ORIGINAL ARTICLE

End-stage kidney disease in Brunei Darussalam (2011-2020)

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ABSTRACT

Introduction: The Brunei Dialysis and Transplant Registry (BDTR) recorded data on patients with end-stage kidney disease (ESKD) from 2011 to 2020, mainly for planning of services and benchmarking of standards. We report the trends of epidemiologic and performance parameters, compare performances between modalities of Kidney Replacement Therapy and evaluate the survival of ESKD patients over the 10-year period.

Materials and Methods: Three groups of data were analysed from the BDTR over the 10-year period. Epidemiological data, blood parameters and dialysis are key performance indicators.

Results: There are increments in prevalence and incidence of treated ESKD patients in Brunei over 10 years, especially with haemodialysis (HD). The projected prevalence and incidence showed an anticipated annual increase of 42.2 per million population (pmp) and 9.9 pmp respectively. Diabetes mellitus (DM) (79%) was the main cause of ESKD. HD (86%), peritoneal dialysis (PD) (9%) and transplant (5%) were the main modalities of kidney replacement therapy in 2020. Cumulative results over the decade showed significant improvements in serum phosphate, peritonitis rates and HD blood flow rates. PD patients have better survival rates, lower systolic blood pressure and better adequacy. PD survival (patient survival of 91%, 73% and 56% at 1, 3 and 5 years respectively) was superior to HD survival (86% and 64% at 1 and 2 years, respectively), but patient demographics (age and DM status) were different. The 2020 dataset showed satisfactory anaemia management but mineral bone disease management was sub-optimal. Seventy percent of prevalent HD patients had arteriovenous fistula access. Thirty-two percent and fifty-two percent of HD and PD patients, respectively, achieved target dialysis adequacy. Peritonitis rate was 0.3 episodes per patient year.

Conclusion: Brunei has a high incidence and prevalence of treated ESKD in the last decade, especially DM-related ESKD. This study has identified many specific areas to be targeted for improvements and provided evidence for further proliferation of PD and transplant preference policy.

KEYWORDS:
Brunei; registry; dialysis; end-stage kidney disease; peritoneal dialysis; haemodialysis

INTRODUCTION

Brunei Darussalam is a small country in South East Asia with a reported total population of 453,600 in 2020.[1] The country has a relatively high Gross Domestic Product (GDP) per capita of around USD29,600 (BND39,989),[1] which ranks amongst the highest in the region.[2] Citizens and residents enjoy total government subsidies for healthcare, which includes dialysis treatment, transplant, medications and hospital admissions. Due to the small size of the country and free universal healthcare, kidney patients have attainable and equitable access to all the amenities of kidney replacement therapy (KRT). Data from the World Health Organization reported a high prevalence of diabetes (9%), obesity (19%) and hypertension (18%) in the country.[3] As a consequence of these adverse risk factors and open access to healthcare, there have been perpetual annual increments prevalence and incidence of end-stage kidney disease (ESKD) over the past few decades.[4]

The Brunei Dialysis and Transplant Registry (BDTR) was inaugurated in 2011 to describe the state of ESKD in the country and benchmark practice against other countries.[5] Results from the BDTR have influenced economic and fiscal policies employed by the local government, particularly in rationalizing decisions about the country's peritoneal dialysis (PD) preference policy[6] and kidney transplant program.[7] Previous local studies stemming from the BDTR have indicated that PD and transplant patients had a better quality of life and longer life expectancy,[8,9] which fueled momentum to propagate and proliferate the aforementioned policies. Despite the policy push, there has not been any major shift in penetration of PD and transplant in the last few years, likely as result of inadequate training and poor acceptance by patients.[10]

Benchmarking of standards with other countries is a major objective of any registry, as it enables assessment of progress and identification of major implementation goals. Brunei has been represented in the United States Renal Data System (USRDS), as a country with a high prevalence and incidence of kidney disease, particularly through diabetic kidney disease.[11] The decade-long journey of registry experience enables a more detailed and meaningful analysis with established registries, particularly through processes which can identify factors that can influence patients' outcomes and jeopardise the quality of services.

This article was accepted: 02 December 2022
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The main objectives of the study are to report the trends of key performance indicators over a ten-year period, compare performances between different modalities of KRT and evaluate the survival of ESKD patients.

