

Global Dialysis Perspective: Brunei Darussalam

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Introduction

Brunei Darussalam is a small country in Southeast Asia, with a population of less than half a million people. Hemodialysis (HD) first began in the country in 1968, using single-patient Dylade model B proportioning machines with heat sterilization and Kiil dialyzers (1,2). Scribner arteriovenous shunts were inserted into patients' legs by nephrologists. Interestingly, patients were required to manage their own dialysis, which usually extended to 10 hours each session, independent of nursing staff. There were stringent criteria for patient selection. Since the open-door policy was set out in 1985, the incidence and prevalence of KRT have increased significantly (Figure 1).

Brunei has some of the world's highest KRT incidence and prevalence. In 2018, the incidence and prevalence of KRT were 380 and 1769 per million population, respectively (Table 1), placing Brunei in the top five globally for incidence and in the top nine for prevalence of patients on KRT (3). The Brunei Dialysis and Transplant Registry was created in 2011 to enable a systematic collection of KRT data. The registry has enabled our nephrology services to be benchmarked against international registries, and it is unique as it captures all patients on KRT in the country. However, in our Brunei Dialysis and Transplant Registry, patients who were incident were excluded if death happened within 2 weeks of starting KRT, rather than the more commonly defined 90 days in other national registries, which might explain the disproportionately higher incidence compared with prevalence in Brunei. In 2019, the mean and median ages of death were 61.3 and 62 years, respectively. About 25% of the mortality happened within the first year of dialysis. The top cause of mortality was infection (28%), followed by cardiovascular death (23%). Hospitalization data are not available.

In 2019, diabetes mellitus accounted for 58% and 76% of patients with prevalent and incident kidney failure, respectively, some of the highest rates in Asia (4). In total, 21% of kidney failure was attributed to GN and 13% to hypertension. Brunei also has the highest prevalence of childhood obesity in Southeast Asia. Rising incidence of all these risk factors has contributed to the trend of kidney failure. The mean age at KRT initiation was 54 years old, one of the lowest in Asia. Half of the prevalent KRT population were

aged 41–60 years in 2019, with a significant effect on employability and economic productivity (4).

Health Care Funding and Dialysis Subsidies Funding

Brunei is classified as a high-income country, with a gross domestic product per capita of BN\$39,989 (US\$29,700) in 2019 (5). Brunei citizens and permanent residents enjoy the benefits of universal health care coverage. Essential health care is fully subsidized by the government. All patients with kidney failure have free and unrestricted access to dialysis. However, because health services are predominantly government subsidized, further efforts to support sustainable financing are required. An example of this is the implementation of the peritoneal dialysis (PD) preference policy. In the rare circumstances of noncitizens requiring dialysis, payment is usually out of patients' own pockets because private health care insurance is not well developed. Because there is full government subsidy for dialysis, there are no not-for-profit voluntary welfare organizations providing dialysis funding, such as that seen in neighboring countries such as Singapore.

Dialysis care delivery is solely provided by nephrologists in the country. There are only six nephrologists (50% local), all employed in the public sector. This gives a prevalence of 13 nephrologists per million population, comparable to many upper-middle and high-income countries (6). Unfortunately, nephrology training programs are not available locally.

Cost of Dialysis

The total health care expenditure was 2% of gross domestic product in 2018 (7). Approximately 5–10% of the health care budget is spent on providing dialysis care (8). In line with the expected expansion of the future dialysis population, it is predicted that >20% of health care budget may be taken up for dialysis by 2035 (Figure 2). For an average of 13 HD sessions a month, the cost of HD treatment per patient is BN\$2512 (US\$1865) per month. These costs include the use of erythropoietin stimulating agents, and indirect costs such as staff salaries, maintenance of equipment, and so on. The average monthly cost of automated PD (APD) and continuous ambulatory PD (CAPD) treatments are BN\$2045 (US\$1518) and BN\$984 (US\$731),

