,13] Haemodialysis patients generally had lower reported rates of hospitalisation, which may be accounted for by case-mix, but Metcalfe's study reported an increase. Changing practice and demographics may affect hospitalisation rates. The 1998 USRDS reported higher admissions for peritoneal dialysis patients but overall there was a decline, with more marked reductions than in haemodialysis patients. However, the 2008 USRDS reported increasing hospitalisation for the first 6 months of starting dialysis over the last 12 years overall.[2] It is also known that ESRD patients accepting RRT are older and this may be a reason why hospital admissions may increase in future.[16] We note that 21% of all our patients who received RRT were aged 70 years and above. This shows that tracking hospital admissions carefully and accurately may potentially help improve resource utilisation and reduce costs in ESRD management.

Approximately 80% of our patients who started dialysis survived the first year, similar to that from a neighbouring country with a similar racial mix and culture.[4] Congestive heart failure is the strongest predictor for death in patients on dialysis and is characterised objectively in our study by patients with echocardiographic evidence of a reduced left ventricular systolic fraction of less than 50%.[2] Having a plan for dialysis and the urgency of therapy was also previously noted to be an important factor for early mortality.[14] Some other reported factors important in early mortality (<90 days) and deaths in the first year include low serum albumin on initiation, lower socio-economic status, presence of diabetes, residual renal function, treatment frequency (haemodialysis), and timing of nephrology referrals.[14,17,18] Treatment centre effects could also be important but this study was performed on patients treated prior to guidelines for dialysis adequacy.[19] In our study, patients dialysing with the hospital-associated outpatient unit were at a much higher risk of dying. However, these patients were more sick; high-dependency patients who could not be safely dialysed in an outpatient centre, or who were on palliative dialysis for symptom relief (fluid overload). It is also heartening to note that patients on dialysis programmes associated with charities do not have increased mortality, although they have more hospital admissions. This is probably due to the low threshold for referral to hospitals since these outpatient units typically do not have a full-time nephrologist or dialysis nurse clinician in attendance to assess and manage potential problems in the outpatient setting.

Our study is limited by unavailable outpatient dialysis laboratory results, socio-economic and religious affiliation data. These may be important factors in the choice of ESRD treatment, the care of primary kidney disease in the first instance and the duration of hospitalisation. Despite this, our study identified key areas where clinical services and clinical research need to be expanded in order to improve clinical outcomes in newly diagnosed ESRD patients.

Acknowledgements: Mr Shaun Tan, a medical student from the University of Glasgow, United Kingdom, was on clinical research elective attachment with us and helped in the initial data verification and analysis. This was presented in part at the National Healthcare Group Annual Scientific Congress 2008, Singapore.

Conflicts of interest: None to declare

Author contributions: BWT and EJCL conceived and supervised the conduct of the study. VM, and BWT verified the data with hospitals records. BWT, VM, EJCL, and LJL analyzed the data. BWT wrote the initial draft of the manuscript. All authors reviewed and edited the manuscript for submission.

Other members of the National University Hospital Nephrology Clinical Research Group include Prof A Vathsala, Dr Titus Lau, Dr Rajat Tagore, Dr Ho Chee Khun, Dr Yeoh Lee Ying and Dr Claude Jeffrey Renaud

Source of funding: This study is funded internally by the Division of Nephrology, Department of Medicine.

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