MATERIALS AND METHODS

Ethical committee permission was not sought for this research as data were collected through a national registry. Raw secondary data over a 10-year period was collected and collated from the Brunei Dialysis and Transplant Registry (BDTR), dating from 1st January 2011 and ending on 31st December 2020. Data on point prevalence (on the 31st December every year), annual incidence, percentage annual death rate and aetiology of kidney disease were collected at the end of every year. Blood results of patients [including haemoglobin (Hb), calcium (Ca), phosphate (Ph), parathyroid hormone (PTH), cholesterol, albumin and potassium] were collected at half-yearly intervals, where the average was taken as the patients' results for the year. Key performance indicators (including systolic blood pressure, diastolic blood pressure, PD peritonitis rates, PD weekly Kt/V and haemodialysis (HD) (urea reduction ratio) were also collected. Direct comparisons of blood parameters and key performance indicators between HD, PD and transplant patients were made with the appropriate statistical methods described below. For benchmarking purposes, whenever possible, comparisons were made with data from other similar regional registries (Singapore and Malaysia)[12,13] and established international registries; USRDS,[11] United Kingdom Renal Registry,[14] Australia and New Zealand Renal Registry[15] and European Renal Association and European Dialysis Transplant Association (ERA-EDTA) Registry.[16] References and recommendations from established international advisory and guideline working groups Kidney Disease Improving Global Outcomes (KDIGO), Kidney Disease Outcomes and Quality Initiatives (KDOQI) and International Society of Peritoneal Dialysis (ISPD) were used to benchmark dialysis parameters.[17-22] The benchmarking standards that were utilized include KDOQI for urea reduction ratio of 0.7 for HD patients, ISPD for Kt/V of 1.70 for PD patients. For blood parameters, KDOQI guidelines ranges for serum phosphate (1.13–1.78 mmol/l), PTH (16.5–33 pmol/l) and calcium (2.10–2.37 mmol) were used as reference points. For anaemia management, the target Hb was set at > 10 g/dl, through a hybrid of KDIGO and KDOQI benchmarks, and also to be consistent with reporting patterns of other registries.

The data were collated with Excel (version 2018) and analysed with R (ver.3.5) software (R core team, 2018) and Statistical Package for the Social Sciences software (version 18.0; SPSS Inc, Chicago, IL, USA) and R package. All data were expressed using measures of central tendency and dispersion (means and standard deviations) for quantitative variables. For statistical analyses, mean comparison was made using Student's t test for two groups and one-way ANOVA for multiple groups, with Scheffe's procedure for post hoc analysis. Pearson's Chi Square test was used to determine association between categorical or nominal variables. Pearson's correlation test was used to perform hypothesis testing to determine correlation between variables over the 10-year period. Correlation statistic runs from –1 to +1, utilizing the Munro grading for degree of significance (no, low, moderate, high, very high). Linear regression was also used to determine the relationship between the numerical variables with time for determination of regression coefficient to predict future outcome.

Kaplan–Meier method was used for patient survival and log-rank (Mantel-Cox) test to compare the curves. Primary end-point was defined as death. In patient survival analysis; patients who were lost to follow-up, who received kidney transplants or transferred to other modalities were censored. Survival analyses were performed for incident HD patients from 2018 to 2020 and incident PD patients from 2011 to 2020. Results were considered statistically significant if the *p*-value was less than 0.05.

RESULTS

The total number of treated KRT patients increased from 562 in 2011 to 881 in 2020. This is equivalent to a prevalence of 1430 per million population (pmp) in 2011 and 1944 pmp in 2020, after computation with official annual population census.[1] The incidence of KRT patients (defined as being on dialysis for greater than 3 months) fluctuated between 279 pmp and 479 pmp over the 10-year period. The calculated projected prevalence and incidence with simple linear regression showed an anticipated annual increase of 42.2 pmp and 9.9 pmp, respectively.

Table I compares data of HD, PD and transplant patients in 2020. There were 752, 81 and 48 patients on HD, PD and with transplant graft respectively on the 31st of December 2021. There was a significant age disparity between the three groups of KRT patients with younger patients on PD (49.57 ± 13.10 years) and transplant (38.61 ± 8.34). Prevalent PD and transplant patients were significantly less likely to die compared to HD patients in 2020. PD patients had lower systolic blood pressure, potassium levels and were more likely to achieve targeted adequacy levels.