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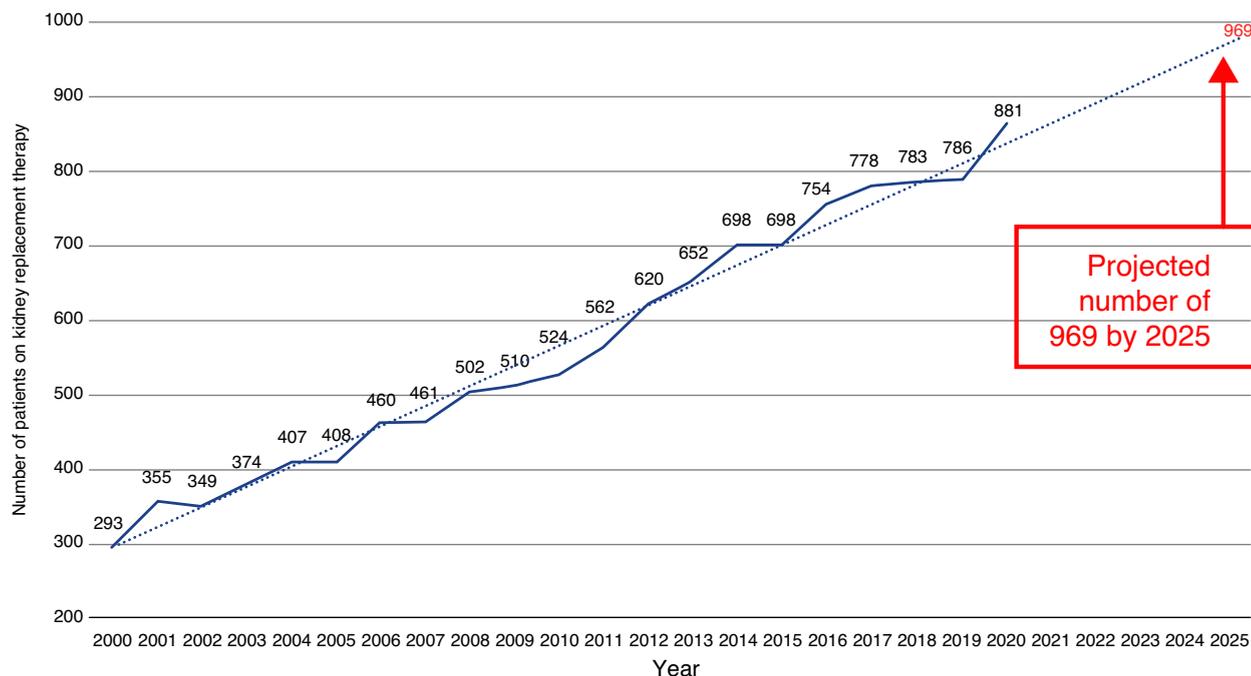


Figure 1. | Incidence and prevalence of KRT.

Table 1. Annual trend of kidney replacement therapy in Brunei Darussalam

Year	Prevalent Numbers			Total	Prevalence Rate, Per Million Population	Incidence Rate, Per Million Population
	Hemodialysis	Peritoneal Dialysis	Transplant			
2010	429	63	32	524	1347	325
2011	468	60	34	562	1430	279
2012	533	53	34	620	1550	401
2013	570	46	36	652	1605	404
2014	606	53	39	698	1710	411
2015	586	67	45	698	1694	256
2016	629	78	47	754	1808	420
2017	656	75	47	778	1809	387
2018	655	82	46	783	1769	380
2019	660	80	46	786	1708	382
2020	752	81	48	881	1942	520

respectively. Overall, the cost of HD to PD treatments per patient in Brunei is 1.33 times.