Table II summarises the 10-year trend of the important ESKD parameters through simple linear regression. The results showed a 'very high' correlation for annual increment in prevalent ESKD patient numbers over all the KRT modalities, but incidence of ESKD only showed 'low' correlation without achieving statistical significance. There was a significant improvement in serum phosphate levels, peritonitis rates and HD blood flow rates but a reduction in PD adequacy over the decade.

Tables III compares epidemiological parameters and dialysis performance indicators of the BDTR against six other registries: Singapore, Malaysia, United States, United Kingdom, Australia and New Zealand. HD was the main modality of KRT (86%), followed by PD 9%) and transplant (5%). DM was the main cause of ESKD (79%). PD survival (patient survival of 91%, 73% and 56% at 1, 3 and 5 years, respectively) was superior to HD survival (86% and 64% at 1 and 2 years, respectively), with PD survival consistent with results from other registries. Targets for Hb (> 10g/dl), pH (1.13–1.78 mmol), PTH (16.3–33 pmol/l) and calcium (2.10–2.37) were achieved in 80%, 39%, 21% and 49% of patients, respectively. Thirty-two percent and 52% of HD and PD

Table I: Comparison of demographic and key performance indicators between HD, PD and Tx patients (n=?)

	HD (n= 752)	PD (n=81)	Tx (n=48)	*p* value
Age	55.22 ± 13.16	49.57 ± 13.10	38.61 ± 8.34	< 0.05*
Gender	381 /752 males	41/81 males	33/48 males	<0.05**
Mortality	131 / 883 died	7 / 88 died	1/ 39 died	< 0.05**
Haemoglobin	11.66 ± 2.01	10.81 ± 1.65		<0.05
Phosphate	1.87 ± 0.61	1.91 ± 0.61		0.35
Calcium	2.19 ± 0.24	2.23 ± 0.23		<0.05
PTH	68.2 ± 84.9	74.1 ± 70.3		0.43
Albumin	37.60 ± 5.15	34.75 ± 5.09		<0.05
Potassium	4.49 ± 0.74	3.90 ± 0.61		<0.05
Total Cholesterol	3.98 ± 1.14	4.04 ± 1.40		0.55
Systolic blood pressure	139 ± 15.20	136 ± 15.84		<0.05
Diastolic blood pressure	80 ± 7.80	84 ± 10.82		<0.05
Dialysis adequacy > target URR or Kt/V	240 out of 752 patients	42 out of 81 patients		< 0.05**

Note:
1. * Statistical analysis was done with One Way Anova and post-hoc analysis with Scheffe's procedure.
2. ** Statistical analysis was done with Chi-Square test
3. All other analysis was done with Student T-test
HD - haemodialysis, PD - peritoneal dialysis, Tx - transplant
PTH: Parathyroid Hormone
URR: urea reduction ratio

Table II: Pearson's correlation to assess trends over ten years (2011-2020)

	10 years mean	SD	Correlation	95% CI		*p*	t
All	721	93.87	0.97	0.89	0.99	<0.05	12.22
HD	612	78.48	0.95	0.8	0.99	<0.05	8.61
PD	68	13.56	0.86	0.5	0.96	<0.05	4.71
Tx	42	5.77	0.91	0.65	0.98	<0.05	6.19
Prevalence	1702.7	146.21	0.87	0.54	0.97	<0.05	5.08
Incidence	379.9	65.84	0.46	-0.24	0.84	0.18	1.45
Mortality	15.2	2.04	0.47	-0.23	0.84	0.17	1.49
Hb	11.1	0.38	-0.17	-0.71	0.51	0.65	-0.47
Ph	1.93	0.09	-0.67	-0.91	-0.07	<0.05	-2.53
PTH	42.9	9.72	0.38	-0.43	0.85	0.35	1.02
Ca	2.24	0.05	0.08	-0.57	0.67	0.82	0.23
SBP	144.2	3.94	-0.48	-0.85	0.22	0.17	-1.53
DBP	82.4	1.26	-0.2	-0.73	0.49	0.57	-0.59
HD URR	0.66	0.03	-0.22	-0.75	0.47	0.54	-0.64
PD kt/v	1.83	0.09	-0.99	-0.99	-0.93	<0.05	-15.62
Peritonitis	31.6	9.63	0.81	0.37	0.95	<0.05	3.92
HD flow	255.2	15.73	0.74	0.22	0.94	<0.05	3.15
HD % AVF usage	71.75	5.18	0.18	-0.61	0.78	0.67	0.44

patients achieved target adequacy levels, whilst 70% of prevalent HD patients had AVF.

Figure 1 shows the survival of HD patients through Kaplan–Meier analysis. From the shortlisted 538 HD patients between 2018 to 2020, 128 were excluded for failing to meet the inclusion criteria (patients who did not have enough baseline data or died within 3 months of dialysis). 410 patients were included in the final analysis with a total follow-up period of 1167 months. Kaplan–Meier survival plots showed an overall actuarial patient survival of 93%, 86%, 74% and 64% at 6, 12, 18 and 24 months.

Figure 2 shows the patient survival of PD patients through Kaplan–Meier analysis. From the shortlisted 187 PD patients between 2011 and 2020, 26 were excluded for acute kidney injury and being on dialysis for less than 3 months. Of the 158 eligible patients; there were 44 deaths, 46 transfer to HD (technique failure) and 6 transplants. Kaplan–Meier survival plots showed an overall patient survival of 91%, 73% and 56% at 1,3 and 5 years.

DISCUSSION

The decade-long registry journey has been important in facilitating emendatory changes to the services. There have been noticeable improvements in certain key performance indicators (serum phosphate, PD peritonitis, HD blood flow rate) over the 10-year period. On the other hand, certain performance parameters (PD and transplant national penetration, HD AVF usage rate, dialysis adequacy) remained steadfastly unaltered despite valiant efforts to improve these outcomes. Estimations from data over the last ten years showed an annual increment of 9.9 per million population (pmp) per year, which was lower than the rates achieved in neighbouring countries like Thailand (19.4 pmp/year) and Malaysia (13.4 pmp/year), but higher than many Western countries (USA 2.2 pmp/year, UK 1.0 pmp/year, Australia 0.9 pmp/year).11 Whilst we accept that continued progression of ESKD prevalence and incidence is a commonly observed worldwide phenomenon, we believe that more can be done to curb this progression at grassroot levels and especially, through collaboration with other allied specialties. Preventative strategies with general practitioners, endocrinologists, cardiologists and geriatricians to focus on

Table III: Comparison of epidemiological factors and dialysis key performance indicators between registries