Dialysis Practices HD Practices

HD remains the main KRT modality, treating >85% of patients with kidney failure. Within a span of 30 years from 1983 to 2012, six HD centers have been built in the country. Four of the six centers are within or near hospitals, and only two are freestanding ambulatory satellite centers. All six HD centers are run by the only nephrology department in the country, under the Ministry of Health. In March 2021, a seventh HD center was set up as part of a public-private partnership, to cater for the increasing

demand for HD treatments, while improving the efficiency and productivity of the services.

Incremental HD is not practiced in Brunei and almost all patients undergo thrice weekly dialysis. HD sessions are usually 4 hours long, with a typical prescribed blood flow rate of 250–300 ml/min and a prescribed bicarbonate dialysate flow rate of 500 ml/min. In all six public HD centers, dialyzers are reused up to a maximum of ten times. However, starting from April 2021, the nephrology department will use single-use dialyzers in all public HD centers. A combination of high-flux and low-flux dialyzers are used.

HD small solute clearance is measured using a urea reduction ratio instead of Kt/V. In 2019, only 60% of patients on HD managed to achieve an urea reduction ratio ≥65%. However, blood flow rates have improved from an average of 255 ml/min in 2018 to 280 ml/min in 2019.

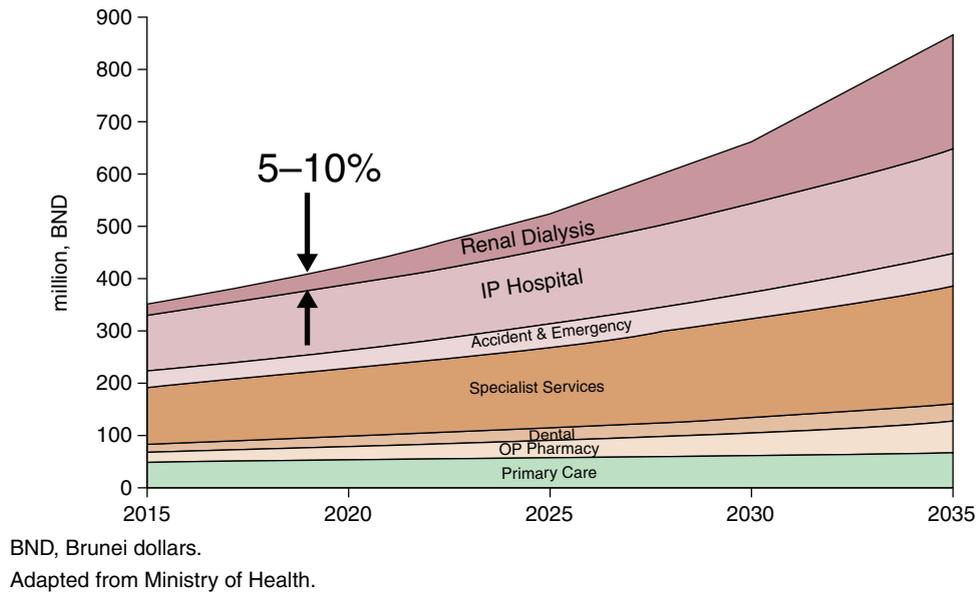


Figure 2. | Health care budget showing current and predicted expenditures. IP, Inpatient; OP, Outpatient.

Table 2. Summary of dialysis delivery in Brunei Darussalam in 2020	
Characteristics	Details
Patients on dialysis, <i>n</i> (pmp)	833 (1811)
Patients by modality, %	
Hemodialysis	90.3
Peritoneal dialysis	9.7
Hemodialysis centers, <i>n</i>	
Public	6
Private	1
Location of dialysis center, %	
Community	28.6
Institution	71.4
Cost per dialysis session, US\$	
Hemodialysis	143
Automated peritoneal dialysis	50
Continuous ambulatory peritoneal dialysis	24
Reimbursement per dialysis session, %	100 (fully covered by the government)
Dialysis delivery staff	Staff and assistant nurses
Ratio of dialysis nurses to patients	1:6
Average hemodialysis session duration, hr	4
Nephrologist review	At least once every 3 months
Dialysis access in hemodialysis patients, %	
Arteriovenous fistula	81
Central venous catheter	19
Arteriovenous graft	0

pmp, per million population.