	Brunei	Singapore	Malaysia	UK	Australia	New Zealand	USA
Year	2020	2020	2016	2020	2020	2020	2018
Incidence (pmp)	479	364	248 (does not include transplant)	139	124 (does not include transplant)	131 (does not include transplant)	390
Prevalence (pmp)	1944	2030	1286 (does not include transplant)	1290	1078 (does not include transplant)	1022 (does not include transplant)	2317
% DM in ESKD (incidence)	79	68	65	18	39	48	47
Modality (prevalence)	HD 86% PD 9% Tx 5%	HD 73% PD 11% Tx 16%	HD 86% PD 10% Tx 4%	HD 37% PD 6% Tx 57%	HD 43% PD 9% Tx 48%	HD 41% PD 16% Tx 42%	HD 64% PD 7% Tx 29%
Mortality (annual)	HD 15% PD 8% Overall 13%	HD 11% PD 16% Overall 12%	HD 13% PD 19% Overall 14%	NA NA NA	NA NA NA	NA NA NA	NA NA NA
Overall survival	NA	1 and 5 years- 91% and 56%	1, 3, 5 years- 88%, 67%, 52%	1 year survival- 90%	NA	NA	NA
HD Survival	1 and 2 years- 86% and 64%ç	1 and 5 years – 91% and 61%	1,3,5 years- 88%, 68% and 53%	NA	1,3,5 years- 87%,68%, 51%	1,3,5 years 90 %,71%, 54%	NA
PD Survival	Patient survival 1,3,5 years- 91% ,73%, 56%	Patient survival 1 year and 5 years – 90% and 41%	Patient survival 1,3, 5 years- 87%, 61% and 44%	NA	Patient Survival (PD) 1,3,5 years- 91%,71%, 51%	Patient Survival 1,3, 5 years- 90%,67% 42%	NA
Hb (mg/dl)	Mean – 11.57 Median- 11.50	NA	Median on ESA - 10.3 (HD), 10.2 (PD) Median without ESA- 11.8 (HD), 11.4 (PD)	Median 11.1 (HD and PD)	Median 11.0 (HD)	Median 11.1 (HD)	Incidence Hb 9.3 only 13% on ESA
	79% with Hb > 10	77% with Hb > 10 (HD)	62% with Hb > 10 (PD	59% Hb > 10 (on ESA and HD) 54% Hb > 10 (on ESA and PD)	58% between 10 and 12 (HD) 54% between 10 and 12 (PD)		
Ca (mmol/l)	Mean 2.19 Median 2.19 49% between 2.10 and 2.37	NA 74% < 2.37 (HD) 62% < 2.37 (HD)	Median 2.2 (HD), 2.3 (PD) 55% (HD and 49% (PD) between 2.1 to 2.37-	Median 2.3 79% between 2.2-2.5 (HD)	NA 62% between 2.1 to 2.4 (HD)	NA 58% between 2.1 to 2.4 (HD)	NA NA
Ph (mmol/l)	Mean and median - 1.87 and 1.83	NA	Mean and median 1.80 and 1.70 (HD) Mean and median 1.6 (PD)	NA	NA	NA	NA
	39% between 1.13 and 1.78	58% between 1.13-1.78 (HD) 52% between 1.13-1.78 (PD)	48% between 1.3-1.8 (HD) 51% between 1.3-1.8 (PD)	NA	45% between 0.8-1.6 (HD)	32% between 0.8 -1.6 (HD)	NA
PTH (pmol/l)	Mean and median- 69 and 43	NA	Mean and median 265 and 110 pg/ml (HD) Mean and median 288 and 195 pg/ml (PD)	NA	NA	NA	NA
	21% between 16.3 and 33 (KDOQI	30% between 16.3-33 (HD) 28% between 1 6.3-33 (PD) (KDOQI)	13% between 150-300 pg/ml (HD) 23% between 150-300 pg/ml (PD)	NA	NA	NA	NA
AVF usage (%)	Prevalent – 70% Incident- 20%	NA NA	Prevalent - 86% NA	Prevalent – 68% Incident – 36%	Prevalent- 83% Incident – 41%	Prevalent- 67% Incident- 22%	NA Incident- 20%

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Table III: Comparison of epidemiological factors and dialysis key performance indicators between registries

	Brunei	Singapore	Malaysia	UK	Australia	New Zealand	USA
HD adequacy (URR)	32% of patients > 0.7	97% of patients > 0.65	82% of patients > 0.65	85.6% of patients > 0.65	69.6% of patients > 0.7	54.6% of patients > 0.7	NA
PD adequacy (weekly Kt/V)	52% of patients > 1.7	41% of patients > 2	75% of patients > 1.7	NA	NA	NA	NA
Peritonitis	0.3 episodes per patient year	NA	1 in 42.3 patient months	0.38 episodes per patient year	0.26 episodes per patient year.	NA	NA

Note:
1. All blood result are prevalent data unless stated otherwise.
2. Adult registry data are utilized for comparisons, but some registries may not have specified the age range of the population they included in their registry data.

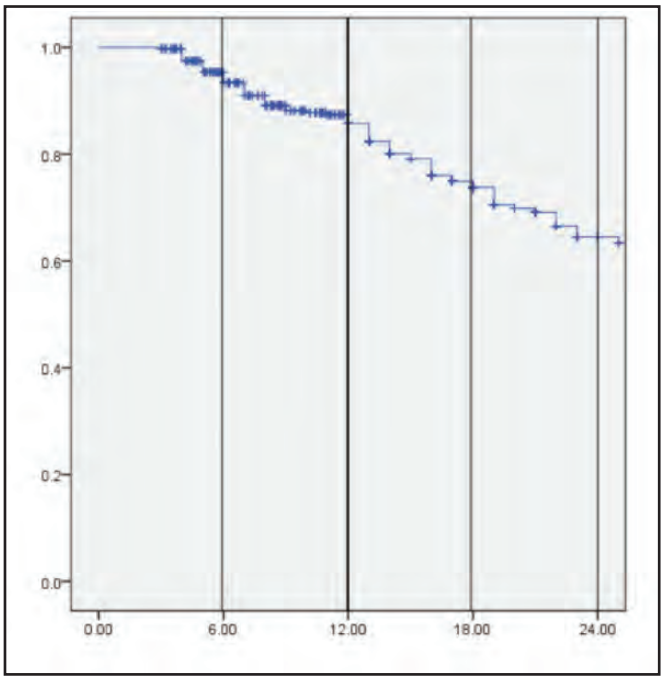

Fig. 1: Kaplan Meier Patient Survival for incident HD patients (2018-2020) (n=427); X-axis- months, Y axis – survival ratio