Erythropoietin stimulating agents are freely available, and anemia coordinators are empowered to make dosage adjustments, per protocol.

Dialysis treatments are managed by staff or assistant nurses. The ratio of dialysis nurse to patient per dialysis shift is 1:6, as a result of a significant dialysis nursing staff shortage. The same group of doctors in one nephrology

department looks after all patients on dialysis in the country. This allows for a smoother transition from an inpatient to an outpatient setting, with better continuity of care. Routine laboratory tests are taken, and the in-center reviews of patients on dialysis are conducted every 3 months by a nephrology specialist or a medical officer (Table 2). Currently, Brunei has no home HD or online hemodiafiltration program.

PD Practices

CAPD was first introduced in 1993 and APD in 1998 (2). Within 5 years of its introduction, APD has surpassed CAPD as the preferred mode of PD, amounting to 86% of the total at the end of 2020.

All patients on PD are under the care of nephrologists in a public setting. There is only one PD unit in the whole country, consisting of four PD nurses, and catering for about 80 patients on PD. This corresponds to PD penetration of about 10%, which has remained static for past few years, despite the implementation of a PD preference policy in 2014. For many patients, their socioeconomic status is not conducive to home dialysis. Perception of PD as a second-line therapy is still prevalent in certain HD population groups. All PD treatments are performed by the patient or their caregivers at home.

Incremental PD is widely practiced, which allows dry days. Icodextrin is freely available and more than half of patients on PD are on it. With centralized care, the national peritonitis rate is low, at one episode in 53 patient-months in 2019. In total, 58% of patients on PD had a weekly Kt/V ≥ 1.7 . In a trend that had been evident since 2012, patients on PD had a lower annual mortality rate of 12%, compared with 19% in patients on HD (4).

Dialysis Access

Vascular Dialysis Access

Arteriovenous fistulas (AVF) are predominantly created by vascular surgeons and, more recently, plastic surgeons. The increasing availability of operating theater slots has probably contributed to the improvement in AVF prevalence of 67% in 2017 to 76% in 2018, and 81% in 2019. However, only 18% of patients with kidney failure started HD with an AVF, the rest started with a dialysis catheter. All tunneled dialysis catheters are inserted by interventional radiologists in a tertiary hospital. There are no arteriovenous grafts being performed currently, because we have experienced infective complications.

Designated dialysis nurses have recently been trained in ultrasound-guided cannulation of AVF. Vascular access surveillance with a transonic access flow measurement is not available. Monitoring of vascular access is done by routine clinical examination of the vascular access by the HD nurses and nephrologists. An AVF salvage program is provided by the private sector.

PD Access

The majority of PD catheters are inserted using the advanced laparoscopic technique by general surgeons. Since 2012, nephrologists have been trained to insert PD catheters using the Y-TEC peritoneoscopic (Merit Medical) technique. The standard break-in period, regardless of technique, is 2 weeks.

With an aging population and the emergence of noncommunicable diseases such as diabetes mellitus and hypertension, it is likely the incidence of kidney failure will continue to increase in the coming years. This will place even more burden on the one nephrology department in the country, and divert more of the limited health care budget to providing dialysis care. Strategies to ensure a sustainable delivery of dialysis care have been used, such as that of privatization to enable competition and diversification of care to other sectors. Efforts to expand PD and transplantation are crucial, but more importantly, there needs to be more concerted effort with primary health care in tackling early chronic kidney disease to curb the rising incidence of kidney failure.

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Author Contributions

C. Lim conceptualized the study, was responsible for data curation, and wrote the original draft; both authors reviewed and edited the manuscript.

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