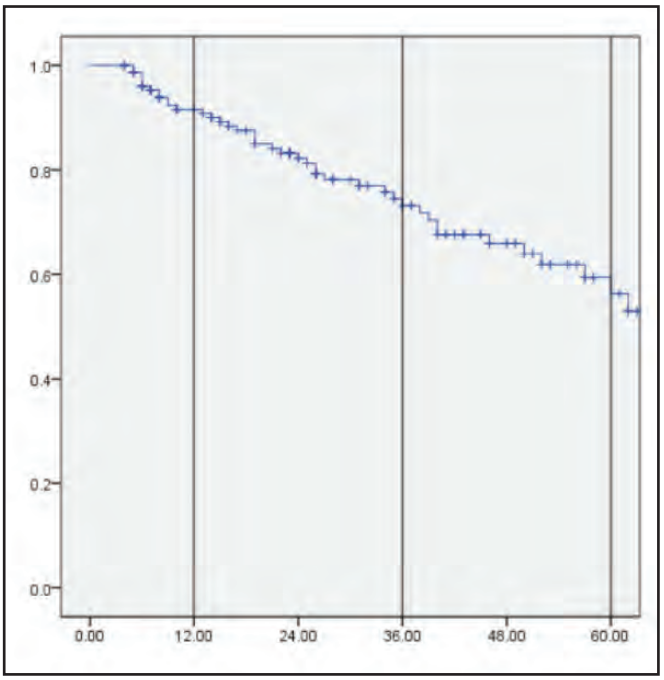

Fig. 2: Kaplan Meier Patient survival for incident PD patients (2011-2020) (n=158); X-axis- months, Y-axis- survival ratio

non-communicable diseases like diabetes mellitus and hypertension have been initiated at national level.

This study provided evidence that PD and transplant patients were not inferior to HD in certain aspects of their treatment outcomes. In fact, overall annual mortality of PD and transplant patients were significantly better than HD patients, although the latter group had a higher percentage of diabetes mellitus and were older (HD -55.22 ± 13.16 years vs PD-49.57 ± 13.10 years and transplant -38.61 ± 8.34 years). There were significant differences in haematological and biochemical parameters, but this could be related to differential implementation of guidelines, rather than being directly related to modality (eg. regular erythropoiesis-stimulating agent usage in HD patients affecting serum haemoglobin, pre-dialysis blood pressure measurements over HD, excessive PD effluent loss of potassium and albumin). Previous studies had also shown that local PD and Tx patients had a better quality of life8 and increased life expectancy.[23,24] Additionally, transplant has been shown to be provident and economical in cost effective exercises conducted by the Ministry of Health.[7] Plans are afoot to overhaul the infrastructure to provide less barriers for patients to take up PD; particularly through reducing waiting time for PD tube insertion, education of healthcare givers and increasing social support to patients. Transplant numbers are slowly increasing through the recent initiation of a local living-related kidney transplant program, but more time is needed for the program to mature and for the public to accept the concept of kidney donation. Additional furtherance activities have been initiated to pioneer a cadaveric and ABO-incompatible transplant program.

The 1- and 2- year patient survival of HD patients were 86% and 64% respectively. Projected 3-year survival of Brunei data through extension of the Kaplan–Meier analysis show a

likely actuarial survival of 57%. Correspondingly, these results were inferior compared to registry results from Singapore (1- and 5-year mortality of 91% and 56%) and Malaysia (1- and 3-year mortality of 88% and 67%) (12,13). Additionally, data from The Dialysis Outcomes and Practice Patterns Study (DOPPS) showed a 1-year HD survival rate of 93%, 84% and 78% in Japan, Europe and USA, respectively.[25] Australia and New Zealand reported similar first year survival (87% and 90%, respectively) but superior survival at 3 years (68% and 71%, respectively) (15). The poor local HD survival rate is likely to be a result of high proportion of incident diabetic HD patients compared to non-South East Asian cohorts, low arteriovenous fistula usage rate and high rates of catheter-related bloodstream infections. We also believe that our patients need more education on fluid and dietary compliance (complacency from free healthcare) and infection control. Contrastingly, the patient survival (91%, 73% and 56% at 1, 3 and 5 years) for PD patients were comparable to most countries like Singapore, Thailand and Hong Kong (83–91% and 40–54% at 1 and 5 years).[26]

DM-related ESKD (79%) and ESKD incidence rates are extremely high in Brunei, compared with the rest of the world. If these data were to be projected into the 2018 USRDS charts, Brunei would have ranked first for DM-related ESKD and second for ESKD incidence in the world. This pattern is similarly observed in neighbouring South East Asian countries, where DM-related ESKD accounted for 67% and 66% of incident ESKD patients in Malaysia and Singapore, respectively.[11] By contrast, only 12% of European ESKD population had reported diabetes mellitus as an aetiological cause,[20] with UK, USA and Australia registering at 18%, 47% and 39%, respectively.[11,14,15] Prevalence of DM in Brunei is similar to other developed countries,[27] indicating that there may strong local environmental and genetic factors that predispose diabetic patients to kidney failure.

Anaemia management, with a mean Hb of 11.57 g/dl and nearly 80% of the KRT population achieving a mean Hb level of > 10 g/dl, was higher compared to most countries, likely related to universal availability of erythropoietin. In terms of achieving the desired calcium, phosphate and PTH outcomes, only 49%, 39% and 21% of patients respectively achieved the pre-determined standards influenced by KDOQI and KDIGO.[19,20] This could be related to non-adherence to medication,[28] poor dietary compliance[28] and limited availability of non-calcium-based binders and calcimimetics.[29] AVF usage rate amongst HD patients (70% of prevalent patients) was similar to UK (68%) and New Zealand (67%), but inferior to Australia (83%) and Malaysia (86%).[13,14,15] Peritonitis rates in Brunei have been consistently below the ISPD recommended rate (0.4 episodes per patient year at risk), with the latest result being 1 in 40 patients-month or 0.3 episodes per patient year in 2020. This figure was comparable with Thailand (0.40), United Kingdom (0.38) and Australia and New Zealand (0.35).[30]

The registry results have allowed service introspection, which highlighted factors that were amenable to change. Restructuring of the education and training system for our staff and patients (through face-to-face encounters, seminars and workshops with dieticians, nurse educators, patient advocates and pharmacists) were done to improve delivery of messages to patients. The comparisons with other established practice have allowed us to establish norms in standard practice and learn from the experiences of others. It has also reaffirmed the justified preference for PD and transplant practices, which has led us to persuade the government to continue the emphasis of development of both practices ahead of HD. This includes public endorsement of these modalities, prioritisation in training of healthcare workers, enlisting professional support from overseas and investing in specialized infrastructure.

LIMITATIONS

The data collected were secondary data from the BDTR and there were missed data for some patients, particularly those who started dialysis near the annual cut-off date (31st December). The data for survival analyses for HD patients were only limited to 2018-2020, because there were many incomplete data before 2018 as the initial BDTR data were not collected with the intention for survival analysis. Nevertheless, typically more than 90% of data from patients were captured annually. Differences in methodologies and statistical analyses made certain international comparisons difficult; but as much as possible, these were presented in their unaltered formats to allow individual judgements and interpretations. As some registries do not update their data regularly, comparison can only be made with the last publicly available data.

CONCLUSION

Brunei had a high incidence and prevalence of treated ESKD in the last decade, likely related to the easy access of ESKD patients to KRT and free healthcare treatment. Diabetes mellitus, as a cause of ESKD, was disproportionately high compared to other countries in the world. PD outcomes (death rates, survival, dialysis adequacy) are superior to HD in the country, and on par with international targets, but factors like age and co-morbidities could have affected the outcomes. Mineral bone disease, HD adequacy, HD AVF rates and HD survival rates are areas that have been targeted for improvements. Concerted efforts have been initiated to improve the identified deficiencies, and to proliferate PD and transplant penetrance in the near future.

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